



# Devices for an arrhythmia



Working together to improve the diagnosis, treatment and quality of life for all those affected by arrhythmias

[www.hearhythmalliance.org](http://www.hearhythmalliance.org)

Registered Charity No. 1107496

# Glossary

- Arrhythmia** An abnormal heart rhythm
- Atria** The two upper chambers of the heart
- AV node** Part of the electrical pathway between the atria and the ventricles
- Bradycardia** A slow heart rate, normally less than 60 beats per minute
- Cardiac arrest** When the heart completely stops beating
- Catheter** A long, thin, flexible tube or wire that is put into a blood vessel and threaded to your heart
- Cardiac Physiologist/Scientist** A healthcare professional skilled in interpreting and providing information on your heart rhythm
- Cardiology Department** A hospital department where management of your heart take place
- Cardioversion** The use of a small synchronised energy shock to stop fast heart rhythms

## Important Information

This booklet is intended for use by people who wish to understand more about remote monitoring, implantable cardiac monitors, pacemakers, CRT/ ICD/ S-ICDs, cardiac resynchronisation therapy, miniature insertable cardiac monitors and useful information for various arrhythmia devices. The information comes from research and previous patient experiences and offers an explanation of various procedures.

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**Defibrillation** The use of a higher non-synchronised energy shock to stop fast heart rhythms

**Electrocardiogram (ECG)** A non-invasive simple test that records the electrical activity within the heart

**Extravascular Implantable Cardioverter Defibrillator (EV-ICD)** Similar to the S-ICD, the implanted device constantly monitors the heart and will deliver small electrical signals to correct the heart rhythm, or an electrical shock if the rhythm continues to be too fast

**Heart attack** Occurs when one of the coronary arteries becomes blocked by a blood clot. The blood supply to part of the heart muscle is blocked, causing part of the heart muscle to die

**Heart Block** Electrical impulses are slowed or blocked as they travel from the top to the bottom chambers of the heart

**Implantable Cardioverter Defibrillator (ICD)**  
A device that monitors the heart rhythm continuously and treats dangerously fast heart beats the device sits on the side of your chest, and the lead goes next to the sternum (S-ICD) or under the sternum (EV-ICD)

**Implantable Cardiac Monitor (ICM)** Previously known as an implantable loop recorder (ILR), an ICM is a small, thin device inserted under the skin to record your heart's activity

**Leadless Pacemaker** A small device that helps the heartbeat regularly using painless electrical pulses.

## Telehealth

Telehealth is a way to talk with healthcare providers, such as doctors, GPs or nurses from any location. With telehealth there is no need to physically attend a face to face meeting with a doctor, nurse or specialist; instead the healthcare provider will schedule an audio or video appointment with the patient. This prevents patients from having to visit the surgery or hospital in person, protecting them from illnesses and viruses, and reduces your risk to others.

To watch useful videos about devices and arrhythmia, please visit our YouTube channel at [www.youtube.com/user/ArrhythmiaAlliance/videos](https://www.youtube.com/user/ArrhythmiaAlliance/videos)



**Pacemaker** A small device that is placed in the chest to help control abnormal heart rhythms (arrhythmias)

**Pulse generator** The part of the ICD which contains the battery and electric circuits

**Subcutaneous Implantable Cardioverter Defibrillator (S-ICD)** Is implanted to deliver an electrical shock to the heart to restore normal (sinus) rhythm if required

**Ventricles** The two lower chambers of the heart. The right ventricle pumps blood into the lungs and the left ventricle pumps oxygenated blood around the body

**Ventricular Fibrillation (VF)** A fast, irregular, dangerous heart rhythm which causes the heart to stop pumping blood efficiently. This rhythm needs a shock to stop it and return the heart back to a normal rhythm. A cardiac arrest can soon follow if the rhythm is not treated quickly with a shock

**Ventricular Tachycardia (VT)** A fast heart rhythm which causes the heart to pump less efficiently, and can lead to dizziness, fainting and unconsciousness. If not treated with medication or an electric shock, the rhythm can lead to ventricular fibrillation

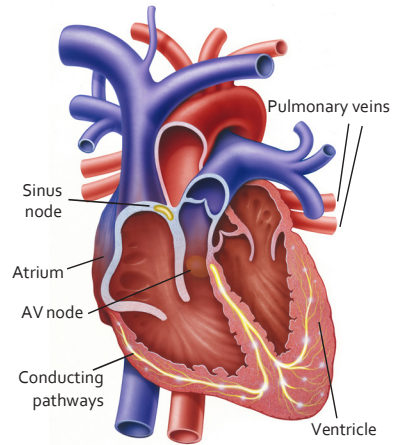
# The heart during normal rhythm

The heart is a muscle; its function is to pump blood and oxygen around your body to all of your vital organs. A normal healthy heart usually beats in a regular fashion at around 60 to 100 beats a minute. It has four chambers, two at the top (the right and left atria) and two at the bottom (the right and left ventricles). The heart also has an electrical system, which sends impulses through the heart causing it to contract and pump blood around the body.

Each normal heartbeat begins in the natural pacemaker of the heart (the sino-atrial or SA node - SAN), which lies at the top of the right atrium. It then travels across the two top chambers and down through a small junction box (the atrio-ventricular or AV node - AVN), which lies between the upper and lower chambers. It then spreads rapidly through a special conducting system through the ventricles causing the heart to contract and pump.

Sometimes the electrical system in your heart does not work as well as it should. This can cause your heart to beat too quickly or too slowly. A defibrillator can stop fast heart rhythms that start in the ventricles. This fast heart rhythm is called ventricular tachycardia or VT. Some people can have an even faster, irregular heart rhythm called ventricular fibrillation or VF. This is life-threatening if it is not treated quickly with an electric shock delivered to the heart. If you suffer from ventricular arrhythmias, you will need to have some tests before the decision to have an ICD fitted is made, such as an electrocardiogram, an echocardiogram, blood tests, and maybe a few others. Your cardiologist will advise as to what is needed.

## The heart and normal conduction



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# ICDs and S-ICDs

## What is an ICD?

ICD stands for implantable cardioverter defibrillator, often called an ICD or defibrillator. An ICD is a device that monitors the heart rhythm continuously. If the heart starts to beat dangerously fast, the ICD is able to detect this and treat it, potentially saving the person's life. There are two types of ICDs being implanted today; transvenous ICD systems (through the veins and into the heart) and the subcutaneous S-ICD, which does not touch the heart but sits just under the skin.



ICD

## What is an S-ICD?

S-ICD stands for Subcutaneous Implantable Cardioverter Defibrillator. An S-ICD will recognise and monitor your heart rhythm, and will deliver electrical therapy to shock your heart back into a normal (sinus) rhythm if required. The S-ICD is a sophisticated, battery powered, electronic device that is placed just under the skin on the left side of your chest. The device is connected to one insulated wire (lead), placed just under the skin alongside the breastbone, that senses the heart's electrical signals.

## What is an EV-ICD?

EV-ICD stands for Extravascular Implantable Cardioverter Defibrillator. The device constantly monitors the heart to check if your heart is beating too fast, or irregularly, if so, the EV-ICD will send small electrical signals to correct the heart rhythm (known as anti-tachycardia pacing/ATP). If the heart rhythm continues to beat too fast, it will deliver another shock to reset and return to sinus rhythm. It can also monitor and treat a heart rhythm that is too slow by sending signals to the heart.

## **What is the difference between an ICD and S-ICD/EV-ICD?**

A traditional implantable cardioverter defibrillator (ICD), otherwise known as a transvenous ICD (TV-ICD), has one or more leads that enter through your veins into the heart and across the valve, allowing the device to provide pacemaker functions as well as defibrillation. The S-ICD and EV-ICD performs exactly the same function as the ICD, however, the device sits on the side of your chest, and the lead goes next to the sternum (S-ICD) or under the sternum (EV-ICD). It is able to monitor your heart rhythm. An EV-ICD also has anti-tachycardia pacing and pause prevention pacing (NOT bradycardia pacing like the TV-ICD). It can accurately keep a check on your heart rhythm and send the right electrical signals if needed. These devices are implanted to give you the best treatment for your heart rhythm condition. Conversely, an S-ICD leaves the heart and blood vessels untouched and intact, presenting a less invasive option for patients not in need of any cardiac (bradycardia) pacing. S-ICDs do not provide antitachycardia pacing therapy, only shock delivery. They may only be suitable for some people as the S-ICD needs to be able to read the electrical impulses of the heart through the rib cage.

## **What can the ICD do?**

If your heart rhythm is too slow, the device can give your heart extra beats by working as a pacemaker. This is called bradycardia pacing. If your heart beats too fast, the ICD can give you a burst of extra beats at an even faster rate which could return your heart back to a normal rhythm. This is called anti-tachycardia pacing (ATP). If the anti-tachycardia pacing does not bring your heart back to a normal rhythm, or if the ICD senses a faster, more erratic rhythm called ventricular fibrillation, the ICD can give you one or more high energy shock. This is called defibrillation.

## **Why has your doctor recommended a defibrillator?**

If the doctor has suggested that you need a defibrillator you may have experienced, or be at risk of experiencing an abnormal, fast heart rhythm. Your symptoms, heart history, or future health may indicate that you are at risk of sudden cardiac arrest (SCA). SCA is a serious condition, which if not treated within minutes, can lead to death. A defibrillator is designed to administer lifesaving therapy in the event of SCA.

## **How are the devices implanted?**

Before the TV-ICD implant procedure starts, the doctor will inject some local anaesthetic under the skin just below your collarbone (usually the left side). This will numb the area and allow the doctor to pass a small lead or electrode through a vein into your heart. You may have two or three leads inserted depending on what your doctor recommends. The leads are then connected to the pulse generator box, which is about the size of a matchbox. This will be placed under the skin.

Before the S-ICD procedure begins, depending on your hospital/doctor's practice, general or local anaesthesia will be administered to make you feel comfortable during the procedure. An incision is made on the left side of the chest, next to the rib cage, where the S-ICD device will be inserted. One or two small incisions are made over the breastbone to allow the lead to be placed under the skin.

The S-ICD is implanted just under the skin using a left-sided incision and one to two smaller incisions along the breastbone to place and secure the system components.

The area will then be stitched with dissolvable or non-dissolvable stitches. If your stitches need to be removed by your GP, Practice Nurse, or District Nurse, you will be informed before you leave hospital.

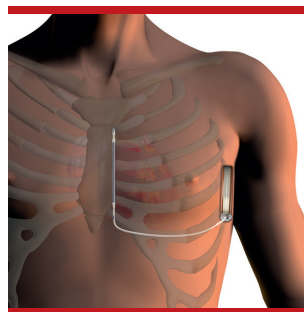
## **What happens after the ICD is fitted?**

After the procedure and once all the checks have been made, you will be taken back to the cardiology ward. You will be asked to lie in bed for a couple of hours then you can get up and eat and drink as normal. Since the wound can feel quite bruised and sore, especially for the first day or two, your nurse will give you regular painkillers. It is very important that you tell your nurse immediately if you have any pain at all. You will also be given some antibiotics to take before, and perhaps after, the procedure to minimise the risk of infection. The wound should be kept clean, and dry until it has fully healed, although it is fine to have a shower after the first three or four days. Ask your nurse for a protective dressing so that you can bathe without wetting the wound. Report any wound problems to your nurse.

If a TV-ICD system is implanted, there is a small chance that the leads can move out of position. To minimise this risk, you should not lift the arm on the same side as the defibrillator (usually the left arm) above shoulder level for at least one to two weeks after the procedure. If a S-ICD system is implanted, the arm restrictions described for the TV-ICD do not apply, however it is advised to avoid arm movements that could create pressure on the wound. Local advice may vary so check with your nurse/doctor before leaving hospital.

However, it is important to do gentle arm and shoulder exercises to keep the arm mobile. You should avoid any vigorous or violent movement of that arm until you have had your first ICD check-up. Your cardiologist will visit you on the ward at the end of the day and you will probably be allowed to go home the next day provided your ICD is checked, there are no complications, and your doctor assesses it is safe. Your ICD will be checked before you go home by a cardiac physiologist or the ICD nurse specialist. This check will involve the use of a special programmer that can look at the device settings and make sure the ICD is working properly. This check takes about 15 minutes.

After this check, most patients will also have a chest x-ray to check lead positions and make sure all is well following the implant procedure. Please ask the physiologist or ICD nurse if you have any questions or worries about the device. At this stage, you will be given an ICD identity card, emergency information, instructions and also a helpline number should you have any queries.



S-ICD

## Care at home

### Arm movements:

For a TV-ICD system, scar tissue will grow around the lead(s) in your heart after a few weeks, which will prevent them moving out of place. Try to avoid lifting the arm on the same side as the ICD above shoulder height for one to two weeks at least. For an S-ICD system, try to avoid arm movements that could create pressure on the wound.

### Wound site:

Your wound site should take about six weeks to heal fully. Try to avoid wearing tight clothing over the wound until it has healed completely to avoid excess rubbing over the area. If you notice any redness, soreness or swelling of the area, or any signs of bleeding or oozing from the wound, report this immediately to your ICD clinic as these may be signs of wound infection. You will probably be able to feel the defibrillator box under your skin as well as other lumps close by. These are the leads that are attached to the box, curled up beside the box under the skin. It is extremely important that you don't try to move the box or leads, but please let someone know if they continue to bother you.

## How long will my ICD battery last?

Like anything that is battery operated, the life of an ICD will depend on how much the battery is used; the battery is used every time the device delivers therapy as well as during simply monitoring the heart rhythm. ICDs are powered by special, long-lasting batteries. They do not suddenly wear out, but instead give you around six months' notice that they are reaching the end of their battery life and will need replacing. ICD batteries may last as little as 4 years, but with new technology, they can last 10 years or more.



## **How reliable will my ICD and lead be?**

ICDs are extremely reliable. They have been rigorously tested in order to meet the stringent criteria set by regulatory authorities around the world. All manufacturers are required to publicly report any unexpected issues with the devices and other related information. Recently, there has been an increased focus on reliability of the leads, so make sure to also ask for more information and research the reliability of the leads that will be implanted in you.

## **Will my ICD ever need replacing?**

The ICD battery will need replacing every 4-10+ years, depending on the life span of the particular device used. Changing the ICD battery requires a small operation that does not take as long as the initial ICD implantation because the leads normally do not need to be replaced unless they are damaged. The longer the battery lasts, the fewer operations you will need.

## **Driving and ICDs**

The Driving and Vehicle Licensing Agency (DVLA) has strict guidelines in relation to patients who require an ICD and whether or not they are safe to drive. There will be some restrictions but these will vary depending on why you have had your ICD fitted. It is very important that you discuss this with your nurse, physiologist or doctor at your ICD centre who will explain this in more detail. You can access the guidelines on the DVLA website. You will also need to tell your motor insurance company to let them know that you have had an ICD fitted.

# Cardiac resynchronisation therapy (CRT)

Cardiac resynchronisation therapy (CRT) devices are used to help treat heart failure, and can be either a permanent pacemaker, or an ICD. They work by making the lower heart chambers (ventricles) pump at the same time (synchronously) and improve the overall function of the heart so that you potentially feel less breathless and have more energy. There are two types of CRT device, CRT pacemakers, and CRT ICDs.

## CRT Pacemakers (CRT-P)

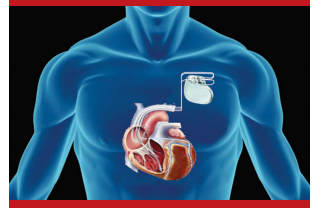
These devices work in the same way as traditional pacemakers. They help the heart to beat in a regular rhythm and are especially useful when the heart's natural pacemaker stops working properly. An implanted pacemaker sends out electrical signals which make the heart beat in a normal way. A traditional pacemaker has either one or two leads which are put into the right side of your heart. One lead will be put into the lower right chamber (right ventricle) and a second lead may be put in the right upper chamber (right atrium). However, if you have heart failure you may need a more advanced type of pacemaker. The main difference with a CRT pacemaker, is that an additional lead is placed on the left side of the heart and electrical signals can make the left ventricle beat at the same time as the right. This can restore the heart's coordination and make the heart pump more efficiently. In two out of three people implanted with a CRT pacemaker, symptoms of breathlessness improve and they have more energy and generally feel healthier.

## CRT ICDs (CRT-D)

People who have had a fast-abnormal heart rhythm, or who are at risk of developing one in the future, and who also need a CRT-pacemaker, may be suitable for a combined device. This is called a CRT-defibrillator, or CRT ICD, and works in much the same way as the standard ICD. It also has the advantage of improving symptoms of heart failure, in the same way as the CRT-pacemaker. Your cardiologist will advise you as to what is best for you.

## Who might need a CRT device?

These devices do not work for all types of heart failure and you will need to have a heart scan (echocardiogram) to check the pumping function of your heart and an ECG (electrocardiogram) to check the electrical function. It is also important to note that any device fitted is not a replacement for your heart failure medication.



## Why might I need a CRT pacemaker?

If you have a problem with the electrical pathways in the heart, which means your heartbeat is too slow, and the left side of your heart is beating out of time with the right. If your overall heart function is markedly less than normal and you suffer with symptoms of heart failure despite medication and lifestyle changes.

## Why might I need a CRT ICD?

If you have heart failure, if you have previously had ventricular tachycardia or ventricular fibrillation or if you are felt to be at risk of these due to your type of heart failure, or an inherited heart condition, or if you have had a heart attack as this can cause damage to the pumping action of the left ventricle as well as causing problems with the electrical pathways in the heart.

# Miniature Insertable Cardiac Monitor (ICM) system

If a doctor is unable to diagnose the cause of your symptoms with simple recording methods such as an ECG or a 24-hour monitor, they may consider an implantable cardiac monitor (ICM). Implanted under the skin on the left side of a patient's chest in order to capture a recording of the heart rate and rhythm at the time of an episode. The device can be used to document any episodes, which would then be assessed by a heart rhythm specialist.

The ICM is a diagnostic tool that will monitor the heart's electrical activity and help a heart rhythm specialist identify the cause of your symptoms. Virtually invisible to the naked eye, it is more comfortable and much less noticeable under the skin.

## How is the ICM fitted?

As this miniature monitor is so small and easy to implant, it is intended that the procedure could be performed in a treatment room as an outpatient, rather than a theatre setting. Implantation of the device requires an incision of less than 1cm which can then be closed very simply with medical adhesive, steri strips or one suture. The procedure will only take about ten minutes and is done under local anaesthetic (risks associated with this include bleeding, bruising, and infection). The procedure may be performed by highly specialised cardiac physiologists and/or specialist nurses. Hopefully this will reduce the waiting lists for this diagnostic device to be fitted.

## **How is an episode captured?**

Although the device may be supplied with a separate 'activator' this is not essential as the ICM is remotely monitored, wirelessly, through a receiver in your house. Some devices can be monitored via a smartphone. Any unusual heart activity will be transmitted via a 4G signal to a secure system which will alert the heart rhythm specialist. You would then be contacted if necessary. Inevitably this will provide more peace of mind for a patient.

## **Removal of an ICM**

Once a heart rhythm disturbance has been captured and the cause determined through this monitor, the device can be removed with another quick, simple procedure. Further investigations and treatments can then be undertaken.

# Pacemaker Information

If your doctor has suggested that you have a pacemaker fitted, it is because you have an abnormality in the electrical conduction system of your heart.

A pacemaker is a small device that is placed in the chest to help control abnormal heart rhythms (arrhythmias). It uses a battery and electronic circuits connected to the heart by one or more wires (leads) to prompt the heart to beat at a normal rate. These leads are passed along a blood vessel to your heart and the pacemaker box is usually implanted under the skin in your upper chest.

The pacemaker can monitor your heart and produce electrical impulses to treat abnormal heart rhythms. Pacemakers are largely used to treat slow heart rhythms (bradycardia), but are also used to treat some fast heart rhythms that come from the top chambers of the heart (the atria).

One type of pacemaker, the biventricular pacemaker or cardiac resynchronisation therapy pacemaker, is increasingly being used to treat patients with heart failure; this is not suitable for all, but can be discussed with your doctor.

Pacemakers may be single (one lead), dual (two leads) or triple (three leads) chambered and you will be fitted with the device appropriate for your particular condition. Recently leadless pacemakers have become available for use in specific patients. These are very small devices that are implanted directly into the heart and there are no leads required. Your doctor will know whether this is something that would be suitable for you. There are approximately 70,500 pacemakers implanted in the UK every year.



## What are leadless pacemakers?

Leadless pacemakers are small devices that help the heartbeat regularly using painless electrical pulses. As the name suggests, a leadless pacemaker offer a new approach to pacemaker options. The small device is placed directly inside the heart using a thin tube inserted through a vein, either via the groin or neck, meaning no chest incision, as they do not have any leads or wires. Therefore, this simplifies the procedure, which can be carried out under local anaesthetic. It is also beneficial to those patients with certain clinical factors, such as a higher infection risk, previous pacemaker problems or limited access to veins. This allows patients to recover more quickly and return to normal daily activities sooner. For further details speak to your consultant who will be able to explain if the device is suitable for you. Even with miniaturisation, the device battery is expected to have an average lifespan of 10-17 years.



An example of a leadless pacemaker



## How is a pacemaker implanted?

On the day of your procedure, you will be taken to the cardiac pacing theatre or catheter lab. The procedure is not usually performed under a general anaesthetic, but you may be given sedation, which will make you relaxed and sleepy.

Before the procedure starts, the doctor will clean the skin with some antiseptic solution and inject some local anaesthetic under the skin just below your collarbone (usually on the left side as most people are right handed, however if you are left handed your doctor may be able to implant the device on the right side).

This will numb the area and allow the doctor to pass a small lead or electrode through a vein into your heart. You may have one, two or three leads inserted depending on what type of pacemaker you need. The lead(s) are then connected to the pacemaker box. This will usually be placed under the skin on your chest wall.

The area will then be closed with dissolvable or non-dissolvable stitches. If your stitches need to be removed by your GP, practice nurse or district nurse you will be informed before you leave hospital. The whole procedure should take approximately 60 to 90 minutes.

## **Are there any risks of having a pacemaker implanted?**

There are some small risks associated with having a pacemaker fitted. Your doctor/specialist nurse will discuss these with you in more detail before you sign your consent form. The most common risks are:

- Infection, bleeding and bruising to the pacemaker site.
- Lead displacement – the pacemaker lead can move and would then need to be repositioned.
- Perforation of the lung during the procedure (a pneumothorax) – this is often detected on the chest x-ray that is performed following the pacemaker implant and can sometimes rectify itself without treatment. Very occasionally a small drain may need to be inserted through your side into your lung (in the space between your ribs) to allow the punctured lung to re-inflate.

This is a simple procedure and the drain will be removed prior to your discharge home.

## **What happens after the pacemaker is fitted?**

After the procedure, you will be taken back to the ward. You will be asked to lie in bed for a couple of hours before you can get up, eat and drink. Your heart rhythm may be monitored for a while to make sure that the pacemaker is doing its job, so you may be attached to an ECG monitor. As the wound can feel quite bruised and sore, especially for the first day or two, it is recommended that you take regular painkillers. It is important that you tell your nurse immediately if you have any pain or discomfort. You may also be given some antibiotics to take before and after the procedure to minimise the risk of infection.

The wound should be kept clean and dry until it has fully healed, although it is fine to have a bath or shower after the first three or four days. Ask your nurse for a protective dressing so that you can bathe without getting the wound wet. Report any wound problems to your nurse.

You will probably be allowed to go home the same or the next day provided your pacemaker is checked, there are no complications and your doctor assesses it is safe. Your pacemaker will be checked before you go home by a cardiac physiologist or the specialist nurse. This check may involve the use of a special programmer that can look at the device settings and make sure the pacemaker is working properly, or a simple magnet check and an ECG will be sufficient. This check takes about 15 minutes and can either be done on the ward or in the pacemaker clinic. You will also have a chest x-ray to check lead positions and make sure all is well following the implant procedure. Please ask the physiologist or specialist nurse if you have any questions or worries about the device.

You will be given a pacemaker identity card which has details of the make and model of your pacemaker. You should always carry this card with you. If you require any further medical treatment in the future it is important that you show this card to the health care professionals treating you.

## **Pacemaker clinic visits**

Your pacemaker should be checked regularly and you will be invited to attend your pacemaker clinic as required. You will be seen at least once a year and may be asked to attend more often if necessary. You may also see the consultant cardiologist or their registrar at your clinic visit.

During each clinic visit, the physiologist or specialist nurse will examine your pacemaker using a special programmer. This machine will allow them to examine the settings and the battery life of your device. Special measurements are also done to assess the state of the leads that connect the pacemaker to your heart. If your condition has altered, changes may be made to the pacemaker settings using the special programmer. Your wound will also be checked and you may have other tests done. Please also take this opportunity to ask any questions or let the medical team know if you have any problems or worries.

Most people can now have their pacemaker checks done remotely over the internet via their own home transmitter, meaning not everyone has to have regular clinic appointments. The pacemaker activity and your heart rhythm are then analysed by the clinic in exactly the same manner as when you physically attend the clinic.

## **Changing the pacemaker**

Normally a pacemaker battery lasts between six and thirteen years. Your battery will be checked at every visit to the pacemaker clinic and staff at the clinic will be able to predict when you need a new pacemaker box and arrange for you to be admitted at a convenient time for you. Don't worry, it will not be allowed to completely run down. You will need to be admitted to hospital and the procedure is similar to having your first pacemaker fitted, but it will not usually involve having new leads.

## **Is there any equipment that could affect my pacemaker?**

Electromagnetic interference will not damage your pacemaker but may temporarily interfere with its settings whilst you are in contact with it. Most mechanical and electrical devices that you use in your normal daily activities will not affect your pacemaker. Household equipment such as ordinary radios, fridges, cookers, remote controls, televisions, electric razors, computers and microwaves etc. will not affect your pacemaker, as long as they are in good working order. If you buy an electrical appliance, you may find that the instructions state 'do not use if you have a pacemaker'. This statement is normally put in to cover the manufacturers and often is not necessarily applicable. It is best to check with your pacemaker clinic for advice. If you feel dizzy or experience palpitations whilst using an electrical appliance, you should move away from the appliance and phone the physiologist, specialist nurse or doctor at the pacemaker clinic for advice. Please note : DO NOT use an AliveCor Kardia Mobile with a pacemaker, ICD, S-ICD, CRT or similar implantable device.

## **Magnets**

Do not carry magnets or place a magnet over your chest. Avoid carrying stereo or hi-fi speakers as they contain strong magnets that can interfere with your pacemaker.

## **Shop doorway security systems**

It is advised that you walk through shop doorway security systems at a normal pace and not to wait around in this area.

## **Travel**

You can safely travel abroad with your pacemaker, but you are advised to show the security staff your pacemaker identification card. Walk through the metal detector archway if asked to do so, but the metal casing of the device may set off the airport security alarm. The detector will not cause any harm to your pacemaker provided you walk briskly through the arch.

## **Medical equipment and other hospital treatments**

Most equipment used by your hospital or GP surgery will not cause any problems to your pacemaker. However, it is advised that you let medical and dental staff know that you have a pacemaker. Please take your ID card with you whenever you go to hospital. It may also be useful to contact your implanting centre for advice before you go into hospital for any investigations or operations that are not associated with your pacemaker.

It is safe for you to have x-rays, CT scans and mammograms. Some pacemakers are MRI conditional which means they have been demonstrated to pose no known hazards in a specified MRI environment with specified conditions of use. Other pacemakers and ICDs have not been tested in an MRI environment, and so are not designated "MRI conditional". Patients with these other implants can undergo MRI scanning if the benefits of the scan outweigh the (low) risk. These scans need to be performed under strict monitoring and are performed at specialised MRI centres.

If you have any concerns, please speak to your pacemaker clinic. Some electrical nerve and muscle stimulators (TENS units) may cause interference

# Remote Monitoring

with pacemakers but this depends on where they are being applied, and, if any of these treatments are suggested to you then your pacemaker clinic should be contacted for advice.

Registered MRI centres that perform MRI scans can be contacted directly at [mrimypacemaker.com](http://mrimypacemaker.com). Approximately 30 centres have registered across the UK, and their contact details for patients are published online.



## What is remote monitoring?

The term remote monitoring means exactly what it implies: monitoring your heart and implanted device while you are at home, and 'remote' from the care team at your hospital. Remote monitoring of pacemakers, ICDs and ILRs use a special transmitter. Using an integrated aerial, the implant automatically sends medical and technical information from your heart, to your doctor, arrhythmia nurse and the cardiac physiologists who are treating you, usually via your remote monitoring device which may be connected through a mobile phone or internet link. This allows your heart rhythm specialists to monitor your condition based on accurate, up-to-date clinical information at any time – not just when you are at the hospital.

Remote monitoring will not replace the first visit after the device is implanted, which is important to check that the wound is well-healed, and you may still need to attend the clinic on an annual or 18-monthly basis as certain tests or any change of the settings cannot be carried out remotely. However, if all is well, and no problems are detected, it may take over the routine checks on your device, which relieves you from having to visit the hospital.

## How does remote monitoring work?

Information will be sent from your device via whatever transmission system you are linked to by arrangement with your implanting centre. This is usually on a three-monthly basis but can also be done more or less frequently. The information received at the centre will allow them to look at any changes that may have occurred in your heart rhythm or with the battery and the lead status.

In order to send the signals from your ICD or pacemaker, you will need a special transmitting device. This may look like a large mobile phone or may be a box which you will need to plug into your telephone line. However, most monitors now use mobile networks without a landline plugged in.

The type of transmitter you receive will depend on which company made your implantable device. Some devices are able to connect to your smartphone instead. Your implanting centre will provide you with full details of how to send transmissions and also a helpline number to call if you experience problems. The transmitter works similarly to a mobile phone and automatically forwards the data to a computerised server. The data is coded during transmission in order to maintain confidentiality. The pacing/ICD clinic staff are then able to view and evaluate the data on a special, secure internet site. The Clinic staff cannot alter any of the settings on your pacemaker/ICD/CRT via remote monitoring.

Therefore you may receive occasional phone calls to attend clinic if the clinic staff decides the settings need to be adjusted.

## Can remote monitoring be used with any ICD or pacemaker?

Pacemakers and ICDs are very complex medical devices and are subject to continual evaluation and improvement. Unfortunately, at the time of writing, not all devices have the option of remote monitoring. Most ICDs that are



Pacemaker/ICD

currently being used are compatible with remote monitoring, but it is still not available for most pacemakers. This may change in the future.

Many centres are currently evaluating the possibility of using remote technology in pacemakers, but not all devices have this option. If you have an ICD or pacemaker that was implanted some years ago, then it is unlikely that you will be able to have a remote monitor.

## **The benefits of remote monitoring**

By using remote monitoring technology, your doctor, arrhythmia nurse and physiologist can be kept up-to-date about changes in your heart rhythm or with the leads attached to your device. This enables them to schedule your hospital appointments or your remote follow-up appointments according to your personal needs. Should you need to contact your follow up clinic because you are experiencing symptoms that cause you concern, they can evaluate your heart remotely and decide what course of action, if any, to take.

### **Travelling and remote monitoring**

You should contact your follow-up clinic if you are travelling abroad, as some of the remote monitoring systems use different telephone networks and so may not function in some countries. You may also choose not to take your remote monitor on holiday with you.

### **Physical activity**

The likelihood of arrhythmia during exercise is very small, but when it occurs it is usually due to an abnormality of heart function, and not the presence of an implantable cardioverter defibrillator (ICD). This is especially true if you have suffered considerable damage to your heart as a result of a heart attack (myocardial infarction) or have a heart muscle disease (cardiomyopathy).

The likelihood of arrhythmia is no greater during moderate intensity aerobic exercise than during resting but there are certain types of exercise that increase the risk of arrhythmias. If you exercise hard from rest, without a warm-up, and immediately cease exercise, without a cool down or active recovery period, you increase the likelihood of arrhythmia.

In cardiac rehabilitation exercise programmes, where a warm-up and cool down are the norm, arrhythmia rarely occurs.

Following your initial recovery, normally about four to six weeks, it is recommended that you try to increase your level of activity if possible. You may be offered cardiac rehabilitation or exercise testing to restore your confidence and get you back to normal.

## **How might exercise affect my ICD?**

Your ICD detects abnormal heart rhythms in a number of ways, one of which relates to the speed of the heart during the arrhythmia.

Most arrhythmias treated with ICDs will be significantly faster than your normal heart rate would reach, even with strenuous exercise. Occasionally, however, the ICD needs to be programmed to recognise abnormal heart rates that are close to those that can be achieved with exercise. For this reason, it is worthwhile checking how your ICD is programmed before undertaking anything other than recreational exercise or exercise to lose weight; your cardiologist, arrhythmia nurse or cardiac physiologist can advise you about how high you can safely raise your heart rate.

If you are concerned about your safe exercise level, you should ask your cardiologist, arrhythmia/ICD nurse, or cardiac physiologist whether an exercise test would be a helpful way to gain reassurance. When you have an exercise test, your ICD should be disabled during the test. This is to avoid inappropriate shock treatment. If you are concerned, you may also be referred to an exercise specialist within the cardiac rehabilitation team. If you would like to know how your ICD has been set up, your cardiac physiologist/nurse can give you this information.

You should be careful of any contact sports. Although the ICD itself is very tough, bruising or breaking the skin over the site where the device is implanted may lead to infection, which can then become very troublesome to treat and resolve. You should also recognise that you are unlikely to be able to obtain insurance for winter sports such as skiing or, indeed any other 'extreme' sports where the effects of a shock may put you or others at risk. This may be possible in some special cases particularly in those patients who have had an ICD implanted for 'just in case' reasons.

Swimming can be undertaken once your implant wound has healed fully. We suggest you do not swim alone in a private pool. Some ICDs are implanted for arrhythmias which may be triggered specifically by swimming (some Long QT Syndromes - check with your cardiologist) but snorkelling is not recommended and SCUBA diving should not be undertaken.

Water sports generally should be undertaken only if you are accompanied at all times by at least one other person who is able to get you out of the water in case your ICD goes off. You will not be able to take part in any form of competitive motor sport, as you will not be eligible for an appropriate licence.

You should also avoid any sport (or indeed any situation) where you might be exposed to strong magnetic or electrical fields, or a powerful radio source (radio-controlled planes, cars, boats, etc. may be a problem - please check with your local implant centre).

## **What exercise can I do?**

Research has shown that physical activity and exercise are beneficial for people fitted with an ICD. Aerobic and skilled flowing movement, muscular endurance and flexibility should dominate the exercise and physical activity sessions. Such activities are very well tolerated, effective and lead to optimal carry-over into your daily life. The most favourable fitness improvements occur with a moderate intensity performed frequently.

Physical activity and exercise should be progressed slowly and should use one of the standard approaches of monitoring, e.g. heart rate or perceived effort. An exercise intensity of between 60-75% target heart rate (220 minus age) is sufficient to bring about significant health benefits and improve fitness and endurance. If you are taking beta-blocker medication, you may not be able to reach these heart rate levels. Instead, you should look to increase your exercise heart rate by 30 to 40 beats above your resting heart rate.

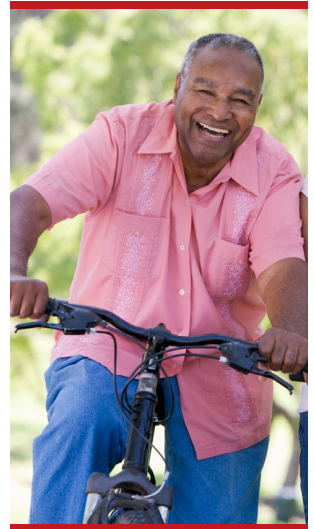
The key is to avoid becoming too breathless during exercise, as this will sap your strength and overload your cardiovascular system.

All exercise sessions should start with a warm-up and finish with a cool-down period, both of which should last for ten minutes, so that the cardiovascular system has time to adjust to the alteration in demand. The sequence of exercise should vary from arm work to trunk and legwork, with flexibility and co-ordination exercises following the more strenuous exercises.

The main part of the training programme should consist of graded aerobic circuit training exercises lasting 25 to 30 minutes and incorporating multi-jointed movements with part body weight and moderate resistance.

Static exercise where you are holding tight, or resisting strongly, and 'holding your breath' should be avoided as this type of exercise has no health benefit and is dangerous. The key is to emphasise the skill of the activity, be it aerobic exercise or strength and with practice the task will become easier.

In general, most exercises should be performed standing, with horizontal (lying down) and seated arm exercises kept to a minimum. Seated arm exercise with weights leads to excessive cardiac demand and an increased likelihood



of arrhythmia. If seated exercise is to be performed, then the intensity of exercise should be low and the emphasis placed on muscular endurance (lots of repetitions without feeling unduly fatigued).

Gentle leg exercises (for example, alternate heel lifts) reduce the load on the heart during combined (seated) arm work. A note of caution is required for those few patients who are at risk of ICD lead problems. This situation is often known about immediately post-operatively and your ICD implant team will have informed you about it.

Continuous physical activity of 30 minutes or more is considered most effective, although multiple activity sessions of ten to fifteen minutes duration, on the same day, have also demonstrated significant health improvement.

## **Other useful information**

### **DIY**

You can safely use equipment such as electric drills as long as they are in good working order, although you should keep them away from your ICD site.

### **Electronic ignition systems**

Avoid leaning over the alternator in a car whilst the engine is running, otherwise it is generally safe to work as a mechanic.

### **Medical equipment and other hospital treatments**

Most equipment used by your hospital or GP surgery will not cause any problems to your ICD. However, it is advised that you let medical and dental staff know that you have an ICD, as technical support may be required before some treatments. Please take your ID card with you whenever you go to hospital.

It may also be useful to contact your implanting centre for advice before you go into hospital for any investigations or operations that are not associated with your ICD.

However, you should seek advice from your ICD clinic before undergoing an MRI scan as not all devices are MRI safe. It is safe for you to have x-rays, CT scans and

mammograms. Some electrical nerve and muscle stimulators (TENS units) may cause interference with ICDs but this depends on where they are being applied and, if this form of treatment is suggested to you, then your ICD clinic should be contacted for advice.

## Operations

If you require an operation, you must tell your surgeon and anaesthetist that you have an ICD. It may be necessary to temporarily switch off (deactivate) the shocks on your ICD for the duration of the operation. This can be done through a programmer, but equally can be done using a magnet taped over your ICD. This will prevent unnecessary shocks being given during operations, especially when diathermy cautery is used as this can be sensed by the ICD.

## Travel

You can safely travel abroad with your ICD, but you are advised to show the security staff your identification card and ask to be searched by hand. This is because the hand-held wands can temporarily interfere with your ICD.

Only walk through the metal detector archway if asked to do so, but the metal casing of the device may set off the airport security alarm. The detector will not cause any harm to your ICD provided you walk briskly through the arch. You will need to make sure that your travel insurance company is aware that you have an ICD.

Some insurance companies require written confirmation from your cardiologist that you are fit to travel. Travel companies may also try to increase your insurance premiums and it is suggested that you shop around if this happens. Many ICD clinics carry a list of ICD friendly insurance companies.

If you wish, you may be given addresses of ICD clinics in the area that you are visiting. Please contact the ICD clinic at least six weeks before you intend to travel or check the manufacturer's website for information. Please be aware that your doctor may advise against you visiting very isolated destinations.

## Arc welding

This should be avoided.

## Mobile phones/portable music players

Some studies have shown that mobile phones and portable music players can affect the ICD if held within six inches of the device. It is therefore recommended that you do not keep them in a coat or shirt pocket over the ICD. Keep the handset more than six inches away from the ICD; ideally hold your phone over the ear on the opposite side to the device.

5G radio frequency signals, used to transmit in mobile systems, can very rarely generate electromagnetic interference with cardiac implanted active electronic devices (CIEDs) and temporarily change their functionality.

Although 5G radio signals are at frequencies not considered by previous regulatory standards, extensive investigation has shown that these different (5G) frequencies pose no greater risk of interference (through electromagnetic mechanisms) than the frequencies specified for the older 3G/4G communication technologies.

It has long been the advice that recipients of CIEDs (such as pacemakers and implantable defibrillators) should keep communication devices using 3G/4G radio frequencies (such as mobile phones), when in use, a minimum distance of 15 cm from their CIED to further reduce the already very low risk of any temporary electromagnetic interference. This same advice holds good for communication devices using 5G radio frequencies and no additional or new precautions are required.

## Planning to deactivate ICD shocks

People with heart problems, who have received an ICD may later be diagnosed with progressive heart disease or other life-limiting illness. It may well come to a stage where cardiopulmonary resuscitation is unlikely to be helpful or is no longer wanted by the individual. In this situation, it is often appropriate to

deactivate ICD shocks. This is to avoid the situation where a person who is dying for another reason receives shocks which are unpleasant, but will not save their life. This can be distressing for the person involved but also for their family and loved ones.

As more and more people in the world have an ICD fitted, we have to be more aware of planning for the end of life. These conversations can be difficult and emotional but it is important to discuss these issues early. Ideally, these discussions should take place while the individual is still able to make their own decisions, but in some circumstances the next-of-kin may need to be involved. Switching off shock therapies is straightforward but is not always available out-of-hours. An ICD physician or a physiologist has to reprogram the device.

It is safe to use an automated external defibrillator (AED) on someone who has a pacemaker or implantable cardioverter defibrillator (ICD). It is important not to place the pads in contact with, or directly over the device. The pads are usually placed on the upper right of the chest and on the left side of the rib cage, so a device should not get in the way. If someone has an implanted device, you will notice a scar and a bump. Place the pad to the side of the device (about 3cm).

The shock produced could affect the functioning of the pacemaker or device, however the benefits of using the AED to save someone's life outweigh this potential risk. If you receive CPR or defibrillation, you should have your device checked afterwards to ensure the settings are still accurate. If you have any questions or concerns, please contact your cardiologist.

The following points are important:

- The device will no longer provide shock therapy in the event of fast abnormal heart rhythms (VT or VF)
- Turning off shocks will not in itself cause death
- Turning off shocks will not be painful, nor will the failure to shock cause pain
- The decision is not irreversible, shocks can be turned back on if the situation changes
- The device will continue to provide pacemaker functioning to prevent slow heart rhythms (these are small impulses that are not painful)
- There will be a plan to ensure healthcare professionals are available to answer questions or concerns that may arise
- A deactivation request form will need to be filled in, with the involvement of the ICD physician
- The palliative care team may be helpful where difficult decisions need to be made

## ICD patient support

Many patients who have ICDs implanted do have concerns and anxieties after the implant. These may be about the condition for which it has been implanted or fear of shock treatment from it. Some patients also have anxieties after they have had treatment from the ICD. If you do have concerns about this or any other issues, it is important to raise them with either your consultant or the ICD clinic team. They will be able to put you in touch with other patients in a similar situation or someone that you can discuss this with. You need time to be able to talk about these anxieties, so make sure you raise them when you go to clinic. Many implanting centres now have patient support groups, and if there is not one in your area you may be able to access one in another area.

There is a list of all support groups affiliated to Arrhythmia Alliance on the website: [www.heartrhythmalliance.org](http://www.heartrhythmalliance.org)





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**“Really helpful advice about exercising after having my ICD fitted”**

**David, Scotland**

To view our patient resources, scan the QR code below:



Please remember that this publication provides general guidelines only. Individuals should always discuss their condition with a healthcare professional. If you would like further information or would like to provide feedback, please contact us.

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