

Remote monitoring of implanted cardiac devices: A guide for patients and families

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1 | INTRODUCTION

Patients who have had or are at high risk for experiencing abnormal heart rhythms (cardiac arrhythmias) may receive a cardiovascular implantable electronic device (CIED) as part of their medical treatment. CIEDs include both defibrillators and pacemakers, each of which are used to treat specific heart rhythm problems.¹ For example, if your heart beats too slow, causing symptoms of fatigue or dizziness, you may have a pacemaker implanted to help your heart beat at a normal rate. If your heart beats too fast or in an abnormal rhythm, you may need an implantable cardioverter defibrillator (ICD). ICDs monitor the heart and if a dangerous heart rhythm is detected, they will deliver small electrical pulses or high energy shocks directly to the heart to restore a normal heart rhythm and prevent sudden death. ICDs also have a built-in pacemaker which can treat slow heart rates, if needed. Another type of implantable device provides “cardiac resynchronization therapy” (CRT), and was developed specifically for patients with heart failure. It helps the lower chambers of the heart—the ventricles—beat “in sync,” which helps the heart pump blood and oxygen more efficiently throughout the body. Some CRT devices function as pacemakers (CRT-P), while others have built-in defibrillators (CRT-D).

While these cardiac devices are highly effective treatments on their own, your doctor may recommend that you also have a remote monitor. A remote monitor (sometimes called a transmitter) is a small portable electronic device that collects important information from your cardiac device and sends it to your healthcare team at regularly scheduled times. This allows your healthcare team to monitor your cardiac device between clinic visits and may reduce the number of times you need to travel to your clinic for routine follow-up appointments.

Understanding how your remote monitor keeps you connected to your healthcare team is important and can help you feel more con-

fidant in your treatment plan. Many patients and their families may have questions about remote monitoring, or have concerns about data privacy and security. This guide was developed to provide basic information about remote monitoring for patients, families, and caregivers, to describe potential benefits and common challenges associated with this technology, and to answer frequently asked questions.

2 | REMOTE MONITORS—WHAT DO THEY DO?

In addition to treating abnormal heartbeats, cardiac devices automatically collect and store information about your heart rhythm and device function every day. They collect information about your heart rhythm (heart rate, atrial and ventricular arrhythmias), device function (battery life, lead function), device-delivered treatments (antitachycardia pacing [ATP] and ICD shock), and physical activity (steps taken per day). Some cardiac devices also collect information about fluid build-up in the lungs, and this can be useful for treating patients with heart failure. All this information helps your healthcare team monitor your heart and cardiac device, and change your medications, if needed.

Your healthcare team can access information from your cardiac device in two ways: (1) by placing a “wand” or “device reader” directly over your cardiac device during a routine clinic appointment (called a “device interrogation”), or (2) by reviewing a device transmission that is sent to the clinic from a remote monitor set up in your home. Your remote monitor provides nearly the same information to your healthcare team that an in-office routine device check appointment provides.

What Remote Monitors Do:

- Monitor your cardiac device.
- Send information from your cardiac device to your healthcare team.

- Allow your healthcare team to monitor your heart rhythm between clinic visits, which can help them adjust medications and treatment, if needed.

What Remote Monitors DON'T Do:

- Prevent cardiac symptoms, provide treatment or tell your cardiac device to deliver therapies (e.g., ICD shock).
- Turn your cardiac device on or off, change settings, or reprogram your device.
- They are not an emergency medical alert system—they do not call 911 during a health emergency. If you are not feeling well, call your healthcare provider or dial 911.

3 | HOW DO I GET A REMOTE MONITOR?

Your doctor will typically discuss remote monitoring and whether it is right for you while you are still in the hospital for your cardiac device implant procedure, at your first in-person device clinic appointment, or even a few months later. Though clinical guidelines recommend remote monitoring as part of standard care for cardiac device patients,² enrollment is voluntary. If you decide that it is right for you, your doctor will write a prescription for you to obtain the necessary equipment. This equipment can be provided to you at the time of implant, or at any device clinic appointment. It can also be mailed directly from the device company to your home. Cardiac devices are made by several companies and each has its own remote monitoring system (see Table 1 for a list of device companies and their remote monitors).

4 | HOW DO I SET UP MY REMOTE MONITOR?

4.1 | Pairing the monitor with my cardiac device

When you receive your remote monitor, you will need to “pair” it with your cardiac device—this allows for secure communication between devices (if you have a Biotronik cardiac device, pairing is not required). If you receive your remote monitor while you are in the hospital, your doctor's assistant or a representative from the device company can complete the pairing process for you at that time. These individuals are extremely knowledgeable about remote monitoring and work closely with your healthcare team to ensure successful set-up. If you receive your remote monitor at a follow-up device clinic appointment, a member of your healthcare team can help you complete the pairing process during that appointment. If your remote monitor is mailed directly to your home, follow the instructions in the set-up guide to complete the pairing process. For help with set-up or technical assistance, call the device company directly using the patient services telephone number provided in your set-up guide. The monitor will display a confirmation message, image, or signal (e.g., green light, green check mark) letting you know that the pairing process is complete. Your remote monitor and cardiac device will remain “paired” or connected for future transmissions.

We recommend that you place the remote monitor in a room where you spend a lot of time each day, for example, on a table next to your bed. This is because you need to be within 10 feet of your monitor for it to collect information from your cardiac device.³ Review your monitor set-up guide for specific instructions about your remote monitoring system.

4.2 | Transmission schedule

Your device clinic will schedule dates for routine transmissions from your remote monitor. Most patients will have routine, scheduled remote device interrogations (similar to an in-person device check-up) every 3–6 months and have at least one in-person office visit per year.² Remote transmissions can also be sent on unscheduled days. For example, if you have a concern or are experiencing frequent or distressing cardiac symptoms, call your device clinic and let them know—they may ask you to send a remote transmission. Additionally, your remote monitor may be programmed to automatically send a transmission to your clinic if your cardiac device sends an alert or if it is not working correctly. For example, your cardiac device may be programmed to automatically send a remote transmission if atrial fibrillation is detected. These alerts can be tailored to your specific needs and cardiac condition.

5 | HOW DO REMOTE MONITORS WORK?

Figure 1 shows the general procedures for how remote monitoring works.

Step 1: Set-up Your Remote Monitor and Get Your Transmission Schedule

Proper set-up is critical so that your remote monitor can send information securely between your cardiac device and your clinic. Follow the instructions in your set-up guide and complete the pairing process. Your clinic will send you a list of dates for your routine scheduled transmissions. If you have questions about your transmission schedule, call your device clinic for more information.

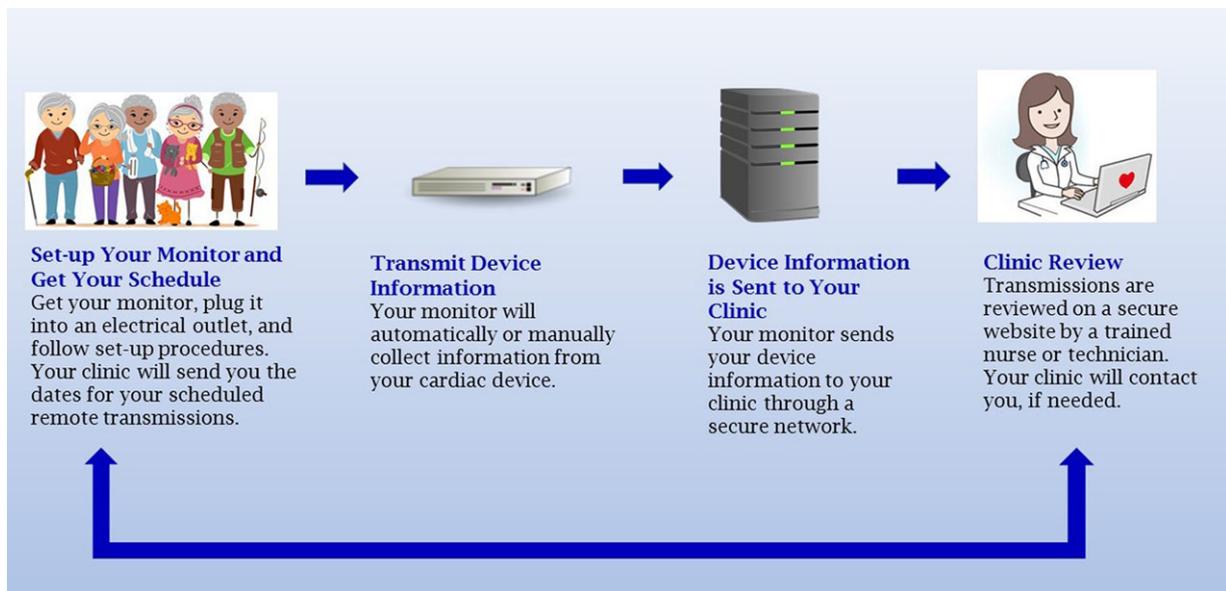
Step 2: Transmit Information from Your Cardiac Device to Your Remote Monitor

Most cardiac devices automatically send information to your remote monitor using radiofrequency or Bluetooth technology. That means on the day of your scheduled transmission, your remote monitor automatically collects information from your cardiac device without interfering with your daily activities; for example, if you place the remote monitor next to your bed, this happens while you sleep.

Some cardiac devices require patients to manually send information to their remote monitor. If you have a manual system you will need to press a button on your remote monitor every time you are scheduled to send a transmission. Some manual systems may also require you to place an external “wand” or “device reader” over your cardiac device to send information to your remote monitor. Your healthcare team will let you know if you have an automatic or manual system. This information is also available in your remote monitor set-up guide.

TABLE 1 Device companies and their remote monitoring systems

Device manufacturer	Remote monitoring systems	Web site for patients
Medtronic	Carelink	http://www.medtronic.com/us-en/patients/treatments-therapies/remote-monitoring.html
Boston Scientific	Latitude	http://www.bostonscientific.com/en-US/patients/about-your-device/latitude-home-monitoring.html
St. Jude Medical, Abbott	Merlin.net	https://www.sjm.com/en/patients/arrhythmias/our-solutions/remote-monitoring
Biotronik	Biotronik Home Monitoring	https://www.biotronik.com/en-us/products/services/home-monitoring

**FIGURE 1** How remote monitoring keeps you connected to your healthcare team [Color figure can be viewed at wileyonlinelibrary.com]

Step 3: Send Device Information to Your Clinic

After your remote monitor collects information from your cardiac device, it transmits that information to your healthcare team through a secure network, using a wireless cellular network, a telephone landline, or a wired Internet connection. Your set-up guide will tell you how your remote monitor transmits information to your clinic. Device companies are also in the process of developing new methods of transmitting device information using smartphone technology. Though this technology is not ready for use today, smartphone transmissions may be an option for you in the future.

Most remote monitors will display a confirmation message or image (e.g., green light, green check mark) letting you know that a transmission was successfully sent. If you are unsure about the status of a recent transmission, call your device clinic for more information.

Step 4: Clinic Staff Will Review Your Transmission

Only authorized healthcare providers can access and read your remote transmission, using a secure Web site. Remote transmissions are typically reviewed during normal business hours (Monday–Friday 8:00 am to 5:00 pm). In some cases, your doctor may be contacted after hours if there is an urgent concern or cardiac device alert that requires immediate attention. Typically, if your transmission looks nor-

mal, great! You are all set and can go about your day. If your healthcare team notices something unusual on a transmission that requires more attention, they will call you. They will also let you know if they want you to adjust any of your medications or have you come to the clinic for an in-person appointment.

6 | BENEFITS AND CHALLENGES OF REMOTE MONITORING

Benefits:

- Remote monitoring is a convenient way for your cardiac device to communicate with your healthcare team between clinic visits. That means you may not need to go to the clinic as often for routine device follow-up appointments.
- Problems with your cardiac device or abnormal heart rhythms may be detected earlier and allow your healthcare team to respond faster by adjusting your medications or treatment plan, as needed.^{3,4}
- Remote monitoring, if used correctly, may reduce the occurrence of inappropriate ICD shocks or the need for hospitalization, and may improve device function and quality of life.^{5–8} Additionally,

TABLE 2 Frequently asked questions and answers

Questions	Answers
Do all patients with a cardiac device need a remote monitor?	Remote monitoring is optional but current treatment guidelines recommend it for most patients with a cardiac device. ² However, it may not be appropriate for all patients and you can discontinue your monitoring at any time. Talk to your doctor about whether remote monitoring is right for you.
If I am having symptoms (e.g., heart palpitations, dizziness, or chest pain), can I use my remote monitor to send device information to my clinic?	If you are experiencing frequent or distressing cardiac symptoms, call your clinic and let them know. They may ask you to send a remote transmission to better understand your symptoms.
I'm worried about cybersecurity—can my remote monitor be hacked?	All remote monitors use advanced security methods to protect your personal medical information. There have been no reports of unauthorized access or hacking of an implanted cardiac device.
Will having a remote monitor improve my symptoms or help me live longer?	Having a remote monitor will not improve your symptoms or cure your heart problem. However, problems with your heart or cardiac device may be detected sooner and this information can help your healthcare team better manage your condition.
Should I take my remote monitor with me when I travel? Is airport security screening harmful to my monitor? What happens if I travel to another country?	In general, if you are taking a short trip (1–4 days) you can leave your remote monitor at home. However, you may want to take your remote monitor with you for longer trips. Airport security systems will not harm your remote monitor. Let your healthcare team know if you plan to travel for an extended period of time or plan to travel to another country.
If I am being intimate with my spouse or partner, will my remote monitor record that?	No. Your remote monitor only receives information from your cardiac device about your heart rhythm and device function. It does not collect any information about your daily activities.
If there is bad weather or the power goes out and my remote monitor is disconnected, what should I do?	If there is a loss of power and your remote monitor is disconnected, the initial set-up procedures may need to be performed again. Your cardiac device will still monitor your heart and treat abnormal heart rhythms even if your remote monitor is not working.
Who do I call if I am having problems setting up my remote monitor or if it stops working?	For help with set-up or technical problems, read the set-up manual and/or call the patient services telephone number provided by the company. Information about your specific remote monitor, instructional videos, troubleshooting tips, and patient resources are available online. Contact your clinic if you need further assistance.
Where is the best place to set-up my remote monitor?	You need to be within 10 feet of your remote monitor for it to download information from your defibrillator or pacemaker, so place it in a room where you spend a lot of time each day (e.g., near your bed or next to a favorite armchair).
If I move to a new state or change doctors, will I need to get a new remote monitor?	No, your clinic will transfer your remote monitoring service and follow-up care to your new clinic.
I am having my current cardiac device replaced with a newer model—do I need a new remote monitor?	In some cases, you may need a new remote monitor after a device replacement. Your healthcare team will let you know if you do.
Can other electronic devices (e.g., cell phones, wearable fitness monitors, wireless routers, televisions, and computers) interfere with my remote monitor?	No, electronic devices cannot interfere with your remote monitor.

some research studies have shown that remote monitoring may improve survival⁹ but other studies have not found a survival benefit.¹⁰

- Remote monitoring may improve disease management in patients with heart failure.⁷

Challenges:

- Some people find it difficult to set up the remote monitor. If you have difficulties with your monitor or need technical assistance, call the device company directly. Helpful resources are also available online (see Table 1 for more information).
- If you travel for an extended period of time, your doctor may want you to take your monitor with you. We suggest that you contact your clinic in advance of any extended or international travel.

7 | CONCLUSIONS

Knowledge is power! We hope the information provided in this guide will make talking to your healthcare team easier and help you feel more confident about using your remote monitor.

ADDITIONAL PATIENT RESOURCES

Table 2 contains a list of frequently asked questions and answers about remote monitoring. Helpful patient resources, troubleshooting tips, and instructional videos are also available on the company's Web site (see Table 1). You can contact the company directly using the patient services telephone number provided in your monitor set-up guide.

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