What is a defibrillator?

A defibrillator is a device that sends electrical energy, or shock, to the heart. The aim of using a defibrillator is to treat cardiac arrest. The need for this generally arises when the patient has ventricular fibrillation or ventricular tachycardia, which are life-threatening arrhythmias that occur when contraction of the ventricles become abnormal. Defibrillators have electrocardiogram (ECG) leads and adhesive patches (or paddles). The adhesive electrodes are the patches placed on the patient's chest that deliver the electric shock.

Types of Defibrillators

There are different kinds of defibrillators in use today. They include the manual external defibrillator, manual internal defibrillator, automated external defibrillator (AED), implantable cardioverter-defibrillator (ICD), and wearable cardiac defibrillator.

Manual external defibrillator

These defibrillators require more experience and training to effectively handle them. Hence, they are only common in hospitals and a few ambulances where capable hands are present. In conjuntion with an ECG, the trained provider determines the cardiac rhythm and then manually determines the voltage and timing of the shock—through external paddles—to the patient's chest.

Implantable cardioverter-defibrillator

Another name for this is automatic internal cardiac defibrillator (AICD). They constantly monitor the patient's heart, similar to a pacemaker, and can detect ventricular fibrillation, ventricular tachycardia, supraventricular tachycardia, and atrial fibrillation. When an abnormal rhythm is detected, the device automatically determines the voltage of the shock to restore cardiac function.

Manual internal defibrillator

The manual internal defibrillators use internal paddles to send the electric shock directly to the heart. They are used on open chests, so they are only common in the operating room. It was invented after 1959.

Automated external defibrillator (AED)

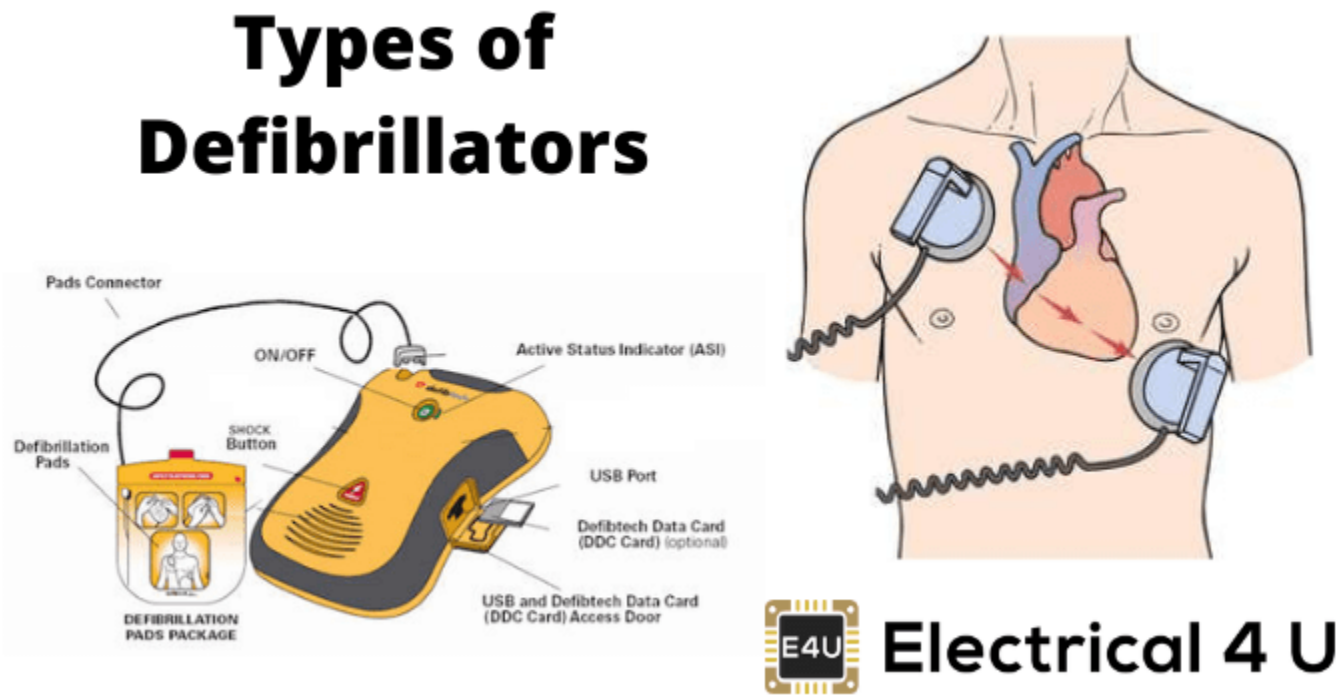
These are defibrillators that use computer technology, thereby making it easy to analyze the heart's rhythm and effectively determine if the rhythm is shockable. They can be found in medical facilities, government offices, airports, hotels, sports stadiums, and schools.

Wearable cardiac defibrillator

Further research was done on the AICD to bring forth the wearable cardiac defibrillator, which is a portable external defibrillator generally indicated for patients who are not in an immediate need for an AICD. This device is capable of monitoring the patient 24-hours-a-day. It is only functional

when it is worn and sends a shock to the heart whenever it is needed. However, it is scarce in the market today.

Types of Defibrillators (AC and DC Defibrillators)



Two **types of defibrillators** are showing below.

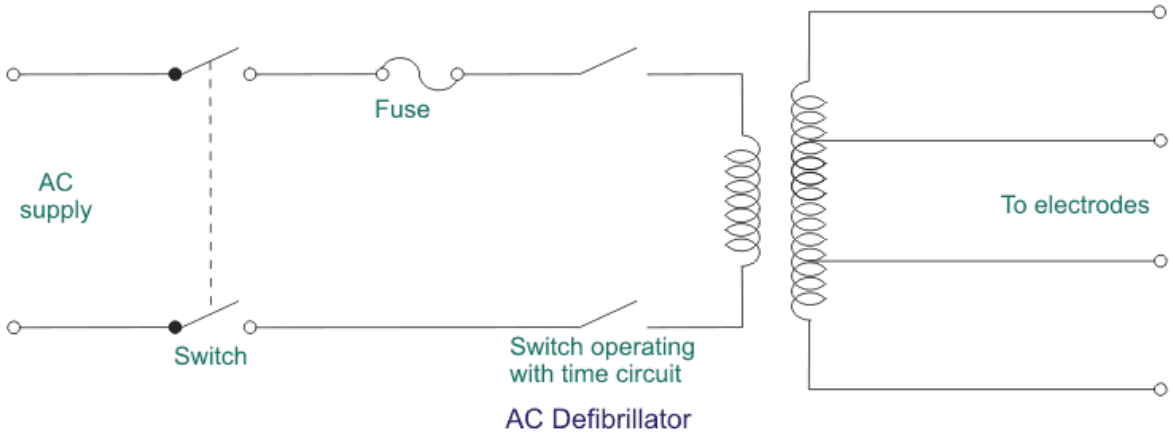
1. AC defibrillators
2. DC defibrillators

AC Defibrillators

An **AC defibrillator** is the oldest and simplest type. The construction of AC defibrillator is such that appropriate values are available for internal and external defibrillation. In AC defibrillation, a shock of 50 Hz a.c frequency is applied to the chest for a time of 0.25 to 1 second through electrodes. The procedure of applying electric shock to resynchronize heart is known as Countershock.

Defibrillation continues until patient responds to the treatment. An AC defibrillator consists of a step-up transformer with primary and secondary winding, and two switches. A.C supply is given through switches and fuse to primary winding of the transformer. The timing circuit is connected with switch, which is used to preset the time for the defibrillator to deliver shock to the patient.

A resistive and a simple capacitor network or monostable multivibrator forms the timing circuit. It is triggered with a foot switch or a push button switch. Various tapping are available along For safety reasons, secondary coil should be isolated from earth to avoid shock. For internal fibrillation voltage values between 60 V to 250 V is applied. To produce uniform and simultaneous contraction of heart muscles large currents are used for external defibrillation. However, this results in skin burn under electrodes and violent contraction of heart muscles. It also results in atrium fibrillation and stops ventricular fibrillation.



AC Defibrillator

DC Defibrillators

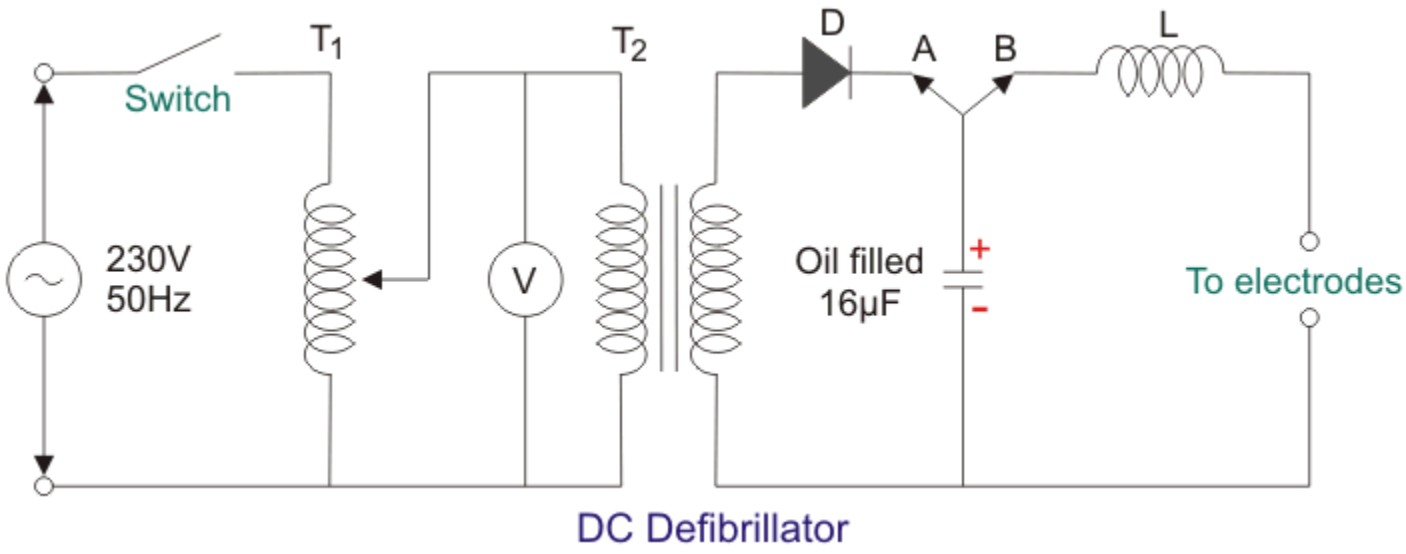
the secondary winding. They are connected to the electrodes that delivers electric shock to the heart of the patient. Voltage value ranging between 250 V to 750 V is applied for AC external defibrillation.

DC defibrillator does not produce side effects and produces normal heartbeat. Ventricular fibrillation is avoided when high-energy shock is passed through discharging capacitor that is exposed to heart or chest of the patient. DC defibrillator consists of auto transformer T_1 that acts as primary of the high voltage transformer T_2.

A diode rectifier rectifies the output voltage from T_2. It is connected to vacuum type-high voltage over switch. At position A, switch is connected to one end of the capacitor. When connected in this position capacitor charges to a voltage. A foot switch present on the handle of the electrode is used to deliver shock to the patient.

Now the high voltage switch changes it position to B that makes the capacitor to discharge to the heart through electrodes. To slow down the discharge from the capacitor an inductor L is placed in one of the electrode lead. This L induces a counter voltage that

reduces the capacitor discharge value.



Pacemaker

What is a pacemaker?

A pacemaker is an electrically charged medical device. Your surgeon implants it under your skin to help manage irregular heartbeats called arrhythmias.

Modern pacemakers have two parts. One part, called the pulse generator, contains the battery and the electronics that control your heartbeat. The other part is one or more leads to send electrical signals to your heart. Leads are small wires that run from the pulse generator to your heart.

Pacemakers generally treat two types of arrhythmias:

- tachycardia, a heartbeat that's too fast
- bradycardia, a heartbeat that's too slow

Some people need a special type of pacemaker called a biventricular pacemaker, or bivent. You may need a bivent if you have severe heart failure. A bivent makes the two sides of the heart beat in sync. This is known as cardiac resynchronization therapy (CRT).

Why do I need a pacemaker?

You need a pacemaker if your heart is pumping too quickly or slowly. In either case, your body doesn't get enough blood. This can cause:

- fatigue

fainting or lightheadedness

shortness of breath

damage to vital organs

eventual death

A pacemaker regulates your body's electrical system, which controls your heart rhythm. With each heartbeat, an electrical impulse travels from the top of your heart to the bottom, signaling your heart's muscles to contract.

A pacemaker can also track and record your heartbeat. A record can help your doctor better understand your arrhythmia.

Not all pacemakers are permanent. Temporary pacemakers can control certain types of problems. You may need a temporary pacemaker after a heart attack or heart surgery. You may also need one if a medication overdose temporarily slowed your heart.

Your doctor or cardiologist will test you to see if you're a good candidate for a pacemaker.

How do I prepare for a pacemaker?

Before receiving a pacemaker, you'll need several tests. These tests can ensure that a pacemaker is the right choice for you.

An echocardiogram uses sound waves to measure the size and thickness of your heart muscle.

For an electrocardiogram, a nurse or doctor places sensors on your skin that measure your heart's electrical signals.

For Holter monitoring, you wear a device that tracks your heart rhythm for 24 hours.

A stress test monitors your heart rate while you exercise.

If a pacemaker is right for you, you'll need to plan for the surgery. Your doctor will give you complete instructions on how to prepare.

Don't drink or eat anything after midnight the night before your surgery.

Follow your doctor's instructions about which medicines to stop taking.

If your doctor prescribes medicines for you to take before the test, take them.

Shower and shampoo well. Your doctor may want you to use a special soap. This reduces your chances of developing a potentially serious infection.

How is pacemaker surgery performed?

Implanting a pacemaker typically takes one to two hours. You'll receive a sedative to relax you and a local anesthetic to numb the incision site. You'll be awake during the procedure.

Your surgeon will make a small incision near your shoulder. They'll guide a small wire through the incision into a major vein near your collarbone. Then the surgeon will lead the wire through your vein to your heart. An X-ray machine will help guide your surgeon through the process.

Using the wire, your surgeon will attach an electrode to your heart's right ventricle. The ventricle is the lower chamber of the heart. The other end of the wire attaches to a pulse generator. This contains the battery and electrical circuits.

Typically, your surgeon will implant the generator under your skin near your collarbone.

If you're getting a biventricular pacemaker, your surgeon will attach a second lead to your heart's right atrium, and a third lead to the left ventricle. The atrium is the upper chamber of the heart.

At the end, your surgeon will close your incision with stitches.

What are the complications associated with a pacemaker?

Every medical procedure has some risks. Most risks associated with a pacemaker are from the surgical installation. They include:

- an allergic reaction to anesthesia
- bleeding
- bruising
- damaged nerves or blood vessels
- an infection at the site of the incision
- a collapsed lung, which is rare
- a punctured heart, which is also rare

Most complications are temporary. Life-altering complications are rare.

What happens after pacemaker surgery?

You may go home that evening, or you could stay in the hospital overnight. Before you go home, your doctor will make sure the pacemaker is programmed properly for your heart's needs. Your doctor can reprogram the device as needed at follow-up appointments.

Over the next month, you should avoid rigorous exercise and heavy lifting. You may also need to take over-the-counter medications for any discomfort. Ask your doctors what pain relievers are safest for you.

Every few months, you'll hook your pacemaker up to a phone line using special equipment provided by your doctor. It allows your doctor to receive information from your pacemaker without the need for an office visit.

Modern pacemakers are not as sensitive to electrical devices as the old ones, but certain devices could cause interference with your pacemaker. For example, you should avoid:

- keeping a cell phone or MP3 player in the pocket over your pacemaker
- standing for too long near certain appliances, such as microwaves
- long exposures to metal detectors
- high-voltage transformers

Comparison between External and Internal pace makers

External vs. Internal Pacemaker

S. No.	External Pacemaker	Internal Pacemaker (Implanted Pacemaker)
1	Placed outside the body	Surgically implanted beneath the skin near the chest or abdomen
2	The electrodes are called endocardiac electrodes, the electrode's tip situated in the apex of the right ventricle	The electrodes are called myocardiac electrodes, in contact with outer wall of the myocardium
3	Open chest surgery not needed	Open chest surgery needed
4	Battery can be easily replaced any defect/adjustment can be easily attended	Battery can be replaced only by a minor surgery. Defect/adjustment cannot be attended
5	No pain and swelling during placement	Pain and swelling arise during placement
6	No safety for the pacemaker	Cent per cent safety for the pacemaker
7	Used for temporary irregularities	Used for permanent heart damages