CLINICAL PRACTICE GUIDE

Deactivation of implantable cardioverter defibrillators at the end of life

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NSW GOVERNMENT

AGENCY FOR CLINICAL INNOVATION

Cardiac Network

The information is not a substitute for healthcare providers' professional judgement.

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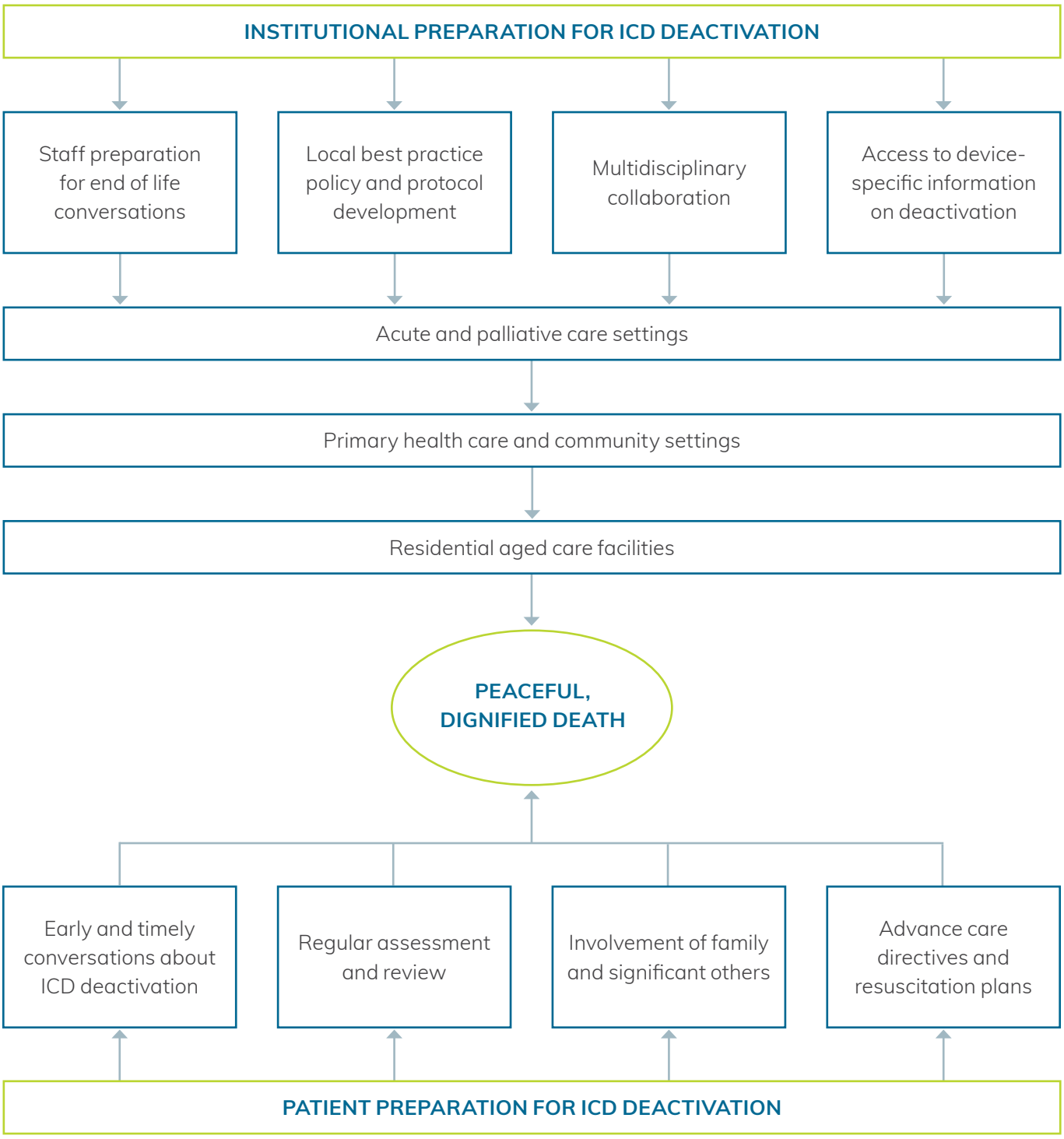
Contents

At a glance

This clinical guide supports clinicians to manage anti-tachycardia pacing and/or shock deactivation from an implantable cardioverter defibrillator to facilitate a peaceful death for patients at the end of life, regardless of the life-limiting cause.



Summary

About this document

Implantable cardioverter defibrillators (ICDs) are devices that are inserted to prevent sudden cardiac death from life-threatening arrhythmias. The device continuously monitors the electrical rate and rhythm in the heart and, if certain arrhythmias are detected, a tachycardia therapy (either anti-tachycardia pacing (ATP) or a defibrillation 'shock') may be delivered to convert the heart into its usual rhythm.

A patient with an ICD may wish for the device to be deactivated, either when they are at the end of their life or for other reasons.

This guide has been designed to assist clinicians to manage ATP and/or ICD shock deactivation and to facilitate a peaceful death for patients at the end of life, regardless of the life-limiting cause. It provides guidance for practice across acute care, primary care, and residential aged care settings, along with device-specific guidance for deactivation. It provides links to other relevant NSW Health policies that intersect with matters of consent and decision-making for patients and families at the end of life.

Please refer to the glossary at the end of this clinical practice guide for important definitions related to end of life care, ICDs and deactivation.

Audience

Cardiac and device technologists and all clinicians in hospital and community settings who may be involved in the management of patients with ICDs from implantation through to end of life care.

Objectives

- Improve the care of patients with an ICD who are approaching the end of life by avoiding unwanted extension of life and unnecessary distress associated with ICD activations
- Inform and build capacity for conversations about deactivation of tachycardia therapies between health care professionals, patients and their families throughout the care continuum: at the initial discussion, on implantation, during routine monitoring of the ICD and at the end of life
- Enhance considerations about ICD functions when planning and discussing an advance care directive, including development of a resuscitation plan and the use of an end of life care pathway
- Promote regular assessment and review of patients with an ICD and the appropriateness of that device therapy across all health settings, where there is either a deteriorating cardiac disease or another life-limiting illness
- Inform local best practice policy and protocol development for the deactivation of ICD tachycardia therapies in hospital and community settings that consider local contexts, equipment and support needs
- Promote recommendations for patient information, professional education and broader health care policy

Background

The purpose of ICDs

ICDs have been shown to improve survival for people at risk of life-threatening arrhythmias (ventricular tachycardia or ventricular fibrillation) and sudden cardiac death.[1, 2] This research has informed guidelines on ICD use from peak cardiac bodies.[3-6] ICDs provide a tachycardia therapy (either ATP or a defibrillation 'shock'), with or without a pacing function, to restore the heart to a normal rhythm. Some devices have a bradycardia pacing function and some also provide a biventricular pacing mode known as cardiac resynchronisation therapy.

The need for a deactivation practice guide

As the indications for ICD implantation expand, the prevalence of ICDs is growing each year and will continue to increase as the population ages.[7] An Australian report noted a threefold increase in ICD implantations between 2002-2015.[8] As a patient ages, the likelihood of them dying from their cardiac condition or another terminal illness increases. The aim to preserve quality of life during end of life care and to facilitate a dignified and peaceful death provides an important impetus for discussions with patients and families about deactivation of ICD tachycardia therapies, at appropriate times, with an openness to patients' values.[9]

ICDs are an example of the complexities new technologies and scientific advancements can add to the provision of end of life care. When death by other causes is thought likely and imminent, there is little to be gained by avoiding an arrhythmic death through intrusive ICD tachycardia therapies. It is distressing when patients, families and health professionals experience or witness inappropriate and/or futile ICD activity in patients with terminal illnesses.[10] For these reasons, and following discussion with the patient and their family, it may be appropriate for ICD tachycardia therapies to be deactivated near the end of life to enhance quality of life and quality of care.[11]

Withdrawal of life-sustaining therapies may occur within a framework of approved and negotiated policies. However, an absence of local policies to support ICD deactivation remains common, and where guidelines do exist, clinicians are often unaware of them.[12] Even patients with a 'No cardiopulmonary resuscitation (No CPR)' directive in their resuscitation plan and those receiving hospice care have commonly not discussed deactivation of their ICD tachycardia therapies. Up to 30% of patients with an ICD receive therapeutic shocks in the last hours of their life.[13] Clinicians receive limited training on difficult conversations about end of life care, which is an additional barrier.[12]

Update

The updated guide incorporates the most current available evidence and expert opinion. It also considers issues that had not been covered in the first version of the guide. New content in the updated guide covers:

- the separate functions of ICD shock therapy versus anti-tachycardia pacing and the need to consider each when making decisions about deactivation of ICD tachycardia therapies
- a person's cultural and religious perspectives as shaping the context for decisions about deactivation
- additional content on discussions about deactivation, including supporting clinicians in difficult conversations through a range of training formats and strategies. The appendices provide links to resources to support clinicians in deactivation processes, conversations about end of life care, advance care directives and resuscitation plans
- residential aged care facilities (RACF) as a location of greatest risk in timely deactivation of ICD tachycardia therapies. Entry to a RACF is noted as a trigger for device identification and review

- technology to assist device identification where the implanting centre is not accessible, including providing a table of radiographic identifiers by manufacturer
- the Australian guidelines for funeral homes including avoiding accidental shock during the preparation for burial of people who died with an ICD
- extending the list of implanting centre contacts and including private facilities and after hours contact instructions
- providing device specific information on magnet deactivation.

Methodology

This guide has been developed using the available evidence and in consultation with the following key groups:

- Cardiac nurses, cardiac technologists, physiologists, cardiac surgeons and cardiologists in both rural and metropolitan areas
- Primary health networks
- Palliative care services
- Community health nurses
- Residential aged care facilities
- Industry representatives from device companies
- Cardiac Society of Australia and New Zealand
- National Heart Foundation
- Clinical Excellence Commission
- Australasian Cardiovascular Nurses' College
- Australian Cardiovascular Health and Rehabilitation Association
- Agency for Clinical Innovation (ACI) Cardiac Network
- Aboriginal Health and Medical Research Council
- Consumer representatives
- NSW Ministry of Health

A rapid evidence check by the Evidence Generation Directorate at the ACI was completed to inform this guide. Peer-reviewed articles were identified using PubMed, Google and Google Scholar. The search terms used were "implantable cardioverter defibrillator*"[Title/Abstract] OR "implantable cardioverter defibrillator*"(Title/Abstract) OR "defibrillators, implantable"(MeSH Terms) AND ("deactivat*"[Title/Abstract] OR "remov*"[Title/Abstract]) AND ("palliative care"[MeSH Terms] OR "palliat*"[Title/Abstract] OR "hospices"[MeSH Terms] OR "terminally ill"[Text Word] OR "Terminal Care"[MeSH Terms] OR "Terminal Care"[Text Word] OR "end-of-life"[Title/Abstract] AND (2010:2021[pdat]). A grey literature search was also conducted using Google.

Studies published in English from 2015 to July 2021 were included. The work was guided by a small working group of subject matter experts with substantial experience in ICD care from facilities across rural and metropolitan NSW, with extensive input from device companies.

Ethical and legal context

The ethical and legal issues relating to ICD shock deactivation at the end of life are similar to concerns about withholding or withdrawal of other life-sustaining medical interventions such as cardiopulmonary resuscitation (CPR). While patients or the person responsible should be included in decisions at all stages of care, including end of life care, health professionals are under no obligation to provide treatment that offers negligible prospect of benefit to the patient, or that under the circumstances, seems unreasonable.[14]

Ideally, patients with any advanced or life-limiting disease should be referred early to a palliative care service. A collaborative, patient and family-centred care plan should be developed between the medical teams involved in the patient's ongoing care e.g. the palliative care team, the general practitioner and the cardiac team.[15] This care plan should be a dynamic document, incorporated into the electronic medical record (eMR).[16] This will assist open and sensitive patient and family communication about prognosis, goals of care,[11, 17] consent and documentation and mechanisms to avoid the initiation of inappropriate resuscitation.

The patient's cultural and religious perspectives should be considered and how these frame choices about death and 'letting life go'.[5] Where conflict exists and inhibits a competent patient from voicing their wishes, it may be appropriate to make a referral to Patient Advocates Australia. When religious or cultural views create conflict, a social worker, chaplain or services specific to the person and/or family's culture and language may facilitate discussions.

The NSW Ministry of Health has published a number of policy directives and resources which further address the legal and ethical issues that should be considered at the end of life. These include:

- Policy directive: Using Resuscitation Plans in End-of-life Decisions (PD2014_030)[18]
- Guideline: End-of-life care and decision-making (GL2021_004)[14]
- End of Life and Palliative Care Framework[19]
- Consent to Medical and Healthcare Treatment Manual (section 7)[20]
- Making an Advance Care Directive – Form and Information Booklet[21]

Where a patient no longer has capacity to make a decision about deactivation, the person responsible should be included in the decision-making process so that, in consultation, a decision can be made in the patient's best interest.[22]

Communication

Early and ongoing discussions about deactivation

It is imperative that the potential for deactivation of ICD tachycardia therapies (if and when end stage disease is reached) is part of the informed consent process at the time of device insertion.[9, 22]

Physicians are obliged to regularly revisit conversations with patients and families about the benefits and risks of ICD therapy. These conversations should take place at all points of care delivery, e.g. outpatient and acute settings,[23] in the context of the patient's current illness trajectory. Last minute discussions on deactivation of the ICD should be avoided.

Content of discussions about ICD tachycardia therapy deactivation

At the time of ICD insertion, as part of the informed consent process, conversations should involve family and carers and include the objectives and limitations of ICD therapy AND the benefits and potential reasons for later deactivation.[3, 12] An advance care directive should be discussed for all patients who have an ICD, regardless of their clinical status, soon after diagnosis of the cardiac condition.[3] Depending on the person's age and clinical condition, there may be rare exceptions to this requirement, e.g. a young, otherwise well person with long QT syndrome.

Ongoing deactivation discussion points could include:

- what patients and families know about the person's illness
- what they know about the role the ICD plays in their health, now and in the future
- any misunderstandings about the illness, the possible outcomes and the role of the ICD
- the patient and/or family's overall goals of care and their desired outcomes[5, 17]
- any additional information patients and families would like to know.

Triggers for discussions about ICD tachycardia therapy deactivation

Triggers to initiate a conversation about deactivation include:

- insertion of an ICD
- ICD clinic appointments
- presence of a 'No CPR' directive in a resuscitation plan
- advanced age with deteriorating quality of life
- entry to RACF to promote care planning
- refractory symptoms of a cardiac condition despite optimal therapy
- heart failure patients who have three episodes of decompensation in six months related to disease progression
- a permanent change in the ability to carry out activities of daily living
- cardiac cachexia
- resistant hyponatraemia
- serum albumin <25g/L
- multiple ICD activations related to disease progression
- co-morbidities with a poor prognosis e.g. advanced malignancy
- a non-reversible decline in cognitive function.[5, 24]

Who may initiate discussions about ICD tachycardia therapy deactivation?

Discussions may be initiated by the cardiologist, but also by nurses with advanced skills[25] in, for example, arrhythmia or heart failure management or palliative care, and by general practitioners or non-cardiologist physicians who provide care for the patient along the ICD care continuum.[17, 22, 26] Patients and their family members should also be welcomed and encouraged to initiate discussions about ICD deactivation.

Clinician's responsible for routine monitoring of the ICD should ask about significant changes in the patients' health at each clinic visit and ask to be informed of significant new diagnoses.

Supporting clinicians to discuss ICD tachycardia therapy deactivation

Clinicians' sense of ill-preparedness for such discussions, their lack of knowledge about ICDs and deactivation and the patient's own complex psychological relationship with their ICD is known to delay deactivation discussions.[15, 27] Hospital and community facilities should promote training of clinicians at all levels, to optimise their capacity to communicate treatment limitations, advance care planning and end of life care.[22] Multidisciplinary team meetings, ethics committees and palliative care consultations should provide further sources of support and oversight.

Seminars, grand round presentations, recordings of training sessions posted online, and immersive role plays are strategies known to prepare clinicians for deactivation discussions.[16, 27, 28] Facilities should consider what decision support tools, alerts or comprehensive discussion documents could be integrated into the eMR to enable discussions about deactivation of ICD tachycardia therapies.[16, 29, 30] The 'Resources' section of this guide provides links to further resources to support clinicians in deactivation processes, conversations about end of life care, advance care directives and resuscitation plans.

Discussion to support informed consent prior to ICD deactivation

Informed consent for ICD tachycardia therapy deactivation should be obtained from the patient or the person responsible, and this process must be documented before initiating the deactivation process. The exception is where the decision has been made by the consultant physician in the patient's best interest (see section 'Ethical and legal context'). In that instance, the rationale for such a decision and preceding conversations with the patient and/or family should be documented in the medical record.

There are several important points which should be considered as part of the informed consent discussion for ICD tachycardia therapy deactivation:[31]

- Discussions relating to ICD tachycardia therapy deactivation should be initiated early, rather than in the last days of life.
- Delivery of tachycardia therapies near the end of life may be ineffective, and shocks may be painful and distressing to patients, their family and carers.
- Turning off ICD tachycardia therapies will not directly cause death.
- Deactivating the tachycardia therapies does not deactivate the pacemaker function of the ICD. Although most ICDs have a pacing function, a small subset of ICDs (subcutaneous ICDs (S-ICDs)) do not.
- Deactivating the ICD will not be painful and dying will not be more painful if the tachycardia therapies are turned off.
- If the patient's circumstances change following deactivation, the patient can request reactivation.
- In some cases, and depending on device capability, shock therapy can be turned off, while retaining ATP therapy as a less traumatic attempt to revert a life-threatening rhythm. This type of deactivation requires a cardiac technologist or physiologist using a computerised programmer. While this approach may prevent distressing shocks, the potential for the retained ATP function to result in an unwanted extension of life should be considered.
- There may be a logistical delay between the request for and the completion of ICD tachycardia therapy deactivation.

ICD deactivation management plan

Cardiologists, general practitioners and hospital or community-based palliative care teams should collaborate to allow timely deactivation of ICD tachycardia therapies in all hospital, residential aged care and other community care settings, including patients' homes. Any centre or provider that coordinates care for patients with an ICD should have access to a formal pathway, for example, a health pathway held by a primary health network, or a pathway provided by a cardiac device clinic to enable deactivation of ATP and/or shock therapies.

Indications for deactivation of ICD tachycardia therapies

Indications that the time for deactivation of tachycardia therapies has arrived include:

- patient preference after informed consent discussions
- imminent death (an active ICD is inappropriate in the dying phase)
- congruence with the patient's wishes in an advance care plan
- withdrawal of anti-arrhythmic medications related to a decline in the trajectory of illness
- an active 'No CPR' order as part of an existing resuscitation plan (although this should not preclude specific consideration or discussion about the ICD).[22]

Decision to deactivate ICD tachycardia therapies

Ideally, the treating medical officer managing the patient's life-limiting illness should be responsible for establishing the patient and their family's current preferences and for facilitating ICD shock deactivation, if required. The decision to deactivate should be made in consultation with the patient's usual cardiologist and/or other physicians actively involved with the patient's care.

The decision to deactivate the device should be made in collaboration with a cognisant patient and their family, or the person responsible when the patient is not capable of participating in this process. In an emergency situation, or where the patient or the person responsible are unable to provide consent, the treating medical team may direct deactivation in the patient's best interests. This decision to deactivate may be made to avoid unnecessary pain and suffering in the face of medical futility. This decision should be guided by the principles of the End of Life Care and Decision-Making guideline[14] and NSW End-of-Life and Palliative Care Framework.[19] This will allow an appropriate focus on palliative care.

Documentation in the medical record

A written order from a medical practitioner is required to confirm that deactivation of ICD tachycardia therapies is to be carried out. The order must include clear documentation of the specific therapies that are to be deactivated as well as therapies that are NOT to be deactivated.

The record of informed consent from the patient or the person responsible should be documented. In the absence of consent from the patient or person responsible, an explanatory rationale from the attending medical officer should be recorded.

The details of the deactivation must be clearly recorded in the patient's medical notes or residential care documents and should be readily available to others involved in their subsequent care, e.g. in the eMR, My Health Record and in relevant referral or discharge letters.[22]

If the deactivation is recent, details of the manner of device deactivation (programmer versus magnet deactivation) **MUST** be documented on the death certificate. Even if the device has been deactivated for an extended period of time, the activation status of the device should be documented in a location visible to, for example, the relevant funeral home. If the

device activation status is not known, this should also be clearly documented.

Identification of the device

The Therapeutic Goods Administration is soon to establish and maintain the Australian Unique Device Identification database (AusUDID). This will strengthen monitoring and follow-up on existing ICDs and will provide more information to patients about their devices.[32] From 1 December 2021, all implantable medical devices are required to have both associated Patient Information Leaflets and Patient Implant Cards.[33] All patients should be strongly advised to carry their Patient Implant Card at all times.[22]

Should the patient not have a Patient Implant Card, their permission should be sought for treating clinicians to contact the implanting centre for details about their device. If the implanting centre cannot be contacted and there is no other way to obtain details about the device, an over penetrated X-ray of the ICD will show a radiopaque marker which will allow identification of the ICD model and manufacturer (see Appendix 1).

There is also a free app (Pacemaker-IDTM) that uses image recognition technology to determine the manufacturer of a given pacemaker and defibrillator in an X-ray image. This currently supports detection of Boston Scientific, Biotronik, Medtronic and Abbott (St. Jude) devices.[34] Although the accuracy of this app in identifying the correct make of device can vary, it may be helpful in an emergency situation.

The ICD manufacturers may be contacted to obtain information on specific devices. 24-hour contact details for the manufacturers that most frequently provide devices in NSW are listed below.

Table 1: ICD Manufacturer 24-hour contact details

Biotronik	1800 227 346
Boston Scientific (formerly Guidant)	1800 245 559
Medtronic (including Vitatron)	1800 643 193
MicroPort (formerly LivaNova, ELA and Sorin)	1300 642 778
Abbott (formerly St. Jude)	(02) 9966 7475 1800 839 259

People present during deactivation of ICD tachycardia therapies

A cardiac physiologist or technologist (either hospital or pacemaker company) will generally be present to reprogram the ICD and the medical officer may be in attendance in metropolitan facilities. Where relevant, a device technologist can often be organised to visit the patient in their own home.

In rural facilities, deactivation will usually be carried out by nursing staff (as detailed in the section 'Rural hospitals, primary and community health, palliative care and aged care facilities'). The patient's family, carer or other support people should be encouraged to be with the patient during the deactivation process.

Personnel, including medical practitioners and industry representatives, who do not wish to participate in deactivation are responsible for identifying qualified individuals who are willing to carry out this request.[5]

Sharing information about deactivation of ICD tachycardia therapies

In line with a competent patient's wishes, the patient's primary carer should be notified about the deactivation of ICD tachycardia therapies if they have not already been informed, ideally prior to deactivation. This should not delay indicated deactivation of tachycardia therapies that are causing, or have potential to cause, a patient immediate distress.

Other multidisciplinary care providers should be informed about deactivation to facilitate care that is integrated and coordinated. Examples include notification to sites involved in ICD telemonitoring, notification (where relevant) to a facility-specific nurse with an arrythmia case-management role, referral to the palliative care team for ongoing comfort measures,[3] or having a social worker available to provide support to the patient and their family.

After death

After death, it is recommended that staff from funeral homes are informed that the person has an ICD. If cremation is planned, the ICD must be removed due to the likelihood of explosion under extreme heat. ICD shock therapy must be deactivated before removal of the device to avoid the small chance of a shock being delivered to the person removing the device. Activation status is often available through liaison with the implanting institution or the patient's cardiologist.

If the activation status cannot be confirmed, it should be assumed that the ICD is **on**. If the type of device is unknown, assume it is an ICD and is programmed **on**.[34]

The Cardiac Society of Australia and New Zealand provides guidance for funeral homes in the Guidelines for the prevention of accidental exposure to high voltage electric shocks during the preparation for burial of deceased persons with Implantable Cardioverter Defibrillators.[35]

Practical implications for healthcare facilities

Temporary deactivation of ICD tachycardia therapies by bar or clinical ring magnet

Ideally, deactivation is conducted by a device technologist using a programmer (a small suitcase-sized machine or tablet, specific to each manufacturer) as soon as possible. However, as a temporary or last resort, all ICDs have a magnet sensitive switch that responds to a bar (or clinical ring) magnet.

- A bar (or clinical ring) magnet that is placed directly over the ICD device will temporarily deactivate shock and ATP function (see information in section 'Device-specific magnet instructions'). The magnet may be taped securely in place.
- Prolonged magnet use may have implications for patient comfort and skin integrity and care should be taken to minimise skin damage, for example, by use of a thin-membraned protective occlusive dressing between the skin and the magnet
- The magnet will not stop existing bradycardia or cardiac resynchronisation pacing functions, but some devices may revert to an asynchronous pacing mode.[22]
- The shock and ATP functions will be reactivated if the magnet is removed. ICDs from all manufacturers will respond in this way.
- Some ICD models may beep continuously or intermittently for a period of time after the magnet is placed over the device.[36]
- In rare cases, the magnet will not inhibit ICD therapy for example, in devices implanted before the mid-2000s when the 'Reed Switch' was set manually for patients who work in environments with strong magnetic fields.[36] In these circumstances, representatives from the manufacturer, in consultation with the patient's medical practitioner or cardiologist, can advise on deactivation of ICD tachycardia therapies using a programmer. Details on ICD manufacturers are provided in section 'Identification of the device').

Availability of deactivation magnet bar or clinical ring

- It is strongly recommended that all facilities likely to care for patients with ICDs have a bar or clinical ring magnet available, in case there is a need for temporary deactivation of tachycardia therapies.
- Bar or clinical ring magnets should be available in emergency, intensive care, cardiology and operating theatre settings. Access should be confirmed periodically through audit. Magnets may be also obtained from the ICD manufacturer for non-clinical settings.
- The magnet should be kept with resuscitation equipment and its availability must be regularly checked with the other emergency equipment. If the magnet is missing, immediate steps must be taken to retrieve or replace it.
- If the facility does not have a resuscitation trolley, the magnet should be placed in a central location which is easily accessible for staff and its availability must be checked regularly.

Metropolitan hospitals

- Local protocols should identify designated contact people within the hospital to provide advice and consultation relating to deactivation of ICD tachycardia therapies. These may include cardiology and palliative care teams and device technologists or physiologists. Some tertiary centres have dedicated clinical nurse consultants who assist in the management of ICDs.
- A list of contact details for technologist support out of hours should be developed by all facilities.
- If there is a delay in suitably qualified staff deactivating ICD tachycardia therapies with the assistance of a programmer, a bar or clinical ring magnet may be applied over the device to temporarily deactivate the shock and ATP function (see section 'Device-specific magnet instructions').

Rural hospitals, primary and community health, palliative care and aged care facilities

- A bar or clinical ring magnet should be taped over the device to temporarily deactivate the defibrillator function when the patient is dying. If there is no cardiac physiologist available to deactivate the shock function, the magnet should be left in place until the patient is deceased (see section 'Device-specific magnet instructions').
- Support and guidance from the device company should be sought if clinicians are unsure of any aspect of deactivation (24-hour contacts for device companies are provided in Table 1).
- If additional expert advice is required, the local clinician may contact the registrar on call at the hospital where the ICD was implanted (See Table 2 for details of many hospitals that provide ICD implantation).
- The magnet must be removed after death. Waiting for a period of at least 15 minutes beyond signs of life will ensure that any residual shockable cardiac arrest rhythm has ceased.
- Community and primary health services including primary health networks, palliative care services and RACFs are encouraged to develop a simple flow chart (or adopt the flow chart in Appendix 2) to assist staff to manage deactivation of ICD tachycardia therapies at the end of life in a timely manner.
- RACFs are considered a location of greatest risk in timely deactivation of ICD tachycardia therapies. RACFs should seek to identify patients with implantable devices on admission, or in a systematic process of review, and should develop an appropriate management plan.
- Entry to a RACF should act as a trigger for device review, including clarification and documentation of the device type, whether the device is a pacemaker or a defibrillator, the implanting centre and the device brand. Likely issues are patient loss to follow-up from their cardiologist and device implantation service and possible misidentification of the ICD as a pacemaker.

Resources

- An instructive video How to switch off an ICD at home for end of life care provides information on magnet use.[37] The removal of the magnet every seven hours in this video covers the possibility of a Biotronik ICD in situ. This step is not required for devices from other ICD manufacturers.
- The NSW Health Making An Advance Care Directive booklet and form provides information to help people understand and complete an advance care directive in NSW.[21]
- Three online education resources support patient and family conversations and are accessible on My Health Learning Health Education and Training Institute platform:
    1. **SHAPE End-of-life Conversations (Course code: 88619342**). This 30-minute module targets clinicians and provides a step-by-step communication framework for clinicians to conduct effective end of life conversations with patients, families and carers.[38]
    2. **Introduction to Advanced Care Planning (Course code: 39997722)**. This 30-minute module targets clinicians. It covers the evidence base and key terms used in advanced care planning, legal information and NSW Heath resources.[39]
    3. **eMR Resuscitation Plans (Course code: 263802555)**. This 30-minute module targets medical officers who are most likely to use advance care documentation and to hold resuscitation plan conversations and other clinicians who need to be aware of a patient's resuscitation plan. The module provides an introduction to using an electronic version of resuscitation plans within the eMR.[40, 41]

Implanting centre phone contacts

This list of ICD implanting centres is not exhaustive. As a general rule (or if the hospital is not listed here), both In hours and After hours, call the relevant hospital switchboard and ask for the cardiology advanced trainee on call. **When the implanting centre is a private hospital**, contact the cardiologist directly (if known) via their private rooms. If not known, contacting the private hospital may help identify the cardiologist and their contact details.

Table 2: Implanting centre phone contacts

Implanting centre		Phone
Blacktown Hospital	Switchboard Cardiology	(02) 9881 8000 (02) 8670 8295
Concord Hospital	Switchboard Arrhythmia case manager (business hours)	(02) 9767 5000 0425 253 314
Eastern Heart Clinic (Prince of Wales public and private hospitals)	Switchboard Ask for cardiology advanced trainee	(02) 9382 2222
Gosford Hospital	AICD physician in diagnostic cardiology via switch (business hours)	(02) 4230 2111
Gosford Private Hospital	Ask for treating cardiologist via private rooms or switchboard	(02) 4324 7111
Hurstville Private Heart Centre	Switchboard Cardiology	(02) 9579 7777 (02) 8197 3322
John Hunter Hospital	Switchboard Ask for cardiology advanced trainee	(02) 4921 3000
Liverpool Hospital	Switchboard	(02) 8738 3000
Mater Hospital Sydney	Switchboard Ask for the patient's cardiologist	(02) 9900 7300
Nepean Hospital	Switchboard Cardiac device clinic	(02) 4734 2000 (02) 4734 3015
Royal North Shore Hospital	Switchboard Ask for cardiology advanced trainee	(02) 9926 7111
Royal Prince Alfred Hospital	Switchboard Arrhythmia case manager (business hours)	(02) 9515 6111 0425 253 314
St George Hospital	Switchboard Ask for either on call cardiologist or cardiology advanced trainee	(02) 9113 1111
Strathfield Private Hospital	Switchboard Ask for the patient's cardiologist	(02) 9745 7444
St Vincent's Hospital	Switchboard ICD/Pacemaker clinic	(02) 8382 1111 (02) 8382 3150
Westmead Hospital	Switchboard Ask for the patient's cardiologist	(02) 8890 5555

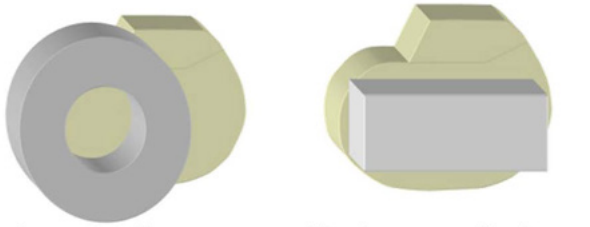
Device specific magnet instructions

Biotronik ICDs

When using a ring magnet to deactivate tachycardia therapies with a Biotronik ICD, offset it slightly so that the opening of the magnet rests just above the edge of the ICD housing (see Figure 1). For Biotronik ICDs, the inhibiting function of the magnet ends after eight hours. If the magnet needs to be kept in situ beyond eight hours, it should be removed for a few seconds before the eight-hour period expires and then it may be repositioned. The magnet may be reapplied for further eight-hour periods providing that it is removed and reapplied before the eight-hour period expires. The eight-hour countdown restarts when the magnet is reapplied to the device.

As soon as the magnetic field is removed, detection and therapy will immediately be reactivated. The application of the magnet does not affect bradycardia pacing and pacing will be resumed in line with the parameters that have been programmed.

Figure 1: Magnet placement for Biotronik ICDs[41]



Boston Scientific ICDs

For most Boston Scientific ICDs and cardiac resynchronisation therapy defibrillators (CRT-D) (**model numbers that do not begin with the letter 'A'**), apply the magnet directly over the implanted device (see Figure 2). This will put the device into 'Monitor Only' mode. No shocks or anti-tachycardia pacing will be delivered as long as the magnet remains in place. Beeping tones will be heard once every second for 60 seconds. There is no change to pacing therapy.

Model numbers beginning with 'A': Emblem S-ICD or emblem MRI S-ICD (A209, A219)

Subcutaneous ICDs are frequently placed in the left lateral chest wall (versus the usual left anterior subclavian region for ICDs with transvenous leads) (see Figures 3 and 4). For the S-ICD Emblem models, apply the magnet off-centre over the device header or over the lower edge of the device, as illustrated in Figure 2 (labelled 'Model numbers beginning with the letter A'). LISTEN for beeping tones (use a stethoscope if necessary). Therapy is not suspended until beeping tones are heard. After about 30 seconds, a longer tone will indicate that tachycardia therapies are disabled.

If no beeping is heard, try other positions within the target zones (at the upper and lower borders of the ICD) sweeping the magnet vertically and horizontally across the device borders. Maintain the magnet in each tested position for one second (as it takes approximately one second for the pulse generator to respond to the magnet). NOTE: If the beeper is disabled or if the patient has been through a magnetic resonance imaging (MRI) scan, the beeper may be inaudible. It may be necessary to engage a device technologist to use a programmer device to suspend therapy for these patients.

Secure the magnet in place to keep the therapy suspended. Beeping will continue for 60 seconds while the magnet is held in place. After 60 seconds, the beeping stops, but therapy continues to be inhibited unless the magnet has been moved. If it is necessary to confirm therapy is still being inhibited after the beeping has stopped, remove and replace the magnet to reactivate the beeping tones. This step can be repeated as necessary.

Magnet use for patients with deep implant placement

- Some patients with S-ICDs placed in the intramuscular tissue in the mid axillary line may have deeper than usual implantation. Multiple magnets may be used in a stacked configuration to increase the likelihood of eliciting the beeping and associated inhibition of therapy.
- If beeping tones cannot be detected, it may be necessary to use the programmer to suspend therapy. In patients with a deep implant placement (where there is greater distance between the magnet and the pulse generator), magnet application may fail to elicit the magnet response. In this case the magnet cannot be used to inhibit therapy. It will be necessary to engage a device technician to use a programmer device to suspend therapy in these patients.

Figure 2: Placement of magnet for Boston Scientific ICD models[42]

Most Boston Scientific ICD, CRT-D and S-ICD models (that do not begin with letter “A”)

Model numbers beginning with the letter "A"

Figure 3: Anatomic location and transvenous wires of most ICDs[43]

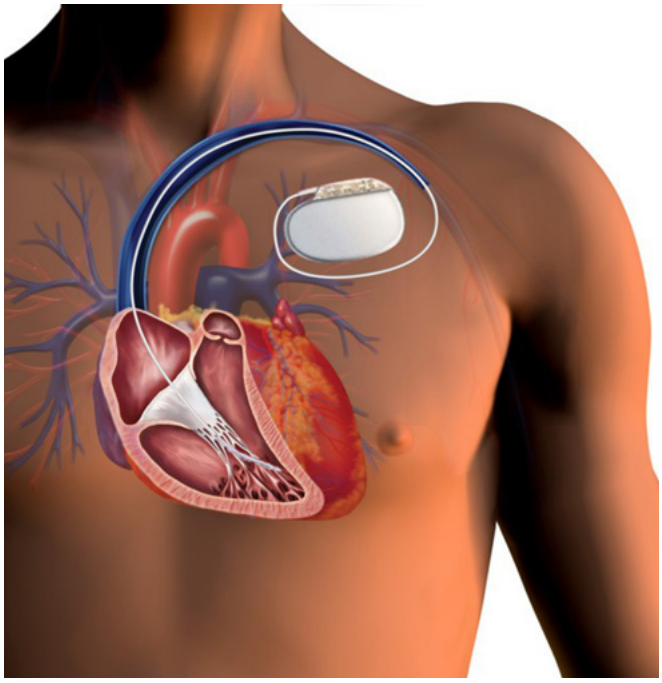
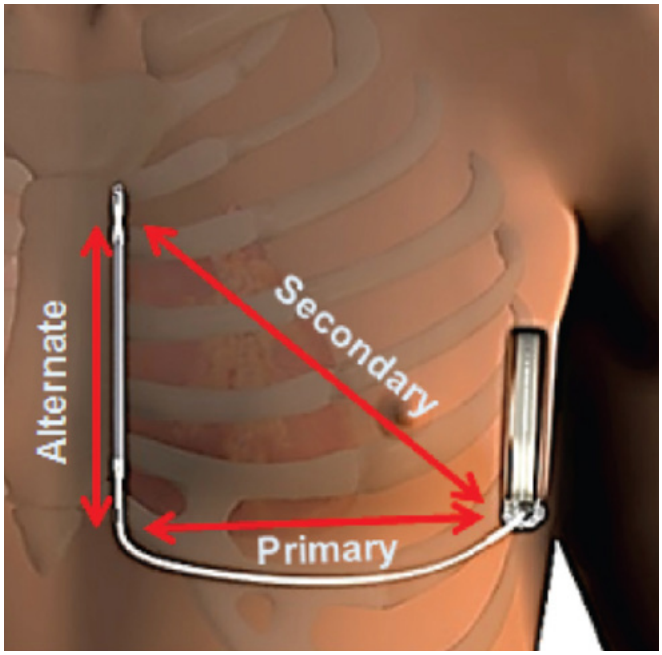


Figure 4: Anatomic location (and vectors) of subcutaneous implantable cardioverter defibrillators (S-ICD)[44]

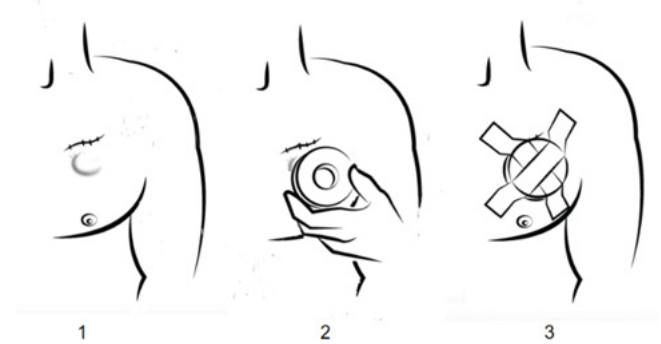


Medtronic ICDs

Positioning a magnet over a Medtronic ICD or CRT-D device suspends tachyarrhythmia detection, meaning that no therapies are delivered until the magnet is removed. This will not affect or change the pacemaker function of the device. Applying a magnet may cause a steady audible tone to emit from the device for 10 seconds when the magnet is first applied correctly over the device. A beeping or oscillating tone indicates an alert condition, and the ICD care provider should be contacted.

Figure 5a: Magnet for Medtronic ICD models[36]

Figure 5b: Placement of magnet for Medtronic ICD models[22]



Microport, Sorin and LivaNova

For all Microport, Sorin and LiavaNova ICDs the magnet should be centred over the left side border of the ICD (to avoid the header part at the top right corner).[36] When the magnet is applied, tachycardia therapy functions are inhibited (detection of rhythm disturbances, charging and therapy). Additional ICD responses to magnet application are that hysteresis, VV delay (delay between right and left ventricular activation in biventricular pacing), and AVD (delay between atrial and ventricular) paced/sensed offset are set to 0. The pacing rate is set to magnet rate and the following functions are disabled: Mode switch, Anti-PMT, Smoothing and Rate response.

Figure 6: Placement of magnet for Sorin or MicroPort (formerly Livanova, ELA and Sorin) ICD models[36]

Abbott or St. Jude ICDs

The pulse generator contains a giant magneto resistor (GMR) that, when activated, prevents delivery of tachyarrhythmia therapy. Bradycardia pacing is not affected. The GMR is activated in the presence of a strong magnetic field. A magnet placed over the pulse generator can, therefore, be used to prevent the delivery of therapy if a programmer is not available to turn the device off.

The magnet should be positioned off-centre so that the curve of the donut magnet is over the top or bottom end of the device or to either side as shown to the right. The pulse generator can be programmed to ignore the GMR. Therapies would then be delivered in the normal manner in response to detected arrhythmias. Magnet application would have no effect on operation. The pulse generator does not emit an audible tone when a magnet is placed over it. The effectiveness of magnets varies. If one magnet does not interrupt operation of the pulse generator, place a second magnet on top of the first or try a different magnet. Pressing firmly on the magnet to decrease the distance between the magnet and the pulse generator may also help.

Figure 7: Placement of magnet for St. Jude or Abbott ICD[45]

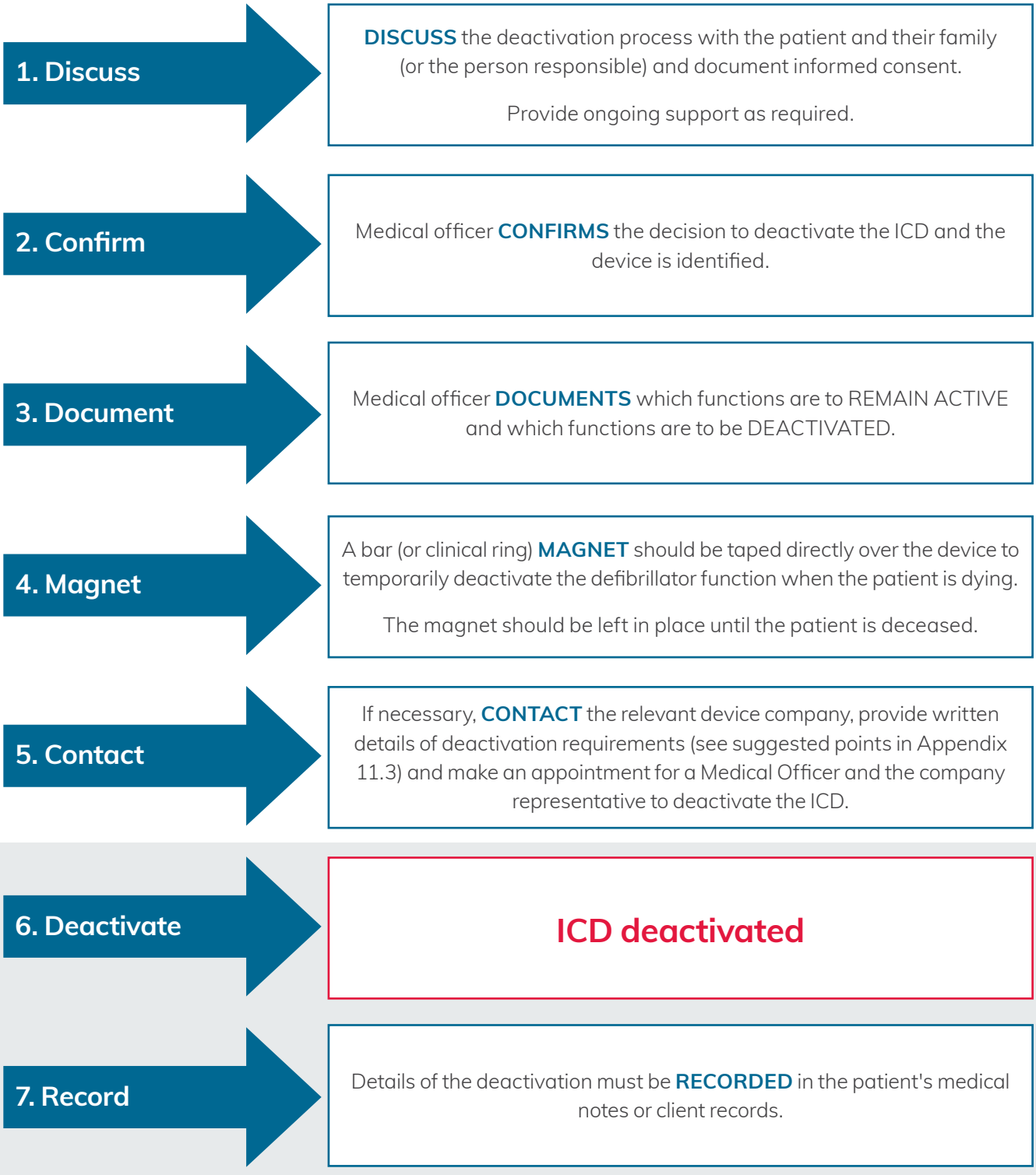
Appendix list

1. Radiographic identifiers by manufacturer
2. Process flowchart – community and residential aged care facilities
3. Request form for deactivation of an implantable cardioverter defibrillator
4. Implementation and compliance checklist.

Appendix 1: Radiographic identifiers by manufacturer

Manufacturer	Radio-opaque identifiers (typically at the 'header' or upper component of ICD)
Abbott or St. Jude Medical	Each device has an alphanumeric identifier corresponding to a specific model and can be identified from technical manuals or by calling technical services.
Biotronik	ICDs/CRT identifier is a three-part code: 1) Year of manufacture 2) Biotronik logo 3) Two-letter code unique to each device family 4) More recent devices have a Biotronik logo only
Boston Scientific (Guidant)	Manufacturer identifier is "BOS" followed by a three-digit number which does not correlate with a model number, rather it signifies which model software application is needed to communicate with the pulse generator. Devices bearing the mark "GDT" were manufactured by Guidant Corp.
Medtronic (including Vitatron) 	Originally used a Medtronic-identifier symbol (Medtronic "M") followed by a unique alphanumeric identifier for each model. In contemporary devices, the radiographic identifier to the left signifies a broader grouping of Medtronic devices.
MicroPort, Sorin and LivaNova	Sorin Group/Sorin Biomedica (including LivaNova) current devices consist of a three-letter code beginning with 'S' followed by both a group and a model letter. Older Sorin Biomedica devices may have five letters.

Appendix 2: Process flowchart – community and residential aged care facilities



Appendix 3: Request form for deactivation of an implantable cardioverter defibrillator

Client/patient contact details
Name:
Address:
Phone number:
Contact details for person requesting deactivation
Name:
Position:
Phone:
Email:
Device and deactivation details
ICD brand and model:
Expected deactivation date:
Reason for deactivation:
ICD functions to be deactivated:
ICD functions NOT to be deactivated:
Comments:

Appendix 4: Implementation checklist and compliance self-assessment

The self-assessment checklist may be a useful quality improvement tool to identify and audit key requirements detailed in this clinical guide in relation to your specific facility and patient group. Examples of these activities may include: identifying patients who have an ICD and documenting their ICD type and relevant medical contacts; determining if patients or the person responsible have had a recent discussion about deactivation and how this may align with an existing or new advance care directive; checking the availability of, and a routine audit process for, a magnet in inpatient and residential aged care facilities; or, providing access to education and resources on end of life conversations or magnet deactivation processes.

Organisation/Facility:			
Assessed by:	**Date of assessment:**		
Key requirements	**Not commenced**	**Partial compliance**	**Full compliance**
	Notes:		
	Notes:		
	Notes:		
	Notes:		
	Notes:		

Glossary

Term	Definitions
Advance care directive	A record of a patient's preferences regarding future healthcare treatments, should they reach a position where they are seriously ill or injured, or otherwise without capacity to make or communicate decisions about their care and treatment.
Anti-tachycardia pacing (ATP)	When a re-entrant tachycardia (for example ventricular tachycardia) is detected by an ICD, paced impulses are delivered at a rate higher than the patient's rate, to override the abnormal rhythm. This is a less painful therapy than defibrillation and is the first-line response of an ICD to some rhythms.[46]
'Best interests' of the patient	Considerations that reflect the patient's wishes and values while avoiding both inappropriate over and under-treatment.[14]
Bradycardia pacing	Bradycardia pacing is a function of most ICDs; the ICD will deliver a paced rhythm at a pre-set rate in response to a drop in the patient's heart rate below a pre-set limit.
Cardiopulmonary resuscitation (CPR)	A combination of chest compressions and delivery of breaths to sustain organ function during management of cardiac arrest.
Cardiac resynchronisation therapy (CRT)	CRT is a pacing function of some ICDs where a patient's ventricles may, due to changes in their structure, contract at slightly different times, disrupting their optimal mechanical function. CRT paces the right and left ventricles at the same time, overcoming this ventricular dyssynchrony to improve cardiac output.[3]
CRT-D	Cardiac resynchronisation therapy defibrillators
End of life care	Care that optimises the quality of life for individuals, their families and carers approaching and reaching the end of life, reducing suffering and promoting dignity. It is designed for those with a life-limiting condition and often for those in the last year of life.[19]
Electronic medical record (eMR)	An electronic interface that contains patient data and progress notes that document a person's medical and treatment history within an organisation.
Giant magneto resistor (GMR)	A component of an implantable cardioverter defibrillator that, when activated by a strong magnetic field, causes a change in the electrical resistance, thus disabling anti-tachyarrhythmia therapies.
ICD deactivation	The tachycardia therapies of an ICD can be turned off, ideally by a technologist using a computerised programming device. However, in the short-term and if necessary, the application of a strong magnet over the ICD stops the ATP and shock functions when it is placed securely over the device on the chest wall (see section Device-specific magnet instructions). Deactivation using either a computer programmer or a magnet will not interrupt the bradycardia pacing function (where the pacing will continue at a pre-set rate and may be decreased, but not turned off), nor will it interrupt CRT pacing.

Term	Definitions
Implantable cardioverter defibrillator (ICD)	ICDs are devices that are implanted in the chest wall with electrode leads running to the heart (in most cases transvenously), with the aim to prevent sudden cardiac death from life-threatening arrhythmias. The device continuously monitors the electrical rate and rhythm in the heart and if certain arrhythmias are detected, a tachycardia therapy (either anti-tachycardia pacing or a defibrillation 'shock') may be delivered to convert the heart into a safer rhythm.
Informed consent	Informed consent is a person's decision, given voluntarily, to agree to a healthcare intervention that is made 1) following the provision of accurate and relevant information about the healthcare intervention and alternative options available and 2) with adequate knowledge and understanding of the benefits and risks of the proposed intervention relevant to the person.
Person responsible	When a patient lacks capacity to provide consent to treatment, the person responsible can give valid substitute consent. Section 33A of the *Guardianship Act 1987* sets out the hierarchy, in descending order, of the person responsible (other than for a child or a person in the care of the Director General): (a) The person's guardian (including enduring guardian) (b) The person's spouse or de facto spouse, who has a close and continuing relationship (c) The person's carer who is unpaid (d) A close friend or relative providing they are not receiving remuneration for any services provided.[47]
Residential aged care facility (RACF)	Residential facility for older people who can no longer live at home and need ongoing help with everyday tasks or health care.
Resuscitation plan	A medically authorised order to use or withhold resuscitation measures, which also documents other aspects of treatment relevant at the end of life.
Subcutaneous implantable cardioverter defibrillator (S-ICD)	All ICDs have pulse generators inserted subcutaneously, however S-ICDs also have leads placed subcutaneously (rather than transvenously). With the exception of 30 seconds of pacing following post-shock asystole, S-ICDs do not have a pacing function for bradyarrhythmias, nor for cardiac resynchronisation therapy.[44] Some S-ICDs are inserted deeper into the intramuscular tissue,[48] near the left mid-axillary line, whereas ICDs and pacemakers are implanted just under the skin in the subclavicular region. With the exception of the discussion of magnet use in S-ICDs in section Boston Scientific ICDs, use of the term ICD in this document is inclusive of S-ICDs.

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