

## Cardiac (Heart) Screening

### What is cardiac (heart) screening?

Screening exams find disease before symptoms begin. The goal of screening is to detect disease at its earliest and most treatable stage. In order to be widely accepted and recommended by medical practitioners, a screening program must meet a number of criteria, including reducing the number of deaths from the given disease.

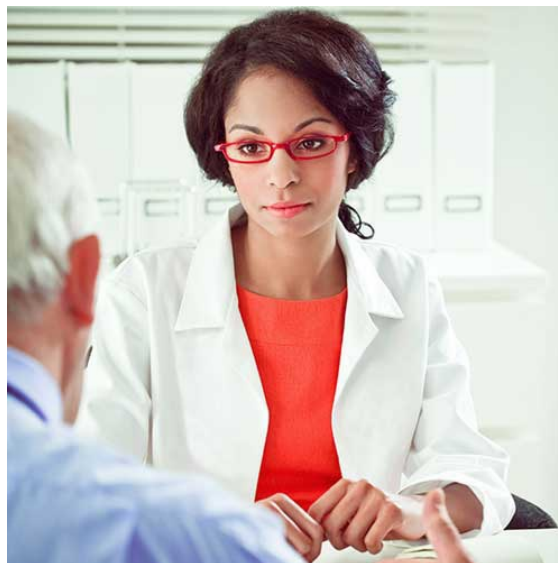
Screening tests may include lab tests that check blood and other fluids, genetic tests that look for inherited genetic markers linked to disease, and imaging exams that produce pictures of the inside of the body. These tests are typically available to the general population. However, an individual's needs for a specific screening test are based on factors such as age, gender, and family history.

Coronary artery disease (CAD) is the most common form of heart disease. In heart screening, doctors may test individuals with no signs or symptoms of CAD to measure:

- the amount of cholesterol in your blood. This measure includes low-density lipoproteins (LDL). High levels of LDL can lead to a buildup in the arteries. It also includes high-density lipoproteins (HDL), which absorb cholesterol and carry it back to the liver, where it is flushed from the body.
- the amount of sugar present in your blood (blood glucose levels).
- the amount of C-reactive protein in your blood. Your doctor will test this with a high-sensitivity c-reactive protein assay. C-reactive protein appears in higher amounts when there is inflammation or swelling somewhere in the body.
- Your blood pressure. This is the force of blood against the artery walls both when the heart beats (systolic) and when it is at rest (diastolic).

Depending on your screening test results and whether you are at risk for CAD, your doctor may prescribe more tests, including:

- Electrocardiography (ECG or EKG) measures the electrical activity of the heart and records information on heart rate and rhythm.
- Exercise cardiac stress test involves walking on a treadmill or pedaling a stationary bike at increasing levels of difficulty. During this test, the doctor checks your heart rate and rhythm, blood pressure, and the electrical activity of your heart using ECG. This helps check if there is enough blood flow to your heart when it is stressed. If you cannot exercise, you will instead receive medication to make your heart beat harder and faster.
- Echocardiography uses ultrasound to create moving pictures of the heart. In a stress echocardiography, ultrasound looks at the heart before and after it is stressed from exercise or medication.
- Cardiac CT for Calcium Scoring ([https://www.radiologyinfo.org/en/info/ct\\_calscoring](https://www.radiologyinfo.org/en/info/ct_calscoring)) uses computed tomography (CT) to show whether there is calcium in your coronary arteries. This gives your doctor an idea of how much calcified plaque you have in your arteries. Importantly, calcium scoring only measures the presence of calcified plaque. It cannot evaluate how severely your coronary arteries have narrowed, a condition called stenosis. It cannot evaluate if you have noncalcified plaque (the other type of plaque).



- Coronary CT angiography (CCTA) (<https://www.radiologyinfo.org/en/info/angiocorocct>) uses CT and contrast material to create three-dimensional images of your coronary arteries. This helps your doctor pinpoint the exact location, extent of plaque buildup (both calcified and noncalcified), and if there is blockage or narrowing (called stenosis) of your coronary arteries.
- Myocardial perfusion imaging (MPI) (nuclear stress test) injects a small amount of radioactive material into your vein. The material accumulates in your heart muscle. A special camera takes pictures of the heart while you are at rest and after exercise. This helps determine the effect of physical stress on the flow of blood through the coronary arteries to the heart muscle.
- Coronary catheter angiography (<https://www.radiologyinfo.org/en/info/angiocath>) takes pictures of the blood flow through your coronary arteries. Your doctor will insert a thin plastic tube called a catheter into an artery. The doctor guides the catheter to the heart and injects contrast material through it. X-rays capture images of your heart. This allows your doctor to see any blockage or narrowing of the coronary arteries.

## Who should consider heart screening – and why?

### About Coronary Heart Disease

According to the National Institutes of Health (<https://www.nlm.nih.gov/medlineplus/heartdiseases.html>), heart disease is a leading cause of death and disability in the United States. Heart disease comes in many different forms. Coronary artery disease (CAD) is the most common and is a major cause of heart attack (myocardial infarction).

CAD occurs when plaque builds up along the walls of the heart's arteries. This is called atherosclerosis. Plaque is a collection of fat, cholesterol, and other substances. As plaque builds up, the coronary arteries narrow and blood clots (<https://www.radiologyinfo.org/en/info/bloodclot>) may form. This may limit blood flow and create a risk for the vessel to become completely blocked. This blockage may result in a heart attack.

### Risk Factors

A risk factor is anything that increases your chance of developing disease. Risk factors for CAD include:

- age
- gender
- family history
- tobacco smoking
- high blood cholesterol
- high blood pressure
- physical inactivity
- obesity
- diabetes

### Screening Recommendations

The American Heart Association (<https://www.heart.org/en/health-topics/consumer-healthcare/what-is-cardiovascular-disease/heart-health-screenings>) recommends the following screening tests for coronary artery disease (CAD) starting at age 20. Blood glucose screening should begin at age 45. If you have a heart condition or are at risk for CAD, your doctor may suggest having these screening tests more often.

#### *Cholesterol*

People at normal risk for heart disease should have a cholesterol test every four to six years. If you are at an increased risk for heart disease or stroke, talk to your doctor about how often you should have the test.

### *Blood pressure*

If your blood pressure is less than 120/80 mm Hg, you should have this test at least once every two years.

### *Blood glucose*

The United States Preventive Services Task Force (USPSTF) recommends you start screening for type 2 diabetes at age 40 if you are overweight or obese. Repeat the test every three years if your results are normal. The American Diabetes Association recommends you start annual screening at age 45. Talk to your doctor about when to start screening if you are at higher risk for diabetes.

### *High-sensitivity c-reactive protein (hs-CRP) testing*

The American Heart Association and the Centers for Disease Control and Prevention recommend *High-sensitivity c-reactive protein (hs-CRP)* testing as an optional tool for evaluating patients. The test is most useful for those with an intermediate risk (10-20 percent chance) of a heart attack within the next 10 years. Your doctor can help determine whether you are at risk and if you should have this test.

If early testing shows signs of heart disease or you have specific risk factors for CAD, such as abnormal cholesterol, high blood pressure, diabetes, cigarette smoking, or a family history of developing CAD at a relatively young age, your doctor may recommend:

- electrocardiography (ECG or EKG)
- exercise cardiac stress test
- echocardiography or stress echocardiography
- cardiac CT for calcium scoring
- coronary CT angiography (CCTA)
- myocardial perfusion imaging (MPI) (nuclear stress test)
- coronary catheter angiography

## **How are the procedures performed?**

### Cardiac CT for Calcium Scoring ([https://www.radiologyinfo.org/en/info/ct\\_calscoring](https://www.radiologyinfo.org/en/info/ct_calscoring))

The technologist will position you flat on your back on the CT exam table. The doctor may use straps and pillows to help you keep the correct position and stay still during the exam. You will raise your arms over your head. The technologist will attach electrodes (small, sticky discs) to your chest and to an ECG machine. The machine will record the electrical activity of your heart. The technologist will tell you how and when to hold your breath. The exam table will move multiple times as the CT scanner records the images.

### Coronary CT angiography (CCTA) (<https://www.radiologyinfo.org/en/info/angiocoroct>)

A nurse will insert an intravenous (IV) line into a vein in your arm. You may receive medication through the IV or orally to help slow your heart rate. You will be injected with contrast material through your IV. You may also receive nitroglycerin (via spray or a tablet under your tongue) to enlarge your coronary arteries and improve the images. You will lie on an exam table while the technologist attaches electrodes to your chest and to an ECG machine that records the electrical activity of your heart. You will raise your arms over your head for the entire exam. The technologist will tell you how and when to hold your breath. The exam table will move multiple times as the CT scanner records the images.

### *Myocardial perfusion imaging, (nuclear stress test)*

Your doctor will inject a small amount of radioactive material called a radiotracer into your vein. A radiotracer is a drug that emits radioactivity. You will rest for approximately 20 to 40 minutes. Next, you will lie on a moveable imaging table while a nurse or technologist inserts an IV line into a vein in your hand or arm. You may need to raise one or both arms over your head during the exam. After imaging, you will walk on a treadmill or pedal on a stationary bicycle for a few minutes. While you exercise, your

heart rate and blood pressure will be measured. When blood flow to the heart reaches its peak, you will receive a second radiotracer injection through your IV. In about 20-40 minutes, you will return to the imaging table where the technologist will record a second series of images. If you cannot exercise, you will receive a drug to increase blood flow to the heart. *See the Cardiac Nuclear Medicine page (<https://www.radiologyinfo.org/en/info/cardimuclear>) for more information.*

#### *Coronary catheter angiography*

A nurse or technologist will insert an IV line into a small vein in your hand or arm. The technologist will shave, clean, and numb an area of your groin or arm with a local anesthetic. The doctor will make a small incision in the skin, insert the catheter, and guide it through the coronary arteries. The technologist will take multiple X-ray images of the coronary arteries as the doctor injects contrast material through the catheter. *See the Catheter Angiography page (<https://www.radiologyinfo.org/en/info/angiocath>) for more information.*

## **What are the benefits and risks of heart tests?**

### *Cardiac CT for Calcium Scoring*

#### **Benefits**

- Cardiac CT for calcium scoring is a convenient, noninvasive way to show if you are at increased risk for a heart attack.
- The exam takes little time, causes no pain, and does not require an injection of contrast material.
- No radiation stays in your body after a CT exam.
- X-rays used in standard CT scans have no immediate side effects.
- Cardiac CT for calcium scoring can confirm or exclude the presence of calcified plaque in the coronary arteries—a marker of CAD.
- The exam can guide medical treatment.

#### **Risks**

- Women should always tell their doctor and technologist if they are pregnant. *See the CT Safety During Pregnancy (<https://www.radiologyinfo.org/en/info/safety-ct-pregnancy>) page for more information about pregnancy and x-rays.*
- CT is generally not recommended for pregnant women unless medically necessary because of potential risk to the baby.
- A high calcium score may sometimes be followed by other tests for heart disease. These other tests may not provide clinically valuable results and can be associated with side effects.
- Radiation may slightly increase your lifetime risk of cancer. However, the benefit of a correct diagnosis generally outweighs the risk. Your doctor will minimize the amount of radiation as much as possible.
- The amount of radiation for this procedure varies. *See the Radiation Dose (<https://www.radiologyinfo.org/en/info/safety-xray>) page for more information.*

### *Coronary CT angiography (CCTA)*

#### **Benefits**

- Coronary CTA is not invasive. An alternative test, cardiac catheterization with a coronary angiogram, is invasive. The test also has more complications related to placement of a long catheter into the arteries, movement of the catheter in the blood vessels, and recovery time.
- Coronary CTA can detect or exclude coronary artery blockages and plaque build-up.
- CT can view bone, soft tissue, and blood vessels all at the same time. Therefore, CT can be useful in finding other reasons for your discomfort, such as an injury to the aorta or a blood clot in the lungs.

- A CT exam is fast.
- CT is cost-effective for a wide range of medical problems.
- CT is less sensitive to patient movement than MRI.
- Unlike MRI, your doctor can use CT even if you have an implanted medical device.
- No radiation stays in your body after a CT exam.
- X-rays used in standard CT scans have no immediate side effects.

## Risks

- In some people with abnormal kidney function, the CT contrast material may worsen kidney function.
- Contrast material may leak out from the vessel being injected and spread under the skin where the IV is placed. While this is unlikely, it may damage the skin, blood vessels, or nerves. Tell the technologist at once if you feel any pain in your arm at the location of the IV during contrast material injection.
- The amount of radiation for this procedure varies. *See the Radiation Dose (<https://www.radiologyinfo.org/en/info/safety-xray>) page for more information.*
- Women should always tell their doctor and technologist if they are pregnant. *See the CT Safety During Pregnancy (<https://www.radiologyinfo.org/en/info/safety-ct-pregnancy>) page for more information about pregnancy and x-rays.*
- CT is generally not recommended for pregnant women unless medically necessary because of potential risk to the baby.
- IV contrast manufacturers say mothers should not breastfeed their babies for 24–48 hours after receiving contrast medium. However, the American College of Radiology (ACR) and the European Society of Urogenital Radiology note that the available data suggest that it is safe to continue breastfeeding after receiving IV contrast. *For further information, please consult the ACR Manual on Contrast Media (<https://www.acr.org/Clinical-Resources/Contrast-Manual>) and its references.*
- Serious allergic reactions to CT contrast material are extremely rare, and radiology departments are well-equipped to deal with them. If you have a known reaction to CT contrast, you may need premedication with a steroid prior to the exam to limit risk of another reaction.
- Radiation may slightly increase your lifetime risk of cancer. However, the benefit of a correct diagnosis generally outweighs the risk. Your doctor will minimize the radiation dose as much as possible.

### *Myocardial perfusion imaging (nuclear stress test)*

## Benefits

- Nuclear medicine offers unique information, such as details on the function and structure of your heart muscle. This information is often unattainable using other imaging procedures.
- Nuclear medicine offers the most useful information for diagnosing ischemic heart disease and determining proper treatment, if any.

## Risks

- If you have CAD, you could experience chest pain while exercising or when you receive a drug for the stress test. However, your doctor will monitor your heart. If necessary, your doctor can supply medication for your chest pain.
- Your doctor will always weigh the potential risks and benefits of nuclear medicine procedures. Your doctor will tell you about all significant risks prior to treatment and give you an opportunity to ask questions.
- Allergic reactions to radiotracers are extremely rare and usually mild. Tell the medical personnel about any known allergies or prior problems with nuclear medicine.
- The radiotracer injection may cause slight pain and redness. This should rapidly resolve.
- Women should always tell their doctor and technologist if they are pregnant. *See the Radiation Safety (<https://www.radiologyinfo.org/en/info/safety-radiation>) page for more information about pregnancy, breastfeeding and*

nuclear medicine exams.

- Radiation may slightly increase your lifetime risk of cancer. However, the benefit of a correct diagnosis generally outweighs the risk. Your doctor will minimize the amount of radiation as much as possible.

### Coronary catheter angiography

#### Benefits

- Catheter angiography (<https://www.radiologyinfo.org/en/info/angiocath>) offers detailed, clear, and correct pictures of the blood vessels. This is especially helpful when your doctor is considering a surgical or percutaneous intervention.
- Unlike CT angiography (CTA) (<https://www.radiologyinfo.org/en/info/angiact>), the use of a catheter makes it possible to diagnose and treat in a single procedure. For example, if you have an area of severe stenosis or narrowing, your doctor may perform angioplasty and place a stent. *See the Angioplasty and Vascular Stenting* (<https://www.radiologyinfo.org/en/info/angioplasty>) page for more information.
- Catheter angiography displays a level of detail that may not be available with any other noninvasive procedures.
- No radiation stays in a patient's body after an x-ray examination.
- X-rays usually have no side effects in the typical diagnostic range for this exam.

#### Risks

- If you have a known contrast material allergy, your doctor may recommend premedication for 24 hours to reduce the risk of allergic reaction. Or, your doctor may prescribe a different exam that does not use contrast material.
- Contrast material may leak out from the vessel being injected and spread under the skin where the IV is placed. While this is unlikely, it may damage the skin, blood vessels, or nerves. Tell the technologist at once if you feel any pain in your arm at the location of the IV during contrast material injection.
- Women should always tell their doctor and technologist if they are pregnant. *See the CT Safety During Pregnancy* (<https://www.radiologyinfo.org/en/info/safety-ct-pregnancy>) page for more information about pregnancy and x-rays.
- IV contrast manufacturers say mothers should not breastfeed their babies for 24-48 hours after receiving contrast medium. However, the American College of Radiology (ACR) and the European Society of Urogenital Radiology note that the available data suggest that it is safe to continue breastfeeding after receiving IV contrast. *For further information please consult the ACR Manual on Contrast Media* (<https://www.acr.org/Clinical-Resources/Contrast-Manual>) and its references.
- Serious allergic reactions to iodine contrast materials are extremely rare, and radiology departments are well-equipped to deal with them.
- There is a small risk that a blood clot will form around the tip of the catheter. This could block the artery and make surgery to reopen the vessel necessary.
- If you have diabetes or kidney disease, the contrast material may cause kidney damage. In most cases, the kidneys will regain their normal function within five to seven days.
- Rarely, the catheter punctures the artery and cause internal bleeding. It also is possible that the catheter tip will separate material from the inner lining of the artery. This could cause a blockage downstream in the blood vessel.
- Radiation may slightly increase your lifetime risk of cancer. However, the benefit of a correct diagnosis generally outweighs the risk. Your doctor will minimize the amount of radiation as much as possible.

## What happens if something is detected on my screening exam?

If screening tests reveal CAD, you can lower your risk of heart attack or worsening heart disease. Your doctor may recommend a healthier diet, exercise, and quitting smoking. Medication may also be necessary. Medication can treat CAD risk factors such as high cholesterol, high blood pressure, irregular heartbeat, and low blood flow. In some cases, advanced treatments and surgery can help restore blood flow to the heart.



A negative cardiac CT for calcium score ([https://www.radiologyinfo.org/en/info/ct\\_calscoring](https://www.radiologyinfo.org/en/info/ct_calscoring)) means you have no calcification within your coronary arteries. This suggests that CAD is absent or so minimal this technique cannot see it. Under these circumstances, your risk of heart attack over the next two to five years is very low.

A positive cardiac CT for calcium score means CAD is present, regardless of whether you are experiencing any symptoms. The amount of calcification is expressed as the calcium score. A score of:

- 1-100 shows mild evidence of CAD
- 100-300 shows moderate evidence
- 301-999 shows severe evidence of disease.

A score of 1000 or more shows extensive evidence of CAD.

Your calcium score helps predict the likelihood of heart attack in the coming years. It also helps your doctor decide whether to prescribe preventive medicine or other measures such as diet and exercise to lower your risk for heart attack.

If CAD is present, you can reduce your risk of heart attack and manage symptoms using lifestyle changes, medications and, if necessary, surgical interventions such as:

- Angioplasty and stenting (<https://www.radiologyinfo.org/en/info/angioplasty>) : Angioplasty uses X-rays to guide a balloon-tipped catheter into a coronary artery and advance it to where the vessel is narrow or blocked. Your doctor inflates the balloon to open the vessel, then deflates and removes it. During angioplasty, your doctor may permanently place a small wire mesh tube called a stent inside the artery to help keep it open. Stents may be bare metal (wire mesh) or drug-eluting (coated with a drug).
- Coronary artery bypass graft surgery (CABG): CABG surgery reroutes blood around diseased vessels. During this surgery, a healthy artery or vein from elsewhere in the body is connected, or grafted, to a coronary artery to bypass the blockage. This creates a new path for oxygen-rich blood to flow to the heart muscle.

## Where can I find more information about heart screening?

You can find more information on heart screening at:

- *American Heart Association* (<https://www.heart.org>)

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