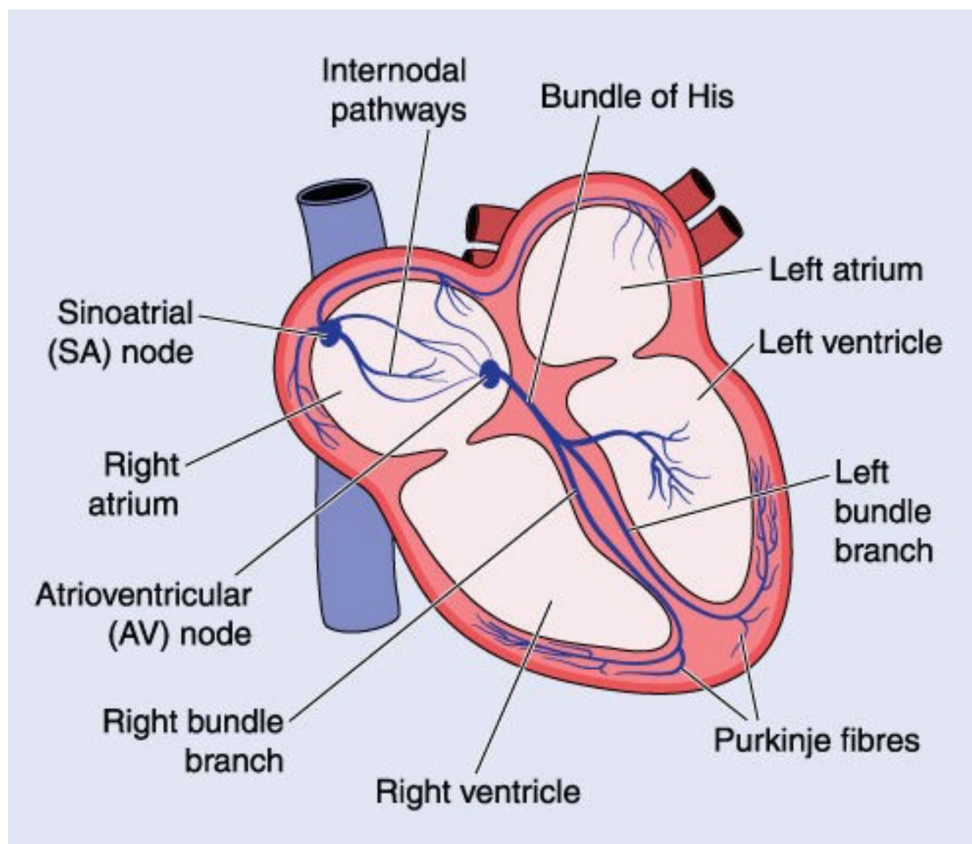


# How does the electricity in my heart work?

To understand how a pacemaker works it is important to understand how the electrical system in your heart works. When your heart beats, it pumps blood to all parts of your body. It needs electricity in order to pump. When this electricity travels through the heart muscle it causes it to contract or beat.

A normal heartbeat is started by an electrical signal that comes from the heart's natural pacemaker, the sinoatrial (SA) node, located at the top of the right atrium. The electrical signal travels through the atria and reaches the atrioventricular (AV) node.



After crossing the AV node, the electrical signal passes through the bundle of His. This bundle then divides into branches that extend into the right and left ventricles. The electrical signal travels down the left and right bundle branches and eventually reach the muscle cells of the ventricles, causing them to contract and pump blood to the body.

# Why would my doctor recommend a pacemaker?

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Some patients have problems with the electrical signal in their heart not working properly. There can be problems with either the SA node or the AV node. In some cases, the heartbeat can be slow only occasionally. Other people experience a slow heart rate all the time.

## **SICK SINUS SYNDROME**

- **Sinus Bradycardia:** this is a slow heart rate that occurs when the SA node sends signals out too slowly
- **Sinus Pause:** this is a long pause in between heartbeats and occurs when the SA node fails to send a signal. Without a signal the atria (upper chambers) don't contract
- **Tachy-brady syndrome:** this is when the heartbeat alternates between too fast and too slow. This occurs when the SA node alternates in the signals it sends out between slow and fast

## **Atrioventricular (AV) BLOCK**

AV block, also called heart block occurs when the AV node has problems passing the electrical signal from the atria to the ventricles. If the ventricles don't receive a signal, they don't contract. This may happen intermittently or all the time. If this happens all the time, the heart may go into an "escape rhythm." This means it continues to beat but at a slower and less reliable rate (usually in the 30's)

### **What are the symptoms of a slow heart rate?**

Oxygen is carried throughout your body by blood. If your heart is beating too slowly, less oxygen is delivered to areas that need oxygen and may cause symptoms

- Dizziness
- Lightheadedness
- Shortness of breath
- Fatigue
- Fainting (syncope)

### **What are the causes?**

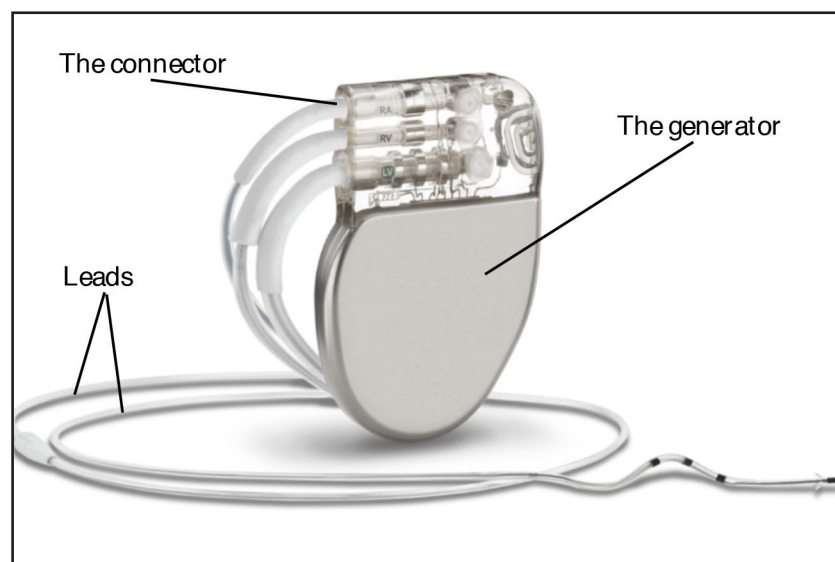
- Changes in electrical system of heart due to aging
- Heart disease or previous heart surgery
- Taking medication that slows the heart such as beta blockers
- Heart defect present at birth

# What is a Pacemaker?

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Artificial pacemakers are devices that are implanted into the body, usually just below the collarbone with wires called leads, that are connected to your heart. A pacemaker “listens” to your heart beat. If your heart is beating on its own at a sufficient rate, the pacemaker does nothing. If your heartbeat is too slow, the pacemaker sends a small electrical signal to stimulate your heart to beat.

## Parts of a pacemaker:

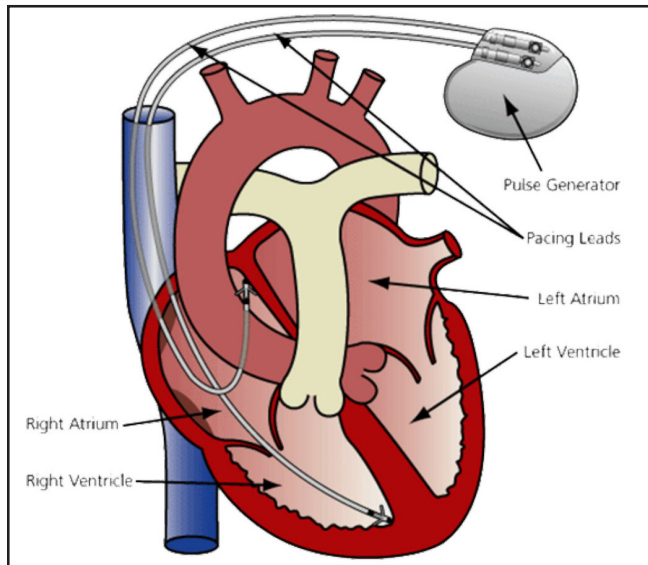


**The generator:** The generator weighs only an ounce and is approximately the size of a large wristwatch face. A pacemaker contains a computer with memory, electrical circuits and a powerful battery. The battery is safety sealed within its casing. It continuously monitors your heart rhythm and provides a small amount of energy to pace your heart if your heart rate becomes too slow.

**Leads:** These are thin insulated wires that connect the pacemaker to your heart. You may have one, two or three wires depending on your need for the pacemaker. The generator creates electrical impulses that are carried by the leads to the heart muscle, signaling it to pump.

**The connector:** or “header” is the part of the generator where the lead (or leads) are attached.

# Types of Pacemakers

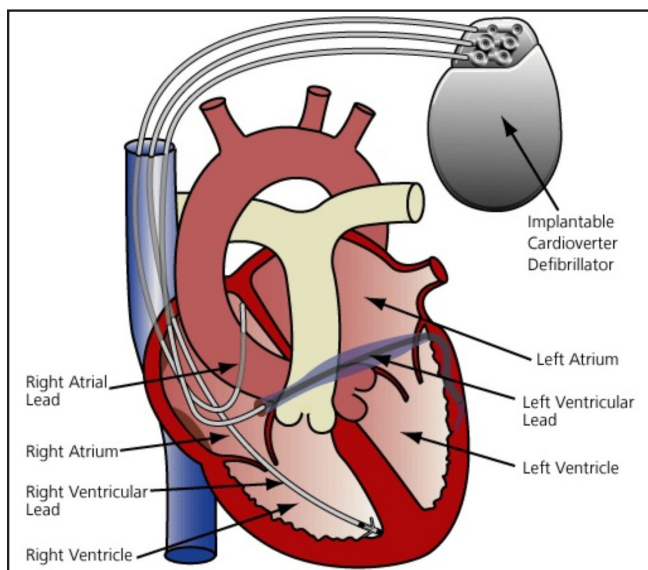


## Single chamber pacemaker:

A single chamber pacemaker has one lead that is placed in either the right upper chamber (atrium) or the right lower chamber (ventricle), most commonly the right ventricle.

## Dual chamber pacemaker:

A dual chamber pacemaker has two leads, one in the right atrium and one in the right ventricle. Having two leads helps coordinate the upper and lower chambers.



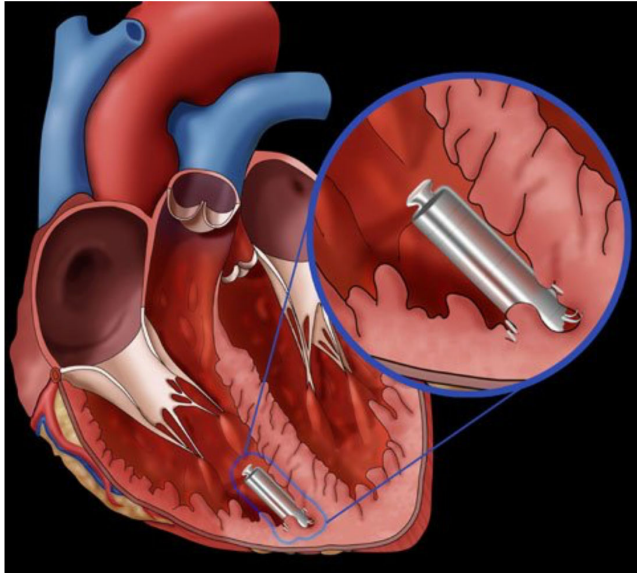
## Biventricular pacemaker:

A biventricular pacemaker, also called cardiac resynchronization therapy (CRT), has three leads, one in the right atrium, one in the right ventricle and a third around the left side of the heart.

These are more complicated and take more time to implant. By delivering near simultaneous electrical impulses to both lower chambers, a biventricular pacemaker causes the heart to beat in a more synchronized, efficient manner.

## Leadless Pacemakers

A Micra is a leadless pacemaker that is implanted in your right ventricle by threading a catheter from the vein in your groin up to your heart. Once the Micra is positioned, your doctor will deploy it from the catheter and remove the catheter.



To implant a Micra pacemaker, your doctor will deliver the device to your heart by using a long catheter with a handle that controls deployment of the device. Your doctor will insert the catheter into the femoral vein in your groin and from there thread it up to your heart.

Once your doctor has the Micra positioned in your right ventricle, he will deploy it from the catheter and remove the catheter. The Micra has four small self-expanding tines that will anchor into your heart muscle.

### Why Micra?

- Less chance of complications due to lack of leads and lack of generator implanted in left chest
- Complications that are eliminated include pocket infections, hematoma, lead dislodgment, and lead fracture.
- Cosmetic appeal due to lack of chest incision or visible pacemaker pocket.

### Who is a candidate for a Micra?

- A Micra can only be used for pacing in the ventricle; it **cannot** be used for patients that require pacing in both the upper and lower chamber
- Chronic atrial fibrillation with slow ventricular rates
- Bradycardia (slow heart rate)
- Complete heart block

## **How does a pacemaker work and will I feel it working?**

Pacemakers work “on demand.” This means the pacemaker will only pace your heart when needed. The pacemaker will monitor your heart rate on a beat-to-beat basis and if your heart rate falls below a set rate, then the pacemaker will send an electrical impulse to your heart to beat. You will not feel these impulses.

When you are active doing work or exercise, your body demands more oxygen. Usually, your heart responds by increasing your heart rate. If you are unable to do this on your own, you may need to rely on the pacemaker to do this for you. Your pacemaker has a combination of settings referred to as “rate response” that will increase your heart rate when you are active to provide more oxygen to your body with increased activity. These settings are individualized and sometimes take a few adjustments after you initially get your pacemaker to get them optimized just right for you.

## Getting a pacemaker implant— what to expect:

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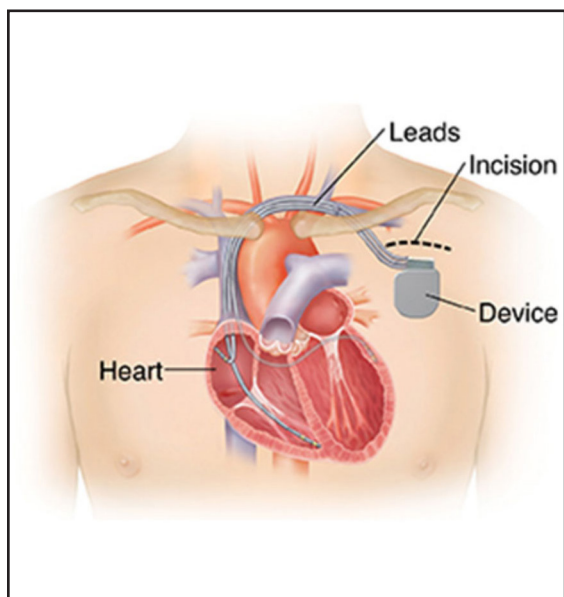
- Prior to your procedure, your nurse will review pre-procedure instructions that your doctor wants you to follow by one of three ways. She will either call you, send you written instruction via MyChart or will send you a letter in the mail.
- You will be given an antiseptic soap called Hibiclens to shower with the evening prior to and the morning of your procedure
- You will be asked to fast after midnight the night before the procedure
- Follow all the instructions that you were given, especially regarding medications

### **What to expect on the day of procedure**

- You will need a driver to and from procedure
- You usually do not have to stay the night but be prepared to stay if your doctor decides to keep you overnight to monitor you.
- You will be asked to check in 2 hours prior to your procedure so that the nurse can prepare you
- You will be given an IV to provide fluids and medication & have labs drawn
- The doctor will have you sign a consent form if you haven’t already
- The skin where your pacemaker will be implanted will be washed and hair in that area may be removed

## During the procedure:

- Pacemakers can be placed on either side but are usually implanted on the left side of the chest just under the collar bone. The procedure usually takes 1-2 hours



You will be taken to the operating room or cardiac catheterization lab for the procedure. Once there, the staff will connect you to equipment to monitor your vital signs. You will be draped in sterile drapes.

Your doctor will first cleanse the site with antiseptic and then inject it with local anesthetic. An incision is made just under your collar bone. A small “pocket” for the generator is created. The incision lets your doctor access a vein that leads to your heart

The leads are guided through a vein into your heart. They are secured in your heart using small anchors on the tips of the leads. Electrical measurements are done to find the best area for lead placement.

Once the leads are secure, they are attached to the generator. The generator is then placed in the pocket beneath your skin. Your doctor will then close the incision with internal sutures and surgical glue or steri-strips on the outside of the incision. You will then be taken to the Cardiovascular Admit Recovery Unit (CVAR) to recover.

## Risks of the procedure

Possible risks/complications of implanting a pacemaker include:

- Discomfort/pain to incision
- Bleeding
- Infection
- Bruising or swelling at implant site
- Puncture of the lung (pneumothorax)
- Damage to the heart (perforation or tissue damage)
- Puncturing of the heart or a vein on the outside of heart (tamponade)
- Clotting in the vein
- Heart attack/stroke/death (very rare)

# What can I expect for recovery?

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## Activity restrictions:

After you go home you will be asked to restrict the arm movement on the side the pacemaker was implanted. This is because until scar tissue forms around the lead, your leads are vulnerable to being dislodged. The following arm-movement restrictions help prevent lead dislodgement—**For 6 weeks:**

- Do not raise arm on affected side above shoulder
- Do not lift more than 10 lbs. with affected side
- No aggressive/repetitive arm movements such as sweeping, raking, vacuuming, golfing, chopping wood, tennis, or similar type movements

You can otherwise resume your usual activities. If you work, ask your doctor when it is ok to return to work or start driving again.

## Caring for your incision:

It is normal to have some pain and stiffness around your incision in the first few days after you have your implant. Over-the-counter pain medication may be helpful. Use the following tips to care for your incision:

- If you have any dressing other than steri strips or skin glue, it can be removed in 24 hours; **do not pick or peel off steri strips or skin glue.**
- Do not shower until 24 hours after your procedure; when you do avoid rubbing incision, but you may get it wet during shower. Gently pat dry after.
- Do not apply any creams, lotions, ointments or powder to implant site
- Look at your incision every day watching for any signs of infection
- It is normal to have some bruising around your incision, to your chest or even under your arm on the side the pacemaker is implanted. This gradually fades away
- It is also common to experience some minor swelling in the first couple of days
- Call your doctor if you note any changes to incision noted below

## Report any of the following to your doctor:

- redness to incision/surrounding area
- new or worsening swelling
- new or sudden onset bruising
- increased warmth to touch
- incision opens/drainage from incision
- presence of suture
- non-stop hiccups
- fever >100F



# Pacemaker Follow-up

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The standard follow up after having a pacemaker:

- **1 week post-implant:** This is a visit with a Nurse Navigator to check your pacemaker function and that your incision is healing properly.
- **3 month follow-up:** This is an appointment with an ARNP or PA-C with another pacemaker check (done by device tech or device nurse)
- **6 month or annual follow ups:** with physician and a pacemaker check. Your physician will choose whether you are to be seen annually or every 6 months, depending on your individual needs; some patients may see physician annually and come in clinic for a pacemaker check every 6 months.

## How is a pacemaker evaluated?

To ensure your pacemaker is working properly, your pacemaker will be evaluated in the clinic by a device nurse or device tech when you come in for follow up. You will initially have a one-week follow up after your pacemaker is first implanted. This is a visit with a Nurse Navigator to check your pacemaker and your incision.

When your pacemaker is evaluated, the pacemaker's function and battery is evaluated and if needed, settings may be adjusted. This fine-tunes the pacemaker to ensure it is working the best it can for your heart.

Each time your device is evaluated in the clinic, the need for adjustments will be assessed. Your doctor wants your pacemaker to doing the best job it can for you. The nurse or device tech will ask about your activities and if you have any fatigue with activities to see if any adjustments are necessary.

## Checking your pacemaker from home

You will receive a home monitor that will be paired with your pacemaker. This monitor will automatically be able to send your clinic an update on your pacemaker every three months.

It is also very important to keep your monitor plugged in every day. Each day your monitor will check to see if there are any problems with your pacemaker. Your pacemaker has alerts programmed into it, mainly related to lead integrity and if any alerts are triggered within the pacemaker, your monitor will send your clinic a message notifying them of the alert.

The third function of your monitor is the ability to manually send a report to your clinic. If you are not feeling well and call your clinic, your nurse may prompt you to send a report from your home monitor. You can remotely transmit a pacemaker report from home with your home monitor.

# Home Monitors

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**Medtronic** pacemakers offer two options—either a cell phone APP or a stand-alone monitor



This is the monitor for **Abbott** pacemakers.



This is the monitor for **Boston Scientific** pacemakers

# How long will my pacemaker last?

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Although manufacturers vary, pacemaker batteries last 10-15 years. When your battery runs out, we do not replace the battery, we replace the whole generator.

Your device has an “elective replacement indicator” (ERI) trigger and once that has been triggered, it is time to replace your device. There is also approximately three months of battery after the ERI has been triggered in order to schedule the replacement procedure. To replace your device, the doctor will go in the same incision, take the old device out and connect a new device to the existing leads as long as your leads are still working well. If you need a new lead or leads, it is similar to the original implant. Old leads however are rarely explanted unless they are causing harm.

# Living with a Pacemaker

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It may take time to get used to having a pacemaker, but most people are able to lead normal lives. It is safe for you to do almost any activity you like but there are things to consider when you have a pacemaker.

## Pacemaker ID Card

You will receive an ID card that contains important information about your pacemaker. A temporary one is given to you at the hospital until a permanent one comes in the mail 6-8 weeks after you have had your pacemaker. Always carry this with you and show it to any healthcare provider you go to so that they are aware that you have a pacemaker. You will also need to show your card to security staff in airports so that they know to follow special procedures that prevent the security wand from interfering with your pacemaker.

## Does a pacemaker affect driving privileges?

Whether or not you are able to drive once you have a pacemaker will depend on your specific symptoms and the driving laws where you live. In general, a pacemaker does not prevent you from being able to drive, although your doctor may ask you to wait until you recover from the initial recovery stage of the pacemaker implant procedure. Ask your doctor about any restrictions that you may have.

## Your pacemaker and outside signals

Most household appliances and items do NOT interfere with your pacemaker. For example, it is safe to use microwave ovens, computers, radios, televisions, hair dryers, electric blankets, heating pads, razors, remote controls, vacuums, and many other household appliances. People with pacemakers do need to be aware that pacemakers can be affected by electromagnetic interference (EMI). EMI is caused by strong electrical or magnetic fields.

A few things can create signals that may interfere with your pacemaker:

- *Cellular phones*: should not be kept in a pocket over your pacemaker; should be 6 inches away. As you talk, talk on the opposite side of the pacemaker.
- *Electromagnetic anti-theft systems*: are often located near store entrances and exits. Walking through one is okay but avoid standing or leaning up against one.
- *Very strong magnets*: Do not place a magnet over your pacemaker
- *Strong electrical fields* can be created by heavy duty power equipment such as an arc welder. Stay 6 feet away from large industrial power sources. If you use welding equipment, ask your physician for more information
- *Chainsaws*: avoid use of a chainsaw when you have a pacemaker, it can interfere with the function of your pacemaker.
- *TENS units or massagers*: avoid use of these on the upper body. Use of these on the upper body can cause interference with your pacemaker

## **Am I able to have an MRI scan?**

Some patients need an MRI (Magnetic Resonance Imaging) scan to diagnose different health conditions. MRI is a diagnostic tool that uses different types of magnetics and electromagnetic fields to image soft tissue of the body. Many pacing systems are not appropriate for use during an MRI; however, you may be eligible to have an MRI if you are implanted with an MRI conditional pacing system. This means that the leads and the generator must be designed to work in an MRI environment and meet the conditions of use. Your cardiologist will be able to work with you to determine if your pacing system can undergo an MRI scan.

## **Can I travel with my pacemaker?**

Once you have recovered from your implant procedure, you can feel confident to resume your normal activities including any travel. Make sure you carry your ID card with you at all times to alert medical and security personal that you have an implanted device.

It is important to carry your ID card with you because it tells airport security that the device may contain metal components that may set off metal detectors. Walking through a metal detector will not harm your pacemaker. Airport security wands could temporarily affect the device. If security personnel use a wand, ask them to do the search quickly and to not hold the wand directly over the device. You can also request a hand search if you prefer.

## **Exercise Regularly**

Having a pacemaker does not mean that you can't be active. In fact, you will likely find that exercising is easier with a pacemaker. Regular exercise is good for your overall health and is encouraged. You can do most activities with your pacemaker but if you play any contact sports or do weightlifting, please discuss these with your doctor. If you need help knowing how to start an exercise program, ask your doctor for advice.