



**Boston Scientific Electromagnetic (EMI) Compatibility Table  
for Pacemakers, Transvenous ICDs, S-ICDs and Heart Failure Devices**

If online, follow these instructions to search for an item:  
While holding down the **Ctrl** key, click the letter **F**. The **Find** screen should appear.  
Type in the name of the item for which you wish to search. Then click **Find Next** or the **Enter** key.

**TERMS OF USE:** The information provided on the Electromagnetic (EMI) Guide should not be considered the exclusive or only source for this information. The table lists a general category of items only and is not intended to be an exhaustive list. The recommendations and precautions may be based on information provided by the manufacturers of the items in question, and specific items within a category may function differently. It is best practice to consult the original manufacturer of the item with potential EMI to verify any specific guidance concerning operation and compatibility with implantable devices. If at any time there is a question about the function and potential for Electromagnetic Compatibility, contact the manufacturer of the item in question for further information. At all times, it is the responsibility of the licensed healthcare professional to exercise medical clinical judgment in a particular circumstance.

The information provided is not intended to be used for medical diagnosis or treatment or as a substitute for professional medical advice. The recommendations and precautions contained in this document apply to device function of Boston Scientific Cardiac Rhythm implantable devices. Specifically device susceptibility to electromagnetic interference.  
**Always seek the advice of your physician or other qualified health provider with any questions you may have regarding a medical condition.**

**Terminology**

**Safe under normal use:** These items are only considered safe from electromagnetic interference with your device when used normally in accordance with their intended use. Check with your doctor for any additional restrictions that you may have for these items.

**Use precautions:** When you are near any of these items, you should use precautions. Check with your doctor for detailed information before using these items. Any medical equipment, treatment, therapy, or diagnostic test that introduces electrical current into the body may have the potential to interfere with implanted cardiac device therapy.

**Do not use:** Talk with your doctor.

Recommendations and precautions for transvenous devices also apply to S-ICD devices.

Hobbies			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Activity Tracker	<b>Use precautions:</b> As this wireless technology usually uses Bluetooth, maintain at least a 6 inch (15 cm) separation between the activity tracker and implanted device due to Bluetooth technology. This is a device or application that may track steps taken, distance walked or run, calories consumed, and in some cases heartbeat and quality of sleep. The tracker may be synchronized, in many cases wirelessly, to a computer or smartphone. In some activity trackers, heart rate is measured 2 ways: 1) By LED lights which reflect onto the skin to detect blood volume changes or 2) by using a chest strap which measures and sends the heart rate to a wrist watch.	FITBIT: Flex, Force, NIKE: Fuel, GARMIN: Vivofit, MISFIT: Shine, Flash, Link, Bolt, Beddit BODY BUGG: Bodybugg Version 3, BASIS: Peak	<a href="#">Click here for Bluetooth Technology</a>
Appliances - kitchen countertop	<b>Safe under normal use.</b> Your implanted heart rhythm device is intended to work properly around most appliances and equipment. Most standard items you use at home in the kitchen are not likely to cause a problem with your implanted device.	Electric can opener, toaster, coffee maker, food processor, blender	
Biaxial Magnet	<b>Do not use.</b> Battery-powered devices produced by Nikken that utilize a rapidly rotating magnet to create a very strong 3D magnetic field. The website claims 1700 Gauss for field strength.		
Bingo Game Magnetic Wand	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the wand and the implanted device. Some bingo wands may contain a permanent magnet.		
Casino Slot Machine	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between the slot machine and the implanted device.		
Electric Golf Cart	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the battery and the implanted device, and at least a 12 inch (30 cm) separation between the AC battery chargers and the device.		
Electric Guitar	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the guitar and the implanted device. Magnetic/electrical fields associated with the guitar are very low and will not affect the Pacemaker or ICD.		
Electric Toy Train	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the transformer and the implanted device. Do not touch power rail, especially with wet hands.		

Hobbies			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Hydroelectric Dam Tour	<b>Do not attend tour:</b> The policy of the Hoover Dam does not recommend that individuals with an ICD go on tour within the dam because of the 50 /60 Hz magnetic field present. Other Hydroelectric dams may have policies for ICD individuals that differ from those of the Hoover Dam. Because of the uncertainty of the magnetic environment within other Hydroelectric plants, we cannot predict the intensity of the magnetic field within any specific dam. There is the potential for Pacemaker or ICD interaction. Consult physician for level of risk that interaction with the device may present. Tours of non hydroelectric dams would pose a low risk of affecting the Pacemaker or ICD. Visiting outside any hydroelectric dam reduces the risk of EMI interaction.	Hoover Dam	
Kiln: (Pottery, Jewelry or Glass) / AC resistive heating element	<b>Use precautions:</b> Maintain 12 inch (30 cm) separation between the kiln and implanted device. Most of these kilns use resistive-type heaters similar to heating elements associated with common electric stoves. Wood or gas fired kilns will have no affect on the Pacemaker or ICD. ICD. The magnetic field associated with the operation of this type of kiln is minimal. In contrast, kilns used in association with inductive heating of metals produce magnetic fields that can extend a much greater distance from the kiln. Also see Induction Heater/Kiln by clicking the link in the right column.		<a href="#">Click here to see Induction Heater/Kiln</a>
Laser Tag	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between any magnet in the vest and the implanted device. Low risk of laser tag gun and associated detection circuit in the vest affecting the Pacemaker or ICD. The device uses only light energy; however, some vests may contain magnets and/or a radio frequency transmitter that communicates to a scoreboard.		
Metal Detector	<b>Use precautions:</b> Keep the metal detector device head pointed away and at least a 24 inch (60 cm) distance from the implanted device.	Beachcomber	
Rifle/Shot Gun	<b>Use precautions:</b> Consult with heart doctor regarding physical impact due to firearm discharge. Recommend using firearm on opposite shoulder of implant to avoid possible damage to your implanted device.		
Roller Coaster - Electromagnetic	<b>Use precautions:</b> consult your heart doctor. Avoid riding on or performing maintenance on this type of rollercoaster. Electromagnetic Roller Coasters are the type that go AGAINST gravity and can be found at amusement parks, fairs, etc. This is a sub-group of roller coasters which use electromagnets to propel them (linear induction motors).	Amusement park rides, fair rides	
Roller Coaster - Traditional Gravity	<b>Safe under normal use.</b>	Amusement park rides, fair rides	

Hobbies			
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Scuba Diving	<b>Use precautions:</b> Consult with heart doctor. Prior to SCUBA diving the patient's heart doctor should be consulted to assess the potential consequences relative to the patient's specific health condition. It is possible that your physician may suggest that you limit certain activities, such as scuba diving, to a level that is more restrictive based on medical concerns rather than the single factor of pressure tolerance of your pacemaker/ICD. Because of many factors associated with scuba diving, specific depth limitations cannot be provided. Some of the factors include the possibilities of blows to the area of the device during the time the device is under pressure stress, the number of pressure cycles the device is exposed to over the implant time of the device, and the activity or exertional level of the individual during the dives. Our device pressure testing is conducted for compatibility with hyperbaric chamber therapy. We can share with you that a pressure of two and one-half atmospheres absolute is the maximum pressure recommended for hyperbaric chamber therapy.		<a href="#">Elevated Pressure (HBOT/SCUBA) and Implanted Medical Devices</a>
Static Electricity Plasma Ball (Van de Graaff generator)	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the ball and the implanted device. Do not touch the ball.		
Tattoo Machine	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the tattoo machine /related tattoo accessories and the implanted device. Avoid tattoo over implant location.		
Train: Magnetic Levitation / high speed train	<b>Safe under normal use for passengers.</b>		

Personal Use			
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Ab-Stimulator®	<b>Do not use:</b> Muscle Stimulator is fitness-related equipment designed to stimulate muscles to improve muscle definition and fitness. Provides electrodes that are placed on muscles, such as abdominal muscles, and delivers electrical stimulus, usually strong enough to cause the muscle to twitch.	Abtronic, Ab Tronic, Ab Sonic	
Air Filter (standalone) - Ionized / Air Purifier	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the air filter and implanted device. An air purifier is a device which removes contaminants from the air.	HEPA	
Air Purifier, Personal	<b>Safe under normal use:</b> Do not wear this device during a programmer check as it may interrupt communication between the programmer and implanted device. This is a personal air filter worn around the neck.	Fresh Air Buddy	
Alternator / Running Motor	<b>Use precautions:</b> Maintain at least a 24 inch (60 cm) separation between running motor / alternator and implanted device. Avoid leaning over motors and alternators of a running vehicle. Safe to drive or ride in a vehicle. An alternator is an electromechanical device that converts mechanical energy to electrical energy in the form of alternating current. Alternators create magnetic fields which could potentially interact with ICD's and pacemakers.	Car, Tractor, Truck, Vehicle Motor	
Badge (name tag) with magnetic clasp	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the magnet associated with the badge and the implanted device.		
Badge Reader (Security)	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation from wall unit (reader) and the implanted device. Radio Frequency Identification (RFID) is a wireless technology used to identify RFID tags mounted on objects or carried by (or imbedded in) people or animals. Data stored in the RFID tag is read by wireless devices, called RFID readers. The RFID reader contains one or more RF antennas that emit RF signals within a specified range. When an RFID tag enters the reader's RF signal field, information stored in the tag is captured by the reader. Each RFID tag relies on the reader to transmit information contained in the tag. RFID readers may be a potential source of EMI and could have temporary effects on implanted cardiac devices. Because the presence of RFID systems may not always be apparent in public and occupational settings, patients who feel symptomatic (e.g., light-headed, fast heart rate) should move away from nearby electrical equipment (or the identifiable RFID system), and call their physician to report the episode.		<a href="#">Radiofrequency Identification and Implantable Pacemakers and Defibrillators</a>

## Personal Use

Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Blood Pressure Monitor (Upper Arm)	<b>Safe under normal use.</b> Automatic, semiautomatic or manual means of monitoring blood pressure, typically with a digital display. This can include both units for home use and those larger units found at pharmacies.		
Blood Pressure Monitor (Wrist)	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the wrist monitor and the implanted device. Wrist Blood Pressure Monitors are ambulatory BP Monitors which are worn on the left wrist. Some of these Wrist BP monitors require the wearer to cross their wrists over their upper sternum. Maintain a 6 inch separation between the wrist monitor and the implanted device.		
Body Hydration Scale	<b>Do not use.</b> Scale measures hydration ("body water") using bio-electrical impedance.	Conair, Bio Electrical Impedance, BioElectrical Impedance, Body Fat Weight Scale	
Car - Electric	<b>Use precautions:</b> Do not sit in the car while car is charging from charging tower. Professionals servicing the car should maintain at least 24 inch (60 cm) separation between running motor and implanted device.	Nissan Leaf	
Car - Hybrid	<b>Safe under normal use:</b> Professionals servicing the car should maintain at least 24 inches (60 cm) between running motor and implanted device. In case of Service Personnel, please refer to Running Motors/Alternator for recommendations.	Hybrid car, electrical vehicle, smart car	
Clothes Washer and Dryer	<b>Safe under normal use.</b> Your implanted heart rhythm device is intended to work properly around most appliances and equipment. Most things you use at home or work will not cause a problem.		
Convection Oven	<b>Safe under normal use.</b>		
Copy Machine	<b>Safe under normal use.</b>	Copier, Xerox, Photocopier	

Personal Use			
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Crocs Footwear	<b>Safe under normal use.</b> Rubber shoes that have generated controversy surrounding their ability to generate a static electricity charge.		
E-Book Reader	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the reader and the implanted device. An electronic device that is designed primarily for the purpose of reading digital books and periodicals.	Kindle, Nook	
Electric Blanket	<b>Safe under normal use:</b> Do not place transformer over implanted device.		
Electric Fence	<b>Safe under normal use:</b> Consult your heart doctor if you receive a shock.		
Electric grocery cart or personal scooter	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the battery and the implanted device or charger and implanted device.		
Electric outlet shock or shock from any 60 Hertz source (momentary shock or memorable momentary shock)	<b>Recommendation:</b> If a shock is received from an external source, Boston Scientific recommends that you consult your heart doctor.		
Electric Toothbrush	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the charging base and the implanted device as radio frequency fields may be present. Refrain from leaning over charger.	Sonicare Toothcare	
Exercise equipment (magnetic resistance)	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the magnets and implanted device.	Exercise bike, Elliptical	
Hair Dryer - Hand held or Salon	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the hair dryer and the implanted device.		

Personal Use			
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Headphones (wired)	<b>Use precautions:</b> Maintain 6 inches (15 cm) distance between the headphones/ear buds and the implanted device. Avoid draping wires over implanted devices.	Ear buds, Sony, Bose, Beats	<a href="#">Portable Multimedia Players and Implantable Pacemakers and Defibrillators</a>
Heart Rate Monitor (monitors that use a chest band)	<b>Use precautions:</b> Maintain 6 inches (15 cm) distance between chest strap or wrist monitor. Suggest rotating chest band to opposite side, away from device implant site.	Polar, Omron, Timex, Suunto, Nordic Track, New Balance	<a href="#">Polar Heart Rate Monitors and Implanted Medical Devices</a>
Heating Pad	<b>Safe under normal use.</b>		
Hill ROM Hospital Bed	<b>Safe under normal use.</b> The Hill-Rom hospital beds contain magnets in the bottom of the mattress to help hold the mattress in place. Magnets located in mattress or motor of bed should not be in direct contact with the surface of the device.		
Home Security Systems - Infrared & Ultrasonic	<b>Safe under normal use.</b>		
Home Security Systems - Microwave	<b>Use precautions:</b> Maintain 6 inch (15 cm) distance from transmitter. Microwaves emit low energy electromagnetic impulses.	Microguard	
Hot Tub	<b>Safe under normal use.</b>	Whirlpool baths	
Ignition Systems -- see Tools			<a href="#">Click here for Ignition Systems</a>
Induction Heater (Furnace/Kiln)	<b>Use precautions:</b> Magnetic field intensity should be measured by a worksite survey professional. Contact your doctor to review specific concerns.		
Induction Stove Top (AC Magnetic Field)	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between stove top and device. This stove differs from the more common electric and gas stoves. With this type of stove, a magnetic field heats the metal pots directly and only when they are placed on the stove top. The stove top remains cool to the touch. The metal in the bottom of the pan interacts with the magnetic field causing heating of the metal. Low risk if not leaning over stove.	Induction Stove, Induction Oven, Induction Cooktop	
Ionized Bracelet	<b>Safe under normal use.</b>	Qray, Balance	
Kitchen appliances (countertop)	<b>Safe under normal use.</b> Your implanted heart rhythm device is intended to work properly around most appliances and equipment. Most things you use at home or work will not cause a problem.	Electric can opener, toaster, coffee maker, food processor, blender	



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Magnetic Back Brace	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between magnetic brace and implanted device. Magnetic belt worn on lower back.		
Massager - hand held	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the massager and the implanted device. Do not place directly over implanted device. Small motors within hand massager may produce magnetic fields.		
Massager chair	<b>Safe under normal use.</b>	HoMedics, Shiatsu, Rolling, Vibration, Percussion, Back Massage Cushions, Backrests, Body Mats, Foot Massagers (with no electrical stimulation), Neck and "Spot" Massagers	
Medical Alert Necklace (and other patient alert devices)	<b>Use precautions:</b> If necklace or other wearable alert product has cell phone function, affix pendant on side opposite implanted device. Maintain at least a 6 inch (15 cm) separation between the medical alert necklace and the implanted device.	Lifeline, Life Line, Medic Guard, First Alert, Life Alert, Guardian Alert 911, 5Star, GreatCall.	
Microwave Oven (both residential and commercial)	<b>Safe under normal use.</b>		
Motorcycle	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between the ignition system and the implanted device.		
Motorcycle Vest (Electrically Heated)	<b>Safe under normal use.</b> DC current used to heat the vest.	Gen X, Gerbing	
Oven - Electric and Gas	<b>Safe under normal use.</b>	Range, Cook Top, Stove	
Pest Control - Ultrasonic	<b>Safe under normal use.</b> Ultrasonic pest control unit emits sound energy.		

Personal Use			
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Sensewear Activity Monitor	Do not use. Sensewear can interfere with LATITUDE communicator, blood pressure monitor, and weight scale operation. May also interfere with programmer used in clinic.		
Sewing Machines / Sewing Sergers	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the motor of the sewing machine or sewing serger and the implanted device.		
Shaver with electrical cord or battery operated	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the shaver and the implanted device. Avoid draping cord over implanted device.	electric razor	
Soloflex Vibration Training	<b>Safe under normal use.</b> Low amplitude mechanical vibrations pulsing through your body 28 to 60 times a second do the work to improve circulation, strength, flexibility and balance.	Whole Body Vibration, WBV Platform, Weight Bench	
Space Heater - Portable	<b>Safe under normal use.</b>		
Speakers	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) distance between the speaker and the implanted device. Large stereo speakers often have large magnets.		
TV (Television)	<b>Safe under normal use.</b>		
TV Audio Headset (Radio frequency receiver)	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the transmitter (component usually on or near TV) and the implanted device. Radio frequency system consists of transmitter and headset. Headset will not affect Pacemaker or ICD. Do not drape cord over implanted device.		<a href="#">Portable Multimedia Players and Implantable Pacemakers and Defibrillators</a>
TV Remote - Infrared (standard)	<b>Safe under normal use.</b>	Remote Controls (TV, Garage Door, Stereo, Camera/Video Equipment)	
Tanning Bed	<b>Safe under normal use.</b> Consult your doctor.		
Tanning - Magna Tanning	<b>Safe under normal use.</b> The electrostatic Magna-Tanning booth utilizes a high DC voltage potential at the tanning booth spray nozzles. The high DC voltage potential associated with these nozzles impart small electrical charges on the droplets of the tanning spray mist. The booth is designed in such a way that the person standing in the booth attracts the tanning mist droplets on the skin. This procedure does introduce a very small direct current into the body. The level of this very small current is well below the levels of susceptibility of both the Pacemaker and ICD. (Procedure takes less than one minute to complete)		

Personal Use			
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Transformer Box - See Telecommunications	<a href="#">Click here for Transformer</a>		
Vacuum cleaner	<b>Safe under normal use.</b>		
Telecommunications			
AM/FM Radio	<b>Safe under normal use.</b>		
Airport Security	<p><b>Safe under normal use.</b> Tell security personnel you have a device and show medical device ID card.</p> <p>Metal detector: Low risk to walk through archway metal detector. If the archway detects metal in the device, request a hand search.</p> <p>Hand-held wand: If the hand-held metal detector wand is to be used, request that the wand be passed quickly over the device.</p> <p>Full body scanners (x-ray backscatter or millimeter wave): The Transportation Security Administration (TSA) currently uses these two types of full-body "people scanners". Neither type of scanner should affect your implanted pacemaker or defibrillator system.</p>	<p>Airport Security Systems Full Body Scanner Advanced Imaging Technology security archway Jail/Prison Security system Court Security system Department Store Security Systems Metal Detector</p>	<a href="#">Information for the Traveling Pacemaker or Defibrillator Patient</a>
Bluetooth Technology	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) distance between the transmitter/receiver and the implanted device. Wireless communication technology for TV's, radios, computers, and other electronic devices. Radio frequency waves can communicate/control remote electronic devices. Do not place next to LATITUDE communicator, blood pressure monitor, or weight scale.	Bluetooth headphones, router, Google Home, Amazon Echo	
CD/DVD Players	<b>Safe under normal use.</b>		<a href="#">Portable Multimedia Players and Implantable Pacemakers and Defibrillators</a>

Telecommunications			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Cable Locater	<b>Use precautions:</b> Maintain at least an 18 inch (50 cm) separation between the implanted device and the buried cable. This system is used to locate buried cable. The system consists of two separate pieces of equipment: the transmitter and the receiver. The transmitter is connected to the buried cable at an access point and injects a test signal onto the buried cable. The magnetic field generated by this test signal can be detected by the receiver. As the operator passes the receiver over the search area, the receiver will indicate when that buried cable has been located. Various frequencies and power levels can be used to differentiate between different cables and locations.	Dynatel 2273 Advanced Cable Locater (3M)	
Cell Phone / PDA / Broadband connectivity	<b>Use precautions:</b> Keep at least a 6 inch (15 cm) separation between phone and implanted device. Keep at least a 12 inch (30 cm) separation between cell phone and implanted device if phone/PDA transmits more than 3 watts. Hold phone to ear on the opposite side of the body from device. Do not carry phone in breast pocket or on belt if within 6 inches (15 cm) of device. See also PDA.	iPhone, Blackberry, PalmPilot, Android	<a href="#">Cellular Phones and Implantable Devices</a>
Clearwire Modem- Wireless Broadband /Cell Phone Connected Internet Link	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation from the antenna on the modem. Clearwire uses a wireless modem that can be plugged into a desktop computer, laptop, or local network. It works by transmitting signals to and from nearby cellular towers instead of using a traditional phone line.		
Commercial Cellular Tower Antenna	<b>Safe under normal use</b> for public use. Professionals servicing cellular towers should contact your doctor for further information.		
Commercial Broadcasting Towers- Radio and TV	<b>Safe under normal use.</b> Professionals servicing cellular or television towers should contact Boston Scientific Patient Services for further information.	Digital Television Transmission Tower, TV	
Computer Equipment - Wireless (with radio-frequency link)	<b>Use precautions:</b> For modem or wireless card operation within the 2.4-2.5 GHz and 5 GHz bands maintain at least a 6 inch (15 cm) separation between the modem/wireless card and the implanted device.	Personal computers	
Computer - Tablet	<b>Use precautions:</b> Maintain at least a 6 inch (15cm) distance between the iPad, its cover, headphones and implanted device. The iPad is a line of tablet computers designed and marketed by Apple Inc. Avoid propping iPad on patient's chest.	iPad, tablet, kindle, nook, etc.	<a href="#">Portable Multimedia Players and Implantable Pacemakers and Defibrillators</a>

Telecommunications			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Cordless Microphone	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the microphone antenna and the implanted device. Most cordless microphones operate at very low power levels. These guidelines are more dependent on the power output of the microphone than the specific radio frequency associated with the microphone.	Microphone, Lavalier, Wireless Microphone, Portable Microphone	
Cordless Phone (portable) and associated base station	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the antenna on the cordless phone and the implanted device. In addition, maintain at least a 6 inch (15 cm) separation between the base station of the cordless phone and the implanted device. Do not place cordless phone directly over implanted device. A cordless phone used within the house or yard are low power (usually less than 100 milliwatts).	Clarity Amplified Cordless Phone, DECT	
Dog Shock Collar (with a central radio frequency transmitter in home and wire buried in the ground)	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between the radio frequency transmitting antenna (usually inside the house) and the implanted device. Do not pet the dog in the areas where the shock collar will be activated.	Invisible Fence	
Fax machine	<b>Safe under normal use.</b> Faxing is the telephonic transmission of scanned printed material (both text and images), normally to a telephone number connected to a printer.	Facsimile machine	
Global Positioning System (GPS) Satellite Navigation System	<b>Safe under normal use.</b> Device only receives, there is no transmitter. If the GPS is embedded in another device (for example cell phones, radio), refer to the guidelines for that device.	Garmin, Tom Tom, Magellan, OnStar	

Telecommunications			
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GPS - Survey Equipment (Professional use)	<b>Use precautions:</b> For standard GPS survey equipment, there is a low risk of affecting Pacemaker or ICD.		
GPS - Survey Equipment (Professional use with repeater transmitter)	<b>Use precautions:</b> For GPS survey equipment used with repeater transmitter (output power of 25 watts or less), maintain at least a 24 inch (60 cm) separation between the antenna and the implanted device.		
House Arrest Anklet or Bracelet	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the device and anklet or bracelet.		
Internet connection - In- Building BPL - Broadband over Power line (BPL) or Internet Connection over Power line Carrier (PLC) or Access BPL - Broadband	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the internal wiring associated with the power distribution system and the implanted device.  In-Building BPL (LAN) utilizes electrical power wiring to transmit radio frequency signals to network computers within a building.  Access BPL (Broadband) uses electrical power distribution lines to extend a connection to the Internet. The power distribution lines are used to transmit radiofrequency signals to local internet connection points within the neighborhood.		
Infrared Scanner (barcode scanner)	<b>Safe under normal use.</b> A bar code reader uses visible light to scan an item. This equipment poses a low risk of affecting Pacemaker or ICD (used in grocery and department stores). RFID is not used in bar code readers.		
Lie Detector Test - See Medical	<a href="#">Click here for Lie Detector Test</a>		
Metal Detectors or Magnetometers (in jails, courtrooms, some schools)	<b>Use precautions:</b> Tell security personnel you have a device and show medical device ID card. Low risk to walk through archway metal detector. If the archway detects metal in the device, request a hand search. If hand held metal detector wand is to be used, request that the wand not be placed directly over the device.	Airport Security Systems; Full Body Scanner; Advanced Imaging Technology	<a href="#">Information for the Traveling Pacemaker or Defibrillator Patient</a>

## Telecommunications

Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article						
Nintendo Wii and Wireless Remote Controls	<b>Safe under normal use:</b> Do not place control directly over implanted device. The Nintendo Wii uses wireless technology with various handheld controllers. The manual for Nintendo Wii recommends keeping these controllers 9" away from an implanted heart device.								
OnStar® technology	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the antenna and the implanted device. Device found in cars for navigation. Works with cell phone & GPS Technology. Antenna usually on roof, transmitter in glove box.								
PDA (Personal Digital Assistant)	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) distance between the PDA and the implanted device. These are handheld personal computers. PDAs with wireless links use frequencies and modulations that are very similar to digital cellular phones. In addition, the power transmitted by the PDA is no greater than that used by cellular phones.	Palm Pilot, Toshiba Pocket PC, and Sony Hand Helds							
Pagers - Receiver Only	<b>Safe under normal use.</b>								
Pagers - 2 Way with receiver and transmitter	<p><b>Use precautions:</b> Maintain at least the minimum separation suggested.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Pager</th> <th>Distance between Antenna and Implanted Device</th> </tr> </thead> <tbody> <tr> <td>Less than 3 watts</td> <td>6 inches (15 cm)</td> </tr> <tr> <td>3 - 15 watts</td> <td>12 inches (30 cm)</td> </tr> </tbody> </table>	Pager	Distance between Antenna and Implanted Device	Less than 3 watts	6 inches (15 cm)	3 - 15 watts	12 inches (30 cm)		
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Phone Headset (cordless)	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the antenna and the implanted device. Do not place directly over implanted device.								

Telecommunications			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Portable Multimedia Player	<b>Use precautions:</b> maintain at least 6 inches (15 cm) between the player/headphones/earbuds/cellular phone and the implanted device. Some of these players and their accessories contain magnets.	ipod, i pod, MP3 player	<u>Portable Multimedia Players and Implantable Pacemakers and Defibrillators</u>
Power Lines - high voltage	<b>Safe under normal use for residential exposure (general public).</b> Low risk of affecting Pacemaker or ICD when walking, driving underneath, or living in a house or building near high voltage power lines. See precautions for occupational exposure. <b>Use Precautions:</b> Professionals servicing high voltage power lines (occupational exposure) may be susceptible to interaction with their implanted device. For this work environment, contact your doctor to review specific concerns.		
Radar	<b>Use precautions:</b> Maintain a 12 inch (30 CM) separation from implanted device. This recommendation does not include weather, avionics or military application of RADAR. A system that uses reflected radio waves to determine the presence, location, and speed of distant objects. The system has law-enforcement and navigational applications.	Radar Detector, Radar Locating System, Sensor, Position Finder	
Radar - small boats	<b>Use precautions:</b> For radar transmitting from 1 to 4 kilowatts (kW) effective radiated power (ERP) maintain an overhead (vertical) distance of 3 feet (1 meter). Inside radar console display is unlikely to affect the Pacemaker or ICD.		
Radar - commercial or cruise ships	<b>Safe under normal use:</b> For passengers on commercial or cruise ships, radar antennas are mounted in a configuration such that they are unlikely to affect Pacemaker or ICD function; for example, when an individual is on a normally accessible deck or bridge area. In other areas, there may be the potential for Pacemaker or ICD interaction.		



## Telecommunications

Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article																				
Radio - Amateur or Ham Radio Bands	<p><b>Use precautions:</b> The following minimum distances, measured between the antenna and the implanted device, and associated power transmission levels are recommended for a low risk of interaction with an implanted device.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Power Transmission</th> <th style="text-align: center;">Separation between Antenna and Implanted Device</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Less than 3 watts</td> <td style="text-align: center;">6 inches (15 cm)</td> </tr> <tr> <td style="text-align: center;">3 - 15 watts</td> <td style="text-align: center;">12 inches (30 cm)</td> </tr> <tr> <td style="text-align: center;">16 - 30 watts</td> <td style="text-align: center;">24 inches (60 cm)</td> </tr> <tr> <td style="text-align: center;">31 - 50 watts</td> <td style="text-align: center;">3 feet (1 meter)</td> </tr> <tr> <td style="text-align: center;">51 - 125 watts</td> <td style="text-align: center;">6 feet (2 meters)</td> </tr> <tr> <td style="text-align: center;">126 - 250 watts</td> <td style="text-align: center;">9 feet (3 meters)</td> </tr> <tr> <td style="text-align: center;">251 - 500 watts</td> <td style="text-align: center;">12 feet (4 meters)</td> </tr> <tr> <td style="text-align: center;">501 - 1000 watts</td> <td style="text-align: center;">20 feet (6 meters)</td> </tr> <tr> <td style="text-align: center;">1001 - 2000 watts</td> <td style="text-align: center;">30 feet (9 meters)</td> </tr> </tbody> </table> <p>If closer than the minimum recommended distances, for continuous transmissions, there is a potential for device interaction. CW (continuous wave) transmissions (Morse code) may also have the potential for device interaction.</p>	Power Transmission	Separation between Antenna and Implanted Device	Less than 3 watts	6 inches (15 cm)	3 - 15 watts	12 inches (30 cm)	16 - 30 watts	24 inches (60 cm)	31 - 50 watts	3 feet (1 meter)	51 - 125 watts	6 feet (2 meters)	126 - 250 watts	9 feet (3 meters)	251 - 500 watts	12 feet (4 meters)	501 - 1000 watts	20 feet (6 meters)	1001 - 2000 watts	30 feet (9 meters)		
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Radio - Marine (Very High Frequency / VHF and Single Side Band / SSB and UHF)	<p><b>Use precautions:</b> see recommendations below.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Power Transmission</th> <th style="text-align: center;">Separation between Antenna and Implanted Device</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Less than 3 watts</td> <td style="text-align: center;">6 inches (15 cm)</td> </tr> <tr> <td style="text-align: center;">3 - 15 watts</td> <td style="text-align: center;">12 inches (30 cm)</td> </tr> <tr> <td style="text-align: center;">20 - 25 watts</td> <td style="text-align: center;">24 inches (60 cm)</td> </tr> </tbody> </table>	Power Transmission	Separation between Antenna and Implanted Device	Less than 3 watts	6 inches (15 cm)	3 - 15 watts	12 inches (30 cm)	20 - 25 watts	24 inches (60 cm)														
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## Telecommunications

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Radio - Military	<b>Use precautions:</b> Maintain 24 inch (60cm) separation from transmitter antenna and implanted device. Military radio operating between 30MHz and 512MHz. Two power settings are used; 10W for AM operation and 20W for FM operation.														
Radio - Two Way Portable Radio	<p><b>Use precautions:</b> The following minimum distances, measured between the antenna and the implanted device, and associated power transmission levels are recommended for a low risk of interaction with an implanted device.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Power Transmission</th> <th>Separation between Antenna and Implanted Device</th> </tr> </thead> <tbody> <tr> <td>Less than 3 watts</td> <td>6 inches (15 cm)</td> </tr> <tr> <td>3 - 15 watts</td> <td>12 inches (30 cm)</td> </tr> <tr> <td>16 - 30 watts</td> <td>24 inches (60 cm)</td> </tr> <tr> <td>31 - 50 watts</td> <td>3 feet (1 meter)</td> </tr> <tr> <td>51 - 125 watts</td> <td>6 feet (2 meters)</td> </tr> </tbody> </table> <p>CB and police radios: maintain 24 inch distance from implanted device.</p> <p>NOTE: Recommend 12 inch separation between dash-mounted transmission / control box and implanted device.</p>	Power Transmission	Separation between Antenna and Implanted Device	Less than 3 watts	6 inches (15 cm)	3 - 15 watts	12 inches (30 cm)	16 - 30 watts	24 inches (60 cm)	31 - 50 watts	3 feet (1 meter)	51 - 125 watts	6 feet (2 meters)	hand-held, walkie-talkie, police, CB, Law Enforcement, Fire, and Emergency Vehicle radios	
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## Telecommunications

Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Radiofrequency Identification, and Check out Counter Tag Deactivators	<b>Use precautions:</b> Maintain a 24 inch (60 cm) separation between source of RFID (reader and RFID receiver chip) and the implanted device. Refer to A Closer Look article. Radio Frequency Identification (RFID) is a wireless technology used to identify RFID tags mounted on objects or carried by (or imbedded in) people or animals. Data stored in the RFID tag is read by wireless devices, called RFID readers. The RFID reader contains one or more RF antennas that emit RF signals within a specified range. When an RFID tag enters the reader's RF signal field, information stored in the tag is captured by the reader. Each RFID tag relies on the reader to transmit information contained in the tag.	security, theft, tag	<a href="#">Radiofrequency Identification and Implantable Pacemakers and Defibrillators</a>
Remote Control RF Transmitter	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between control unit and implanted device. For 2.4 GHz frequency: 6 inch (15 cm) separation. Hand-held control unit for remote control boats and airplanes.		
Remote to unlock car	<b>Safe under normal use:</b> Do not place directly over implanted device.		
Satellite Dish (residential) - receiving only	<b>Safe under normal use:</b> This includes the receiving Unit which usually sits next to the TV. Includes dish antenna located on rooftop.	Direct TV, Hughesnet, Dish TV	
Satellite Dish (residential) - transmitting/receiving	<b>Use precautions:</b> Recommend that the antenna be mounted in such a way that at least a 24 inch (60 cm) overhead vertical distance be maintained between the satellite dish and the individual with a Pacemaker or ICD. Avoid direct exposure to the main energy beam.		

Telecommunications			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Smart Key System	<b>Safe under normal use.</b> Boston Scientific testing suggests that the smart key system remote unit and/or smart key system antennas should not interfere with Boston Scientific CRM implanted pacemakers or defibrillators. Note: Patients should consult with their device following physician to discuss any concerns they might have regarding the potential for interference. Smart Key systems operate using two-way communication between its remote unit and special antennas located throughout the vehicle. The remote unit transmits signals to the antennas when the motorist pushes certain buttons on the remote unit.		<a href="#">Automobile "Smart Key" Systems and Implantable Pacemakers and Defibrillators</a>
Solar Flares	<b>No restrictions.</b> Solar Flares can cause interruption in radio and cellular service. However, the disruptions are far smaller than the sensing capabilities in the CRM devices.		
Theft Detector pedestals (located at store exits)	<b>Use precautions:</b> Walk through theft detection systems at a normal pace. Do not lean against or linger near security gates or tag readers that include Radio Frequency Identification (RFID) equipment. Theft detectors are used in stores and libraries. These systems are unlikely to affect implanted cardiac device function when walking through security gates at a normal walking pace.	security Electronic Article Surveillance (EAS)	<a href="#">Radiofrequency Identification and Implantable Pacemakers and Defibrillators</a>
Trace Portal Machine	<b>Safe under normal use.</b> A high throughput, non-intrusive walk-through portal that enables rapid detection of both explosives and narcotics.	airport security system, puffer, EntryScan	
Transformer Box 50 / 60 Hertz (residential)	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between transformer and implanted device. These transformer boxes in residential settings are used in association with underground 60 Hertz power distribution. Typically this is a green box found on the ground. Low risk to walk by or have in backyard.		
TV Ears	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the transmitting unit connected to the audio source, the charger, and the implanted heart device.		
Wi-Fi or Wireless Fidelity	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the Wi-Fi transmitter/receiver antenna (if visible) and the implanted device.		
Wireless LANS (Local Area Network System)	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the antenna of the LAN transmitter or the LAN transmitter case and the implanted device.	Peconet	

Tools											
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article								
Battery Charger (car)	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between the battery charger and the implanted device.										
Chainsaw (gas and electric powered)	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) distance between electric motor / ignition system of chainsaw and implanted device.										
Demagnetizer (non-industrial)	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between demagnetizer and the implanted device when the items to be demagnetized are in a closed container.										
Electrostatic Spray Gun (hand held)	<b>Safe under normal use:</b> Do not place directly over implanted device.										
Generator - Residential AC/DC portable/RVs (gasoline or diesel powered)	<p><b>Use precautions:</b> If generator is powered by an engine with an ignition system, maintain at least a 12 inch (30 cm) separation between the components of the ignition system and the implanted device. Does not include industrial generators.</p> <p>EMI specifications: With respect to our 0.1mT (1 Gauss) guideline for 60Hz magnetic fields, the resulting fields generated at 100A, 200A, and 400A would be as follows:</p> <table border="1"> <tbody> <tr> <td>100 Amps</td> <td>8 inches (20 cm)</td> </tr> <tr> <td>200 Amps</td> <td>16 inches (40 cm)</td> </tr> <tr> <td>400 Amps</td> <td>32 inches (80 cm)</td> </tr> <tr> <td>&gt;400 Amps</td> <td>Call for information</td> </tr> </tbody> </table>	100 Amps	8 inches (20 cm)	200 Amps	16 inches (40 cm)	400 Amps	32 inches (80 cm)	>400 Amps	Call for information		
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Tools			
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Ignition Systems (gasoline powered vehicles)	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between the components of an operating ignition system and the implanted device. If the device is closer than 12 inches (30 cm), there is the potential for Pacemaker or ICD interaction. Diesel powered vehicles have no effect.		
Jackhammer	<b>Do not use:</b> Consult heart doctor. An electrical mechanical tool that combines a hammer and chisel to break up rock, pavement, and concrete.		
Jumper Cables	<b>Use precautions:</b> During use, maintain at least a 24 inch (60 cm) separation between the jumper cables and the implanted device when starting an engine.		
Soldering Guns / Soldering Irons	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the soldering gun or iron and the implanted device. The soldering gun contains a transformer.		
Stun Guns (hand held only)	<b>Use precautions:</b> Implanted device should be checked if patient received electrical pulses from stun gun. If the individual receiving the subduing electrical shocks has a Pacemaker or ICD, their implanted device may be affected. <b>Safe under normal use:</b> if the individual with a Pacemaker or ICD is using the stun gun.		See Taser below.
Taser® (hand held gun that shoots two darts propelled by compressed gas cartridge)	<b>Use precautions:</b> Implanted device should be thoroughly evaluated following a taser event. Low risk if the individual with a Pacemaker or ICD is operating the taser. Electrical pulses should not be applied in vicinity of implanted device (typically near heart). One set of electrodes has the ability to project two darts that deliver these high-energy electrical pulses to individuals at a short distance. A second set of back-up electrodes are incorporated into the hand held portion of the taser.		

Tools			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Tools - Battery powered (cordless)	<b>Use precautions:</b> Consult heart doctor. Maintain at least a 12 inch (30 cm) separation between the battery-powered tool, the charger, and the implanted device. Battery operated home and garden equipment includes: circular saws, drills, hedge clippers, lawnmowers.		
Tools - Bench mounted (corded)	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between the motor associated with the power tool and the implanted device. This applies to motors / home workshop tools such as drill presses, table saws, grinders.		
Tools - Hand held or Home & Garden (corded)	<b>Use precautions:</b> Maintain at least a-12-inch (30 cm) separation between power tools and the implanted device. Be sure tools are properly grounded.	drill, saw, sander, router, electric hedge clippers , edge trimmer, weed whacker, weed trimmer	
Tools - Lawn mower, leaf blower, snowblower	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between the motor associated with the power tool and the implanted device.	Backpack leaf blower	
UPS - Uninterrupted Power Source (Commercial power failure back-up system)	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between the Uninterrupted Power Source system operating normally and the implanted device. When the UPS system is running on the battery source, maintain at least an 18 inch (45 cm) separation between the UPS system and the implanted device.		

Welding			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Welding	<p><b>Use precautions:</b> Maintain 24 inch (60 cm) distance between the welding machine/cables/arc and the implanted device at current ratings less than or equal to 200 amps. The welding machine/cables/arc produce and carry the current associated with the welding operation. At rated currents greater than 200 Amps, we recommend contacting your doctor to discuss the specific welding equipment prior to welding.</p> <p>Other arc welding considerations include, but are not limited to:</p> <ul style="list-style-type: none"> <li>• Strictly follow the safety precautions mentioned in the welder manual.</li> <li>• Work in a dry area. Wear dry, electrically insulated gloves and dry shoes.</li> <li>• Keep all cables straight, close together, and extending away from the body. Do not coil cables.</li> <li>• Arrange the work area so that the handle and rod will not contact the metal being welded.</li> <li>• Use short, intermittent, and irregular bursts at the lowest feasible energy levels; wait several seconds between welds. Do not weld with rapidly repeating short bursts, as they are more likely to be interpreted as electrical activity of the heart.</li> <li>• Ensure all equipment is properly grounded and is in proper working condition.</li> <li>• Limit welding currents to less than 200 Amps.</li> </ul>	<p>MIG - metal inert gas TIG - tungsten inert gas Stick, Heli, Arc, plasma cutters, gauging welding instruments</p>	<p><a href="#">Arc Welding and Implanted Medical Devices</a></p>
EDM-Electromagnetic Discharge Machine	<p><b>Use precautions:</b> Maintain 24 inches (60 cm) distance between the equipment and implanted device.</p>		<p><a href="#">Arc Welding and Implanted Medical Devices</a></p>



Dental Procedures			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Dental Apex Locator (root locator)	<b>Safe under normal use:</b> Instrument used to locate the end of a nerve in a tooth.		<a href="#">Dental Equipment and Implantable Pacemakers and Defibrillators</a>
Dental Chair with Magnetic Headrest	<b>Use precautions:</b> some dental chairs contain magnets located in the headrest. If the pacemaker or defibrillator is programmed not to respond to a magnet, patients may sit in these chairs. If the implanted device is programmed to respond to a magnet and: <ul style="list-style-type: none"> <li>• The magnet power is less than 10 Gauss (1 milli-Tesla)—patients may sit in these chairs.</li> <li>• The magnet power is greater than or equal to 10 Gauss (1 milli-Tesla)—patients should not sit in these chairs as device function/programming may be affected.</li> </ul>		<a href="#">Dental Equipment and Implantable Pacemakers and Defibrillators</a>
Dental Drills and Cleaning Equipment	<b>Safe under normal use.</b>		<a href="#">Dental Equipment and Implantable Pacemakers and Defibrillators</a>
Dental Electrocautery (periodontal surgery)	<b>Use precautions:</b> consult heart doctor to evaluate any possible risks associated with these in conjunction with patient's medical condition. This procedure is used in surgeries to cut tissue and stop the bleeding of blood vessels. Electrocautery may temporarily affect the function of an implanted pacemaker or defibrillator. During electrocautery use, Boston Scientific defibrillators can be temporarily deactivated with a magnet (refer to Electrocautery ACL for more details) and a pacemaker can be programmed to pace asynchronously. The physician who monitors the patient's implantable device should be contacted to discuss the use of electrocautery and the potential impact of these programming options.	<a href="#">Also refer to Electrocautery and Implantable Device Systems</a>	<a href="#">Dental Equipment and Implantable Pacemakers and Defibrillators</a>

Dental Procedures			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Dental Pulp Tester	<b>Use precautions:</b> This device is disclaimed for use on Pacemaker & ICD patients by most Dental Pulp Tester manufacturers. However, there are several published studies reporting no interaction with Pacemaker and ICD function, which suggests these technologies may be compatible. This instrument is used to check the viability of the nerve in a tooth. Introduces alternating current (AC) into the tooth.		<a href="#">Dental Equipment and Implantable Pacemakers and Defibrillators</a>
Dental / Ultrasonic scalers/cleaners	<b>Use precautions:</b> reference the linked article.	Cavitron	<a href="#">Dental Equipment and Implantable Pacemakers and Defibrillators</a>
Dental X-rays	<b>Safe under normal use.</b>		<a href="#">Dental Equipment and Implantable Pacemakers and Defibrillators</a>

## Medical Procedures

Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use	Similar brands that were not analyzed	A Closer Look Article
Ablation-Cardiac (Radio frequency)	<b>Use precautions:</b> Consult with heart doctor. This procedure introduces electrical current into the body. This process is done to change or interrupt the electrical pathways in the heart. For device management recommendations, reference the linked A Closer Look "Radiofrequency Ablation and Implantable Device Systems". Radiofrequency (RF) ablation is a minimally invasive treatment method in which a physician uses a small amount of RF current to damage or destroy selected tissue areas within the body. RF ablation is often used to treat cardiac arrhythmias, chronic pain and benign or cancerous tumors.		<a href="#">Radiofrequency Ablation and Implantable Device Systems</a>
Acupuncture - No electrical stimulus	<b>Safe under normal use.</b>		
Acupuncture AC Alternating Current	<b>Use precautions:</b> Consult with heart doctor. This procedure introduces electrical current into the body that may interfere with the implanted device. Electrical current is introduced into the body via acupuncture needles, which are connected to an external current source. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition.		
Acupuncture DC - Direct Current	<b>Safe under normal use.</b>		
Anodyne Therapy	Safe under normal use. Infrared medical device that increases circulation and decreases pain. No electrical current or deep heat is associated with this device.	Pain Therapy	

## Medical Procedures

Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Argon Plasma Coagulation	<b>Use precautions:</b> consult heart doctor to evaluate any possible risks associated with these in conjunction with patient's medical condition. Argon Plasma Coagulation has been used for more than 10 years in open surgery, laparoscopy and thoracoscopy, especially for hemostasis of large surface bleeding. It conducts monopolar or bipolar electrosurgical current to tissue via an ionized argon gas stream (argon plasma). Can be used for coagulation purposes in gastroenterology procedures.	Plasma Knife	
Argon Photo Coagulation	<b>Safe under normal use.</b> Different from Argon Plasma Coagulation, which carries different recommendations. Argon photo coagulation utilizes argon gas in a laser to coagulate tissue. Commonly used in eye procedures in conjunction with laser use. Can also be used for coagulation purposes in gastroenterology procedures. See laser recommendations for additional information.		
BEMER	<b>Use precautions:</b> Maintain 6 inch (15 cm) separation between the Bio-Electro-Magnetic-Energy-Regulation Therapy (BEMER) and implanted device. Consists of a mat on which to lie (lie on back) and hand-held tools that can be used on arms and legs but not placed on chest.		
Bioness H200 Electrical Stimulation	<b>Do not use.</b> If you must use, consult heart doctor. Bioness delivers electrical stimulation to the forearm via five electrodes. It can be used to treat muscle weakness resulting from conditions such as MS, stroke, and cerebral palsy. Maximize distance between Bioness/electrodes and implanted device whenever possible. Avoid electrode paths transecting the implanted device.		

Medical Procedures			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Blood bag dielectric sealing equipment	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between the sealer and implanted device. Do not place power source directly over device. Equipment uses high frequency energy to seal blood bags.	Fenwal, Sebra, Terumo, Baxter, Sarstedt, heat sealer sealing machine	
Body Fat Analysis Scale - Bioelectrical Impedance	<b>Do not use:</b> Body Fat Analysis scale with bioelectrical Impedance. The percentage of body fat is estimated by passing electrical current through the body. Most manufacturers have disclaimers in their product literature excluding the use of this product for individuals with a Pacemaker or ICD.	Body Fat Measuring Scale (hand held), Electrical Body Fat Analysis, BIA, Bioelectrical Impedance Analysis, Weight Scale	
Body Fat Analysis - Near-Infrared Light	<b>Safe under normal use.</b> This type of body fat measurement uses near-infrared light to determine the amount of body fat according to the principle that body fat absorbs light while lean body mass reflects light. The amount of light that is emitted from the light wand and how much is reflected back into the wand is measured.	Futrex	
Body Hydration Scale	<b>Do not use.</b> Scale measures hydration ("body water") using bio-electrical impedance.	Conair, Bio Electrical Impedance, BioElectrical Impedance, Weight Scale	
Bone Density test/Scan	Two types are used: X-ray and Ultrasound. <b>X-ray: Safe under normal use.</b> <b>Ultrasound: Use precautions:</b> Ultrasound technique. Maintain at least a 6 inch (15 cm) separation between the transducer head and the implanted device.	x ray, xray	
Circulators, Sequential	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between the electronic pump and the implanted device. Circulators mimic the lymphatic system by promoting lymphatic flow by stimulating circulation to the extremities. It can be used in treating chronic and acute edema, venous insufficiency, amputations, skin grafts, etc. The appliance is worn by the patient and has a number of air bladders. These bladders are filled and emptied sequentially by an electronic pump connected by a length of hose.		

Medical Procedures			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Cryoablation	<b>Safe under normal use.</b> Most often used in the treatment of prostate cancer; uses for other types of cancer and ablation of heart arrhythmias are less common. Involves controlled freezing (down to -75°F at catheter tip) for the destruction of cancerous or unwanted cells. If used in the heart, avoid lead system contact with the tip of the cryoablation catheter as this could potentially cause lead damage or fracture.		
External Bone Growth Stimulator Alternating Magnetic Field - produced by an alternating current (AC)	<b>Use precautions:</b> Consult with heart doctor to evaluate any possible risks associated with this equipment in conjunction with patient medical condition. When used on leg poses a low risk of affecting Pacemaker or ICD. For use on wrist or arm, maintain at least a 12 inch (30 cm) separation from the implanted device. An insulated cuff surrounding the broken bone produces a magnetic field that promotes bone healing. This therapy does not introduce conducted current into the body; however, there is a magnetic field that is present in the immediate vicinity of the cuff. A battery is used to deliver a short duration, high intensity current pulse to the coil in the cuff that produces the therapeutic magnetic field.		
External Bone Growth Stimulator Direct Current (DC)	<b>Safe under normal use:</b> Low level direct current is not detectable by the Pacemaker or ICD (implanted or external stimulator).		
EBI/Biomet SpinalPak and OrthoPak	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between the EBI leads and implanted device.		
External Bone Growth Stimulator - Spinalogic	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between the stimulator and the implanted device. Promotes healing by inducing weak pulsing electrical currents at the fracture site. These signals are generated by a low energy electromagnetic field created by passing specific current pulses through the treatment coil.	bone healing system	

Medical Procedures			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Internal Bone Growth Stimulator introducing AC current into the body	<p><b>Use precautions:</b> Consult with heart doctor to evaluate any possible risks associated with these responses in conjunction with patient medical condition.</p> <p><b>See additional precautions below.</b> This procedure introduces electrical current into the body that may affect the implanted devices of individuals. Low risk when electrodes are placed on an extremity. If the electrodes are placed on the torso there is the potential for Pacemaker or ICD interaction.</p> <p><b>Use precautions: DJO Bone Healing System</b> - maintain 12 inch (30 cm) separation from implanted device and leads.</p> <p><b>Use precautions: Exogen Ultrasound Bone Healing System</b> - maintain 12 inches (30 cm) from implanted device and leads. Do not place the transducer head directly over the implanted device or leads, or in orientations where the implanted device or leads will be exposed to the ultrasound beam.</p>		
Bravo PH Capsule (used to diagnose reflux disease)	<p><b>Safe under normal use:</b> The Bravo pH Capsule with Delivery System is a single use, disposable device which is intended to be used for gastro-esophageal pH measurement and monitoring of gastric reflux. The Bravo system involves a pH capsule, about the size of a gel cap, which is temporarily attached to the wall of the esophagus. The capsule measures pH levels in the esophagus and transmits readings via radio telemetry to the Bravo Receiver worn on the patient's belt or waistband.</p>		
Capsule Endoscopy-Given model M2A	<p><b>Safe under normal use:</b> The M2A capsule encases a digital camera, light-emitting diodes, batteries, and a transmitter. The M2A capsule emits short bursts of radio frequency energy for twice per second for the eight-hour diagnostic period.</p>		<a href="#">PillCam Capsule Endoscopy and Implantable Device Systems</a>
CAT Scan or CT Scan (Computed Axial Tomography)	<p><b>Use precautions:</b> Consult heart doctor and refer to A Closer Look article. Recommend monitoring heart rate during CT scan.</p>		<a href="#">Computed Tomography (CT) Scanning and Implantable Pacemakers and Defibrillators</a>
Cardioversion	<p>See <b>A Closer Look</b> article (right) and Defibrillation-External (below).</p>		<a href="#">CPR and External Defibrillation for Pacemaker and/or Defibrillator Patients</a>
Colonoscopy	<p><b>Use precautions:</b> This diagnostic procedure by itself poses a low risk of affecting the Pacemaker or ICD. However, if polyps are found electrocautery may be used to remove them. See electrocautery guidelines.</p>		<a href="#">Electrocautery and Implantable Device Systems</a>

## Medical Procedures

Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
CyberKnife	<b>Use precautions:</b> Robotic radiosurgery system used for treating benign tumors, malignant tumors and other medical conditions. Cyberknife utilizes Radiation Therapy, and Boston Scientific Therapeutic Radiation Recommendations apply. Also see Recommendations for Stereotaxis.		<a href="#">Therapeutic Radiation and Implantable Device Systems</a>
DNA Sequencing Equipment	<b>Safe under normal use.</b> Electrophoresis apparatus used in the DNA sequencing process. Uses electrical current to separate the DNA within a gel medium.		
Defibrillation-External (High energy) Cardioversion (Low energy)	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between paddles and implanted device or device lead system. If external defibrillation or Cardioversion is delivered closer than 6 inches (15 cm) from the implanted device or device lead system, Pacemaker or ICD may be damaged or reprogrammed. It is recommended that device function and programming be thoroughly evaluated after any external defibrillation or cardioversion.		<a href="#">CPR and External Defibrillation for Pacemaker and/or Defibrillator Patients</a>
Deep Brain Stimulator	<b>Use precautions:</b> both neurologist and cardiologist/EP should consult with Boston Scientific Technical Services (1-800-CARDIAC) prior to combining these systems in the patient to minimize adverse interactions. Used for movement disorders such as Parkinson's disease. The deep brain stimulator is implanted in the body of the patient. An electrode is implanted into the thalamus, deep within the brain. This electrode is connected to a pulse generator that is implanted in the pectoral region via a lead. The device is activated and sends continuous electrical pulses to the brain to inhibit tremors. The device can be turned on or off by holding a handheld magnet over the generator.	DBS, Activa, Itrel, Soletra, Kinetra	
Diathermy - Shortwave or Microwave	<b>Do not use:</b> Diathermy is NOT recommended. This process heats body tissue and may result in Pacemaker reversion or ICD shock if no precautions are taken.		
Diathermy Ultrasound	<b>Use precautions:</b> Consult heart doctor and maintain a 6 inch (15 cm) separation between the transducer head and the implanted device. A form of physical therapy in which deep heating of tissues is accomplished by the use of high frequency electrical current.		
ECG/EKG Electrocardiogram	<b>Safe under normal use:</b> The ECG/EKG is limited to sensing electrical activity of the heart.	EKG, ECG, 12-lead, twelve-lead	



Medical Procedures			
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Echocardiogram	<b>Use precautions:</b> Maintain a 6 inch (15 cm) separation between the transducer head and the implanted device. A test in which ultrasound is used to examine the heart.	Transesophageal Echo, TEE, Echocardiography	
ECT (Electroconvulsive Shock Therapy)	<b>Use precautions:</b> Consult with heart doctor to evaluate any possible risks associated with these responses in conjunction with the patient's medical condition. This procedure introduces electrical current into the body that may affect the implanted devices of individuals. ECT is used to treat depression, anxiety and other mental disorders.		
EECP - Enhanced External Counter Pulsation Therapy	<b>Safe under normal use:</b> This therapy helps to maintain arterial pressure longer, resulting in better perfusion of the heart and other body organs. No effect on the implantable device electrical sensing. Enhanced external counterpulsation, or EECP, is used for controlling angina in patients that are not considered surgical candidates. Trousers are placed over patients from ankle to waist and pneumatically inflated in diastole and deflated prior to the next systole (coronary arteries fill in diastole). Similar to Intra-Aortic Balloon Pump, except non-invasive.		
EEG - Electroencephalography	<b>Safe under normal use:</b> Scan brain wave activity. A recording of the electrical potentials on the skull generated by currents emanating spontaneously from nerve cells in the brain (i.e. surface ECG of the brain).		
Electrocautery or Electrosurgery	<b>Use precautions: Anesthesiologist</b> should consult heart doctor to evaluate any possible risks associated with these in conjunction with patient's medical condition. This procedure is used in surgeries to cut tissue and stop the bleeding of blood vessels. Electrocautery may temporarily affect the function of an implanted pacemaker or defibrillator. During electrocautery use, Boston Scientific defibrillator can be deactivated and pacemakers can be programmed by the physician to pace asynchronously. The physician who monitors the patient's implantable device should be contacted to discuss the use of electrocautery and the potential impact of these programming options. Consider potential programming options such as magnet application to minimize interactions between electrocautery and the implantable device. Avoid placing cautery tool directly over implantable device.	Bovie, Hyfreator, Cautery, Argon Plasma, Electrosurgery, Plasma Knife	<a href="#">Electrocautery and Implantable Device Systems</a>
Electrolysis - AC or Electrolysis - Blended (uses both DC and AC) Thermolysis	<b>Do not use:</b> Consult with heart doctor to evaluate any possible risks associated with these responses in conjunction with patient's medical condition. This procedure introduces electrical current into the body that may affect the implanted device.		

## Medical Procedures

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ELOS	<b>Do not use:</b> Consult with heart doctor. Called ReFirme ST Skin Tightening system, developed by Syneron and designed to reduce wrinkles and tighten skin in the face and neck area. It uses 'ELOS' technology which combines three energy sources: laser, infrared and radio frequency. ELOS technology uses a pulse repetition rate of one pulse per second.		
Electron Beam Tomography (EBT)	<b>Safe under normal use.</b> EBT is a method of high-resolution imaging for all body organs. It is designed to evaluate cardiac and pulmonary anatomy, blood flow and function, and can yield a full set of images during a single breath-hold. EBT uses a powerful electron beam focused onto one of four tungsten target rings positioned beneath the patient.		
Nerve Conduction Test	<b>Use precautions:</b> Consult with heart doctor to evaluate any possible risks associated with your medical condition. This procedure introduces electrical current into the body that may affect the implanted cardiac devices.	EMG, electromyography	
EMG Electromyography- Single/Multiple Stimuli	<b>Use precautions:</b> Consult with heart doctor to evaluate any possible risks associated with your medical condition. This procedure introduces electrical current into the body that may affect the implanted cardiac devices.		
Electronystagmography (Audiology - ENG)	<b>Safe under normal use:</b> The ENG test is used to assess balance and movement disorders. Passive electrodes are placed on the head to evaluate the electrical potentials associated with eye movement. (Similar to EKG, EEG)	Refer to EEG	
Electroretinography	<b>Safe under normal use.</b> Electroretinography is a test to measure the electrical response of the eye's light-sensitive cells (rods and cones). Electrodes are placed on the cornea and the skin near the eye. The electrodes measure the electrical activity of the retina in response to light, which is then fed into a monitor where it can be viewed and recorded.		
Electrostatic Discharge	<b>Safe under normal use.</b> ESD is a charge which builds up on the skin of the patient and is discharged to a grounded object via the patient's extremities. This is in the form of a spark.		

Medical Procedures			
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ERCP Endoscopic Retrograde Cholangiopancreatography	<b>Safe under normal use unless electrocautery is used.</b> Refer to electrocautery. ERCP is an endoscopic study that incorporates the use of x-ray with an endoscope. It is used primarily to diagnose and treat conditions of the bile ducts including gallstones, inflammatory strictures (scars), leaks and cancer. If the exam shows a gallstone or narrowing of the ducts, the physician can insert instruments into the scope to remove or relieve the obstruction. Also, tissue samples (biopsy) can be taken for further testing.		
Fibrostat	<b>Safe under normal use.</b> Portable testing station used to analyze the fibrinogen levels in the blood.		
Functional Electrical Stimulation (FES)	<b>Use precautions:</b> Maintain at least a 12 inch (30 cm) separation between motor and implanted device. Use patches as suggested in the FES product manual (i.e. only on the legs). Electrical activation of muscles via surface electrode patches in order to facilitate motion, specifically pedaling a bicycle.		
Gamma Knife	<b>Use precautions:</b> Consult with heart doctor and radiologist. Used to treat arteriovenous malformations (AVM) and certain brain tumors without an incision. Incorporates 3-D information from MRI (see MRI recommendations) or CT. The Gamma Knife uses beams of radiation to damage abnormal tissue. This is accomplished by multiple beams of radiation intersecting to form a precise tool. These beams are focused on the target area and designed to destroy only that which is abnormal.		<a href="#">Therapeutic Radiation and Implantable Device Systems</a>
Hospital Patient Monitoring Equipment	<b>Use precautions:</b> Consult with physician. Some hospital equipment used for monitoring a patient's respiratory, cardiac, and hemodynamic parameters deliver similar low-level electrical currents into the body to obtain transthoracic impedance measurements. Examples of such equipment include, but are not limited to, respiratory monitors, diagnostic echo imaging, and ECG and hemodynamic machines.	Mechanical Ventilation, ventilator	<a href="#">ACL: Interactions between Hospital Monitoring or Diagnostic Equipment and Pacemakers Using Minute Ventilation Sensors</a>
Hyperbaric Chamber	<b>Use precautions:</b> Only to be used under medical supervision. A chamber large enough to accommodate one or more persons in which pressure is above normal atmospheric pressure. It is used to treat several medical conditions (i.e. carbon monoxide poisoning, infections, burns, pressure related diving injuries).		<a href="#">Elevated Pressure (HBOT/SCUBA) and Implanted Medical Devices</a>

## Medical Procedures

Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Impedance Cardiography	<b>Use precautions:</b> Only to be used under medical supervision. Impedance cardiography allows a clinician to non-invasively assess a patient's hemodynamics. It can be used for treating heart failure, hypertension, pacemaker, and dialysis patients. The impedance signal is a result of the application of a low-level AC current to the thorax of a patient during a monitoring session.	bioimpedance, transthoracic impedance	<a href="#">Interactions Between Hospital Monitoring or Diagnostic Equipment and Pacemakers Using Minute Ventilation Sensors</a>
Insulin Pump	<b>Use precautions:</b> Maintain 6 inch (15 cm) separation between the insulin pump and the implanted device. Battery operated unit that provides a scheduled release of insulin to the patient. Typically worn around the patient's waist.	Minimed	
Interferential Electrical Current Therapy	<b>Use precautions:</b> Consult with heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. This procedure introduces electrical current into the body that may affect the implanted devices of individuals.		
Iontophoresis	<b>Use precautions: consult heart doctor.</b> Method of delivering water-soluble ionized medication into the skin for inflammation and pain control. Involves placing two electrodes on the skin, one containing the drug. The electrodes are then hooked up to a low level external power supply (typically no more than 4.0 milliamps of DC current), which acts as the dose controller. Do not place electrodes over device or lead tip. Although interaction is unlikely, monitoring device function the first time treatment is received can provide confidence of compatibility with the cardiac implant. As an additional precaution, the health care professional may use a magnet to deactivate inappropriate ICD therapy or provide asynchronous pacemaker function during iontophoresis treatment.		
Laser / Laser Surgery	<b>Use precautions:</b> Maintain a 3 to 4 feet (90 cm - 120 cm) separation between generator or cabling from implanted device. LASER is an acronym for light amplification by stimulated emission of radiation. It is a mechanism for emitting electromagnetic radiation, typically light or visible light, via the process of stimulated emission. The emitted laser light is usually a narrow low-divergence beam that can be manipulated with lenses.	Laser, YAG, Odyssey, Holmium, Argon, CO2 Laser = Laser Generator:	

Medical Procedures			
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Lasik Eye Surgery	<b>Use precautions:</b> Recommend the application of a magnet to disable ICD detection circuit, or program ICD detection circuit off prior to surgery. These precautions are taken so legitimate therapy will not be delivered during critical portions of this delicate corrective eye procedure. Laser light associated with this procedure has a low risk of affecting the Pacemaker or ICD. A magnet is not used to disable a pacemaker.	Eye Surgery, Eye Laser Procedure, Cataract Surgery, Lasik, Radial Keratotomy, Corneal Surgery, Vitrectomy, Pan Retinal Photocoagulation, Blepharoplasty	
Lithotripsy	<b>Use precautions:</b> Consult with heart doctor. Lithotripsy is used in the non-invasive treatment of kidney stones (urinary calculosis) and biliary calculi (stones in the gallbladder or in the liver). The scientific name of this procedure is Extracorporeal Shock Wave Lithotripsy (ESWL). Lithotripsy attempts to break up the stone with minimal collateral damage by using an externally applied, focused, high-intensity	Extracorporeal Shock Wave Lithotripsy, ESWL	<a href="#">Lithotripsy and Implantable Pacemaker and Defibrillator Systems</a>
Lithotripsy (Ossatron)	<b>Use precautions:</b> Consult with heart doctor. Basically a form of lithotripsy, but it uses a water-filled membrane around the emitter instead of a water bath. The possible affected area during treatment is more focused than in regular lithotripsy.		<a href="#">Lithotripsy and Implantable Pacemaker and Defibrillator Systems</a>
Lie Detector Test	<b>Safe under normal use:</b> Lie detector tests introduce only direct current into the body. This direct current poses a low risk of affecting a Pacemaker or ICD.	Polygraph	
Magnetic mattresses	<b>Do not use:</b> Magnetic mattresses.		
Mammogram (Diagnostic X-ray) (2D / 3D)	<b>Safe under normal use:</b> Inform technician you have a device to ensure device does not get compressed. X-ray equipment can be adjusted to make individual more comfortable and lessen the pressure on the Pacemaker or ICD.		
Mechanical ventilation with a respiration rate monitor	<b>Use precautions:</b> Ventilators are used to help individuals breathe during surgery. Respiration rate monitors are used in conjunction with the ventilators to help verify that an individual's breathing rate is in a normal range during surgery. See A Closer Look article linked in right column.		<a href="#">Interactions between Hospital Monitoring or Diagnostic Equipment and Pacemakers Using Minute Ventilation Sensors</a>

Medical Procedures			
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Medical Helicopter	<b>Safe under normal use.</b>		
MET (Microcurrent Electrical Therapy) Alpha- Stim 100®	<b>Use precautions:</b> Consult with heart doctor. This procedure introduces electrical current into the body that may affect the implanted devices of individuals. It is recommended that individuals considering this procedure consult their heart doctor to evaluate any possible risks associated with these responses in conjunction with their medical condition. Similar to TENS unit with somewhat less current.		
Microcurrent, Frequency Specific	<b>Do not use.</b> Similar to TENS, microcurrent is introduced into the body to alleviate a variety of conditions including pain.	Muscle stimulation, stimulator	
MRI (Magnetic Resonance Imaging)/MRA	<b>Do not use:</b> Consult with heart doctor. Not recommended. Even when the MRI is not in use, the Pacemaker & ICD may be affected by the static magnet field that is always present near the MRI. There is the potential for Pacemaker magnet rate operation and disabling of ICD detection circuit (please reference BSC approved MRI compatible devices - ImageReady Lookup Tool.	<a href="#">ImageReady Lookup Tool</a>	<a href="#">Magnetic Resonance Imaging (MRI) and Implanted Medical Devices</a>
MR Conditionally approved BSC Systems	<b>Use precautions:</b> BSC's <b>IMAGEREADY™</b> MR-Conditional Pacing System consists of specific combinations of pulse generator and lead components. Note that system approval is geography-specific. To determine if the system under consideration is approved as MR-Conditional, please refer to the IMAGEREADY LOOK-UP TOOL. Guides can be downloaded from the link. Only patients implanted with a complete system designed, optimized, and tested for the ability to function correctly under specified conditions during an MRI scan are eligible to be scanned.	Approved devices and leads are listed in the IMAGEREADY LOOK-UP TOOL (click on the link at right)	<a href="#">ImageReady Lookup Tool</a>

Medical Procedures			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Myelogram	<b>Use precautions:</b> Test used to evaluate the flow of cerebral spinal fluid around the spinal column and nerve roots. It is used to diagnose bulging discs, herniated discs, or changes in the bones surrounding the spinal cord. Test involves injecting a special dye (contrast) and taking a series of x-rays, often in combination with a CT scan. If done with a CT scan, see CT scan precautions.		
Myotherapy	<b>Use precautions:</b> Avoid use of electrical stimulation. Myotherapy is a combination of therapies employed by chiropractors to relieve muscle pain. Treatment plans typically include trigger point therapy, stretching of muscles and joints, thermal therapy, myofascial dry needling (i.e. acupuncture), muscle strengthening and electrical stimulation.		
Navigator Bionavigation System	<b>Do not use:</b> Consult with heart doctor. Used to assist with the placement of central venous catheters and PICC lines. The transmitter is located in a hand-held device which is waved over the patient. The receiver is located within the stylet in the catheter.	Central Venous Catheter Placement, PICC Line placement	
Neocontrol Extracorporeal Magnetic Innervation	<b>Do not use.</b> Involves contracting muscles through application of a time-varying magnetic field.	ExMI, Urinary Incontinence	
Nuclear Stress Test	<b>Safe under normal use:</b> This procedure is used to see blood flow in the patient's heart at rest and during activity. A radioactive substance is injected into the patient's bloodstream and viewed with a special scanner. No reported interference with this procedure.		
Nuclear Medicine	<b>Safe under normal use.</b> Involves injecting a radioisotope in conjunction with a series of scans similar to x-rays.	MUGA Scan, PET Scan, Thallium Stress Test/Scan, MIBG Study, Cystogram, Renogram, MAG3 Study, Neuroblastoma Study, HIDA scan	
PET Scan (Positron Emission Tomography)	<b>Safe under normal use:</b> Radioactive dye is injected into body. Radiation given off by the body is monitored. Similar to a diagnostic X-ray.		

Medical Procedures			
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PFES	<b>Use precautions:</b> Consult with heart doctor. Incare, produced by Hollister, uses biofeedback and painless electrical stimulation to treat urinary incontinence. Use lowest setting possible, monitor patient's cardiac activity, stopping procedure if interference occurs.		
Phototherapy, UVB	<b>Safe under normal use.</b> Typically used for dermatological conditions such as psoriasis.	Ultraviolet B Phototherapy, Light Therapy	
Powered Muscle Stimulator	<b>Do not use.</b> If you must use, consult heart doctor. H-Wave involves passing electrical current through the body, and may interfere with pulse generator function. Any medical equipment, treatment, therapy, or diagnostic test that introduces electrical current into the body may have the potential to interfere with implanted cardiac device therapy. If H-Wave is medically necessary, evaluate the H-Wave therapy setting for compatibility with the pulse generator. Refer to TENS recommendations.	H-Wave, Pain Therapy, H-Wave Stimulator	<a href="#">Click here for TENS</a>
Pro-Adjuster	<b>Safe under normal use.</b> Used by doctors/chiropractors for spinal analysis and adjustment.	Chiropractic	
Pulse Radiation Therapy (Radio frequency)	<b>Use precautions:</b> Consult with heart doctor to evaluate any possible risks associated with these responses in conjunction with patient's medical condition. This procedure introduces electrical current into the body that may affect the implanted devices of individuals. Magnet application recommended for Pacemaker & ICD. Similar to radiofrequency ablation. This procedure is used to interrupt nerve pathways for pain management.		<a href="#">Radiofrequency Ablation and Implantable Device Systems</a>
Radiation Therapy (External X-ray or Gamma knife)	<b>Use precautions:</b> Consult with heart doctor. See A Closer Look article.		<a href="#">Therapeutic Radiation and Implantable Device Systems</a>
Radiation Therapy - Surgery (Internal/implants)	<b>Use precautions:</b> Consult with heart doctor. Prolonged exposure. See A Closer Look article. Recommend physician follow-up post surgery.		<a href="#">Therapeutic Radiation and Implantable Device Systems</a>
Radiation, Therapeutic	<b>Use precautions:</b> Consult with heart doctor. Follow physician guidelines. See A Closer Look article.	Neutron Radiation	<a href="#">Therapeutic Radiation and Implantable Device Systems</a>
Rebuilder	<b>Do not use:</b> Consult with heart doctor. An electrical stimulation device primarily used for the treatment of neuropathies in the feet, but can be used in the hands. Use on the hands will pose more of a risk for device interaction than use on the feet. The equipment uses a separate footbath for each foot, such that all the current injected into one foot passes through the patient's torso and out the other foot.		



Medical Procedures			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Relief Band®	<b>Safe under normal use:</b> Used to prevent motion sickness from traveling. Delivers a small electrical pulse at the wrist area. Low risk of affecting Pacemaker or ICD.		
Rhizotomy, Percutaneous Facet	<b>Use precautions:</b> maintain at least a 12 inch (30cm) separation between the neutral plate and the implanted device. The Leksell Neuro Generator is a complete system for stereotactic lesioning, pain treatment, stimulation and bipolar coagulation. It features an RF energy source with integrated monitoring and control features. Avoid high stimulation pulse settings, especially amplitude.	RF Facet Rhizotomy	
Rife Wellness Machine	<b>Do not use:</b> Consult with heart doctor. Rife Wellness Machines use what they term a Mortal Oscillatory Rate (MOR) resulting in destruction of various pathogenic organisms, as well as cancer. Nearly all of these machines send electrical current into the patient's body.		
Sacral Nerve Stimulation	<b>Use precautions:</b> both neurologist and cardiologist/EP should consult with BSC Technical Services (1-800-CARDIAC) prior to combining these systems in the patient to minimize adverse interactions. Mild electrical stimulation is delivered to the sacral nerve (in the lower region of the spine) via an implantable system that includes a lead, neurostimulator and an extension wire.	Urinary incontinence, Interstim, Itrel	
Safe Cross System	<b>Use precautions:</b> Consult with heart doctor. Consider potential programming options such as magnet application to minimize interactions between electrocautery and the implantable device. Uses RF energy to assist clinician in positioning therapeutic equipment.		
Scalpel, Harmonic or Ultrasonic	<b>Use Precautions:</b> Consult with heart doctor. Ultrasonically activated scalpel. Operates at a mechanical frequency of 55.5kHz over a distance of 80µm. No electrical current flow through the tip into the body. Avoid placing scalpel directly over implanted device.		
Shunt - Programmable	<b>Use precautions:</b> Maintain a 12 inch (30 cm) separation between the programmable shunt and the implanted device. Drains fluids from the brain for treatment of normal pressure hydrocephalus (NPH). Shunt is programmable to various pressure settings with an external programmer, consisting of a doughnut-style magnet connected to an electrical unit. The magnet is placed near the patient's head for reprogramming.		
Sleep Apnea Machine	<b>Use precautions:</b> Maintain a 6 inch (15 cm) separation between all power cords and monitor.	CPAP	

Medical Procedures			
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Somnoplasty	<b>Do not use:</b> Consult with heart doctor. A temperature-controlled radiofrequency based technology for use in the treatment of chronic nasal obstruction and sleep disordered breathing. Operates by heating a targeted area of obstructive tissue below the surface. An electrode is used at outputs of 10+ Watts using an operating frequency of 460kHz. A grounding pad is placed on the patient's lower back.		
Sonatron	<b>Use precautions:</b> Consult with heart doctor. Direct the Sonatron away from the implantable device. Somewhat resembling a hairdryer, the device is applied externally and can be pointed toward an area of the body to assist with wound healing and pain management. It uses long wave RF and emits a low-frequency sound.		
Sound Waves - Environmental	<b>No restrictions.</b>	Thunder, music, fireworks	
Spinal Cord Stimulator	<b>Use precautions:</b> both neurologist and cardiologist/EP should consult with BSC Technical Services (1-800-CARDIAC) prior to combining these systems in the patient to minimize adverse interactions. Pain treatment that delivers low voltage electrical stimulation to the spinal cord or peripheral nerve to inhibit or block the sensation of pain. The system consists of stimulation lead(s), a pulse generator/power source, and an extension wire that connects the two.	Neurostimulation, Nerve Stimulator, Neuro Stim	
Stereotaxis	<b>Use precautions:</b> Consult with heart doctor. Stereotactic surgery or stereotaxis is a minimally invasive form of surgical intervention which makes use of a three-dimensional coordinate system to locate small targets inside the body and to perform on them some action such as ablation, biopsy, lesion, injection, stimulation, implantation, radiosurgery. There are 2 different methods for developing the three dimensional coordinate system: 1) <b>MRI: Do not use (see A Closer Look article)</b> 2) <b>CAT Scan:</b> If this method utilizes MRI- <b>do not use.</b> For the method utilizing CAT Scan: <b>follow CT scan Recommendations (see A Closer Look article)</b> 3) <b>Coronary Stereotaxis: Do not use.</b> Uses magnets surrounding the patient in order to guide a catheter (with a magnet at its tip) through the coronary vasculature.	<a href="#">Magnetic Resonance Imaging (MRI) and Implanted Medical Devices</a>	<a href="#">Computed Tomography (CT) Scanning and Implantable Pacemakers and Defibrillators</a>
Synchromed Infusion System	<b>Use precautions:</b> Maintain at least a 10 inch (30 cm) separation between programmer head (which contains a magnet) and implanted cardiac device. Includes a small catheter connected to a pump, both of which are implanted into the body. Delivers medication directly to the spinal cord.	implantable drug pump	
TMS (Transcranial Magnetic Stimulation)	<b>Do not use:</b> Consult with heart doctor. This magnetic pulse therapy used in Psychiatry generates strong magnetic fields to stimulate nerve cells in the brain.		

## Medical Procedures

Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
TENS Unit (Transcutaneous Electrical Nerve Stimulation)	<p><b>Do not use.</b> If you must use, consult heart doctor. TENS involves passing electrical current through the body, and may interfere with pulse generator function. If TENS is medically necessary, evaluate the TENS therapy setting for compatibility with the pulse generator.</p> <p><u>THE FOLLOWING GUIDELINES MAY REDUCE THE LIKELIHOOD OF INTERACTION:</u> Place the TENS electrodes as close together and as far away from the pulse generator and leads as possible. Use the lowest clinically appropriate TENS energy output. Consider cardiac monitoring during TENS use, especially for pacemaker dependent patient.</p> <p><u>ADDITIONAL STEPS CAN BE TAKEN TO REDUCE INTERFERENCE DURING IN-CLINIC USE OF TENS:</u> If interference is suspected during in-clinic use, turn off TENS unit. Do not change TENS settings until you have verified that the new settings do not interfere with pulse generator function.</p> <p><u>IF TENS IS MEDICALLY NECESSARY OUTSIDE THE CLINICAL SETTING (AT-HOME USE), PROVIDE THE FOLLOWING INSTRUCTIONS:</u> Do not change the setting or electrode position unless instructed to do so. End each TENS session by turning off the unit before removing the electrodes. If the patient receives a shock during TENS use, or if they experience symptoms of lightheadedness, dizziness, or loss of consciousness, they should turn off the TENS unit and contact their physician.</p>	BIOSTIM Electro Medicine, e-stim, Quell, Circulation Maxx	
TUMT (Transurethral Microwave Thermotherapeutic Device)	<b>Do not use:</b> Consult with heart doctor. This is a diathermy-type of therapy. Most manufactures of this type of device contraindicate the use of this therapy with Pacemaker or ICD patients.		
TUNA Therapy (Transurethral Needle Ablation)	<b>Do not use:</b> Recommend consulting with physician for other therapeutic prostate procedures that pose less risk of interacting with a Pacemaker or ICD. Used to treat urinary symptoms caused by an enlarged prostate.		
TURP- Prostate test (Transurethral Resection of the Prostate)	<b>Do not use:</b> Consult with heart doctor to evaluate any possible risks associated with these responses in conjunction with patient's medical condition. This procedure introduces electrical current into the body that may affect the implanted devices of individuals.		

Medical Procedures			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Thermography	<b>Safe under normal use.</b> Thermography uses the same technology as military “night vision”, but with medical applications (e.g. breast cancer, poor circulation). An infrared camera detects the heat emitted from the body. Nothing is introduced into the patient.		
Transurethral Microwave Thermotherapy	<b>Use precautions:</b> Consult with heart doctor. Similar to electrocautery. Used for treatment of Prostatism (urethral obstruction). Consists of simultaneous microwave heating of the prostate and conductive cooling of the urethra.	TMX, Thermatrix, Prostate Surgery, TURP	
Ultrasound (Diagnostic) or Sonogram	<b>Use precautions:</b> Do not place transducer head directly over the implanted device or leads, or in orientations where the implanted device or leads will be exposed to the ultrasound beam. This procedure uses ultrasound technology to create images of organs and other body parts. *A sonogram is a type of diagnostic ultrasound used during pregnancy.	Transcranial Doppler, TCD, Diagnostic Ultrasound, Echo	
Ultrasound (Therapeutic)	<b>Use precautions:</b> Do not place transducer head directly over the implanted device. Heating of the tissues through sound waves. Will often be used in combination with an anti-inflammatory drug or cortisone.		
Vagal Nerve Stimulator	<b>Use precautions:</b> Consult with heart doctor. VNS is a device which is placed subcutaneously in the chest with leads that wrap around the vagus nerve. Electrical stimulation is applied to reduce epileptic seizure activity.		
Ventricular Assist Devices	<b>Safe under normal use.</b> A ventricular assist device, or VAD, is a mechanical device that is used to partially or completely replace the function of a failing heart. In many cases, it is a long-term therapy.	LVAD, BiVAD, RVAD, Thoratec Heartmate, Tandem Heart	
Virtual Colonoscopy performed with CAT Scan (CT Scan)	<b>Use precautions:</b> See A Closer Look article for more information. A procedure that is used to diagnose colon and bowel disease, including polyps, diverticulosis, and cancer. The procedure is performed with a CAT SCAN or MRI. The procedure using an MRI is not recommended.		<a href="#">Computed Tomography (CT) Scanning and Implantable Pacemakers and Defibrillators</a>

Medical Procedures			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Virtual Colonoscopy with MRI	<b>Do not use:</b> MRI is not recommended. See A Closer Look article. The implanted device may be affected by the static magnet field that is always present near the MRI.		<a href="#">Magnetic Resonance Imaging (MRI) and Implanted Medical Devices</a>
Vital Stim	<b>Use precautions:</b> Consult with heart doctor. Uses conducted electrical current. VitalStim Therapy consists of an operating unit, lead wires, and surface electrodes that are placed on the front of the patient's neck. See ACL for further guidance.		<a href="#">VitalStim Therapy and Implanted Medical Devices</a>
X-ray (Diagnostic)	<b>Safe under normal use.</b>	x ray	
Hearing Aids			
Audio Induction Loop Systems	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between a hand-held loop receiver or induction loop and the implanted device. Induction Loop: loop of wire around a room or building that generates a magnetic field, allowing sounds to be picked up by a cochlear implant or hearing aid.	audio frequency induction loop or hearing loop	
Cochlear Implant	<b>Use precautions:</b> Maintain at least a 6 inch (15 cm) separation between the processor and the implanted device. The processor is either behind the ear or clipped to the waist connected to the implant by hardwire. Wear the processor on the side opposite the pacemaker or ICD. The hard wire to the implant behind the ear should be kept away from the implanted pacemaker/ICD. Most cochlear implants are comprised of two central pieces: a processor that fits behind the ear and an internal piece implanted under the skin.		
Hearing Aid in ear or behind ear	<b>Safe under normal use.</b> Behind the ear hearing aids or in the ear ONLY. The distance between the hearing aids and implant site is enough to mitigate any affects from hearing aids.	In-The-Ear (ITE), Behind-The-Ear (BTE), Mini BTE, In-The-Canal (ITC), and Completely-in-Canal (CIC), Mik-in Helix (MIH), Invisible-In-Canal (IIC), Receiver-In-Canal (RIC), Over-the-Ear (OTE)	
Hearing Aid in ear or behind ear with a hard wired connection to an acoustical detector worn on the belt or other locations not close to the ear (most Cochlear implants)	<b>Use Precautions:</b> Clip the main unit to the waist on the opposite side of the implanted device. Also, the wire from the external acoustical detector to the hearing aid should be kept away from the implant site of the pacemaker/ICD.	William Sound Pocket Talker	

Hearing Aids			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Personal Sound Amplifier, Sennheiser Personal Sound	<b>Use precautions:</b> Keep at least 6 inches (15 cm ) between implanted device and each component (receiver, charging unit or headphones).	Sennheiser A200, Set 820 system, RR 820, TR 820 RF, Personal Sound Amplifier	
Starkey Radiant Beam Array	<b>Do not use:</b> The Radiant Beam Array (RBA) is a multi-microphone array incorporating six spatially separated microphones. The array is worn around the neck with the microphones positioned across the chest. Output from the array is transmitted to hearing instruments. The microphones in this assistive listening device are too close to the implant site.		
Stereo Listener	<b>Use precautions:</b> Clip the main unit to the waist, on the opposite side of the implanted device. Also, clip the headphone wires on the opposite side of the implanted device. Sound amplification system consisting of headphones and a clip-on amplifier unit.	Assisted Listening Device, Headset, RadioShack	
TV Ears	<b>Use precautions:</b> Do not place the headphone ear pieces directly over the implanted device. Maintain a 12 inch (30 cm) distance from the transmitting base station and the implanted device. The system features a wireless rechargeable headset that rests under the chin (receiver) with foam ear tips, and a transmitter/recharger base.	Senhieser Set, Stethoset	

Workplace			
Item	Safety precautions: Recommendations are based on normally functioning products. Be sure all items are in good working order and properly grounded. Follow manufacturer's instructions for use.	Similar brands that were not analyzed	A Closer Look Article
Forklift powered by diesel, gasoline, propane, or compressed natural gas (CNG)	<b>Use precautions:</b> Maintain a 24 inch (60 cm) separation from the components of the ignition system of the gasoline/propane/CNG engine and the Pacemaker or ICD.		
Forklift powered by electricity or battery	<b>Use precautions:</b> Maintain a 12 inch (30 cm) separation between the electric motor and the implanted device. The DC/AC current used to power the electric motors and the permanent magnets associated with the motor operation can affect the Pacemaker or ICD.		
<p><b>TERMS OF USE:</b> The information provided on the Electromagnetic (EMI) Guide should not be considered the exclusive or only source for this information. The table lists a general category of items only and is not intended to be an exhaustive list. The recommendations and precautions may be based on information provided by the manufacturers of the items in question, and specific items within a category may function differently. It is best practice to consult the original manufacturer of the item with potential EMI to verify any specific guidance concerning specific operation and compatibility with implantable devices. If at any time there is a question about the function and potential for Electromagnetic Compatibility, contact the manufacturer of the item in question for further information. At all times, it is the responsibility of the licensed healthcare professional to exercise medical clinical judgment in a particular circumstance.</p>			
<p>The information provided is not intended to be used for medical diagnosis or treatment or as a substitute for professional medical advice. Always seek the advice of your physician or other qualified health provider with any questions you may have regarding a medical condition.</p>			
<p>Recommendations and precautions for transvenous devices also apply to S-ICD devices.</p>			
<p>Patient manuals may be found by clicking on the appropriate link below.</p>			
<p style="text-align: center;"> <a href="#">Pacemaker Patient Manual</a>  <a href="#">Defibrillator (ICD) and S-ICD Patient Manuals</a> </p>			