

Question 1:

- A.
- a. Superior vena cava
 - b. Aorta
 - c. Pulmonary artery
 - d. Pulmonary vein
 - e. Left atrium
 - f. Mitral valve
 - g. Aortic valve
 - h. Left ventricle
 - i. Right ventricle
 - j. Inferior vena cava
 - k. Tricuspid valve
 - l. Pulmonary valve
 - m. Right atrium
 - n. Pulmonary vein
- B. Function of A: Receive deoxygenated blood from the upper regions of the body, function of J: Receive deoxygenated blood from the lower regions of the body, function of B: Carry blood from the heart to the rest of the body
- C. The blood carried by A/J is deoxygenated (high carbon dioxide content and low oxygen content). The blood carried by B is oxygenated (low carbon dioxide content and high oxygen content).
- D. The function of F is to allow blood to only flow from the left atrium to the left ventricle, while the function of K is to allow blood to only flow from the right atrium to the right ventricle.
- E. Parts like F or G are valves. These may not open fully, which can block or restrict the flow of blood (*valve stenosis* or *valve narrowing*), or not close fully, which means blood can leak back into the heart instead of forwards (*valve incompetence*, *valve regurgitation* or *leaky valve*). Overtime, these problems can put extra strain on the heart and cause it to work harder, increasing the risk of heart attacks, strokes or other heart conditions.
- F. The forces needed to pump blood around the whole body are higher than those needed to carry blood to the lungs for oxygenation.

Question 2:

[Research can be conducted by students individually or in groups.]

Example: Ebstein's anomaly

Mechanisms: The tricuspid valve usually sits between the right atrium and ventricle. However, in Ebstein anomaly, the valve sits lower in the right ventricle, causing the right atrium to enlarge and not work properly. The leaflets of this valve are also abnormally formed, leading to blood leaking back into the right atrium and your heart will not work as efficiently.

Outcomes: mild cases of the condition tend to not cause any complications. However, possible combinations may include heart failure, sudden cardiac arrest and stroke.

Risk factors: family history of heart defects and CHD (however, the genetic heritability of this condition has not been investigated), use of certain medications (e.g. lithium) or second-hand cigarette smoke exposure during pregnancy

Treatments: This depends on the severity of the defect (some might only have a slightly abnormal valve while others have a valve that leaks severely).

For milder cases, a doctor might only recommend:

- Regular monitoring, including physical examinations and tests such as electrocardiogram, echocardiogram and a Holter monitor test
- Medications to control your heart rhythm, ease signs of heart failure (such as drugs to prevent water retention) and preventing blood clots

For more severe cases in which the symptoms are affecting the patient's quality of life, surgery or other procedures might be required, such as:

- Tricuspid valve repair: the size of the valve opening is reduced to allow the valve leaflets to come together and work properly. A band might be placed around the valve to keep it in place. This procedure is mostly done when there's enough valve tissue to allow repair.
- Tricuspid valve replacement: the valve will be removed and replaced with either a biological tissue (bioprosthetic) or mechanical valve (although mechanical valves are not used often for this type of valve replacement)

Sources:

Downing, K. F., Riehle-Colarusso, T., Gilboa, S. M., Lin, A. E., Oster, M. E., Tinker, S. C., Farr, S. L., & National Birth Defects Prevention Study (2019). Potential risk factors for Ebstein anomaly, National Birth Defects Prevention Study, 1997-2011. *Cardiology in the young*, 29(6), 819–827. <https://doi.org/10.1017/S1047951119000970>

Mayo Clinic. (2022, May 5). *Ebstein anomaly - Diagnosis and treatment*. Mayo Clinic. Retrieved August 10, 2022, from <https://www.mayoclinic.org/diseases-conditions/ebsteins-anomaly/diagnosis-treatment/drc-20352132>

Mayo Clinic. (2022, May 5). *Ebstein anomaly - Symptoms and causes*. Mayo Clinic. Retrieved August 10, 2022, from <https://www.mayoclinic.org/diseases-conditions/ebsteins-anomaly/symptoms-causes/syc-20352127>

Question 3:

Social determinant 1: people with a **lower socioeconomic status** are more likely to be uninsured, receive poor quality health care and seek health care less often. When they do seek care, it is more likely to be for an emergency (in this context, this might be a cardiac arrest). Therefore, this has been associated with an increased risk of cardiovascular disease and mortality.

Social determinant 2: someone's **employment** may require long working hours, and there might be higher job insecurity and an increased risk of job loss. This might not only increase psychosocial job stress which is associated with an increased risk of various cardiovascular diseases (e.g. higher blood pressure and heart rate), but might also make it difficult for the person to have the time to attend medical appointments.

Social determinant 3: **people from racial or ethnic minorities often have to experience discrimination or stereotyping in the healthcare system**, largely due to the implicit biases of healthcare professionals. Physicians may perceive, interact with and treat patients from these minorities differently due to unconscious prejudices. This can be shown in patient-provider clinical decision making, which may, for example, lead to doing less diagnostic testing and poor chronic disease management of cardiovascular diseases.

Sources:

Atkinson, H. G., Kiss, J., & Koruth, J. (n.d.). *SOCIAL DETERMINANTS OF CARDIOVASCULAR DISEASE* | *Hurst's The Heart, 14e* | *AccessMedicine* | *McGraw Hill Medical*. AccessMedicine. Retrieved August 10, 2022, from <https://accessmedicine.mhmedical.com/content.aspx?bookid=2046§ionid=176567506>

Note: these social determinants only serve as examples and students may of course write about determinants not included here.

Question 4:

A 45-year-old man presents to the hospital. He has a history of poorly controlled coronary artery disease and hypertension. He reports shortness of breath during exertion that has limited his ability to carry out exercise over time, as well as weakness in his arms and legs for the past 3 months. His blood pressure is 150/95 and his BMI is 33. He has an S4 gallop and a pitting edema in his right leg. An electrocardiogram you conduct also suggests an LVH. Ultimately, you diagnose him with class II heart failure. Your patient asks you why he developed this condition.

- A. Heart failure oftentimes develops after other conditions have weakened or damaged the heart. In heart failure, the ventricles become stiff (enlarging the heart muscle) and are unable to fill properly between beats. Eventually, the ventricles will be unable to send enough blood to the rest of the body. As the condition progresses, the patient's ability to carry out physical activity without discomfort also decreases, and symptoms such as fatigue, rapid/irregular heartbeat and shortness of breath worsen.

New York Heart Association (NYHA) Classification of Heart Failure

Class	Patient Symptoms
Class I (Mild)	No limitation of physical activity. Ordinary physical activity does not cause undue fatigue, rapid/irregular heartbeat (palpitation) or shortness of breath (dyspnea).
Class II (Mild)	Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in fatigue, rapid/irregular heartbeat (palpitation) or shortness of breath (dyspnea).
Class III (Moderate)	Marked limitation of physical activity. Comfortable at rest, but less than ordinary activity causes fatigue, rapid/irregular heartbeat (palpitation) or shortness of breath (dyspnea).
Class IV (Severe)	Unable to carry out any physical activity without discomfort. Symptoms of fatigue, rapid/irregular heartbeat (palpitation) or shortness of breath (dyspnea) are present at rest. If any physical activity is undertaken, discomfort increases.

Coronary artery disease: this disease results from the buildup of fatty deposits in the coronary arteries. The narrowing of the arteries reduces oxygen-rich blood flow to the rest of the body, which can weaken the heart and worsen its ability to pump blood (leading to heart failure).

Hypertension: a higher blood pressure forces the heart to work harder to circulate blood to parts of the body. Over time, this extra exertion causes the ventricles to thicken, which increases the risk of heart failure and heart attacks.

B. Treatments:

- Monitor weight and exercise regularly
- Restrict dietary sodium (salt)
- Taking angiotensin-converting enzyme (ACE) inhibitors, which widen blood vessels to lower blood pressure, improve blood flow and decrease the heart's workload. Examples include captopril, enalapril (Vasotec) and lisinopril (Prinivil, Zestril, Zestoretic).
- For the poorly controlled coronary artery disease that is causing the heart failure, a coronary bypass surgery could be performed. This involves taking a healthy blood vessel from your leg, arm or chest and connecting it below and above the blocked arteries in your heart. The new pathway improves blood flow to your heart muscle.

[Other medications or surgeries could be used in the answer.]

C. Interventions:

- Educating the community about the risk factors for heart failure
- Conducting campaigns to encourage certain behaviours (e.g. reduced sodium intake, exercising regularly) and establishing supportive environments to support this behaviour
- Linking high-risk individuals to primary care to reduce the risk of strokes or heart attacks
- Conducting community-based blood pressure screenings

[Other interventions could be used in the answer.]

Sources:

Mayo Clinic. (2021, December 10). *Heart failure - Diagnosis and treatment*. Mayo Clinic. Retrieved August 10, 2022, from

<https://www.mayoclinic.org/diseases-conditions/heart-failure/diagnosis-treatment/drc-20373148>

Mayo Clinic. (2020, November 25). *Left ventricular hypertrophy - Diagnosis and treatment*. Mayo Clinic. Retrieved August 10, 2022, from

<https://www.mayoclinic.org/diseases-conditions/left-ventricular-hypertrophy/diagnosis-treatment/drc-20374319>

Cheadle, A., Rosaschi, M., Burden, D., Ferguson, M., Greaves, B., Houston, L., McClendon, J., Minkoff, J., Jones, M., Schwartz, P., Nudelman, J., & Maddux-Gonzalez, M. (2019). A Community-Wide Collaboration to Reduce Cardiovascular Disease Risk: The Hearts of Sonoma County Initiative. *Preventing chronic disease*, 16, E89. <https://doi.org/10.5888/pcd16.180596>