British Heart Foundation

Tests helped me understand my heart

June Phillips

FIGHT FOR EVERY HEARTBEAT

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ABOUT THIS BOOKLET

This booklet describes the special tests that are commonly used to help diagnose heart conditions. Some of the tests are also used to assess the current condition of people who have already been diagnosed with heart disease.

The information in this booklet is a general guide. The arrangements for each test, and the way tests are carried out, may vary between different hospitals.

This booklet does not replace the advice that your doctors and other healthcare professionals involved in your tests may give you, but it should help you to understand what they tell you.

You may be reading this booklet because your doctor has just suggested you have some tests to find out if your symptoms are due to heart disease. Or you may already know that you have heart disease and need tests to find out more about your condition.

You may feel worried about being referred for tests. It's natural for you to feel a bit anxious. If you do feel anxious, bring your partner, or a relative or friend with you. For some tests they can sit with you. For others they can wait outside the room, so that they're close at hand when the test is over. If you have the chance to talk to the doctor straight after the test, you can ask if your partner, relative or friend can see the doctor with you.

Some of the tests involve high-tech equipment with lots of machines, wires and computer screens, which may feel very impersonal. This booklet explains what the tests are for and how they are done. You can watch film clips of people having some of these tests on our website at **bhf.org.uk/tests**

TOP TIPS ON TESTS

1. If you feel anxious about having a test, ask if your partner, or a relative or friend, can go with you.
2. If you feel uneasy when you go for the test, tell the people doing the test how you feel. They can explain things to you, which can be reassuring.
3. At the end of the test, ask when you will get the results.
4. When you go to see your GP, cardiologist or the nurse to get your results, you may find it helpful to take in a list of the questions you want to ask.
5. Ask what you can do if you think of any more questions afterwards – for example, if there is someone you could contact.

An electrocardiogram, or ECG, records the electrical activity of your heart. Most GP surgeries can do an ECG for you if you need one. Some GPs can give you the result while you are there, but sometimes they send it on to a specialist for them to check first.

Sometimes people have an ECG before having a routine operation. If you go to the accident and emergency department of a hospital because you have chest pains or an abnormal heart rhythm, you will have an ECG. Or you might have one as part of a private health check-up, even if there is no suspicion of heart disease.

What happens?

Small sticky patches called 'electrodes' are put on your chest, and sometimes your arms and legs. These are connected, by wires, to an ECG recording machine. The recording machine picks up the electrical activity in your heart and interprets it into wavy lines which are printed onto paper.

The whole test takes about five minutes. The ECG machine will only record electrical signals from your heart. It does not give electric shocks and does not damage your heart. It isn't painful or uncomfortable.

However, you will need to be able to lie still, because body movements can affect the result.

What can the test show?

Your ECG may detect problems called arrhythmias. These are abnormal heart rhythms where the heart beats too slowly, too fast or irregularly. Or, if you get sudden symptoms such as chest pain, an ECG can help doctors to diagnose if you are having a heart attack. An ECG can often show if a person has had a heart attack days, weeks or even years ago. It can also show if the heart might be enlarged, or if the heart wall might have become thicker because there has been too much strain on it.

The ECG is a simple and useful test, but it has some limitations. An abnormal reading does not necessarily mean that there's something wrong with your heart. Some people may have a normal ECG recording even though they do have a heart condition. This is why you may need to have one or more other tests as well as the ECG.

You can watch a film clip about having an ECG at bhf.org.uk/tests

Exercise ECG

This test is also known as a **stress test**, an **exercise electrocardiogram**, **exercise stress testing** or an **exercise tolerance test**.

An exercise ECG is an electrocardiogram that is recorded while you are walking on a treadmill or cycling on an exercise bike. The idea of this test is to see how your heart works when you are moving about and when your heart has to work harder – which is what happens in everyday life. The heart needs more blood and oxygen when you are active.

What can the test show?

Your heart pumps blood to your heart muscle, through your coronary arteries. An exercise ECG can show if your heart muscle is receiving enough blood.

The test can be used in the following ways:

- It helps doctors find out if you have coronary heart disease. If, during the test, there are certain changes in the ECG pattern, or if you develop symptoms such as chest pain or tightness, or if there are abnormal changes in your blood pressure or heart rate, this

may mean that there is narrowing of the coronary arteries and that you'll need further tests.

- If you already know you have coronary heart disease, an exercise ECG gives information about how severe your condition might be. For example, it can give some idea of how much strain your narrowed coronary arteries are under when you exercise. This can help your doctors to assess if your condition has got worse, and help them plan the best treatment for you.
- An ECG also helps doctors to see how well your heart is working if you have recently had heart surgery or a coronary angioplasty, or had a heart attack. And it can help doctors decide what level of exercise you should do as part of your cardiac rehabilitation programme.
- An exercise ECG is sometimes used to find out if someone is fit to drive, including people who drive a bus, coach or lorry for their job.
- It can also be used if you have been collapsing or having blackouts, particularly if this happens while you are being active or exercising.

Getting ready for the test

You will be asked to wear light, comfortable clothes and shoes. You shouldn't have a heavy meal before the test.

Exercise raises your pulse rate. However, this effect shows up less if you are taking a type of medicine called beta-blockers. So, if you take beta-blockers, the cardiac department may ask you to stop taking them for a day or two before the test. If you're worried about this, discuss it with your GP.

What happens?

Several small sticky patches (electrodes) are put on your chest. These are connected, by wires, to an ECG machine to record all the electrical activity of your heart, in the same way as for the ECG described on page 5. You will then be asked to exercise, either on a treadmill or on an exercise bike.

The test starts off at a very easy rate and is gradually made harder, either by increasing the speed and slope of the treadmill, or by applying a brake to the bike. The exercise you have to do is not as intensive as an exercise workout. A doctor or specially trained physiologist will carefully check your ECG reading, blood pressure and

pulse at regular intervals throughout the test.

The tester will tell you when to stop exercising – usually when they have the measurements they need. They may also tell you to stop if you start getting symptoms such as chest pain, chest tightness, shortness of breath, tiredness, blood pressure that is too high or too low, or an abnormal heart rate.

Let the tester know if you get any of these symptoms. You can also tell them if you can't carry on with the test. The tester will be with you the whole time while you are having the test.

After you have stopped exercising, they will take more ECG readings.

The exercise test usually lasts between a few minutes and 15 minutes. It can be hard work, but should not be too much for you. Like many people, you may be pleasantly surprised by how much you can achieve. The value of the test is much greater if you try to work as hard as you can.

If you can't do the exercise test because you have another physical condition, such as severe arthritis

or lung disease, your doctor may recommend a radionuclide test (see page 48) or a stress echocardiogram (see page 22) instead.

What can the test show?

If you have coronary heart disease, an exercise ECG can show 'ischaemic changes' during exercise. This means that the test is showing that there's a reduced supply of oxygen to the heart muscle. If you get chest pain and there are ischaemic changes on the ECG recording at the same time, this could mean that the chest pain is coming from your heart.

After the test, you may be told that you have had a 'positive' or a 'negative' exercise ECG.

- A **positive exercise ECG** is when abnormal changes in the electrical activity of the heart are seen on the ECG during exercise. This means that you may have coronary heart disease.
- A **negative exercise ECG** means that no abnormal or significant changes were seen on the ECG during the test.

Sometimes the exercise ECG test may show changes

that suggest coronary heart disease, even though the person has very few or no symptoms.

An exercise ECG is a very useful test. It is widely available and it's a very safe test compared to many other medical tests. Most people find that the test is not unpleasant or distressing. However, the exercise ECG test is not 100% accurate. Occasionally the test may give a '**false positive**' result. This means that someone with a normal heart may have an exercise ECG that shows changes that could indicate heart disease. On the other hand, people who do have coronary heart disease may occasionally have a negative exercise ECG – that is, a '**false negative**' test.

You can watch a film clip about having an exercise ECG at bhf.org.uk/tests

24-hour ECG recording

This test is also known as **Holter monitoring** or **ambulatory ECG monitoring**.

The test involves continuously recording an electrocardiogram (ECG), usually for 24 to 48 hours.

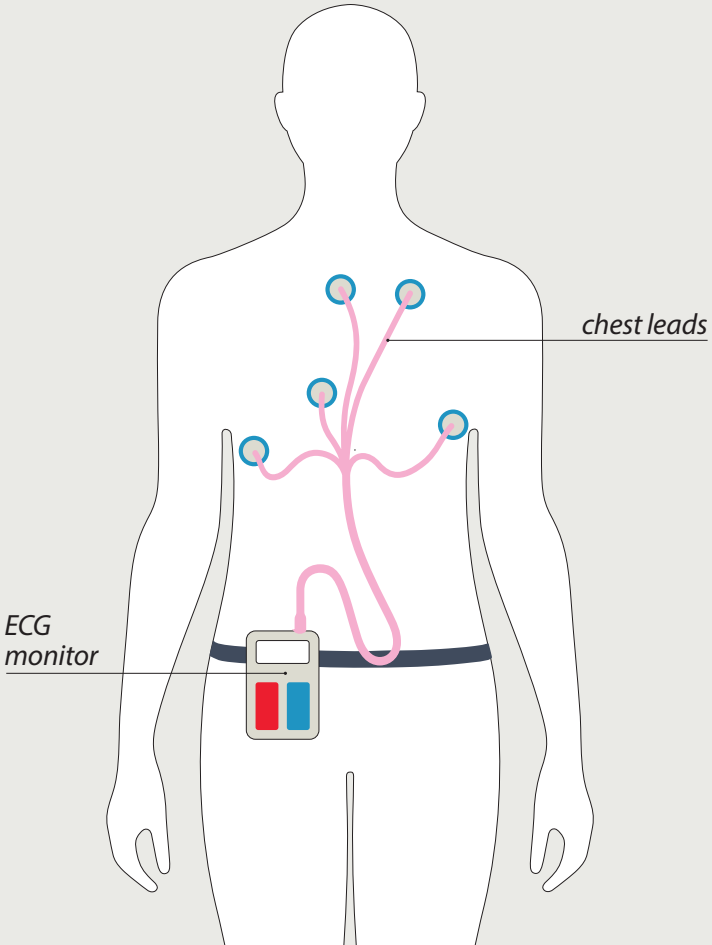
The test is safe and painless. It can help to diagnose the cause of symptoms – such as palpitations – which don't happen all the time and which rarely happen in the GP's surgery.

What happens?

You may need to make two visits to the hospital – one to have the recorder fitted, and one to return it. Some hospitals will let you post the recorder back to them.

The recording device comes in two different forms – either a small portable tape recorder (about the size of a small pack of cards), or a small digital device in the shape of a pager.

24-hour ECG monitor



You wear the device on a belt around your waist. Usually between three and six leads from the device are taped to your chest. The device records the electrical activity of your heart. While you're wearing it, you can do everything you would normally do, except have a bath or shower.

You may be asked to keep a 'diary' while you're wearing the device, and make a note of any times when you have symptoms. This can help when your results are analysed. When the test is finished, you'll need to return the device to the hospital.

What can the test show?

A 24-hour ECG recording can give a lot of useful information. It may show an abnormally fast, slow or irregular heart rhythm that may need treatment. Or, if you are having palpitations but the device records a normal heart rhythm, this can be reassuring for you. In most cases, palpitations are not due to any heart abnormality.

7-day ECG recording

This test is also known as a **7-day Holter monitor test**.

If your palpitations don't happen every day, your doctor may suggest doing a continuous ECG recording for up to seven days. You will have a monitor like the one described on page 13. Someone will show you where to put the electrodes and how to connect them to the monitor. This means that you can remove the monitor once a day so that you can have a shower or bath.

If you have symptoms that don't happen frequently, your doctor may suggest using a cardiac event recorder to record your heart's rate and rhythm over a longer period of time.

There are several different types of event recorders. Some are portable devices – **cardiac event recorders** – that you just hold to your chest when you get symptoms. There is also a device called an **implantable loop recorder** which is placed under the skin and which monitors your heart rate and rhythm continuously.

Cardiac event recorder

If you do not have palpitations very often, or if you collapse occasionally but not regularly, you may be given a small electrical recording device to keep with you. The advantage of this device is that there are no leads attached to it. When you experience your typical symptoms, you just need to hold it to your chest and activate it, and it will record your heart rhythm. You will be shown how to do this. It is not invasive or painful. You then contact the hospital where you are being treated. They will tell you what they want

you to do to get the recording to them. They will then analyse the information and tell you if they find anything abnormal and if you need more treatment.

Implantable loop recorder (ILR)

An implantable loop recorder – or ILR for short – is a device for finding out what is causing symptoms that don't happen very often, such as dizzy spells or blackouts. It records the electrical activity of your heart. Doctors may use an ILR if other cardiac event recorders have failed to reveal an underlying problem with the heart's electrical signals.

The ILR is a small, slim device, about the size of a packet of chewing gum or a computer memory stick. It has a battery that can last up to three years.

Inserting the ILR is a very simple and quick procedure. You will have a local anaesthetic and a small cut of about 2 centimetres will be made, to allow the device to be implanted under the skin. It is usually placed in the upper left chest area.

When you experience symptoms, you place a hand-held activator over the ILR and press a button to start the recording. A friend or family member can help you with the activator. The ILR stores the information before, during and after you press the button. It can also be programmed to detect an abnormal rhythm automatically without using the activator. However, it is important that you use the activator whenever you have symptoms, so that the medical staff can see what is happening to your heart rhythm at that time.

The device can be removed once your doctor is happy that enough heart activity has been recorded, or the cause of your symptoms has been diagnosed, or if the battery runs out. The procedure for removing the ILR is similar to when it was inserted. It is usually done as a day case, which means that you don't have to stay overnight in hospital.

Your doctor may ask you to have a chest X-ray. If you are pregnant or think you may be pregnant, make sure you tell your doctor or radiographer, as they may suggest that you avoid having a chest X-ray during your pregnancy.

What happens?

To have a chest X-ray, most people stand with their chest pressed to a photographic plate. The radiographer will ask you to stay still and to take a deep breath and hold it. This is to make sure that your X-ray image is not blurred. While you are doing this, he or she will turn on the equipment, which sends a beam of X-rays from the X-ray source to the photographic plate. X-rays can be taken from more than one angle. The radiographer will ask you to wait until he or she checks the images and makes sure that they have pictures of the whole chest.

Having an X-ray is painless. The main discomfort may be from the photographic plate which is a bit cold and hard.

What can the test show?

A chest X-ray allows closer examination of the heart, lungs and chest wall. If you have symptoms such as shortness of breath, a chest X-ray can help your doctors find out whether it is caused by a heart or lung condition, or whether it might be caused by something else. If the doctor thinks you might have a heart condition, he or she will probably arrange for you to have other tests too.

An echocardiogram – or 'echo' for short – uses high-frequency sound waves that reflect against structures in your heart to build up a detailed picture of it. It is a similar sort of scan to the ultrasound scan used in pregnancy. An echocardiogram is a safe and easy test, and most people find it's not uncomfortable at all.

What happens?

You will have the test in a private room, because you'll need to take off your clothes from your top half. A recorder (probe) that gives off pulses of ultrasound waves is placed on your chest. Contact gel is used to help make a good contact between your skin and the probe. The ultrasound waves pass through the skin of your chest and the probe then picks up the echoes reflected from various parts of the heart and shows them as an echocardiogram – a picture on a screen. You can see different parts of the heart as the probe is moved around on your chest. Recording these images is a skilful job and can take up to an hour. A specialist then needs to look at your results, so it may be a while before you get them.

What can the test show?

The echocardiogram can give accurate information about the structure and pumping action of your heart. It can detect any abnormalities and help explain the cause of your symptoms, or provide a diagnosis.

Transoesophageal echocardiogram (TOE)

In this test, detailed pictures of the heart are taken from the gullet (oesophagus) which lies behind the heart. You 'swallow' a small probe which is mounted at the end of a flexible tube. To help you, an anaesthetic will be sprayed onto the back of your throat. You may be given a mild sedative first, to help you relax. While the probe is in your oesophagus, it takes 'pictures' of your heart. The pictures are taken quite quickly and the tube and probe are then gently withdrawn.

This test is particularly useful when doctors need a closer and more defined image of the structures at the back of the heart.

Stress echocardiogram

Sometimes an echocardiogram is done while the heart is put under stress by increasing its heart rate – either with exercise or with a certain type of medicine.

If parts of the heart muscle are damaged, they will contract less effectively and this can show up on the echocardiogram. This test is useful if the results of other tests are not clear, and in some hospitals a stress echocardiogram is used instead of radionuclide tests (see page 48).

You can watch a film clip about having an echocardiogram at bhf.org.uk/tests

A Doppler test is a special ultrasound test that shows the movement of blood through your blood vessels.

What happens?

During the test, a technician trained in ultrasound imaging will press a small probe (a bit like a very thick, blunt pen) over the area of your body that is being examined. Contact gel is put on your skin to improve the contact between the probe and your body.

The test is non-invasive and there is normally no discomfort. It takes about 15 to 45 minutes to do the test, depending on which part of the body is being examined.

What can the test show?

A Doppler test can be used to check the blood flow in the major arteries and veins in your abdomen, arms, legs and neck. It can help diagnose many conditions such as:

- narrowing of an artery – for example, of an artery in your neck (carotid stenosis)
- poor blood circulation to your legs due to peripheral arterial disease, and

- poorly functioning leg veins, which can cause blood or other fluids to pool in your legs.

A Doppler test is sometimes done as part of the assessment that people have before having surgery, to assess their risk.

This section includes information on the blood tests you may have.

Cardiac enzyme tests

Cardiac enzyme tests can tell whether or not you have damage to your heart muscle. The most common cause of this damage is a heart attack.

Enzymes are proteins that help with chemical reactions in the body. When the heart muscle is damaged after a heart attack, it releases certain enzymes into the blood. Some of these enzymes are normally found in the blood but at a low level. The more severely the heart is damaged during a heart attack, the more enzymes are released and the higher the levels of enzymes will be in the blood. The levels can be measured from a series of blood samples taken over a few hours.

Troponin test

This is the main type of cardiac enzyme test used to find out if your heart muscle is damaged. If the heart is damaged – for example, by a heart attack – this enzyme leaks into the blood where it can be detected

by a simple blood test. So, this test can help the doctor find out whether or not your symptoms are due to a heart attack.

If you have a raised troponin level but your ECG does not show a clear pattern of a heart attack, this means that you have probably had a heart attack and that you may be at risk of having another one. There are other conditions that can cause a release of troponin from the heart as well as a heart attack. Your doctor can explain this in more detail for you.

Other blood tests

Abnormal heart rhythms can sometimes happen in people with other conditions such as thyroid problems or anaemia. So the following blood tests may also be done.

Full blood count (FBC)

A full blood count test shows the level of haemoglobin in your blood, and can also show if there is an infection. A low haemoglobin level might mean that you have anaemia, which may cause the heart to beat faster so that enough oxygen can be

sent to the rest of your body. An infection can also cause an increase in heart rate.

U and Es test

U and Es stands for urea and electrolytes. This test measures the sodium and potassium levels in your blood. If the level is extremely high or low, this can cause abnormal heart rhythms (arrhythmias).

This test also records your levels of urea and creatinine, which are waste products of the body. If the levels are high, it means that the kidneys may not be working properly.

Thyroid function test (TFT)

If you are having palpitations, or have a very slow or fast heart rate, you may need to have a thyroid function test. This will check the levels of the two hormones in your blood, produced by the thyroid, that help control the body's metabolism. Treating an underactive or overactive thyroid may improve your heart rate and symptoms.

Cholesterol

Cholesterol is a fatty substance which is mainly made in the body. The liver makes some of the cholesterol from the saturated fats in the food you eat, and the body can also take in some cholesterol from certain foods. Too much cholesterol in your blood can increase your risk of having a cardiovascular event, such as a heart attack or stroke.

Finding out your cholesterol level helps your doctor to decide whether you should make changes to your lifestyle and start taking a cholesterol-lowering medicine to reduce this risk. If you're already taking tablets to lower your cholesterol, a cholesterol test will tell whether the treatment is working well or whether the dose of your medicines should be increased.

Natriuretic peptides

Natriuretic peptides are hormones that are produced by the heart muscle cells. There are two natriuretic peptide tests that are used to help diagnose heart failure – a **BNP test** and a **NT-proBNP test**. (BNP stands for B-type natriuretic peptide, and NT-proBNP stands for N-terminal pro-B-type natriuretic peptide.)

Having a high level of these hormones can be a sign of heart failure. If someone has symptoms that could suggest heart failure, doctors might use one of these tests to rule out the possibility of heart failure as a cause. Doctors do not base a diagnosis of heart failure on the results of this test alone. Also, although high levels of BNP and NT-proBNP are usually seen in people with heart failure, a high level can also be caused by other heart conditions.

C-reactive protein (CRP)

CRP is a protein in the blood. A high level of this protein indicates the presence of infection or inflammation in the body. Research is currently being done to find out more about the possible links between inflammation and coronary heart disease.

JUNE'S STORY

June Phillips, 63, had lots of tests before her heart condition was diagnosed.

"Some years after having an abnormal ECG reading at a Well Woman clinic, I began experiencing long episodes of palpitations. I had lots of tests including 24-hour ECGs, angiograms and echocardiograms of my heart, as well as various blood tests.

For a long time, the doctors were unable to identify exactly what was wrong with my heart, but I was eventually diagnosed with heart failure due to dilated cardiomyopathy, a disease of the heart muscle. This was confirmed when I had an MRI scan and an echocardiogram about five years ago. As a mother and a grandmother, I thought it was important to continue having tests done to pinpoint my diagnosis."

This test is also known as **ambulatory blood pressure monitoring**.

Your doctor may want to record your blood pressure at regular intervals over a 24-hour period. This can be done by using a special recording device.

What happens?

On a belt around your waist, you wear a portable recorder for 24 hours. The recorder is about the same size as a pack of cards. This is attached, through tubes under your clothes, to a cuff which is wrapped around your arm. You can carry on with your usual daily activities except for having baths or showers.

For a continuous 24-hour period, including through the night, every hour or so, the cuff automatically inflates and measures your blood pressure. The recorder keeps a record of each blood pressure measurement and the time that it was taken.

The next day, when you go back to the hospital or GP surgery, the device is taken off. Or you may be asked to remove it yourself. The recorder will be analysed and the results will be sent to your GP.

What can the test show?

This test can give an overview of all the blood pressure readings throughout the 24 hours. It confirms whether you have high blood pressure or not. It is particularly useful if your doctor thinks that your blood pressure is unusually high when you have it measured in the doctor's surgery or at hospital appointments. If you're already taking tablets for high blood pressure, it can tell how well or how poorly your high blood pressure is controlled.

This test is also known as **cardiac catheterisation**.

Sometimes doctors cannot make a definite diagnosis of coronary heart disease unless a test called a coronary angiogram is done. This test is also essential for deciding what sort of treatment you should then be offered. It helps your doctors decide if you need to have a coronary angioplasty or coronary bypass surgery, or whether your condition can be treated with medicines.

What can the test show?

A coronary angiogram looks inside the arteries. So it can show exactly where any narrowings in the coronary arteries are and how severe they are. And, if an angiogram of the left ventricle is also done, it shows how well the heart is pumping blood to the rest of the body.

What happens?

The test takes place in a 'cath lab' (also called a catheterisation lab, catheter lab or angio lab). It usually takes about half an hour, but don't be alarmed if it takes longer than this.

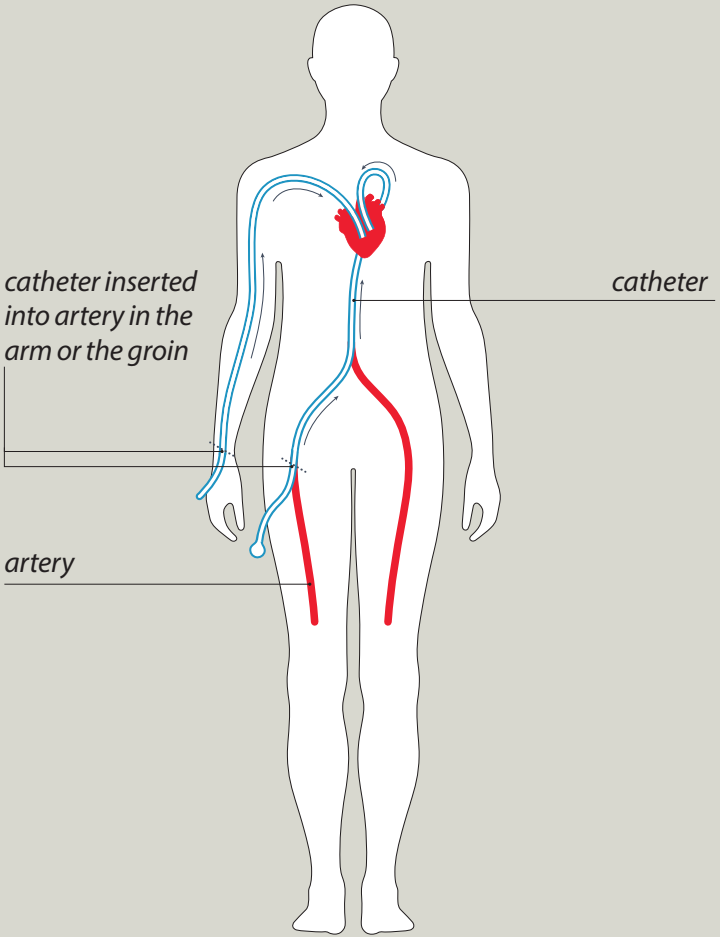
A team – including at least one cardiologist (a doctor specialising in the heart) – carries out this test. It is usually done as a day case, which means that you don't have to stay overnight in hospital. Or, you may have an angiogram if you have been admitted to hospital with chest pain, discomfort or tightness that has been diagnosed as acute coronary syndrome (heart attack or unstable angina).

A **catheter** is a long, flexible, hollow plastic tube, about the width of the lead in a pencil. It is passed into an artery either in your groin or your arm. You will have a local anaesthetic to numb the area where the catheter is put in, so it should not be painful.

The operator then uses X-ray screening to help direct the catheter through the blood vessels and into the correct position in the heart. (See the diagram on the next page.) You can see your heart on the video screen if you want to.

While you are having the angiogram, you will be continually linked to a heart monitor which records your heart rate and rhythm.

Coronary angiogram



A special dye (called a contrast dye) is then injected and a series of X-ray pictures is taken. The dye sometimes gives you a hot, flushing sensation which lasts a few seconds. The dye shows up all the coronary arteries on the X-rays, so your doctor can see if there are any narrowings or blockages there. Sometimes doctors may look at the left heart chamber (the left ventricle) in more detail.

People sometimes feel some chest discomfort during the test. You need to tell one of the team if you are having any pain or discomfort during the procedure.

When the test is over, the catheter is removed from the artery. If the catheter was inserted in your groin, a nurse or doctor will either press on your groin for a period of time, or put in a plug called an angioseal, to stop any bleeding. If the catheter was put into your arm, a tight dressing will be applied there for a few hours, but an angioseal can be inserted there too. A nurse will examine your groin or arm several times after the test, to check for any possible bleeding.

You may feel a bit tired for a few hours after the test, especially if you were given medicine to help with

feelings of anxiety.

The place where the catheter was inserted may be tender for a few days. Most people feel OK after a day or two, but this varies from one person to another.

Is there any risk?

It is rare for anyone to have a reaction to the dye, apart from the brief hot, flushing sensation it can cause, as described on page 39. However, a very small number of people are highly allergic to the dye. If you know you are allergic to iodine or contrast agents, tell the doctor before you have the test.

Sometimes there may be a small amount of bleeding when the catheter is removed, and a swelling or small lump may form around the area. This should go down after a few days, but if you have any concerns, contact your doctor.

A common after-effect is for a bruise to form in the groin or arm. This is not serious, but it may look quite obvious for a week or so.

Serious complications are very rare, as a coronary angiogram is a relatively safe test. The risk of having a serious complication during the test – such as a heart attack, stroke or death – is estimated at less than 1 in every 1,000 people. However, the level of risk varies depending on your overall health and your individual heart condition. So, your doctor will not recommend that you have a coronary angiogram unless he or she feels that the benefits outweigh this small risk.

You will be asked to sign a consent form before having the angiogram. Before you sign the form, you should discuss with your doctor the benefits and possible risks of having this test, and any other worries you may have.

Having a coronary angiogram does mean that you are exposed to some radiation. For more on this, see page 64.

You can watch a film clip about having a coronary angiogram at bhf.org.uk/tests

RICHARD'S STORY

Richard Elgar was 36 when he had a heart attack.

"I had to have an emergency coronary angiogram. I then had an angioplasty and had two stents fitted. It wasn't particularly painful, but I did feel the cardiologist pulling and pushing around my wrist. Thankfully, a nurse was there to explain everything to me as it was happening. She was able to tell me what was going on, giving me a step-by-step description of what the cardiologist was doing and what the outcome would be. This helped to ease any anxiety I felt, and reminded me that I was in good hands.

Since then, my family received a BHF Heart Hero award for hosting fundraising events and taking part in BHF campaigns. My son Alfie and I did a 42-mile sponsored bike ride together. He got so tired he fell off his bike twice, but insisted on getting back on and finishing the ride."

These tests are also known as **cardiac CT scans**.

CT stands for 'computerised tomography'. A CT scan is a sophisticated type of X-ray. It is useful for looking at the internal organs in your body, such as your heart or lungs. Below we describe two tests for the heart which use CT scanning.

CT coronary angiogram

What happens?

For this test, you lie on a bed which passes through a doughnut-shaped opening in a scanner. At the start of the scan, a special dye (called a contrast dye) will be injected into a vein in your arm, to make the blood vessels on the surface of the heart (the coronary arteries) show up. You may be given a medicine called a beta-blocker to slow down your heart rate during the test.

What can the test show?

A CT coronary angiogram shows the blood flow through the coronary arteries and looks for any narrowings in them. If it finds that you do have narrowing of the coronary arteries, you will need to go on to have the standard coronary angiogram we described on page 39, to find out if you need to have a coronary angioplasty and stenting.

A CT coronary angiogram is generally not as good at detecting narrowings in small coronary arteries as the standard coronary angiogram. That's why the standard coronary angiogram is still the 'gold standard' for diagnosing coronary heart disease.

A CT coronary angiogram also provides a calcium score. We explain more about calcium scores on the next page.

Is there any risk?

Having a CT coronary angiogram does mean that you are exposed to some radiation. We explain more about this on page 64.

CT coronary calcium scoring test

What can the test show?

This test is done using a high-resolution CT scanner. It is a way of measuring how much calcium deposit there is in the coronary arteries. Normal, healthy arteries don't contain calcium. If the test detects calcium, it is because there is atheroma in the arteries. Atheroma is the name for the calcium-containing fatty deposits that can build up and cause a narrowing in the coronary arteries.

For certain people, a CT coronary calcium scoring test is recommended as the first test for diagnosing coronary heart disease.

The test gives you a calcium score. If your score is zero, it means that no atheroma has been found and you are unlikely to have coronary heart disease. If your score is very high, you may be advised to have further tests or to start taking medicines.

Is there any risk?

Having a coronary calcium scoring test does mean that you will be exposed to a very small amount of radiation. We explain more about this on page 64.

Radionuclide tests are tests that involve using a tiny amount of radioactive material. The specialised equipment and staff needed are only available at some hospitals in the UK, but you can be referred for these tests if your doctor thinks it is necessary. Below we describe one type of radionuclide test – a myocardial perfusion scan.

Myocardial perfusion scan

This test is also known as a **thallium scan**, **MIBI scan**, **MPS** or **technetium scan**.

What can the test show?

The camera can take pictures to help diagnose coronary heart disease, to look at how well your heart is pumping, or to look at the flow of blood to the walls of the heart muscle.

What happens?

You must not have any drinks containing caffeine for 12 hours before the test.

First, a cannula (a tube) will be put in your hand or arm. There are two parts to this test – rest and stress.

- *Rest* – A doctor, nurse or radiographer will inject a small amount of radioactive substance (isotope) into the blood. Various isotopes are used in different hospitals. These can include technetium and thallium. A large 'camera' will then be positioned close to your chest, to pick up the gamma rays sent out by the isotope as it passes through the heart while you are resting. It takes pictures of different parts of your heart. You will need to lie down for between 5 and 15 minutes for the scan.
- *Stress* – You will then be given another injection of an isotope, and they will ask you to exercise on an exercise bike or treadmill. Or, you will be given a medicine through the vein to create 'exercise stress' without you having to move too much. This is particularly useful if you can't do much exercise. The camera will then take the same sort of pictures as before.

There can be a lot of waiting around during myocardial perfusion scans. This is because there needs to be a certain amount of time in between the rest and stress parts of the scan. Sometimes the two parts are done on different days. Sometimes only the stress part of the test is done.

Is there any risk?

Having a myocardial perfusion scan does mean that you are exposed to some radiation. For more on this, see page 64.

Your doctor will explain the benefits and risks, including the possible side effects of the medicines used in this test. However, side effects are rare.

You can watch a film clip about having a myocardial perfusion scan at bhf.org.uk/tests

MRI stands for 'magnetic resonance imaging'. An MRI scan produces extremely detailed pictures of your internal organs. MRI is available in an increasing number of specialised units in the UK.

What happens?

Having an MRI scan is not painful or uncomfortable. You lie in a short 'tunnel', around which there is a large magnet. Short bursts of magnetic fields and radio waves from the MRI scanner allow images to be created. These images are then processed and analysed. You must lie still while the scan is done. The whole test takes up to an hour. Some people with claustrophobia (fear of enclosed spaces) may find it helpful to have mild sedation before having this type of scan.

One of the advantages of an MRI scan is that it does not expose you to radiation, as it uses a magnetic field rather than radiation to create the images.

What can the test show?

MRI is very good at showing the structure and function of your heart and blood vessels. It can also measure the flow of blood through the heart and some of the major arteries. An MRI scan can show where the heart is not working normally. And it can identify defects in the structure of the heart. MRI scans are not routinely used to diagnose coronary heart disease.

People who have a pacemaker or an ICD are not usually able to have an MRI scan, because the scan can interfere with the way that these devices work. Recently, an MRI-safe pacemaker has been approved for use. People who have this new device will be able to have MRI scans with fewer complications.

If you have coronary stents in place, it is safe to have an MRI scan.

You can watch a film clip about having an MRI scan at bhf.org.uk/tests

These tests are also called **EP studies**, **EPS** or **electrophysiological testing**.

Electrophysiological testing has revolutionised the way we understand and treat abnormally fast heart rhythms. Specialist equipment is needed and the test has to be performed by a cardiologist who specialises in electrical problems in the heart.

What happens?

This test – often called an 'EP study' – is sometimes done as a day case, but some people may need to stay in hospital overnight after the test. If you have catheter ablation treatment during the EP study, you may also need to stay overnight. (We explain more about catheter ablation treatment on page 55.)

The hospital will ask you not to eat or drink anything for a few hours before the procedure. They will tell you for exactly how long.

Most people need only a local anaesthetic and sedation before having this test. The local anaesthetic involves having an injection which numbs the area where the catheters are put in. The sedation is given through a cannula (tube) in a vein in your arm or hand. This helps to relax you during the procedure.

Your cardiologist will place flexible tubes, called catheters, into a large vein in the groin and sometimes also into a vein in the neck area. The catheters are then gently moved into position in your heart. Special electrodes at the tip of the catheters then stimulate the heart and pick up recordings of the electrical activity in your heart.

This can make you have palpitations, and it can make some people feel dizzy. As the tubes are inserted, you may feel a sensation in your chest, but this should not be painful. The team of staff will be monitoring you and reassuring you. The test can take about two to three hours.

Afterwards, the catheters are taken out and the nurse or doctor will press on the vein where the catheters have been removed. You will be asked to stay in bed for a while, first lying down and then sitting up. After that you will be able to walk around, as long as the puncture site (the place where the catheter was put in) is OK. You may need to have more pressure applied to the puncture site, to stop any bleeding. You can get back to your normal activities in a week or so.

What can the test show?

An EP study can diagnose abnormal heart rhythms and identify which areas of your heart are affected.

If the cardiologist can pinpoint the exact area of your heart where special electrical cells are causing your abnormal heart rhythm, they may treat the problem at the same time as they do the test. This involves using either radio-frequency electrical energy or cryo energy to destroy the electrical cells inside the heart which are causing the abnormal rhythm. This treatment is called **catheter ablation**.

Is there any risk?

Like any invasive procedure, having an EP study does involve some risks. These will all be explained to you before you sign the consent form for having the test.

One of the risks is that there may be bleeding from the place where the catheter was put in, leaving a haematoma (where blood collects under the skin). This can feel uncomfortable and can cause bruising.

Abnormal heart rhythms often happen during the test. These can help with the results of the test but occasionally may need to be treated during the EP study.

Also, having an EP study does mean that you are exposed to some radiation. For more on this, see page 64.

You can watch a film clip about having an EP study at bhf.org.uk/tests

This test is used to investigate people who have had frequent episodes of syncope (fainting, collapsing or passing out) which are **not** thought to be caused by abnormal heart rhythms or structures.

It is used for people who have collapsed several times and where:

- the cause is suspected to be an abnormal change in blood pressure and heart rate related to changes in body position
- the person has no structural problems with their heart, and
- no abnormal heart rhythm has been found on ECG recordings.

Sometimes a tilt table test is used for people who collapse and look like they are having an epileptic fit, to find out if they are epileptic or not.

During the test, the doctors and staff will try to make you have an episode of syncope, but in a safe environment. This helps them to diagnose why you have the problem, and to plan the most effective treatment.

What happens?

The tilt table test is often done as an outpatient test. It is a safe, low-risk procedure, but an experienced nurse, cardiac physiologist or doctor will be there, because you may have an abnormally slow heart rate during the test.

You will be told not to eat or drink for some time before the procedure. The hospital can tell you more about this.

A cannula (tube) will be put in your hand or arm, in case you need to have any medicines or fluids during the test.

You will be asked to lie down on the tilt table, and the staff will record your heart rate and heart rhythm using an ECG (see page 5), and measure your blood pressure. If necessary, a medicine can be given to lower your blood pressure.

The head of the table is then raised up so that you are gradually tilted upwards to a standing position, with your feet resting on a foot plate. This can make your blood pressure and heart rate drop.

Seeing how quickly the symptoms you experience disappear, and how quickly your blood pressure and heart rate improve, will help the doctors to make a diagnosis and work out the best treatment for you.

The test doesn't hurt, but sometimes people can feel light-headed or feel faint either during or after the test. Some people feel nervous about being made to faint or about having a collapse brought on, but for many people the test offers the chance of a diagnosis and possible treatment. As you will be strapped to the tilt table, you won't suffer any injuries if you do faint.

For more information on syncope, contact:

Stars
(Syncope Trust and Reflex Anoxic Seizures)
Phone: 01789 867503
Email: info@stars.org.uk
Website: www.stars.org.uk

The BHF continues to fund research into genes and heart disease. Some types of heart conditions can be caused by faulty genes. We all inherit genes from both our parents, so it is possible that any faulty genes can be passed down from one family member to another.

The heart conditions that can be inherited in this way include:

- some types of cardiomyopathies (diseases of the heart muscle), such as **hypertrophic cardiomyopathy**, and
- channelopathies (defects in cell proteins called ion channels), such as **long QT syndrome** and **Brugada syndrome**.

Some of these conditions can occasionally cause sudden death in people of all ages, including children. These conditions are not the same as coronary heart disease, which causes heart attacks and angina.

Who might have genetic testing?

If a person has been diagnosed with a condition that can be passed on through faulty genes – such as hypertrophic cardiomyopathy – it is important to consider whether other members of the person's family (for example, their sister or brother, or their own children) could be at risk. This is done in two main ways:

- The first is to look for signs of the condition in the person's family members, using some of the tests described in this booklet. So, for example, if your sister has cardiomyopathy, your doctor might arrange for you to have an electrocardiogram (ECG) and an echocardiogram to check for signs of cardiomyopathy.
- If no signs of cardiomyopathy are found, DNA tests may be done to find out if you have certain faulty genes that make it more likely that you may, one day, develop the same condition yourself. This is a blood test and you will receive genetic counselling first so that you have the chance to ask questions and understand what is being done and why. If those faulty genes are found, this is an early warning sign. But carrying a faulty gene does not mean that you will definitely develop the condition.

For more information, contact our Genetic Information Service on **0300 456 8383**, or one of the organisations below.

Cardiomyopathy Association
Phone: 0800 018 1024
Email: info@cardiomyopathy.org
Website: www.cardiomyopathy.org

CRY
(Cardiac Risk in the Young)
Phone: 01737 363 222
Email: cry@c-r-y.org.uk
Website: www.c-r-y.org.uk

SADS UK
(Sudden Arrhythmic Death Syndrome)
Helpline: 01277 811215
Email: info@sadsuk.org
Website: www.sadsuk.org

When you go to see your GP, cardiologist or nurse to find out the results of your tests, you may find it helpful to take in a list of the questions you want to ask.

Some of the tests described on pages 20 to 56 – such as chest X-rays and CT coronary angiograms – involve being exposed to radiation.

Every day we are exposed to small amounts of radiation which occurs naturally in the environment. This comes from the ground and building materials around us, the air we breathe, and even outer space (cosmic rays). In most of the UK the largest contribution (which is still only a very small amount) is from radon gas which seeps out of the ground and builds up in our homes.

Our risk of cancer can increase if we are exposed to lots of radiation. That's why it is important only to have tests that are really necessary. Having an X-ray of any type increases your exposure to radiation. For example, a chest X-ray will give you the equivalent of three days of natural background radiation.

Cancers caused by radiation take many years or even decades to develop. So, the younger you are, the greater the risk of developing a cancer caused by radiation. Women who are pregnant will be advised to avoid radiation where possible but, if the mother's health is at serious risk, she may be advised to have a test involving radiation, because the unborn baby depends on her health for survival.

The basic principle is that, when having a medical test, the benefits of knowing the results of the test need to far outweigh the risks of having the test. The amount of radiation used in most medical tests is quite small. So, if you have been told that it is possible that your symptoms are due to coronary heart disease and you need, for example, a coronary angiogram, the risks involved in not having the test may well be far greater than the risks from radiation.

On the next page we explain which tests involve radiation and how much radiation is involved.

How much radiation is involved?

The following tests do **not** involve any radiation: ECG, echocardiogram, Doppler test, blood tests, 24-hour blood pressure recording, MRI scan, tilt table test, cardiac event recorders and genetic testing. The tests listed below do involve some radiation.

Test	Approximate equivalent period of natural background radiation	Approximate extra lifetime risk of cancer for each test (We explain this on page 68.)	Notes
Chest X-ray	3 days	Negligible risk	
Conventional coronary angiogram	Around 3 years	Low risk	The amount of radiation will increase if angioplasty with stenting is needed during the procedure.
Myocardial perfusion scans	Around 3 to 4 years	Low risk	The amount of radiation can vary considerably – for example, depending on which isotope is used.
CT coronary angiogram	About 1 year	Very low risk	The amount of radiation involved depends on the type of scanner used.
CT coronary calcium scoring test	About 1 year	Very low risk	Some scanners give out more radiation than others. For example, a 64-slice CT scanner may give a clearer image but may expose you to more radiation than a scanner with fewer slices. And, if you get a high calcium score, you will probably need further tests which may also contain radiation.
Electrophysiological studies (EP studies)	About 1 year	Very low risk	If catheter ablation is done at the same time as the EP study, it is very likely that this will increase the risk from 'very low' to 'low'.

What do the 'risk' figures mean?

The 'risk' figures on pages 66 and 67 tell you the extra risk of getting cancer in your lifetime, due to the radiation from the test.

Negligible risk:	Less than 1 in 1,000,000 for each test.
Very low risk:	1 in 10,000 to 1 in 1,000 for each test.
Low risk:	1 in 1,000 to 1 in 100 for each test.

These risk levels represent very small additions to the more than 1 in 3 lifetime risk we all have of getting cancer.

Depending on the results of your tests, you may be advised to take medicines, or have treatment such as coronary angioplasty.

If this is the first time you have been diagnosed with a heart condition, it may come as a shock to you. Sometimes it takes a long time for the news to sink in. At times you may feel afraid, angry or depressed. It is natural to feel anxious about what the news means for you, your family life and your work.

Information can be a great help. Ask questions and make sure you get explanations in language you understand. When you go to see your GP, cardiologist or the nurse, you may find it helpful to take in a list of the questions you want to ask. It may help if someone goes with you so that they can also remember what your doctor tells you. If an answer isn't clear, it's OK to say: "I don't understand that. Could you explain it again please?" Before you leave, try and make sure that you know the answers to all your questions, if there is an answer. And ask what you can do if you think of any more questions afterwards – for example, if there is someone you could contact.

LEADING THE FIGHT...

against heart disease

The BHF is the largest independent funder of cardiovascular research in the UK. Some highlights of our research into treating heart disease include:

1. Developing better blood tests to help detect a protein that leaks from damaged heart muscle. In the future, this may help to diagnose heart attacks sooner in people with chest pain.

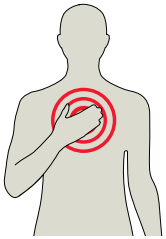
2. Perfecting new heart imaging techniques using magnetic resonance imaging (MRI). This research could help detect underlying damage to the heart after a heart attack, and better diagnose narrowed or blocked blood vessels that need treatment.

Our life saving research is powered by your support. If you'd like to make a donation, please see the inside front cover for more details.

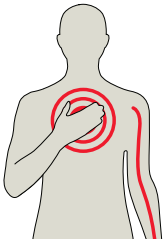
For more information on the BHF's research, see bhf.org.uk/research

A heart attack is when a part of the heart muscle suddenly loses its blood supply. This is usually due to coronary heart disease.

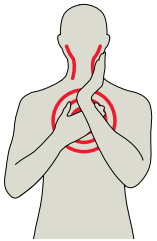
The symptoms of a heart attack



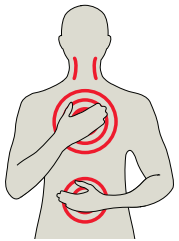
Pain or discomfort in the chest that doesn't go away.



The pain may spread to the left or right arm ...



... or may spread to the neck and jaw.



You may feel sick or short of breath.

Think quick ... act fast. Call 999 immediately.

British Heart Foundation website
bhf.org.uk
For up-to-date information on heart disease, the BHF and its services.

Genetic Information Service
0300 456 8383
(A similar cost to 01 or 02 numbers.)
For information and support on inherited heart conditions.

Online Community
community.bhf.org.uk
Share your experiences, stories, tips and ideas with other people like you in our online community.

Heart Helpline
0300 330 3311
(A similar cost to 01 or 02 numbers.)
For information and support on anything heart-related.

Twitter
@TheBHF
Get our latest news and views directly into your twitter feed.

Facebook
facebook.com/bhf
You can now 'like' our stories on Facebook, share them with your friends, and comment on our wall.

Booklets and DVDs
To order our booklets or DVDs:

- call the BHF Orderline on **0870 600 6566**
- email **orderline@bhf.org.uk** or
- visit **bhf.org.uk/publications**

You can also download many of our publications from our website. For a list of resources available from the BHF, ask for a copy of our catalogue *Take heart*. Our booklets are free of charge, but we would welcome a donation. (See page 2 for how to make a donation.)

Heart Information Series

This booklet is one of the booklets in the *Heart Information Series*. The other titles in the series are as follows.

- Angina
- Atrial fibrillation
- Blood pressure
- Cardiac rehabilitation
- Caring for someone with a heart condition
- Coronary angioplasty
- Diabetes and your heart
- Having heart surgery
- Heart attack
- Heart rhythms
- Heart transplantation
- Heart valve disease
- Implantable cardioverter defibrillators (ICDs)
- Keep your heart healthy
- Living with heart failure
- Medicines for your heart
- Pacemakers
- Peripheral arterial disease
- Physical activity and your heart
- Primary angioplasty for a heart attack
- Reducing your blood cholesterol
- Returning to work
- Tests

Our services

For more information about any of our services, contact the **Heart Helpline** on **0300 330 3311** or visit **bhf.org.uk**

Heartstart

For information about **Heartstart** – a free, two-hour course in CPR and emergency skills training, including what to do if someone seems to be having a heart attack – call the **BHF Helpline** on **0300 330 3311** or visit **bhf.org.uk**

Heart Matters

Heart Matters is the BHF's free, personalised service that provides support and information for people who want to improve their heart health. Join today and enjoy the benefits, including *heart matters* magazine and an online members' area. Call the **Heart Helpline** on **0300 330 3311**, or join online at **bhf.org.uk/heartmatters**

Heart Support Groups

Local Heart Support Groups give you the chance to talk about your own experience with other heart patients and their carers. They may also include exercise classes, talks by guest speakers, and social get-togethers. To find out if there is a heart support group in your area, contact the **Heart Helpline** on **0300 330 3311**.

Make yourself heard – Heart Voices

Heart Voices gives you the skills, confidence and knowledge you'll need to influence health services for the benefit of heart patients and their families across the UK. It aims to develop a nationwide network of representatives to speak out on behalf of heart patients and their carers, and to provide them with training and opportunities to have their say and get involved.

We would welcome your comments to help us produce the best information for you. Why not let us know what you think? Contact us through our website at **bhf.org.uk/contact**. Or, write to us at the address on the inside front cover.

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Particular thanks for his work on this booklet are due to:

- Dr Nic Sabharwal, Consultant Cardiologist, Oxford Heart Centre, John Radcliffe Hospital, Oxford.

THANK YOU

This booklet is part of the *Heart Information Series*. We distributed 2 million booklets from this series last year. Without your hard work and support the British Heart Foundation wouldn't be able to provide this vital information for people with heart conditions.

Donate to the fight at **bhf.org.uk**

British Heart Foundation

For over 50 years our research has saved lives.

We've broken new ground, revolutionised treatments and transformed care.

But heart and circulatory disease still kills one in four people in the UK.

That's why we need you.

With your support, your time, your donations, our research will beat heart disease for good.

FIGHT FOR EVERY HEARTBEAT

bhf.org.uk

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