

## **Pacemakers & Defibrillators**

A pacemaker system consists of a battery, a computerized generator and wires with sensors called electrodes on one end. The battery powers the generator, and both are surrounded by a thin metal box. The wires connect the generator to the heart.

A pacemaker monitors and helps control your heartbeat. The electrodes detect your heart's electrical activity and send data through the wires to the computer in the generator.

If your heart rhythm is abnormal, the computer will direct the generator to send electrical pulses to your heart. The pulses then travel through the wires to reach your heart.

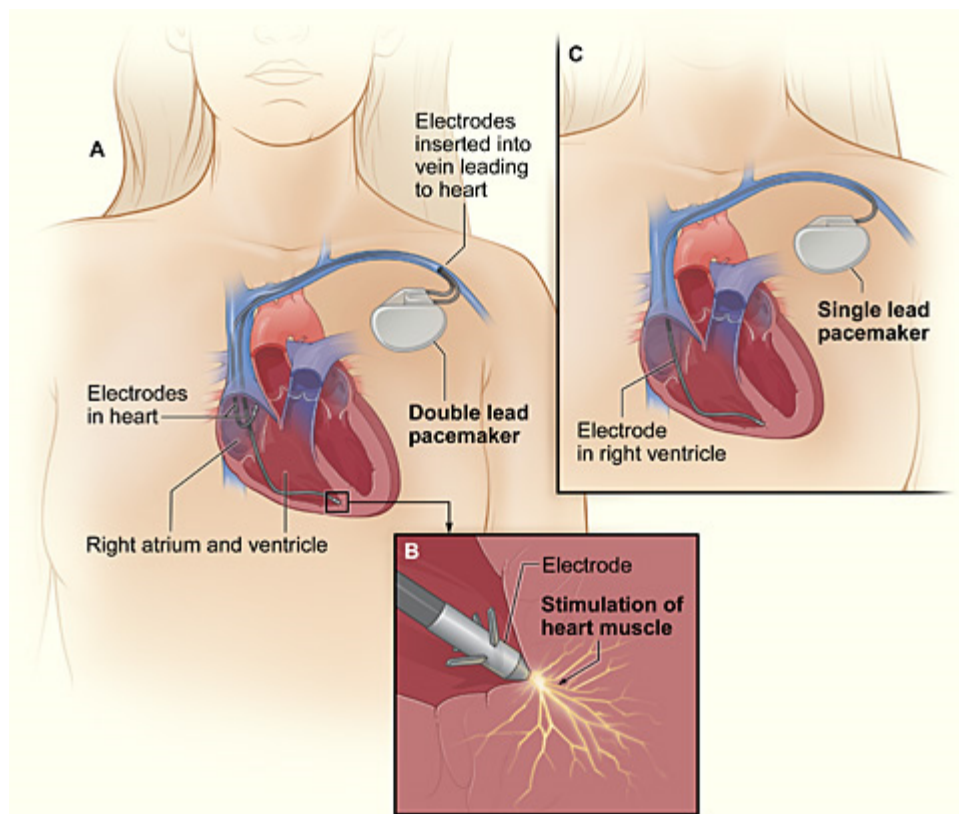
Newer pacemakers also can monitor your blood temperature, breathing, and other factors and adjust your heart rate to changes in your activity.

The pacemaker's computer also records your heart's electrical activity and heart rhythm. Your doctor will use these recordings to adjust your pacemaker so it works better for you.

Your doctor can program the pacemaker's computer with an external device. He or she doesn't have to use needles or have direct contact with the pacemaker.

Pacemakers have one to three wires that are each placed in different chambers of the heart.

- The wires in a single-chamber pacemaker usually carry pulses between the right ventricle (the lower right chamber of your heart) and the generator.
- The wires in a dual-chamber pacemaker carry pulses between the right atrium (the upper right chamber of your heart) and the right ventricle and the generator. The pulses help coordinate the timing of these two chambers' contractions.
- The wires in a biventricular pacemaker carry pulses between an atrium and both ventricles and the generator. The pulses help coordinate electrical signaling between the two ventricles. This type of pacemaker also is called a cardiac resynchronization therapy (CRT) device.



*The illustration shows a cross-section of a chest with a pacemaker. Figure A shows the location and general size of a double-lead, or dual-chamber, pacemaker in the upper chest. The wires with electrodes are inserted into the heart's right atrium and ventricle through a vein in the upper chest. Figure B shows the electrode electrically stimulating the heart muscle. Figure C shows the location and general size of a single-lead, or single-chamber, pacemaker in the upper chest. The wire with the electrode is inserted into the heart's right ventricle through a vein in the upper chest.*

### Types of Pacemaker Programming

The two main types of programming for pacemakers are demand pacing and rate-responsive pacing.

A demand pacemaker monitors your heart rhythm. It only sends electrical pulses to your heart if your heart is beating too slowly or if it misses a beat.

A rate-responsive pacemaker will speed up or slow down your heart rate depending on how active you are. To do this, the rate-responsive pacemaker monitors your sinus node rate, breathing, blood temperature, and other factors to determine your activity level.

Most people who need pacemakers to continually set the pace of their heartbeats have rate-responsive pacemakers.

### What Is an Implantable Cardioverter Defibrillator?

An implantable cardioverter defibrillator (ICD) is a small device that's placed in your chest or abdomen. The device uses electrical pulses or shocks to help control life-threatening, irregular heartbeats, especially those that could cause sudden cardiac arrest (SCA).

SCA is a condition in which the heart suddenly and unexpectedly stops beating. If the heart stops beating, blood stops flowing to the brain and other vital organs. This usually causes death if it's not treated in minutes.

ICDs use electrical pulses or shocks to treat life-threatening arrhythmias that occur in the ventricles (the heart's lower chambers).

When ventricular arrhythmias occur, the heart can't effectively pump blood. You can pass out within seconds and die within minutes if not treated. To prevent death, the condition must be treated right away with an electric shock to the heart. This treatment is called defibrillation.

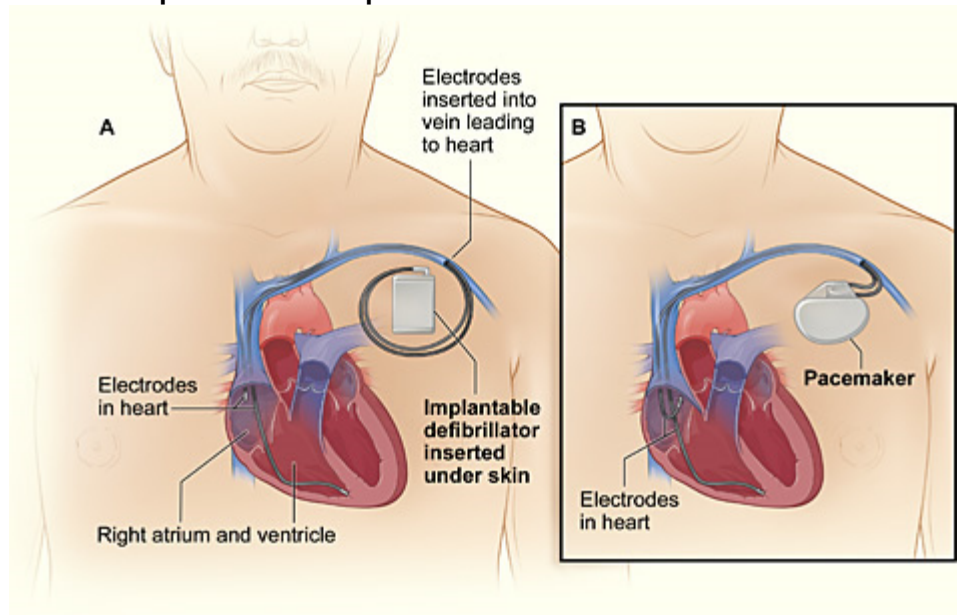
An ICD has wires with electrodes on the ends that connect to your heart chambers. The ICD will continually monitor your heart rhythm. If the device detects an irregular rhythm in your ventricles, it will use low-energy electrical pulses to restore a normal rhythm.

If the low-energy pulses don't restore your normal heart rhythm, or if your ventricles start to quiver rather than contract strongly, the ICD will switch to high-energy electrical pulses for defibrillation. These pulses last only a fraction of a second, but they can be painful.

An ICD is similar to a pacemaker, but there are some differences. Pacemakers can only give off low-energy electrical pulses. They're often used to treat less dangerous heart rhythms, such as those that occur in the upper chambers of your heart. Most new ICDs can act as both pacemakers and defibrillators.

Patients who have heart failure may need a special device called a cardiac resynchronization therapy (CRT) device. The CRT device is able to pace both ventricles at the same time. This allows them to work together and do a better job pumping blood out of the heart. CRT devices that have a defibrillator are called CRT-D.

## Comparison of an Implantable Cardioverter and a Pacemaker



*The illustration compares an ICD and a pacemaker. Figure A shows the location and general size of an ICD in the upper chest. The wires with electrodes on the ends are inserted into the heart through a vein in the upper chest. Figure B shows the location and general size of a pacemaker in the upper chest. The wires with electrodes on the ends are inserted into the heart through a vein in the upper chest.*

### How Does an Implantable Cardioverter Defibrillator Work?

An implantable cardioverter defibrillator (ICD) has wires with electrodes on the ends that connect to one or more of your heart's chambers. These wires carry the electrical signals from your heart to a computer in the ICD. The computer monitors your heart rhythm.

If the ICD detects an irregular rhythm, it sends low-energy electrical pulses to prompt your heart to beat at a normal rate. If the low-energy pulses restore your heart's normal rhythm, you may avoid the high-energy pulses or shocks of the defibrillator (which can be painful).

Single-chamber ICDs have a wire that connects to either the right atrium or right ventricle. The wire senses electrical activity and corrects faulty electrical signaling within that chamber.

Dual-chamber ICDs have wires that connect to both an atrium and a ventricle. These ICDs provide low-energy pulses to either or both chambers. Some dual-chamber ICDs have three wires. They connect to an atrium and both ventricles.

The wires on an ICD connect to a small metal box implanted in your chest or abdomen. The box contains a battery, pulse generator, and computer. When the computer detects

irregular heartbeats, it triggers the ICD's pulse generator to send electrical pulses. Wires carry these pulses to the heart.

The ICD also can record the heart's electrical activity and heart rhythms. The recordings can help your doctor fine-tune the programming of your ICD so it works better to correct irregular heartbeats.

The type of ICD you get is based on your heart's pumping abilities, structural defects, and the type of irregular heartbeats you've had. Whichever type of ICD you get, it will be programmed to respond to the type of irregular heartbeat you're most likely to have.

.