Episode 79 – Cardiovascular Disease – Part 1: Diagnosis & Management

February 24, 2023

Overview

Cardiovascular disease (CVD) represents several heart and blood vessel disorders and is the leading cause of death globally. In 2020, approximately 19.1 million deaths were attributed to CVD worldwide, mainly coronary artery disease and stroke. Symptoms of CVD may range from imperceptible to debilitating. CVD is usually associated with atherosclerosis and increased risk of blood clots. It is also associated with damage to arteries in organs (e.g., brain, heart, kidneys, eyes).

There are many types of CVD, including coronary artery disease, cerebrovascular disease, and hypertensive heart disease. Most CVD can be prevented by addressing behavioural risk factors (e.g., tobacco use, unhealthy diet, obesity, physical inactivity, harmful alcohol use). Early detection of CVD enables prompt management, including counselling and medications. [1] [2] [3] [4]

Cardiovascular system

The primary function of the cardiovascular system is to transport nutrients and oxygen to the body, and remove carbon dioxide and waste products through the blood. The cardiovascular system consists of the heart, blood vessels (arteries, veins, capillaries), and blood.

Heart

- Heart pumps blood throughout the body.
- Normal adult heart pumps about 5 liters of blood every minute.
- Heart has four chambers: right and left atrium receive blood from veins, and left and right ventricle forcefully push blood out of the heart. Left ventricle is the main pumping chamber of the heart.
- Heart wall is made of three layers:
    - Epicardium (outer layer),
    - Myocardium (middle muscular layer), and
    - Endocardium (inner layer).
- Pericardium is the thin sac of tissue surrounding the heart.
- Flow of blood through blood vessels and heart chambers is controlled by valves.
- There are four heart valves, the tricuspid valve, mitral valve (bicuspid valve), pulmonary valve and aortic valve.

Blood vessels

- Vast system of arteries, veins, and capillaries, about 100,000 km long, 80% made up by capillaries.

Arteries

- Arteries carry blood away from the heart.
- Aorta carries oxygenated blood to the rest of the body.
- Common carotid arteries and vertebral arteries are the main arteries supplying oxygenated blood to the brain.
- Pulmonary arteries deliver deoxygenated blood to the lungs.
- Artery walls have three layers: tunica intima (inner), tunica media (middle), and tunica externa (outer). Middle layer is usually the thickest and is made up of smooth muscle that changes the size of arteries to regulate blood flow and blood pressure.

Veins

- Veins carry blood back to the heart.
- Superior and inferior vena cava carry deoxygenated blood to the heart from the body.
- Pulmonary veins carry oxygenated blood from the lungs to the heart.
- Veins walls have three layers: tunica intima, tunica media, and tunica externa.
- Vein walls have less smooth muscle and connective tissue, and are thinner than artery walls.
- Veins have less pressure and can hold more blood than arteries. About 70% of the body's total blood supply is in veins.
- Most veins have valves to help prevent backward flow of blood.

Capillaries

- Small, numerous, thin-walled blood vessels.
- Form the connection between the arteries and veins.
- Primary function is exchange of oxygen, nutrients, carbon dioxide, and waste between the blood and tissue cells.

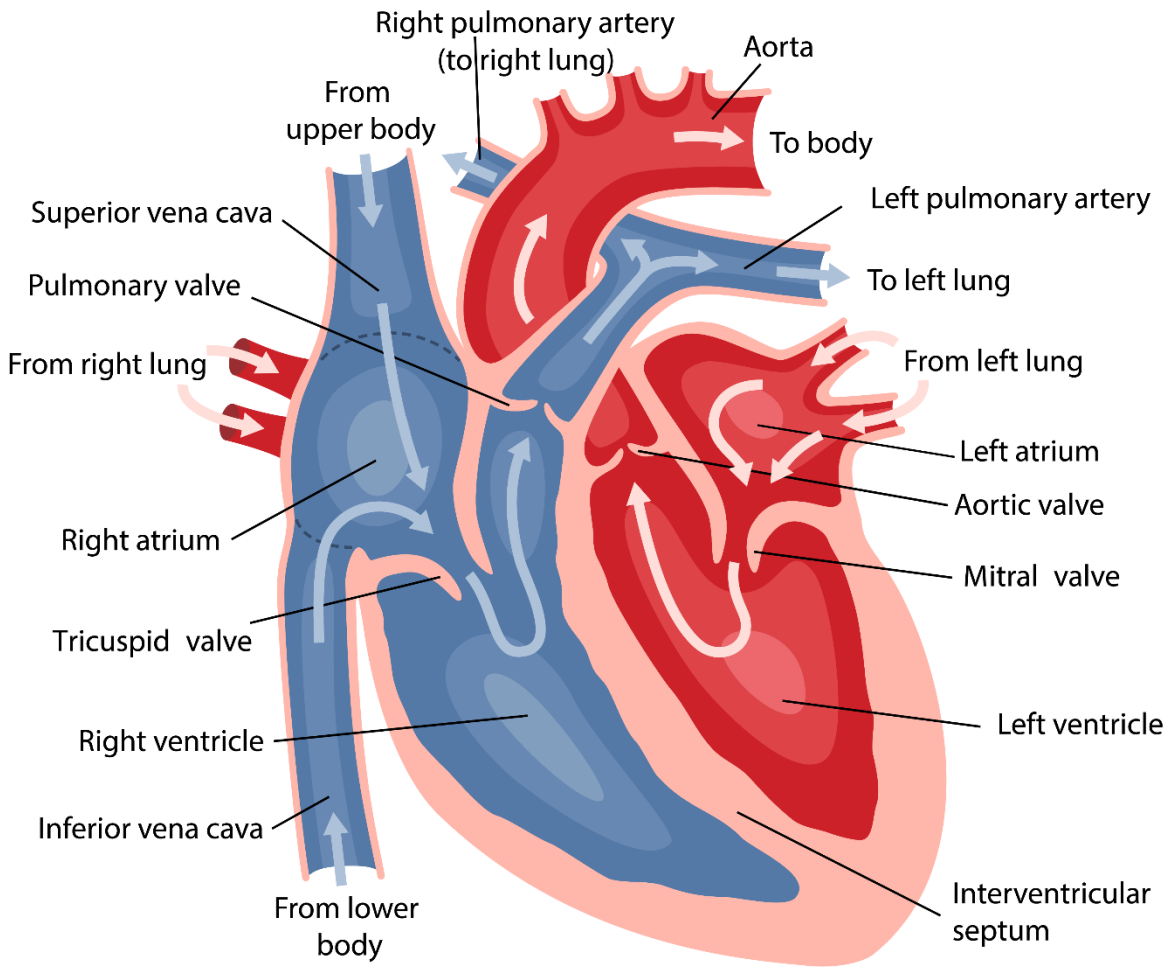
Blood

Blood has four main components:

- Plasma is the fluid portion and makes up about 55% of the blood.
- Erythrocytes (red blood cells) contain hemoglobin, a protein that carries oxygen from lungs to the body and carbon dioxide to the lungs to be exhaled. Makes up about 40-45% of blood volume.
- Leukocytes (white blood cells) are responsible for fighting infection. Makes up about 1% of the blood. Five major types of leukocytes include neutrophils, lymphocytes (includes B and T cells), basophils, eosinophil, and monocytes.[1]
- Thrombocytes (platelets) are essential for clotting. [5] [6] [7]

[1] Refer to Episodes 44 and 45 for discussion on leukocytes and the immune system.

Circulation of blood through the heart



CVD risk factors

Risk factors for CVD include:

- High blood glucose associated with diabetes can overtime damage blood vessels and nerves that control heart and blood vessels. Individuals with diabetes are also more likely to have other conditions that increase CVD risk (e.g., hypertension, hyperlipidemia). [8]
- Tobacco use and exposure to secondhand tobacco smoke. Chemicals in tobacco smoke damage blood vessels, raise heart rate and blood pressure; and increase triglyceride levels while reducing high-density lipoprotein (HDL) levels. [9]
- Hyperlipidemia (high level of low-density lipoprotein [LDL] and triglycerides)
- Physical inactivity can lead to CVD, even for those with no other risk factors. It also increases likelihood of developing other CVD risk factors (e.g., obesity, hypertension, hyperlipidemia, type 2 diabetes). [10]

- Hypertension can damage the inner lining of arteries making them more susceptible to atherosclerosis and coronary artery disease. Constant pressure of blood moving through weakened arteries can lead to aneurysms. [11]
- Unhealthy diet low in vegetables and fruits, and high in salt, saturated fats, and/or trans fats (common in processed foods).
- Recreational drug use, such as amphetamines, cocaine, and cannabis can have adverse effects on the cardiovascular system.[2] [12] [13] [14]
- Harmful use of alcohol. Current research shows drinking a little alcohol neither decreases nor increases ischemic heart disease risk, but increases risk for many types of other CVD, including hypertension, heart failure, atrial fibrillation, and hemorrhagic stroke. [15]
- Obstructive sleep apnea is associated with hypertension, arrhythmia, stroke, and heart failure. Sleep apnea causes the person to stop breathing, which lowers blood oxygen levels increasing heart rate and blood pressure. Stress on the heart from severe sleep apnea can also cause the heart to enlarge. [3] [16] [17]
- Family history of CVD. Genetic factors play a role in hypertension, heart disease, and other related conditions. However, it is also likely people with a family history of CVD share common environments and other factors that may increase their risk. CVD risk can increase more when heredity combines with unhealthy lifestyle choices (e.g., smoking, unhealthy diet). [18]
- High body mass index (BMI) is linked with hypertension, diabetes, high levels of triglycerides and LDL, and low levels of HDL. [19]
- Chronic stress has been shown to increase heart rate and blood pressure. Stress hormones (catecholamines, including epinephrine/adrenaline) have damaging effects if the heart is exposed to elevated catecholamine levels for a long time. Stress can cause increased oxygen demand on the body, spasm of the coronary arteries, and electrical instability in the heart's conduction system. Stress can also contribute to poor health behaviours linked to CVD (e.g., smoking, overeating, unhealthy diet, etc.). [20] [21]
- Increased age elevates risk. However, CVD can happen at any age. High rates of obesity, hypertension, and smoking among younger people (ages 35-64) are putting them at risk for CVD earlier in life. [22]
- South Asian, African, and Indigenous heritage. People of African or South Asian heritage are more likely to have hypertension, diabetes, or other risk factors at a younger age. First Nations, Metis, and Inuit peoples have a higher risk of heart disease and stroke than the general population because they are more likely to have hypertension and diabetes. [23] [24]
- Personal circumstances, including access to healthy food, safe drinking water, and health and social services. [23]
- Environmental factors, such as ambient particulate matter air pollution, household air pollution from solid fuels, lead exposure, exposure to low or high temperature. [25]
- Poor oral health has been associated with increased risk of CVD.[4] [26] [27]
- Having more risk factors increases chance of developing CVD. [3] [25] [28] [29]

[2] Refer to Episode 58 for discussion on the effect of cannabis on cardiovascular health and oral health.
[3] See additional resources below for link to CDHO Obstructive Sleep Apnea factsheet.
[4] Refer to Episode 37 for additional information on periodontal disease and CVD.

Diagnostic tests for cardiovascular disease

Test*	Description	Purpose / indication*
Physical exam [30]	Complete physical exam often assesses:	
	Blood pressure	Hypertension
	Skin tone	Bluish skin tone may indicate low oxygen levels. Pale skin tone may indicate anemia.
	Edema	Edema in feet and legs[5] may indicate congestive heart failure or blood clot (i.e., deep vein thrombosis [DVT]).
	Eyes	Assess for signs of hemorrhage (e.g., blood spots), hypertension, or reduced blood flow (ischemia). Changes in the blood vessels in the eye may indicate presence of diabetes.
	Heart	Listen for sounds that may indicate problems (e.g., arrhythmias).
	Breathing	Listen for abnormal sounds or crackling.
	Abdomen	Listen to abdomen with stethoscope for sounds of blood flow. Certain sounds may indicate a narrowed blood vessel in abdomen.
	Pulse	Assess heart rhythm, rate, and regularity. Pulse may be taken in several areas of body to determine blood flow problems.
Blood tests [31] [32] [33]	Blood tests are used to assess: • Clotting time and level of fibrinogen (clotting component) • Cholesterol, glucose, and calcium levels • Hemoglobin levels	Note: although blood tests can indicate risk of having CVD or other health disorders, often other confirmatory tests are needed to determine diagnosis.

[5] Edema occurs when capillaries leak fluid that builds up in nearby tissues. There are various reasons for mild edema (e.g., sitting too long, too much salt, side effects of certain medications). Serious conditions that cause edema also include liver damage, kidney disease, etc. [105]

Test*	Description	Purpose / indication*
Troponin test	• Liver, thyroid, and renal function • C-reactive protein Troponin (type of protein released by heart muscle when damaged) is not normally found in the blood. When heart muscles become damaged (e.g., myocardial infarction), troponin is released into the bloodstream.	Used to differentiate between angina and myocardial infarction. Monitor angina
Urine test [31]	Urine sample collection.	Helps diagnose conditions related to stroke, including blood clots, kidney disease, and diabetes.
Chest x-ray [34]	Shows the condition and size of heart and lungs.	Angina Cardiomyopathy Heart failure Myocardial infarction Valve disorder
Cardiac computed tomography (CT) scan (Cardiac CT, CT angiography, CTA, x-ray computed tomography) [35] [36]	Uses x-rays to take many detailed images of the heart and its blood vessels. Computers combine images to create a three-dimensional (3D) model of heart. Images are used to determine whether plaque or calcium deposits are present in blood vessels and whether they are causing a blockage. A contrast dye (often iodine-based) is administered intravenously to improve imaging. Sometimes beta blockers are given to slow heart rate or nitroglycerin to dilate arteries.	Aortic aneurysm Atrial fibrillation Congenital heart defects Coronary artery disease Heart failure Heart inflammation Myocardial infarction Assess coronary bypass surgery results
Coronary calcium scan [35]	Uses computerized tomography (CT) imaging to show calcium deposits in artery walls. Buildup of calcium, or calcifications, are a sign of atherosclerosis or coronary artery disease. Test results are given as a score (Agatston score). A score of zero is normal, the higher the score, the higher the risk of CVD.	Angina Aortic aneurysm Atherosclerosis Coronary artery disease Heart failure Myocardial infarction
Cardiac magnetic resonance imaging (MRI) (heart MRI)	Cardiac MRI uses radio waves, magnetic field, and computer to create images of the heart and major blood vessels. A contrast dye (gadolinium)	Arrhythmia Cardiac tumours Coronary artery disease

Test*	Description	Purpose / indication*
[35] [37] [38]	is injected intravenously to improve visualization of the heart muscle and blood flow. MRI images show more detail than CT scans. 3D images can also be produced that can be viewed from different angles.	Congenital heart disease Heart failure Heart valve disease Myocardial infarction Pericarditis
Magnetic resonance angiography (MRA) [39]	MRA is used to study blood vessels and blood flow leading to the brain, heart, kidneys, and legs. MRA uses the same technology as MRI, but at special settings to detect and diagnose blood vessel diseases. A contrast dye may be used to make the images even clearer. MRAs are noninvasive and produce mainly 3D images.	Aneurysms Atherosclerosis Blood clots Other blood vessel problems
Nuclear stress test (nuclear heart scan, cardiac PET scan, cardiac single photon emission computed tomography [SPECT] scan, myocardial perfusion imaging [MPI] study) [40]	Imaging test that shows blood flow to the heart at rest and during exercise (e.g., walking on a treadmill, riding a bike, or if unable to exercise medications are used to mimic the stress of exercise). Small amount of radioactive tracer is given intravenously. A positron emission technology (PET) scanner or single-photon emission computed tomography (SPECT) scanner takes images of how the tracer moves through the coronary arteries to find areas of poor blood flow or heart damage.	Angina Coronary artery disease Heart failure Myocardial infarction Assess blood flow after bypass surgery, angioplasty, or stent placement
Thallium or cardiolite scan (thallium myocardial imaging, cold spot imaging, myocardial perfusion imaging, thallium scintigraphy) [41] [42]	A thallium or cardiolite scan uses a radioactive tracer (thallium or cardiolite injected intravenously) to see how much blood is reaching different parts of the heart. The tracer travels through the coronary arteries and is picked up by the heart muscle cells. Areas of the heart muscle that have adequate blood supply pick up the tracer right away and more completely. Areas that do not have an adequate blood supply pick up the tracer very slowly or not at all. These areas will appear as dark areas (cold spots) on the scan. These tests are the more common forms of nuclear medicine scans. May be combined with a stress test.	Angina Coronary artery disease Heart failure Myocardial infarction

Test*	Description	Purpose / indication*
Echocardiogram [35] [43] [44]	Ultrasound is used to image the heart. Helps identify whether an area of the heart has been damaged. Shows shape, texture, and movement of heart valves, and size and functioning of heart chambers.	Angina Congenital heart defects Coronary artery disease Heart failure Heart infection (infective carditis) Heart inflammation (pericarditis) Heart murmur Heart valve disease Myocardial infarction
Transthoracic echocardiogram	Most common type of echocardiogram where the transducer is applied to the chest.	
Stress echocardiogram	Echocardiogram that is done as part of a stress test.	
Three-dimensional (3D) echocardiogram	Creates 3D images of the heart. May be done as part of a transthoracic or transesophageal echocardiogram.	
Transesophageal echocardiogram (TEE)	Special type of echocardiogram using a transducer placed in the esophagus to obtain clearer images of the heart and its structures.	
Fetal echocardiogram	Used to image an unborn baby's heart to assess for heart problems. The transducer is moved over the abdomen of the pregnant person. When recommended, the test is commonly done 18 to 22 weeks of pregnancy.	Fetal heart health
Carotid ultrasound [35] [45]	Used to examine blood flow through the carotid arteries. It also evaluates the thickness of the carotid artery wall; characteristics of plaque; and checks for clots. Used to detect blocked or narrowed carotid arteries (risk factor of stroke).	Atherosclerosis Stroke
Doppler ultrasound [46] [47]	Shows blood flow through the heart and blood vessels. Used to view and measure obstructions in arteries, and measure the degree of narrowing or leakage of heart valves. Used to assess blood flow through heart, coronary and carotid arteries, or major arteries of arms and legs.	Arteriosclerosis Atherosclerosis
Electrocardiogram (ECG / EKG) [24] [35]	Measures electrical activity of the heart to assess strength and timing of electrical impulses, and heart rate and rhythm. May be part of a routine exam to screen for heart disease. Can be used to monitor recovery from myocardial infarction, progression of heart disease, and effectiveness of heart medications or pacemaker.	Arrhythmias Atrial fibrillation Cardiomyopathy Congenital heart defects Heart failure Heart valve diseases Myocardial infarction
Electrophysiology study (EPS) [48]	Used to determine the type of arrhythmia. Special catheters are inserted through a vein in the groin, arm, neck, or upper thigh, and guided to the heart (i.e., catheterization) to record its	Arrhythmias

Test*	Description	Purpose / indication*
	electrical activity. Controlled electrical impulses are given to see how the heart reacts. For example, if the person is prone to tachycardia, it may be deliberately triggered during the procedure to see how it affects the heart. Medications may also be tested to see which ones will stop the arrhythmia. Once the electrical pathways causing the arrhythmia are found, radio waves can be sent through the catheter to destroy them (ablation). Not everyone with arrhythmia needs an EPS and many may just need an electrocardiogram (ECG/EKG).	
Holter and event monitors [35] [49]	Holter and event monitors are small, portable electrocardiogram devices that record the heart's electrical activity for long periods of time while the person does their regular activities. It records heart rate and rhythm and strength and timing of heart electrical impulses. Also used to assess if treatment for arrythmia is working. There are many types of monitors. Most monitors have electrodes with sticky adhesive patches that attach to the skin on the chest. Some monitors and electrodes used for long-term recording may be implanted under the skin to make it easier to bathe and perform daily activities.	Angina Arrhythmias Atrial fibrillation Cardiac arrest Heart failure Stroke
Holter monitor	Holter monitoring is usually used to diagnose heart rhythm disturbances, specifically to find the cause of palpitations or dizziness. The monitor continuously records the heart's activity. The monitor is usually worn for 24 hours or longer.	
Event monitor	An event monitor does not continuously record the heart for the 24-hour period. It records when symptoms are felt and the person triggers the monitor.	
Stress test (exercise electrocardiogram)	Measures how well the heart works under stress. The test usually involves walking on a treadmill or riding a stationary bike, while heart's	Angina Arrhythmias Arteriosclerosis

Test*	Description	Purpose / indication*
[35] [47] [50]	electrical activity and heart rate (via ECG) and blood pressure are monitored. Blood oxygen level may be measured as well. If a person cannot exercise, they may be given a medication intravenously that mimics the effect of exercise on the heart.	Atherosclerosis Coronary artery disease Heart failure Heart valve diseases
Coronary angiography [35] [51] [52]	Procedure that uses contrast dye, usually containing iodine, and x-ray images to detect blocked or narrowed coronary arteries. During the test, the dye is released into the coronary arteries from a catheter inserted in a blood vessel (cardiac catheterization). The dye makes the blood vessels visible on the image. Angiogram is the x-ray image made during angiography.	Angina Arrhythmias Atherosclerosis Cardiac arrest Coronary artery disease Myocardial infarction Stroke
Cardiac catheterization [35] [52] [53] [54] [55]	Cardiac catheterization can both diagnose and treat some heart and blood vessel conditions. It is used in several different tests, such as angiography and electrophysiology studies. A thin flexible catheter is passed through a blood vessel in the groin, arm, neck, or upper thigh, depending on the reason for the procedure, and guided to the heart, using x-rays (fluoroscopy) as a guide. X-rays are used to image blood vessels and heart. The catheter can also measure pressure and oxygen levels in different areas of the heart (hemodynamic assessment); biopsy heart tissue; take blood samples; etc. The procedure may be used to repair heart defects, replace heart valves, or open a stenotic heart valve or blocked artery.	Angina Arrhythmias Atherosclerosis Cardiomyopathy Congenital heart disease Coronary artery disease Heart failure Heart valve disease Myocardial infarction
Tilt-table exam [56]	Tilt tests determine if different drugs or body positions will trigger an arrhythmia or symptoms (e.g., fainting without explanation). In this test, the person lies on a special bed that can be tilted to different positions. Different drugs are administered intravenously during the test. The bed is tilted to go from a reclining position to almost upright. Heart and blood pressure is monitored throughout the test.	Arrhythmia

* Nonexhaustive list

Drug therapy for cardiovascular disease

Class	Name* Generic (brand name)	Mechanism of action	Indications*	Side effects**
Angiotensin-converting enzyme (ACE) inhibitors [57] [58]	Benazepril (Lotensin) Captopril (Capoten) Cilazapril (Inhibace) Enalapril (Vasotec) Fosinopril (Monopril) Lisinopril (Prinivil, Zestril) Perindopril (Coversyl) Quinapril (Accupril) Ramipril (Altace) Trandolapril (Mavik)	Angiotensin II narrows blood vessels. ACE inhibitors prevent angiotensin II from being produced, which relaxes blood vessels, lowers blood pressure, and reduces work on the heart. Some ACE inhibitors are combined with hydrochlorothiazide (diuretic), which lowers BP by increasing urination.	Hypertension Heart failure Coronary artery disease. After myocardial infarction to prevent complications.	Dry cough Hyperkalemia [6] Fatigue Dizziness (e.g., blood pressure is too low) Headaches Angioedema of lips, face, tongue Loss of taste / taste changes Oral lichenoid reactions
Aldosterone antagonists (aldosterone receptor blockers, mineralocorticoid receptor antagonist) [59] [60] [61]	Eplerenone (Inspra) Spirinolactone (Aldactone)	Diuretic Blocks the hormone aldosterone which can cause salt and fluid retention, contributing to hypertension	Hypertension Heart failure	Dizzy / lightheaded Upset stomach Xerostomia Skin rash Muscle cramps or spasms Hyperkalemia
Angiotensin II receptor blockers (ARBs) [62] [63]	Candesartan (Atacand) Irbesartan (Avapro) Losartan (Cozaar) Olmesartan (Olmetec) Telmisartan (Micardis) Valsartan (Diovan)	Angiotensin II causes blood vessels to narrow. ARBs block action angiotensin II, allowing blood vessels to relax lowing blood pressure. Work as well as ACE inhibitors, may be prescribed	Hypertension Heart failure	Dizzy / lightheaded Hyperkalemia

[6] Hyperkalemia is increased potassium levels in the blood. Serious manifestations of hyperkalemia include muscle weakness or paralysis, cardiac conduction abnormalities, and cardiac arrhythmias. [106]

Class	Name* Generic (brand name)	Mechanism of action	Indications*	Side effects**
		for those having side effects to ACE inhibitors. Some ARBs are combined with hydrochlorothiazide (diuretic) which lowers blood pressure by increasing urination.		
Antiarrhythmics [64]			Prevent and treat arrhythmias Help arrythmia symptoms, such as: Heart palpitations Lightheadedness Fainting Chest pain Shortness of breath	Sun sensitivity Dizziness Urine retention Blurry vision Gastrointestinal upset Seizures
Sodium channel blockers	Disopyramide (Rhythmodan) Quinidine Mixelitine (Teva-Mixelitine) Flecainide (Apo-Fleicanide, Mar-Flecianide) Propafenone (Rythmol)	Slows electrical impulse conduction in the heart muscle itself.		
Potassium channel blockers	Amiodarone Dronedarone (Multaq) Sotalol (Pro-Sotalol, PMS-Sotalol)	Slow down electrical impulse conduction in all heart cells.		
Beta blockers	Atenolol (Apo-Atenol, Act-Atenolol) Metoprolol (Apotex) Esmolol (Brevibloc)	Slows down heart rate by slowing electrical impulse conduction at sinoatrial and atrioventricular nodes.		
Calcium channel blockers	Diltiazem (Act-Diltiazem, Apo-Diltiazem) Verapamil (Isoptin, Apo-Verap)	Slows down heart rate by slowing electrical impulse conduction at sinoatrial and atrioventricular nodes.		Gingival hyperplasia / overgrowth

Class	Name* Generic (brand name)	Mechanism of action	Indications*	Side effects**
Anticoagulants [65]	Apixaban (Eliquis) Dabigatran (Pradaxa) Edoxaban (Lixiana) Heparin Rivaroxaban (Xarelto) Warfarin (Coumadin)	Reduces risk of developing blood clots. May prevent existing clots from getting bigger. With some anticoagulants (e.g., warfarin), routine blood-testing is needed to monitor international normalized ratio (INR) to measure clotting.	Artificial heart valve Atrial fibrillation Cardiomyopathy Myocardial infarction Venous thrombosis	Bleeding
Antiplatelets [66]	Acetylsalicylic acid [ASA] (Aspirin, Asaphen, Entrophen, Novasen) Clopidogrel (Plavix) Prasugrel (Effient) Ticagrelor (Brilinta)	Help to prevent blood clots from forming.	Myocardial infarction Stroke	Bleeding
Beta blockers (beta-adrenergic blocking agents) [67] [68]	Acebutolol (Sectral) Atenolol (Tenormin) Bisoprolol (Monocor) Carvedilol (Coreg) Labetalol (Trandate) Metoprolol (Lopressor, Betaloc) Nadolol (Corgard) Pindolol (Viskazide) Propranolol (Inderal) Timolol (Blocadren)	Reduces blood pressure by blocking effects of the hormone (and neurotransmitter) epinephrine (adrenaline). Lowers heart rate	Angina Arrhythmia Heart failure Hypertension Myocardial infarction	Dizzy Lightheaded Feeling faint Drowsiness Fatigue Swelling of ankles and feet Taste changes
Calcium channel blockers (CCBs) (calcium channel antagonists)	Amlodipine (Norvasc) Diltiazem (Cardiazem, Tiazac, Tiazac XC) Felodipine (Plendil)	Vasodilator Calcium is necessary for muscle contraction. CCBs reduce amount of calcium	Angina Arrhythmia Hypertension	Fatigue Dizziness Heartburn Swelling of ankles and feet

Class	Name* Generic (brand name)	Mechanism of action	Indications*	Side effects**
[69] [70]	Nifedipine XL (Adalat XL) Verapamil (Isoptin, Isoptin SR, Verelan)	entering heart and artery cells, allowing blood vessels to relax and open.		Gingival hyperplasia / overgrowth
Cardiac glycosides [71]	Digoxin (Lanoxin, Toloxin)	Helps heart pump with more force. Slows heart rate and decreases shortness of breath.	Arrhythmia Heart failure	Upset stomach or vomiting Diarrhea Major loss of appetite Weakness Blurred vision
Cholesterol-lowering medications				
Cholesterol absorption inhibitors [72]	Ezetimibe (Ezetrol)	Helps lower overall cholesterol in blood. Helps prevent absorption and storing of cholesterol in liver. Improves cholesterol clearance from blood.	High cholesterol	Headache Diarrhea Dizziness Sore throat Runny nose Sneezing Joint or muscle pain
Fibrates (fibric acid derivatives) [72]	Bezafibrate (Bezalip) Fenofibrate (Lipidil) Gemfibrozil (Lopid)	Lowers triglycerides Reduces LDL Increases HDL	High cholesterol	Skin rashes Upset stomach Stomach pain Vomiting Gas Headache Dizziness Muscle pain
Niacin (nicotinic acid) [72]	Niacin	Slows liver production of LDL Increases HDL	High cholesterol	Flushing (redness, burning, itching) Dry skin Rash Upset stomach

Class	Name* Generic (brand name)	Mechanism of action	Indications*	Side effects**
				Diarrhea Headaches
Resins (bile acid sequestrates) [72]	Cholestyramine (Questran) Colestipol (Colestid)	Cholesterol is needed to make bile. Resins lower cholesterol by: • Using more cholesterol to produce bile. • Binding with bile so it is passed in stool. • Forces the body to make more bile and use more cholesterol.	High cholesterol	Constipation Diarrhea Abdominal pain or cramping Bloating Gas Heartburn Nausea or vomiting
Statins [73]	Atorvastatin (Lipitor) Fluvastatin (Lescol) Lovastatin (Mevacor) Pravastatin (Pravachol) Rosuvastatin (Crestor) Simvastatin (Zocor)	Help to stop plaque from forming in blood vessels and can also prevent existing plaque from getting worse.	High cholesterol	Upset stomach Constipation Gas Sore muscles, cramping, or weakness that does not resolve
Diuretics ("water pills") [74]	Chlorthalidone Ethacrynic acid (Edecrin) Furosemide (Lasix) Hydrochlorothiazide Indapamide (Lozide) Metolazone (Zaroxolyn)	Excess salt and water are flushed out through urine, with out extra fluid, it is easier for heart to pump. Usually combined with other medications.	Heart failure Hypertension	Dehydration Dry mouth / xerostomia Muscle cramps Weakness Dizziness Upset stomach Oral lichenoid reactions (e.g., thiazides)
Hyperpolarization-activated cyclic nucleotide-gated (HCN) channel blockers	Ivabradine (Lancora)	Lowers heart rate by blocking the hyperpolarization-activated cyclic nucleotide-gated (HCN) channel responsible for cardiac	Heart failure	Tiredness, weakness, lightheadedness caused by slow heart rate. Irregular heartbeat

Class	Name* Generic (brand name)	Mechanism of action	Indications*	Side effects**
[75] [76]		pacemaker, which regulates heart rate.		
Nitrates [77]	Nitroglycerin	Vasodilator	Angina	Headaches Flushing Dizziness Fainting Hypotension Arrhythmia

*Nonexhaustive list
**Contact a medical provider or pharmacist if side effects develop.

Surgeries and procedures for cardiovascular disease

Type	Description	Purpose / indication
Ablation [78] [79] [80] [81]	Used to treat tachycardia or fibrillation to restore normal heart rhythm. Used most often if arrythmia is unresponsive to medication. Arrhythmias can cause palpitations, fatigue, shortness of breath, and stroke. Ablation stops abnormal electrical signals from moving through the heart and causing an arrhythmia by ablating (destroying) the cells responsible for the disorganized electrical signals. Ablation can be performed by catheter (nonsurgically) or surgically.	Arrythmia
Catheter ablation	One or more catheters are inserted and threaded into the heart. A diagnostic catheter is used to study the arrhythmia and determine the location of the abnormal heart tissue. Once identified, an ablation catheter is positioned nearby and the tip emits heat (e.g., radiofrequency, microwave, or laser energy) or cold (cryoablation) to destroy the abnormal tissue, resulting in a scar. The scar tissue is incapable of conducting the abnormal electrical signal causing the arrhythmia. Some recurrence of the arrhythmia may be experienced, particularly during the first 2 to 3 weeks. Stable, normal rhythm is usually not achieved until after 3 to 6 months. Antiarrhythmic medications are usually prescribed during this period to help the heart recover its normal rhythm.	

Type	Description	Purpose / indication
Surgical ablation	Less common and may be combined with other open-heart surgeries (e.g., bypass, heart valve repair or replacement). Two main types of surgical ablation are Cox-Maze procedure and minimally invasive surgery.	
Cox-maze procedure (atrial fibrillation ablation)	For the Cox-maze procedure the heart is stopped and a heart-lung machine is used. A pattern of incisions inside the right and left atria are made. The incisions are sutured together which creates scar tissue that stops electrical activity from passing through the upper chambers.	
Minimally invasive surgery	Minimally invasive cardiac surgery for atrial fibrillation uses small incisions between the ribs and chest wall. A videoscope is inserted through an incision to view the heart. Ablations using energy source(s) are then made to the atria to destroy the tissues responsible for the abnormal electrical circuits.	
Atherectomy [82] [83]	Minimally invasive procedure that cuts away plaque built up arteries. Useful for when hard plaque, with a lot of calcium, is blocking an artery. Helpful to remove blockages in vessels not easy to treat with stents, or where arteries are branching. A catheter carrying tiny blades or laser is introduced into the femoral artery through the groin area. The plaque causing narrowing or blockage is cut away or vaporized and collected in a chamber at the tip of the catheter. X-rays and contrast dye are used to image the area. After the plaque is removed, a stent may be put in place to keep the artery open. There are four types of atherectomy, depending on device used.	Atherosclerosis
Rotational atherectomy	Small blades moving in a circular motion cut away plaque.	
Laser atherectomy	Laser vaporizes plaque blockages.	
Orbital atherectomy	Spinning tool moves in a grinding motion to remove plaque.	
Directional atherectomy	Blade shaves plaque in one direction.	

Type	Description	Purpose / indication
Cardiac rehabilitation [50] [78]	Medically supervised programs to help people recovery from myocardial infarction or other heart conditions. They include: • Exercise training to learn how to exercise safely, strengthen muscles, and improve stamina. • Education and counselling to learn how to reduce CVD risks.	Coronary artery disease Heart failure Heart valve diseases Myocardial infarction
Cardiac resynchronization therapy (CRT) (biventricular pacemaker) [84]	In advanced heart failure there may be a delay between contraction of right and left ventricle. CRT involves implanting a small electronic pulse generator under the skin of the upper chest or abdomen, which sends an electronic signal to help both ventricles contract together. The device is made up of three leads attached to the heart muscle at one end (one each to right atrium and right and left ventricles) and to a pulse generator at the other.	Heart failure
Cardioversion therapy [85] [86] [87] Defibrillation	Used to treat atrial fibrillation to help restore normal rhythm. Similar to defibrillation, but uses much lower level of electricity. Performed by placing two external paddles on the chest; or one on the chest and one on the back. A selected amount of electrical pulses is sent to jolt the heart back into normal rhythm. Usually is a prescheduled elective procedure. Performed under intravenous sedation. Emergency procedure used for life-threatening arrhythmias, such as ventricular fibrillation; pulseless ventricular tachycardia; or cardiac arrest due to or resulting in ventricular fibrillation. Automated external defibrillators (AEDs), found in many public spaces, are used during cardiac arrest.	Atrial fibrillation
Coronary artery bypass surgery (coronary artery bypass graft [CABG], bypass surgery) [47] [88]	Surgery to improve blood flow in coronary arteries blocked or narrowed by atherosclerosis. Uses a section of healthy blood vessel (artery or vein) harvested from leg, arm, or chest to create bypass (detour) around the blocked portion of coronary artery. Several bypasses maybe created depending on number of blockages. Done if angioplasty not possible due to many blockages or if catheter for angioplasty cannot reach blockage. Heart is stopped and heart-lung machine is used during surgery.	Atherosclerosis Cardiac arrest Coronary artery disease Heart failure Myocardial infarction

Type	Description	Purpose / indication
Off-pump or beating-heart surgery	Similar to bypass surgery, except heart is not stopped. Uses equipment to stabilize or quiet the area of the heart during surgery.	
Heart transplant surgery [78] [89]	Replacement of a failing heart with a healthy donor heart. Reserved for severe, end-stage heart failure. During surgery, a bypass machine is used to pump blood; most of failing heart is removed; posterior walls of atria are left in place; and donor heart is attached to remaining tissue and blood vessels. If necessary, pacing wires may be placed on heart surface to connect to external pacemaker (wires can be removed prior to discharge). The new heart is shocked to start beating and the chest is closed. Lifelong immunosuppressive therapy is used to prevent heart rejection. A mechanical heart (mechanical assist device) may be used temporarily while waiting for a donor heart. Serious risks of heart transplant include: • Infection • Primary graft dysfunction. The donor heart cannot function and fails. Most common cause of death in first month after transplant. • Heart rejection by immune system. Most likely to occur within six months after transplant. Lifelong immunosuppression therapy is needed to help prevent rejection. These drugs increase risk for infection and cancer, cause diabetes and osteoporosis, and can damage kidneys. • Cardiac allograft vasculopathy. An aggressive type of atherosclerosis that over a few months or years can block coronary arteries and cause donor heart to fail. Despite these risks, heart transplant has a good success rate. Recent survival rates are about 85% at one year after surgery. Survival rates decrease by about 3% to 4% each extra year after surgery, mainly because of serious complications related to heart transplant.	End-stage heart failure

Type	Description	Purpose / indication
Heart valve repair and replacement [90]	Heart valve procedures are performed to repair or replace a poorly functioning heart valve due to valvular heart disease. There are several surgical and nonsurgical procedures for repairing or replacing valves.	Heart valve diseases
Surgical valve repair	Surgical procedures are generally used for problems with the mitral or tricuspid valves.	
Commissurotomy	Used to treat a tight valve. Valve leaflets (flaps) are cut to loosen valve slightly, allowing blood to pass easily.	
Annuloplasty	Used to treat a leaky valve. To repair an enlarged annulus (ring of fibrous tissue at base of heart valve), sutures are sewn around the ring to make the opening smaller. Or, a ring-like device is attached around the outside of the valve opening to support the valve so it can close more tightly.	
Valvulotomy	Used to enlarge narrowed heart valves. Can also be done with the help of a balloon.	
Nonsurgical valve repair	Percutaneous or catheter-based procedures.	
Percutaneous or balloon valvuloplasty/valvotomy	Used to treat stiffened or narrowed (stenosed) pulmonary, mitral, or aortic valves. A balloon tip on the end of a catheter is positioned in the narrowed valve and inflated to enlarge the opening.	
Percutaneous mitral valve repair	Used to fix a leaky mitral valve in a person considered high risk for surgery. A catheter holding a clip is inserted into the groin and into left side of the heart. The open clip is positioned beyond the leaky valve and then pulled back to catch the mitral valve leaflets (flaps). Once closed, the clip holds the leaflets together to stop the valve from leaking.	

Type	Description	Purpose / indication
Heart valve replacement	If a heart valve is beyond repair, surgery may be needed to replace it with a mechanical or biological valve. Age is a factor in deciding type to use, biological valves are generally preferred for older people.	
Mechanical valves	Mechanical valves made of long-lasting metals, carbon, ceramics, and plastic. A fabric ring is used to sew the valve to heart tissue. Mechanical valves can lead to blood clots so anticoagulants must be taken for life. Makes a soft clicking sound when it closes, which can bother some people.	
Biological (bioprosthetic or tissue valves)	Biological valves are from human donors or animals (usually cows or pigs). Short term blood thinners are taken. Biological valves are not as durable as mechanical valves, but are more durable in the aortic position and in older people. Animal source valves (xenograft) are similar to human heart valves. They are tolerated well and are less likely to form blood clots than mechanical valves. Human heart valves from a donated heart (allograft) are tolerated well and tend to last longer than animal valves. Using human valves is uncommon. Valves can also come from a person's own tissue (autograft). In a Ross (or switch) procedure, a functioning pulmonary valve is used to replace the damaged aortic valve. The pulmonary valve is then replaced with a donated one.	
Transcatheter aortic valve implantation (TAVI) (transcatheter aortic valve replacement [TAVR]) [90]	TAVI is a minimally invasive surgical valve replacement used to treat symptomatic aortic valve stenosis. A catheter containing a new collapsible aortic value made from cow or pig heart tissue is inserted through small incisions in the groin or chest. Instead of repairing, or removing and replacing the damaged aortic valve, a new aortic valve is implanted and expanded directly within the damaged valve. Usually considered for people at high risk for complications from open-heart surgery.	Symptomatic aortic valve stenosis (narrowing of the aortic valve)

Type	Description	Purpose / indication
Implantable cardioverter defibrillator (ICD) [87] [91] [92] [93]	An implanted device that monitors and regulates arrythmias. When it detects a dangerous rhythm, it delivers an electrical shock to restore normal heart rate and rhythm. Like a pacemaker, ICD usually consists of two parts: a small computer and pulse generator that monitors heart rhythm and can generate a shock, and electrodes (leads) that transmit electrical signals to and from the heart muscle. ICD is usually placed under the skin, either near the collarbone or somewhere above or at the waistline. There are two basic types:	Bradycardia Ventricular tachycardia Ventricular fibrillation Previous cardiac arrest Used if drug therapy cannot control heart rhythm problem or caused severe side effects
Traditional ICD	Implanted in the chest; the leads travel through veins to attach to the heart.	
Subcutaneous ICD (S-ICD)	Implanted under the skin at the side of the chest below the armpit. It is attached to an electrode that runs along the breastbone. S-ICD is larger than a traditional ICD but does not attach to the heart.	
Implantable pacemaker [94] [95] [96]	Implantable device that regulates heart rate and rhythm. It uses electrical pulses to prompt the heart to beat at a normal rate. Only works when needed. Several types available depending on the condition. May be implanted temporarily or permanently. A permanent pacemaker consists of a pulse generator, which is usually placed under the skin in upper abdomen or upper chest area, and leads (electrodes) connected to the heart. Leadless pacemakers do no require leads and are implanted directly into the heart muscle. A temporary pacemaker is normally inserted through a vein in the neck and remains outside the body.	Arrhythmias particularly those unresponsive to drug therapy
Single chamber pacemaker	Usually carries electrical impulses to the right ventricle.	
Dual chamber pacemaker	Carries electrical impulses to the right ventricle and the right atrium to help control the timing of contractions between the two chambers.	
Biventricular pacemaker (cardiac resynchronization therapy)	Biventricular pacing is for advanced heart failure where there is a delay between the contraction of right and left ventricle. This pacemaker stimulates both the right and left ventricles to make the heart beat more efficiently.	

Type	Description	Purpose / indication
Mechanical assist device [78] [97] [98]	Small pump that can temporarily help pumping action of the heart. Several different devices available depending on the condition.	People requiring this type of temporary support include those with: • Recent myocardial infarction. • Acute myocarditis (heart inflammation). • Difficulty coming off cardiopulmonary bypass after open-heart surgery.
Intra-aortic balloon pump (IABP) (intra-aortic balloon counterpulsation [IABC], balloon pump)	IABP is a balloon that inflates and deflates at a specified rate to help flow of blood through the aorta and decrease workload on the left ventricle. IABP is placed via a catheter inserted into a blood vessel in the leg and threaded into the aorta. Typically, used to help left side of the heart for a short time periods (i.e., <10 days). When treatment is no longer needed, the balloon and catheter are withdrawn.	
Implantable ventricular assist device (VAD), (ventricular assist system [VAS])	VAD is a mechanical pump that supplements and helps the heart pump blood by taking over the function of either or both ventricles when needed. Typically used when the heart is severely weakened and longer-term support is required. Implantation of the VAD requires open-heart surgery. The heart is stopped and a heart-lung machine is used to circulate blood.	VAD may be used: • Until a heart donor for transplantation is available (bridge to transplant). • Until heart function recovers (bridge to recovery). • As long-term therapy in those with severe or end-stage heart failure who are not candidates for transplant.
Total artificial heart (TAH)	Much research has been conducted to develop a mechanical device that can permanently replace the heart and has no external tubes or cables. TAH is a pump that is placed in the chest to replace damaged heart ventricles and valves. Once the pump has been placed in the chest, a machine called a driver controls the pump outside the body. TAH involves open heart surgery. Several successful cases have been reported. TAHs are still experimental and are only available in a few research centres.	Heart failure caused by reduced ventricle function. For those ineligible for heart transplant.
Percutaneous coronary intervention (PCI)	Nonsurgical technique to widen narrowed or blocked areas within coronary arteries due to atherosclerosis. A thin flexible catheter with a small inflatable balloon at the tip is positioned within the narrowed section of the artery. The	Angina Atherosclerosis Coronary artery disease

Type	Description	Purpose / indication
(coronary angioplasty) [47] [78] [99] PCI (angioplasty) with stent	balloon is inflated to compact the plaque against the artery wall to improve blood flow. During PCI, a stent is often placed within the artery to lower risk of narrowing again (restenosis). When the tip of the catheter is in place, a balloon tip covered with a stent is inflated compressing the plaque and expanding the stent. Once the plaque is compressed and stent is in place, the balloon is deflated and withdrawn.	Myocardial infarction
Stent [100] [101] [102]	A coronary artery stent is a small mesh tube that expands inside a coronary artery. A stent is often placed during or immediately after angioplasty to help prevent the artery from closing again. A drug-eluting stent has medicine embedded in it to help prevent the artery from closing in the long term. Sometimes used to treat an aneurysm (bulge in an artery wall). Stents used for coronary arteries are made of metal mesh. Fabric stents, also called stent grafts, are used in larger arteries such as the aorta. Antiplatelet medicines are prescribed to prevent blood clots from forming in the stent, often for one year or more after a coronary stent. It may be one month or more for carotid or peripheral artery stents.	Combined with percutaneous coronary intervention (angioplasty) to treat: • Aortic aneurysm • Atherosclerosis • Coronary artery disease • Myocardial infarction • Peripheral artery disease
Ventricular resection [103]	Ventricular resection is a surgery to treat heart failure when the person has been diagnosed with an enlarged heart. It usually involves reshaping or reducing an over-sized left ventricle to improve its ability to pump blood. It is a form of open-heart surgery, where the heart is stopped and heart-lung machine is used. It is sometimes combined with bypass surgery or valve repair.	Cardiomyopathy Heart failure

Take home messages

Considering the high probability of treating clients with CVD, oral healthcare professionals have an essential role, including:

- Educating clients on risk factors of CVD, including importance of oral health.
- Encouraging reduction in CVD risk factors (e.g., tobacco cessation, salt reduction, healthy diet, regular physical activity, avoiding harmful use of alcohol) and adherence to prescribed drug therapies and treatment.
- Screening for hypertension,[7] including referral for early diagnosis and treatment.
- Screening for obstructive sleep apnea-related risk factors, such as excessive daytime sleepiness, large tongue or tonsils; recessed mandible; high arched palate; large neck circumference; obesity; or nocturnal gasping; loud or irregular snoring; breathing pauses during sleep (as reported by sleeping partner). Referring as indicated.[8] [104]
- Recognizing CVD risk factors in clients and their impact on client cardiovascular health and oral healthcare treatment.
- Considering the effect of client use of cannabis on oral healthcare treatment, especially if epinephrine is to be administered and the client's ability to give true informed consent based on their level of intoxication. [3] [26]
- Awareness of the types of diagnostic tests and management strategies for cardiovascular disease.
- Consulting with medical providers as required in order to provide safe treatment.

References

[1] American Heart Association, "2022 Heart Disease & Stroke Statistical Update Fact Sheet Global Burden of Disease," 2022. [Online]. Available: https://professional.heart.org/-/media/PHD-Files-2/Science-News/2/2022-Heart-and-Stroke-Stat-Update/2022-Stat-Update-factsheet-GIobal-Burden-of-Disease.pdf. [Accessed 13 February 2023].

[2] G. Roth, G. Mensah, C. Johnson, et al., "Global burden of cardiovascular diseases and risk factors, 1990–2019: Update from the GBD 2019 Study," *Journal of the American College of Cardiology,* vol. 76, no. 25, pp. 2982-3021, December 2020.

[3] World Health Organization, "Cardiovascular diseases (CVDs)," 11 June 2021. [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds). [Accessed 13 February 2023].

[4] National Health Service (NHS), "Cardiovascular disease," 22 April 2022. [Online]. Available: https://www.nhs.uk/conditions/cardiovascular-disease/. [Accessed 13 February 2023].

[5] National Institutes of Health, "Heart SEER Training Modules," [Online]. Available: https://training.seer.cancer.gov/anatomy/cardiovascular/heart/. [Accessed 14 February 2023].

[7] See additional resources below for link to CDHO Hypertension in Adults factsheet and Hypertension in Children and Adolescents factsheet. These factsheets contain blood pressure charts.

[8] See additional resources below for link to CDHO Obstructive Sleep Apnea factsheet.

[6] CDC, "How the Heart Works," 24 April 2022. [Online]. Available: https://www.cdc.gov/ncbddd/heartdefects/howtheheartworks.html. [Accessed 13 February 2023].

[7] Lovering, C, "Circulatory," 31 December 2021. [Online]. Available: https://www.healthline.com/human-body-maps/circulatory-system. [Accessed 14 February 2023].

[8] CDC, "Heart Disease," 20 June 2022. [Online]. Available: https://www.cdc.gov/diabetes/library/features/diabetes-and-heart.html. [Accessed 17 February 2023].

[9] U.S. Department of Health and Human Services, "A Report of the Surgeion: General How Tobacco Smoke Causes Disease," 2010. [Online]. Available: https://www.cdc.gov/tobacco/data_statistics/sgr/2010/consumer_booklet/pdfs/consumer.pdf. [Accessed 17 February 2023].

[10] CDC, "Physical Inactivity," 8 September 2022. [Online]. Available: https://www.cdc.gov/chronicdisease/resources/publications/factsheets/physical-activity.htm. [Accessed 17 February 2023].

[11] Mayo Clinic, "High blood pressure dangers: Hypertension's effects on your body," 14 January 2022. [Online]. Available: https://www.mayoclinic.org/diseases-conditions/high-blood-pressure/in-depth/high-blood-pressure/art-20045868. [Accessed 17 February 2023].

[12] CDC, "Heart Health," 19 October 2020. [Online]. Available: https://www.cdc.gov/marijuana/health-effects/heart-health.html. [Accessed 14 February 2023].

[13] American Heart Association, "Illegal Drugs and Heart Disease," 30 September 2015. [Online]. Available: https://www.heart.org/en/health-topics/consumer-healthcare/what-is-cardiovascular-disease/illegal-drugs-and-heart-disease. [Accessed 14 February 2023].

[14] D. Mahtta, D. Ramsey, C. Krittanawong, et al., "Recreational substance use among patients with premature atherosclerotic cardiovascular disease," *Heart,* vol. 107, no. 8, pp. 650-656, April 2021.

[15] Canadian Centre on Substance Use and Addiction, "Canada's Guidance on Alcohol and Health: Final Report," January 2023. [Online]. Available: https://ccsa.ca/canadas-guidance-alcohol-and-health-final-report. [Accessed 14 February 2023].

[16] American Heart Association, "What you need to know about how sleep apnea affects your heart," 10 November 2020. [Online]. Available: https://www.heart.org/en/health-topics/sleep-disorders/sleep-apnea-and-heart-disease-stroke. [Accessed 14 February 2023].

[17] American Thoracic Society, "Obstructive Sleep Apnea and Heart Disease," March 2019. [Online]. Available: https://www.thoracic.org/patients/patient-resources/resources/obstructive-sleep-apnea-and-heart.pdf. [Accessed 14 February 2023].

[18] CDC, "Know Your Risk for Heart Disease," 9 May 2019. [Online]. Available: https://www.cdc.gov/heartdisease/risk_factors.htm. [Accessed 14 February 2023].

[19] Mayo Clinic, "Heart attack," 21 May 2022. [Online]. Available: https://www.mayoclinic.org/diseases-conditions/heart-attack/symptoms-causes/syc-20373106. [Accessed 14 February 2023].

[20] J. Torpy, "Chronic stress and the heart," *JAMA,* vol. 298, no. 14, p. 1722, 10 October 2007.

[21] American Heart Association, "Stress and Heart Health," 21 June 2021. [Online]. Available: https://www.heart.org/en/healthy-living/healthy-lifestyle/stress-management/stress-and-heart-health. [Accessed 14 February 2023].

[22] CDC, "Heart Disease: It Can Happen at Any Age," 26 January 2021. [Online]. Available: https://www.cdc.gov/heartdisease/any_age.htm. [Accessed 14 February 2023].

[23] Heart and Stroke Foundation of Canada, "Types of heart disease," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/what-is-heart-disease/types-of-heart-disease. [Accessed 14 February 2023].

[24] Heart and Stroke Foundation of Canada, "Heart attack," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/conditions/heart-attack. [Accessed 14 February 2023].

[25] M. Vaduganathan, G. Mensah, J. Turco, et al., "The global burden of cardiovascular diseases and risk: A compass for future health," *Journal of the American College of Cardiology,* vol. 80, no. 25, pp. 2361-2371, December 2022.

[26] G. Joshy, M. Arora, R. Korda, et al., "Is poor oral health a risk marker for incident cardiovascular disease hospitalisation and all-cause mortality? Findings from 172 630 participants from the prospective 45 and Up Study," *BMJ Open,* vol. 6, pp. 1-10, 2016.

[27] E. Kotronia, H. Brown, O. Papacosta, et al., "Oral health and all-cause, cardiovascular disease, and respiratory mortality in older people in the UK and USA," *Scientific Reports,* vol. 11, article 16452, August 2021.

[28] Government of Canada, "About heart diseases and conditions," 10 March 2017. [Online]. Available: https://www.canada.ca/en/public-health/services/diseases/heart-health/heart-diseases-conditions/about-heart-diseases-conditions.html. [Accessed 13 February 2023].

[29] Government of Canada, "Prevention of heart diseases and conditions," 10 March 2017. [Online]. Available: https://www.canada.ca/en/public-health/services/diseases/heart-health/heart-diseases-conditions/prevention-heart-diseases-conditions.html. [Accessed 14 February 2023].

[30] Heart and Stroke Foundation of Canada, "Physical exam," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/tests/physical-exam. [Accessed 15 February 2023].

[31] Heart and Stroke Foundation of Canada, "Blood test and urine test," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/tests/blood-test-and-urine-test. [Accessed 15 February 2023].

[32] National Library of Medicine, "Troponin Test," 9 September 2021. [Online]. Available: https://medlineplus.gov/lab-tests/troponin-test/. [Accessed 15 February 2023].

[33] National Heart, Lung, and Blood Institute, "Angina (Chest Pain)," 24 March 2022. [Online]. Available: https://www.nhlbi.nih.gov/health/angina/diagnosis. [Accessed 15 February 2023].

[34] Heart and Stroke Foundation of Canada, "Chest X-ray," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/tests/chest-x-ray. [Accessed 15 February 2023].

[35] National Heart, Lung, and Blood Institute, "Heart Tests," 24 March 2022. [Online]. Available: https://www.nhlbi.nih.gov/health/heart-tests. [Accessed 15 February 2023].

[36] University of Ottawa Heart Institute, "Cardiac Computed Tomography (CT) Scan," 2023. [Online]. Available: https://www.ottawaheart.ca/test-procedure/cardiac-computed-tomography-ct-scan. [Accessed 15 February 2023].

[37] Heart and Stroke Foundation of Canada, "Heart MRI (Magnetic Resonance Imaging)," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/tests/heart-mri. [Accessed 15 February 2023].

[38] Mayo Clinic, "MRI," 4 September 2021. [Online]. Available: https://www.mayoclinic.org/tests-procedures/mri/about/pac-20384768. [Accessed 15 February 2023].

[39] The Texas Heart Institute, "Cardiac Magnetic Resonance Imaging (MRI and MRA)," 2023. [Online]. Available: https://www.texasheart.org/heart-health/heart-information-center/topics/cardiac-magnetic-resonance-imaging-mri-and-mra/. [Accessed 15 February 2023].

[40] Mayo Clinic, "Nuclear stress test," 7 January 2023. [Online]. Available: https://www.mayoclinic.org/tests-procedures/nuclear-stress-test/about/pac-20385231. [Accessed 15 February 2023].

[41] Heart and Stroke Foundation of Canada, "Thallium or Cardiolite scan," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/tests/thallium-or-cardiolite-scan. [Accessed 15 February 2023].

[42] Comanche County Memorial Hospital, "Exercise Cardiolite Scan," 2023. [Online]. Available: https://www.ccmhhealth.com/heart-and-vascular/cardiology/exercise-cardiolite-scan/. [Accessed 15 February 2023].

[43] Heart and Stroke Foundation of Canada, "Echocardiogram," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/tests/echocardiogram. [Accessed 15 February 2023].

[44] Heart and Stroke Foundation of Canada, "Transesophageal Echocardiogram (TEE)," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-

disease/tests/transesophageal-echocardiogram-tee. [Accessed 15 February 2023].

[45] Mayo Clinic, "Carotid ultrasound," 12 January 2023. [Online]. Available: https://www.mayoclinic.org/tests-procedures/carotid-ultrasound/about/pac-20393399. [Accessed 15 February 2023].

[46] Heart and Stroke Foundation of Canada, "Doppler ultrasound," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/tests/doppler-ultrasound. [Accessed 15 January 2023].

[47] Mayo Clinic, "Arteriosclerosis / atherosclerosis," 1 July 2022. [Online]. Available: https://www.mayoclinic.org/diseases-conditions/arteriosclerosis-atherosclerosis/diagnosis-treatment/drc-20350575. [Accessed 15 February 2023].

[48] Heart and Stroke Foundation of Canada, "Electrophysiology Study," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/tests/electrophysiology-study. [Accessed February 2023].

[49] Heart and Stroke Foundation of Canada, "Holter or event monitoring," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/tests/holter-or-event-monitoring. [Accessed 15 February 2023].

[50] Heart and Stroke Foundation of Canada, "Angina," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/conditions/angina. [Accessed 15 February 2023].

[51] Heart and Stroke Foundation of Canada, "Angiography / arteriography," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/tests/angiography. [Accessed 15 February 2023].

[52] Mayo Clinic, "Coronary angiogram," 14 December 2021. [Online]. Available: https://www.mayoclinic.org/tests-procedures/coronary-angiogram/about/pac-20384904. [Accessed 15 February 2023].

[53] Heart and Stroke Foundation of Canada, "Cardiac catheterization," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/tests/cardiac-catheterization. [Accessed 15 February 2023].

[54] Mayo Clinic, "Cardiac catheterization," 15 October 2021. [Online]. Available: https://www.mayoclinic.org/tests-procedures/cardiac-catheterization/about/pac-20384695. [Accessed 15 February 2023].

[55] National Heart, Lung, and Blood Institute, "What Is Cardiac Catheterization," 24 March 2022. [Online]. Available: https://www.nhlbi.nih.gov/health/cardiac-catheterization. [Accessed 16 February 2023].

[56] Heart and Stroke Foundation of Canada, "Tilt table exam," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/tests/tilt-table-exam. [Accessed 16 February 2023].

[57] Heart and Stroke Foundation of Canada, "ACE (angiotensin-converting enzyme) Inhibitors," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/angiotensin-converting-enzyme-inhibitors. [Accessed 16 February 2023].

[58] Mayo Clinic, "Angiotensin-converting enzyme (ACE) inhibitors," 8 September 2021. [Online]. Available: https://www.mayoclinic.org/diseases-conditions/high-blood-pressure/in-depth/ace-inhibitors/art-20047480. [Accessed 16 February 2023].

[59] Heart and Stroke Foundation of Canada, "Aldosterone antagonists," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/aldosterone-antagonists. [Accessed 16 February 2023].

[60] Heart and Stroke Foundation of Canada, "Medications," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications. [Accessed 16 February 2023].

[61] Mayo Clinic, "Other medications sometimes used to treat high blood pressure," [Online]. Available: https://www.mayoclinic.org/diseases-conditions/mental-illness/in-depth/mental-health/art-20046277. [Accessed 16 February 2023].

[62] Heart and Stroke Foundation of Canada, "ARBs (angiotensin II receptor blockers)," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/angiotensin-receptor-blockers. [Accessed 16 February 2023].

[63] Mayo Clinic, "Angiotensin II receptor blockers," 13 August 2021. [Online]. Available: https://www.mayoclinic.org/diseases-conditions/high-blood-pressure/in-depth/angiotensin-ii-receptor-blockers/art-20045009. [Accessed 16 February 2023].

[64] Heart and Stroke Foundation of Canada, "Antiarrhythmics," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/antiarrhythmics. [Accessed 16 February 2023].

[65] Heart and Stroke Foundation of Canada, "Anticoagulants," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/anticoagulants. [Accessed 16 February 2023].

[66] Heart and Stroke Foundation of Canada, "Antiplatelets," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/antiplatelet-medications. [Accessed 16 February 2023].

[67] Heart and Stroke Foundation of Canada, "Beta-blockers," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/beta-blockers. [Accessed 16 February 2023].

[68] Mayo Clinic, "Beta blockers," 13 August 2021. [Online]. Available: https://www.mayoclinic.org/diseases-conditions/high-blood-pressure/in-depth/beta-blockers/art-20044522. [Accessed 16 February 2023].

[69] Heart and Stroke Foundation of Canada, "Calcium channel blockers," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/calcium-channel-blockers. [Accessed 16 February 2023].

[70] Mayo Clinic, "Calcium channel blockers," 16 September 2021. [Online]. Available: https://www.mayoclinic.org/diseases-conditions/high-blood-

pressure/in-depth/calcium-channel-blockers/art-20047605. [Accessed 16 February 2023].

[71] Heart and Stroke Foundation of Canada, "Cardiac glycosides (Digoxin)," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/digoxin. [Accessed 16 February 2023].

[72] Heart and Stroke Foundation of Canada, "Other cholesterol-lowering medications," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/other-cholesterol-lowering-medications. [Accessed 16 February 2023].

[73] Heart and Stroke Foundation of Canada, "Cholesterol-lowering medications (statins)," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/statins. [Accessed 16 February 2023].

[74] Heart and Stroke Foundation of Canada, "Diuretics," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/diuretics. [Accessed 16 February 2023].

[75] Heart and Stroke Foundation of Canada, "Ivabradine," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/ivabradine. [Accessed 16 February 2023].

[76] Servier Canada Inc., "Lancora Product Monograph," 20 December 2016. [Online]. Available: https://pdf.hres.ca/dpd_pm/00037621.PDF. [Accessed 16 February 2023].

[77] Heart and Stroke Foundation of Canada, "Nitrates (Nitroglycerin)," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/medications/nitroglycerin. [Accessed 16 February 2023].

[78] National Heart, Lung, and Blood Institute, "Heart Treatments," 24 March 2022. [Online]. Available: https://www.nhlbi.nih.gov/health/heart-treatments-procedures. [Accessed 17 February 2023].

[79] Heart and Stroke Foundation of Canada, "Ablation," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/surgery-and-other-procedures/ablation. [Accessed 17 February 2023].

[80] American Heart Association, "Ablation for Arrhythmias," 17 November 2022. [Online]. Available: https://www.heart.org/en/health-topics/arrhythmia/prevention--treatment-of-arrhythmia/ablation-for-arrhythmias. [Accessed 17 February 2023].

[81] K. Phan, B. Croce and T. Yan, "Minimally invasive atrial fibrillation surgery," *Annals of Cardiothoracic Surgery,* vol. 3, no. 1, 28 January 2014.

[82] Heart and Stroke Foundation of Canada, "Atherectomy," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/surgery-and-other-procedures/atherectomy. [Accessed 17 February 2023].

[83] J. Roland, "What Is an Atherectomy and What Does It Involve?," Healthline , 15 November 2022. [Online]. Available: https://www.healthline.com/health/heart/atherectomy-heart-procedure. [Accessed 17 February 2022].

[84] Heart and Stroke Foundation of Canada, "Cardiac Resynchronization Therapy (CRT) (Biventricular Pacemaker)," 2023. [Online]. Available:

https://www.heartandstroke.ca/heart-disease/treatments/surgery-and-other-procedures/cardiac-resynchronization-therapy. [Accessed 17 February 2023].

[85] Heart and Stroke Foundation of Canada, "Cardioversion therapy," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/surgery-and-other-procedures/cardioversion-therapy. [Accessed 17 February 2023].

[86] S. Shah, M. Windle, S. L, et al., "Defibrillation and Cardioversion," Medscape, 22 May 2018. [Online]. Available: https://emedicine.medscape.com/article/80564-overview. [Accessed 17 February 2023].

[87] National Heart, Lung, and Blood Institute, "What are Defibrillators?," 24 March 2022. [Online]. Available: https://www.nhlbi.nih.gov/health/defibrillators. [Accessed 17 February 2023].

[88] Heart and Stroke Foundation of Canada, "Coronary artery bypass surgery," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/surgery-and-other-procedures/coronary-artery-bypass-surgery. [Accessed 17 February 2023].

[89] Heart and Stroke Foundation of Canada, "Heart transplant surgery," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/surgery-and-other-procedures/heart-transplant-surgery. [Accessed 17 February 2023].

[90] Heart and Stroke Foundation of Canada, "Heart valve surgery Repair and replacement," , 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/surgery-and-other-procedures/heart-valve-surgery. [Accessed 17 February 2023].

[91] Heart and Stroke Foundation of Canada, "Implantable cardioverter defibrillator (ICD)," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/surgery-and-other-procedures/implantable-cardioverter-defibrillator. [Accessed 17 February 2023].

[92] Mayo Clinic, "Implantable cardioverter-defibrillators (ICDs)," 2023. [Online]. Available: https://www.mayoclinic.org/tests-procedures/implantable-cardioverter-defibrillators/about/pac-20384692. [Accessed 17 February 2023].

[93] National Library of Medicine, "Implantable cardioverter-defibrillator," MedlinePlus, 2023. [Online]. Available: https://medlineplus.gov/ency/article/007370.htm. [Accessed 17 February 2023].

[94] Heart and Stroke Foundation of Canada, "Implantable pacemaker," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/surgery-and-other-procedures/implantable-pacemaker. [Accessed 17 February 2023].

[95] Mayo Clinic, "Pacemaker," 2 December 2021. [Online]. Available: https://www.mayoclinic.org/tests-procedures/pacemaker/about/pac-20384689. [Accessed February 2023].

[96] National Heart, Lung, and Blood Institute, "What Are Pacemakers?," 24 March 2022. [Online]. Available: https://www.nhlbi.nih.gov/health/pacemakers. [Accessed 17 February 2023].

[97] Heart and Stroke Foundation of Canada, "Mechanical assist device," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/surgery-and-other-procedures/mechanical-assist-device. [Accessed 17 February 2023].

[98] National Heart, Lung, and Blood Institute, "What Is Total Artificial Heart?," 24 March 2022. [Online]. Available: https://www.nhlbi.nih.gov/health/total-artificial-heart. [Accessed 17 February 2023].

[99] Heart and Stroke Foundation of Canada, "Percutaneous coronary intervention (PCI or angioplasty with stent)," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/surgery-and-other-procedures/percutaneous-coronary-intervention. [Accessed 17 February 2023].

[100] National Library of Medicine, "Angioplasty and stent placement - heart," MedlinePlus, 2023. [Online]. Available: https://medlineplus.gov/ency/article/007473.htm. [Accessed 17 February 2023].

[101] National Heart, Lung, and Blood Institute, "What Are Stents?," 24 March 2022. [Online]. Available: https://www.nhlbi.nih.gov/health/stents. [Accessed 17 February 2023].

[102] National Heart, Lung, and Blood Institute, "Living With a Stent," 24 March 2022. [Online]. Available: https://www.nhlbi.nih.gov/health/stents/living-with. [Accessed 17 February 2023].

[103] Heart and Stroke Foundation of Canada, "Ventricular resection," 2023. [Online]. Available: https://www.heartandstroke.ca/heart-disease/treatments/surgery-and-other-procedures/ventricular-resection. [Accessed 17 February 2023].

[104] ADA, "Sleep Apnea (Obstructive)," 9 January 2023. [Online]. Available: https://www.ada.org/resources/research/science-and-research-institute/oral-health-topics/sleep-apnea-obstructive. [Accessed 14 February 2023].

[105] Mayo Clinic, "Edema," 4 January 2023. [Online]. Available: https://www.mayoclinic.org/diseases-conditions/edema/symptoms-causes/syc-20366493. [Accessed 15 February 2023].

[106] D. Mount, "Clinical manifestations of hyperkalemia in adults," UpToDate, Inc. , January 2023. [Online]. Available: https://www.uptodate.com/contents/clinical-manifestations-of-hyperkalemia-in-adults. [Accessed 16 February 2023].

Client resources

Heart and Stroke Foundation of Canada Social and Peer Support webpage
Lists various national and provincial support services to help people stay connected
https://www.heartandstroke.ca/services-and-resources/social-and-peer-support

Additional Resources

The global burden of cardiovascular diseases and risk: A compass for future health, Vaduganathan, M; Menash, G; Turco, J; et al. *Journal of the American College of Cardiology*, Volume 80, Issue 25, p 2361-2371
https://www.jacc.org/doi/10.1016/j.jacc.2022.11.005

Is poor oral health a risk marker for incident cardiovascular disease hospitalisation and all-cause mortality? Findings from 172 630 participants from the prospective 45 and Up Study, Joshy, G; Arora, M; Korda, R; et al. BMJ Open, Volume 6, Issue 8, 2016, p 1-10 https://bmjopen.bmj.com/content/6/8/e012386

Oral health and all-cause, cardiovascular disease, and respiratory mortality in older people in the UK and USA, Kotronia, E; Brown, H; Papacosta, A; et al. *Scientific Reports*, Volume 11, Article 16452, August 12, 2021, p 1-10 https://www.nature.com/articles/s41598-021-95865-z

Hypertension In Adults, CDHO Factsheet, May 22, 2022, p 1-7 https://www.cdho.org/Advisories/CDHO_Factsheet_Hypertension.pdf

Hypertension In Children & Adolescents, CDHO Factsheet, May 22, 2022, p 1-7 https://www.cdho.org/Advisories/CDHO_Factsheet_Hypertension_in_Children.pdf

Hypertension, CDHO Advisory, May 5, 2022, p 1-29 https://www.cdho.org/Advisories/CDHO_Advisory_Hypertension.pdf

Obstructive Sleep Apnea, CDHO Factsheet, June 20, 2019, p 1-5 https://www.cdho.org/Advisories/CDHO_Factsheet_Obstructive_Sleep_Apnea.pdf

Direct Oral Anticoagulants, CDHO Factsheet, January 17, 2022, p 1-4 https://www.cdho.org/Advisories/CDHO_Factsheet_DOAC.pdf

Cardiac implantable electronic devices, CDHO Advisory, May 20, 2021, p 1-5 https://www.cdho.org/Advisories/CDHO_Factsheet_Cardiac_Implantable_Electronic_Devices.pdf

Angina, CDHO Factsheet, June 24, 2022, p 1-5 https://www.cdho.org/Advisories/CDHO_Factsheet_Angina.pdf

Angina, CDHO Advisory, January 24, 2022, p 1-22 https://www.cdho.org/Advisories/CDHO_Advisory_Angina_(Angina_Pectoris).pdf

Atrial Fibrillation, CDHO Factsheet, January 17, 2022, p 1-5 https://www.cdho.org/Advisories/CDHO_Factsheet_Atrial_Fibrillation.pdf

Heart Failure, CDHO Factsheet, June 2, 2021, p 1-5 https://www.cdho.org/Advisories/CDHO_Factsheet_Heart_Failure_CHF.pdf

Infective Endocarditis, CDHO Factsheet, June 14, 2021, p 1-8 https://www.cdho.org/Advisories/CDHO_Factsheet_Infective_Endocarditis.pdf

Infective Endocarditis, CDHO Advisory, June 14, 2021, p 1-17 https://www.cdho.org/Advisories/CDHO_Advisory_Infective_Endocarditis_And_Associated_Conditions.pdf

Myocardial infarction, CDHO Factsheet, September 6, 2019, p 1-4
https://www.cdho.org/Advisories/CDHO_Factsheet_Myocardial_Infarction.pdf

Myocardial Infarction and Cardiac Arrest, CDHO Advisory, August 6, 2019, p 1-24
https://www.cdho.org/Advisories/CDHO_Advisory_Myocardial_Infarction_and_Cardiac_Arrest.pdf

Post-Myocardial Infarction, CDHO Factsheet, July 17, 2021, p 1-6
https://www.cdho.org/Advisories/CDHO_Factsheet_Post-MI.pdf

Stroke, CDHO Factsheet, May 3, 2022, p 1-6
https://www.cdho.org/Advisories/CDHO_Factsheet_Stroke.pdf

Stroke, CDHO Advisory, May 3, 2022, p 1-19
https://www.cdho.org/Advisories/CDHO_Advisory_Stroke.pdf