Australian Government
Organ and Tissue Authority

donate life

Best Practice Guideline for Donation after Circulatory Determination of Death (DCDD) in Australia

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Foreword

This national guideline has been developed by the Organ and Tissue Authority (OTA) and the DonateLife Network. It provides guidance in relation to the practice of donation after circulatory determination of death (DCDD) in Australia.

The purpose of this guideline is to promote a consistent, medically appropriate, and highly ethical practice of DCDD in Australia that optimises donation and transplantation outcomes.

It supersedes the 2010 'National protocol for donation after cardiac death'[1]. The earlier national protocol was created at a time when DCDD was relatively new and less widely undertaken in Australia, and at a time when many clinicians may have been unfamiliar with this donation practice. DCDD has become accepted as a routine donation pathway and regularly occurs in throughout Australia.

This guideline focuses on the practice points and issues that are specific to DCDD and should be used in conjunction with other resources that provide guidance on more general aspects of donation practice in Australia. These include:

- Australian and New Zealand Intensive Care Society (ANZICS), 'The statement on death and organ donation', Edition 4.1, 2021.[2]
- Australian and New Zealand Intensive Care Society (ANZICS), 'Statement on care and decision making at the end-of-life for the critically ill', Edition 1.0, 2014.[3]
- The Transplantation Society of Australia and New Zealand (TSANZ), 'Clinical guidelines for organ transplantation from deceased donors', Version 1.6, May 2021.[4]
- National Health and Medical Research Council (NHMRC), 'Ethical guidelines for organ transplantation from deceased donors ', 2016.[5]
- Organ and Tissue Authority (OTA), 'Best practice guideline for offering organ and tissue donation in Australia', Edition 2.[6]

DCDD practice in Australia is similar to that in other countries and guidelines from the United Kingdom (UK)[7,8], United States (US)[9], and Canada[10], have been reviewed in the preparation of this guideline.

Note
This is a guideline only. It is important for clinicians to ensure that their local practice of DCDD is consistent with relevant jurisdictional legislation and policies, and local hospital policies and guidelines.

Scope and context

Donation that occurs following death confirmed using circulatory criteria, referred to as donation after circulatory determination of death (DCDD), currently accounts for about 30% of deceased organ donation in Australia.

There are a limited number of circumstances in which the donation of organs for transplantation can successfully occur after circulatory determination of death – see Table 1.

The Maastricht classifications were first devised in 1995 and have since evolved to include additional categories. In Australia DCDD predominantly occurs according to Maastricht category 3, where cardiac arrest is expected after treatment is withdrawn in a controlled setting such as an intensive care unit (ICU) or operating theatre. This is usually in the context of a critical illness from which the patient is unable to recover and where there has been agreement for withdrawal of cardio-respiratory support (WCRS) because ongoing treatment will no longer be of benefit to the patient.

Typical illnesses that lead to a person being a potential DCDD donor include irreversible brain injury (traumatic, cerebrovascular or hypoxic-ischaemic) where there is little or no possibility of deterioration to neurological death; severe cardiac, respiratory or liver failure; ventilator-dependent quadriplegia; and advanced neuromuscular disease with respiratory failure.

Patients who are medically suitable to donate one or more organs for transplantation and in whom death is likely to occur shortly after WCRS may be suitable for DCDD. WCRS usually involves extubation with cessation of mechanical ventilation and may also include cessation of vasoactive agents provided for haemodynamic support, or removal of more advanced mechanical cardio-respiratory supports.

If circulatory arrest, and thus death, occurs within a short timeframe after WCRS, generally within 90 minutes, donated organs can be transplanted with successful outcomes.

The decision to withdraw treatment is usually a consensus decision between healthcare staff with agreement sought from the family, or by the patient in the rare circumstance that they are conscious and competent to make their own end-of-life decisions.

Donation occasionally occurs in Australia according to Maastrict category 4, after cardiac arrest when death has already been determined using neurological criteria. It may be that DCDD is possible in other circumstances, including after medically assisted dying (Maastricht category 5), noting that donation in this context occurs in other countries and that voluntary assisted dying legislation has been passed in some jurisdictions of Australia.[13–16] DCDD after unexpected cardiac arrest (Maastricht categories 1 and 2) may also be possible, although this is not currently undertaken in Australia due to the complex logistics involved and challenges in obtaining consent.

Table 1 Modified Maastricht classification for DCDD [11, 12]

Category 1	Out of hospital cardiac arrest with unsuccessful resuscitation — dead on arrival at hospital	Uncontrolled
Category 2	In hospital cardiac arrest (unexpected) with unsuccessful resuscitation — in emergency department, ICU, or ward	Uncontrolled
Category 3	Expected cardiac arrest after withdrawal of treatment — in ICU or operating theatre	Controlled
Category 4	Cardiac arrest following neurological determination of death, unexpected or expected — in ICU or operating theatre	Uncontrolled if unexpected Controlled if after planned withdrawal of cardio-respiratory support e.g. family wish to be present at this time
Category 5	Medically assisted death — in ICU, ward, or operating theatre	Controlled

(ICU = intensive care unit)

This guideline is focused on donation in adults according to Maastrict category 3, as this encompasses the vast majority of DCDD in Australia. Not all elements of this guideline may apply or be accurate in other forms of DCDD or where DCDD occurs in child donors.

Donation specialist staff referred to throughout the guideline include:

- Donation specialist refers to either medical or nursing donation staff,
- Donation Specialist Medical (DSM) refer to medical donation staff, and
- Donation Specialist Nurse applies to any of these nursing roles:
  - Donation Specialist Nurse Coordinator (DSNC)
  - Donation Specialist Nurse (DSN)
  - Donation Specialist Coordinator (DSC)
  - Donor Coordinator (DC)

In this guideline, 'family' means those closest to the person in knowledge, care and affection, including the immediate biological family; the family of acquisition (related by marriage or contract); and the family of choice and friends (not related biologically or by marriage or contract)[2]. Jurisdictional legislation must be followed when identifying the appropriate individual to provide formal consents. For donation that will occur after death this person is referred to as the 'senior available next-of-kin' (SANOK) and is specified by jurisdictional human tissue legislation (e.g. Human Tissue Acts, Transplantation and Anatomy Acts). For medical treatments or procedures prior to death in individuals lacking decision-making capacity, including withdrawal of treatment and ante-mortem interventions, consent may be required from a substitute decision maker according to jurisdictional guardianship legislation and this person may be different from the SANOK.

This guideline focuses on the clinical practice of DCDD with the goal of promoting a consistent best practice approach. The guidance does not cover, or necessarily take into account, elements of jurisdictional legislation or policies that might impose limitations in these practices. These limitations mostly relate to ante-mortem interventions and associated consent, where state and territory legislation and policies are not uniform and, in some circumstances, lack clarity and specificity with respect to permissibility of ante-mortem interventions and consent for such procedures. Clinicians must comply with the relevant jurisdictional legislation in their state or territory with respect to ante-mortem interventions and the provision of consent to such procedures.

Key elements of the DCDD process

The guideline focuses on the key steps in the donation process, with an emphasis on the aspects that are specific to the practice of DCDD. It is aligned with the 'Best practice guideline for offering organ and tissue donation in Australia' [6] which outlines the best practice approach for discussing donation with families of potential donors in Australia, including individuals who have the potential to donate by DCDD and donation after neurological determination of death (DNDD).

1 Routine referral and suitability

In most hospitals in Australia there is a requirement for 'routine referral' or 'routine notification' to donation specialist staff, either within the hospital or the local donation agency, of patients in the ICU or the emergency department with planned end-of-life care. This routine communication is to ensure that feasibility of organ donation is assessed sufficiently early so that, if donation is possible, there is an opportunity for the family to be approached and for the assessments and logistical arrangements necessary for donation to be undertaken. At routine referral it is usual for the patient's status on the Australian Organ Donor Registry (AODR) to be checked so that this information, when appropriate, can be shared with the family.

Routine referral is particularly important for DCDD as patient suitability for donation may be less apparent to treating clinicians compared to potential donors who meet neurological death criteria. In addition, early referral is important to ensure the timing of WCRS and end-of-life care allows for DCDD.

Donation specialist staff have specific knowledge about donation, including the required timeframes to facilitate donation, and have access to information that may influence the donation process, such as whether there are transplant candidates awaiting an urgent transplant and the availability of surgical retrieval teams. Their involvement can assist in determining medical suitability and planning for family communication when offering donation.

It is important that routine referral occurs only after there has been medical consensus that continuing active treatment will not be of benefit to the patient. This is important to avoid any perceived conflict of interest in regard to the decision-making for proceeding to WCRS and end-of-life care, and that in relation to donation.[2]

Routine referral criteria are deliberately broad with the purpose of ensuring that all potential donor opportunities are identified. The majority will be able to be excluded based on the medical information available at this time. If considered potentially suitable, the undertaking of further tests and information gathering for the purpose of organ donation should only occur after the family (or patient) has provided consent to donation. It is important that there is clear documentation of the prognosis and plan to transition to end-of-life care, family acceptance of impending death, and discussions with the family about donation.

2 Decision to proceed to DCDD, including prediction of death after WCRS

Predicting whether death will follow soon after WCRS can be difficult and there is often uncertainty. The variables most associated with rapid circulatory arrest after WCRS include patient dependence on controlled ventilation, poor oxygenation, vasopressor use, low Glasgow Coma Scale (GCS), and a higher number of absent brainstem reflexes.[17,18]

Studies have shown that the opinion of an experienced treating intensivist in predicting time to death is as good as, if not superior to, algorithms that rely on physiological or other clinical criteria[19]. The involvement of a second independent intensivist can be useful, especially when the treating specialist has doubt about whether the patient will die in the timeframe required for donation to proceed.

Although current Australian practice requires death to occur within 90 minutes after WCRS, the opportunity for DCDD should not be restricted to cases where it is thought to be highly likely that death will occur in this timeframe. Instead, a case-by-case evaluation led by donation specialist staff should take into account the treating clinician's view about the likelihood of death occurring soon after WCRS, the potential donor's and/or family's expressed wish for donation, the availability of retrieval services and other logistic considerations including donor location, along with the potential outcome in terms of likely benefit to recipient(s). In the circumstances where there is registration on the AODR and strong family support, a lower threshold to proceed to donation may be appropriate.

Currently in Australia, approximately 30% of attempted DCDD cases do not proceed due to death not occurring within a timeframe that allows for successful donation for transplantation.

Using criteria that are too narrow for deciding to proceed with DCDD will result in missed donation opportunities. Criteria that are too broad places an undue burden on donor families, hospitals, and on donation, retrieval, and transplantation services. Maintaining an optimum balance is a shared priority; this will depend on many factors including resource availability given the level of activity at the time and as well as the overall system capacity.

In Australia it is illegal to attempt to hasten death in order to meet the timeframes required for successful DCDD – see section on 'Process for WCRS and ensuring patient comfort and dignity'.

3 Timing of raising donation with the family

Donation should be raised with the family only after they understand the poor prognosis and likely impending death of their relative. Introducing the topic of organ and tissue donation should not be rushed and it is often best raised as a separate discussion to the end-of-life conversation.

In the rare situation where a conscious, competent patient is requesting cessation of supportive treatment and provision of end-of-life care, the same approach should be taken with a separation in time between the end-of-life and donation discussion.

Separating end-of-life and donation discussions can prevent any perceived conflict of interest by ensuring that organ and tissue donation discussions occur only after medical and family consensus has been reached that active treatment will no longer be of benefit to the patient.

Most families benefit from some time and space after receiving the news of death, or impending death, before donation is discussed. The separation of discussions may allow the family to better receive information and make a clearer, more informed decision about donation.

The raising of donation, however, should not be overly delayed. Clinicians and families will often agree a timeline for WCRS and may be reluctant to modify this to facilitate donation. Many families will begin to plan rituals associated with the death of a family member, or organise travel and other important matters at this time. Incorporating donation is easier if considered early rather than late in the process of preparing for death. Also, some families decline donation for the reasons of fatigue and the length of the process, and this may be more likely if there is a delay in raising donation.[20]

DCDD always requires that donation be raised prior to the death of the patient, which differs from DNDD where donation is usually raised after death has been certified. However, it is increasingly common for donation to be raised prior to determination of neurological death, either by family or hospital staff. There may be discussions involving end-of-life care decisions in patients with devastating brain injury with the option offered to continue supportive treatment so as to allow time for loss of all brain function to occur for the purpose of subsequently facilitating DNDD.

In a small number of occasions, a donor initially planned for DCDD loses all brain function during the donation workup process in which case, following neurological determination of death, donation procedures can be adjusted to follow those consistent with DNDD. If this is a possibility, pre-emptive explanation of this during the consent process may avoid families feeling unsettled by such a significant new clinical finding late in the course of events. Also, in circumstances where neurological determination of death has occurred, some families choose to proceed according to DCDD processes for various reasons. The available options, including the associated processes and donation outcomes, should be explained to the family as part of the consent process, as outlined in the next section 'Information conveyed when seeking formal consent for DCDD'.

4 Information conveyed when seeking consent for DCDD

Formal written consent for donation is usually undertaken by the donation specialist nurse. The person obtaining consent should be able to provide detailed and accurate information about the donation process. In obtaining formal consent for DCDD, there are elements of the process that the family (or rarely the conscious patient) need to understand that differ from DNDD. These include:

- How end-of-life care will be provided, including the process of withdrawal of supportive treatments.
- Organ donation can only proceed if death occurs within a specific timeframe. If death does not occur within the required timeframe, the family will be informed and their relative will continue to be cared for in an appropriate location. Tissue donation may still be possible.
- The treating team will give medications for comfort in the same way as for all other patients receiving end-of-life care (the same as for patients who are not donors) in order to relieve pain, distress, shortness of breath, or anything else that may be distressing to the patient or family, such as noisy breathing, seizures and abnormal movements etc.[2]
- The family can be with their relative before, during, and after the withdrawal of the supportive treatments.
- Organ donation procedures and retrieval surgery need to begin with minimal delay following death to limit any deterioration of organs due to lack of blood flow. This means that family will have little time with their relative after death and will need to have said their final goodbyes.
- The location of WCRS (either ICU or operating theatre complex) and, if there is a choice, the impact on donation and transplantation outcomes with the operating theatre complex preferred if the liver and/or heart are to be donated – see sections on 'Location of WCRS and planning meeting for organ retrieval surgery' and 'Warm ischaemic time and stand down process if death does not occur'.
- If relevant (e.g. the patient has severe irreversible brain injury) the small chance of loss of all brain function occurring, in which case donation may be able to be adjusted to a DNDD pathway, and that this would be discussed with the family, if necessary.
- Additional tests and procedures will need to be undertaken for the purpose of donation and are done prior to withdrawing supportive treatments – see section on 'Ante-mortem interventions'.

All information provided to the family should be communicated in simple, plain language and tailored to the individual family, noting that some families/family members wish to receive more detailed information about the processes associated with donation than others. Always consider using an interpreter for families from non-English speaking backgrounds.

5 Agreements for donation to proceed

In addition to obtaining consent from the family (or patient) for donation, further agreements are required in order for donation to proceed.

a Coroner

If the circumstances of death are reportable to the coroner, consent from the coroner for donation to proceed will need to be sought prior to death. The communication with the coroner or his/her representative to seek agreement to donation is often undertaken by the donation specialist nurse, although it is the responsibility of the treating medical staff to formally report the death and complete the medical deposition.

In Australia approximately 50% of all donors have a cause of death that requires it to be reported to the coroner and in the vast majority no limitations are placed on donation.

In most jurisdictions a written 'statement of identification' is required by the coroner that identifies the deceased and this is usually completed by the family. Local protocols should be followed as to whether this statement can be completed before death or only after death.

b Designated officer

All jurisdictions recognise the specific role within a hospital of a designated officer responsible for authorising the removal of organs and tissue for the purpose of transplantation, or other therapeutic, medical, or scientific purposes. The designated officer has the responsibility to ensure that the removal of organs and tissue is in accordance with the law.

The designated officer needs to determine that appropriate consent/lack of objection from the patient/ senior available next-of-kin is provided, with the specific requirements varying according to jurisdictional legislation." For reportable deaths they must also determine that the coroner has provided consent or conditional approval for donation of organs and/ or tissue, or the coroner has advised that consent is not required (as permitted by jurisdictional legislation).

Given the need to proceed with donation promptly with minimal delay after death has occurred, it is important that the designated officer is consulted and has reviewed all of the details prior to WCRS. Where required by jurisdictional legislation, the donation specialist nurse must ensure the designated officer will be contactable as soon as practicable after death in order to provide final written authorisation and for completion of the required paperwork.

6 Ante-mortem interventions

Ante-mortem interventions are procedures that are undertaken on the patient prior to death for the purpose of organ donation.

Organ donation cannot occur without undertaking specific procedures and investigations to determine suitability for transplantation, to facilitate organ matching with suitable recipients, and to maintain organ function and viability. Ante-mortem interventions are for the purpose of enabling donation and/or improving transplant outcomes and are considered ethical if their potential benefits outweigh potential harms in a patient where donation would be consistent with their wishes.[21,22]

Laws and policies relevant to ante-mortem interventions are not uniform in Australia. Not all jurisdictional legislation and policies clearly specify that ante-mortem interventions are permissible and/or which interventions can be undertaken, and the consent arrangements for those interventions. Clinicians must ensure that ante-mortem interventions and the necessary consents comply with jurisdictional, policies, and hospital protocols in their state or territory.

There is no agreed national or international consensus as to what constitutes an ante-mortem intervention. Ante-mortem interventions can be considered in a broad sense, for example, "any intervention prior to death that is for the purpose of organ donation and transplantation" [11] or more narrowly, such as, "interventions undertaken prior to death in order to limit ischaemic injury to transplantable organs".[23]

Certain ante-mortem procedures are essential for DCDD to occur. These include continuing mechanical ventilation and other supportive treatments for a period of time to enable donor assessment and the donation process to be organised, and taking blood tests for organ function assessment, tissue typing, and infectious disease screening.

The following clinical aspects are relevant when considering ante-mortem interventions:

- the potential to cause the patient (or family) discomfort or harm
- their invasiveness or intrusiveness
- whether the procedure is common or unusual relative to those frequently undertaken in critically ill patients in ICU
- the extent to which they alter the usual end-of-life care process for the patient
- their importance for optimising donation and transplant outcomes.

These factors might be used to guide the need for, and acceptability of, specific ante-mortem interventions. For example, interventions may be more acceptable if they are non-invasive, unlikely to cause discomfort, commonly undertaken in ICU, minimally impact end-of-life care, and are important for optimising donation and transplantation outcomes. Specific consent should be obtained from the family (or rarely the patient, if conscious) when ante-mortem interventions are invasive, unusual, have potential to cause discomfort and/or significantly alter the usual end-of-life care process for the patient. Analgesia and/or sedatives should be administered to the patient to minimise any pain or discomfort that may be associated with ante-mortem interventions.

Specific consent would usually be obtained for the following ante-mortem interventions:

- Bronchoscopy
- Trans-oesophageal echocardiography (TOE)
- Intravenous heparin administration (see below)
- Blood product administration[1]
- Cardiopulmonary resuscitation (CPR)
- Femoral cannulation
- Intubation and ventilation for the purpose of organ donation.

The general consent obtained for DCDD is sufficient for the following procedures (additional specific consent not required):

- Blood tests for organ function, tissue typing and infectious disease screening
- Ultrasound, including transthoracic echocardiography (TTE)
- X-ray and computer tomography (CT) imaging
- Insertion of arterial line for monitoring and central venous catheter for administration of vasoactive and other medications (in some ICUs consent for these are sought in all critically ill patients)
- Use of vasoactive medications and intravenous fluids to maintain blood pressure.

Intravenous heparin administration is used variably within Australia as per jurisdictional and hospital policies and protocols. Recent published evidence favours the use of ante-mortem heparin in improving liver transplant graft survival, possibly through enhancing perfusion and preventing thrombosis[24]. Similarly, ante-mortem heparin may reduce the risk of recipient graft thrombosis in DCD pancreas transplantation[25]. Typically, a heparin bolus (e.g. 25,000 units [or 300 u/kg]) is given at the time of WCRS, although if there is any concern that heparin may cause harm or hasten death (e.g. in a potential DCDD donor with an intracranial haemorrhage), the heparin can be given when the patient is apnoeic.[2]

7 Location of WCRS and planning meeting for organ retrieval surgery

As part of the consent process with families, it is explained that organ retrieval surgery needs to commence with minimal delay once death has been declared following circulatory arrest.

The location of the WCRS is important in order to minimise the time between death and the start of the donation retrieval surgery and so limit the ischaemic injury to organs intended for transplantation – see section on 'Warm ischaemic time and stand down process if death does not occur'. The usual locations for WCRS are the ICU or the operating theatre complex, such as the anaesthetic bay, recovery, or operating theatre. As part of explaining the process for donation and obtaining consent from families, it should be conveyed where WCRS will occur and what this will mean if family members wish to be present with their relative during this time. If hospital infrastructure and established protocols allow a choice of location, each option should be explained along with any influence on their experience and possible impact on donation and transplantation outcomes (e.g. through affecting warm ischaemic times). WCRS in the operating theatre complex will facilitate a shorter duration between death determination and organ retrieval, minimising organ warm ischaemic injury. This is the preferred site of WCRS when donation of the liver and/or heart is planned.

If WCRS is to occur within the operating theatre complex, families will need to be made aware of the operating theatre requirements (such as the wearing of scrubs or over garments – as per hospital guidelines) and that they will be escorted from the operating theatre soon after death occurs. If death does not occur within the timeframe that permits donation, end-of-life care will continue in a pre-agreed location (e.g. return to the ICU, or other location).

If WCRS is to occur within the ICU setting, families need to be aware that their family member will be moved from the ICU to the operating theatre very soon after death has occurred. If death does not occur in the timeframe that permits donation, end-of-life care will usually continue in the ICU.

Planning meeting for the organ retrieval team

It is common practice for the donation specialist nurse to convene a meeting 30 minutes prior to WCRS. The purpose is to ensure that the local operating theatre staff and attending surgical retrieval team are appropriately briefed about the donor and that there is a common understanding of how the DCDD will proceed. This meeting often takes about five minutes and can be conducted in the operating theatre complex with the operating theatre team already scrubbed and ready.

The meeting usually covers:

- Introduction of each person to confirm roles and responsibilities.
- Review of donor paperwork including the consent form, coronial approval (if relevant), designated officer's pre-authorisation, and pathology results such as blood group and infectious disease screening (serology and nucleic acid testing). This review streamlines the process so only completion of formal identification and citing of death declaration is required at the time the deceased arrives in the operating theatre.
- Confirmation of organs planned for retrieval and review of the steps involved in the surgical retrieval process.
- Agreement for the process of standing down the planned donation if death does not occur in the timeframe, and the location for ongoing end-of-life care in situations where WCRS is to occur in the operating theatre complex.
- Reconfirmation of the time planned for WCRS.
- Finalisation of operating theatre complex requirements.

8 Process for WCRS and ensuring patient comfort and dignity

The time at which WCRS will be undertaken must be planned for and agreed amongst all parties, including treating clinical staff, the donation team, the operating theatre staff and surgical retrieval team, and undertaken at a time that takes into account the family's preferences. Sometimes the scheduled time for WCRS needs to be adjusted due to logistical and other considerations, in which case the donation specialist nurse will inform the family and all relevant professionals.

It is important to plan for the WCRS and subsequent movement of the deceased to the operating theatre with a focus on minimising barriers that may cause delays. Supportive treatments other than those required for maintaining cardio-respiratory function should be ceased prior to WCRS, including renal replacement therapy and nutritional support. Unnecessary monitoring and other devices (e.g. pneumatic calf compression devices) should also be removed ahead of WCRS. If WCRS is to take place in the operating theatre room, anaesthetic bay or recovery area, using the operating theatre table rather than the ICU bed or trolley can shorten the time to surgery following death. The patient along with pillow and bed clothes can be transferred onto the operating theatre table prior to WCRS. Procedures for donation following death, such as re-intubation and prepping and draping, can then be conducted more quickly than if bed transfers are required following death.

Everything required for donation should be in place prior to WCRS. Close communication between attending donation specialist staff and the treating clinical team is essential. The family, if they have chosen to be present, and the monitoring of the patient should be agreed and in place. The donation specialist should ensure the retrieval team and operating theatre staff are on site and ready.

The provision of comfort care and the WCRS should be managed by the treating clinical team. Treating clinicians should provide comfort care with the goal of symptom relief as they would in any other end-of-life care setting (when donation is not occurring). In particular, the administration of analgesia and sedative agents to relieve pain, anxiety, dyspnoea or other symptoms should be directed by the treating clinical team and not by staff overseeing the donation process. Staff associated with retrieval teams or transplant units should not be present and should have no role in guiding any aspects of palliative care.

Usual practice in the WCRS is the simultaneous cessation of mechanical ventilatory support, generally in the form of extubation (without pre-oxygenation) to room air, along with stopping any vasoactive infusions.

Consideration should be given to reducing the risk of aspiration of stomach contents (irrespective of whether the endotracheal tube is to be removed or not) with feeds ceased for a period and aspiration of the nasogastric tube prior to extubation, extubation with the patient in a 30-degree head-up position and avoidance of external pressure to the abdomen.

DCDD may occasionally be possible in patients who are dependent on non-invasive ventilatory support or high-flow high-concentration oxygen by nasal prongs or mask, in which case WCRS involves removal of these devices and ensuring adequate relief of dyspnoea with sedative and analgesic medication.

Patients with mechanical devices such as cardiac pacing (permanent or temporary), an intra-aortic balloon pump, extra-corporeal membrane oxygenation (ECMO) or a ventricular assist device require these supports to be discontinued as part of WCRS. This process should be carefully planned and led by treating senior medical specialist staff.

Planning meeting for the ICU team

It is usual practice for the donation specialist nurse to meet with the ICU clinical team to confirm the processes related to WCRS, death determination and post donation care (see next sections).

Certain aspects of the process are discussed along with who will undertake specific tasks including those related to technical aspects of WCRS and monitoring, administration of comfort care medication, administration of heparin (if relevant), confirmation of death, supporting the family during the dying process and after death, and moving the deceased to the operating theatre.

9 Monitoring and determination of death

Monitoring should continue following WCRS to enable accurate identification of cessation of circulation (blood flow) for the determination of death, and other important time points including those for the onset of warm ischaemic time (see below).

The preferred monitoring is:

- Arterial catheter for blood pressure
- Pulse-oximetry for oxygen saturation.

If an arterial line is present, electrocardiography (ECG) should not be used (see below).[2]

When WCRS is occurring in the ICU it is usual for the bedside monitor to be turned off. Donation specialist staff and ICU staff can observe the patient's vital signs by viewing a central monitor away from the bedside. When WCRS is occurring in the operating theatre complex (e.g. anaesthetic bay, recovery, or operating theatre), the bedside transfer monitor or operating theatre monitor can be turned away from the family and faced toward donation specialist and ICU staff. Monitor alarms should be disabled.

The determination of death using circulatory criteria is a common event in medicine and the features are well known. They include absence of movement and unresponsiveness, absence of pulse and breathing, and pupils that are dilated and unresponsive to light. The law in Australia states a requirement for 'irreversible cessation of circulation of blood in the body of the person'. In practice, the term 'irreversible' is taken to describe permanent, meaning that the circulation will not resume spontaneously and there will be no attempt to restore it through intervention.

Current scientific evidence supports observation of loss of circulation for a minimum of 5 minutes in order that circulatory arrest be permanent[26]. Spontaneous resumption of the circulation (autoresuscitation) beyond 5 minutes of mechanical asystole after WCRS has not been reported[2]. The requirement is for mechanical asystole and not electrical asystole, noting that electrical activity may continue for many minutes after cessation of circulation. In the context of DCDD, it is important to minimise warm ischaemic organ injury and so the determination of death should not be delayed beyond 5 minutes of circulatory arrest.[2]

Given the requirement for the accurate detection of loss of pulsatile flow (mechanical asystole), arterial line monitoring is recommended. When the use of an arterial line is unacceptable to the patient or family, or is not technically possible, an alternative reliable means must be used (e.g. echocardiography, arterial Doppler, ECG) 27. The use of ECG to assess the cessation of circulation may unnecessarily prolong warm ischemia, since electrical activity can persist with no effective circulation.

Following observation of absent circulation by the above means, confirmation of death is then undertaken by clinical examination (e.g. absence of spontaneous movement, breathing, heart sounds, and central pulse).

After death has occurred it is important that no manoeuvres be undertaken which may restart the circulation (e.g. mechanical ventilation, chest compressions etc) – see section on 'Post-mortem procedures, retrieval surgery, and family viewing'.

Box 1
Determination of death using circulatory criteria in the context of DCDD

- Arterial blood pressure monitoring is recommended.
- Absence of arterial pulsatility for 5 minutes is observed prior to confirmation of death.
- Electrical asystole is not required, noting that electrical (ECG) activity may persist beyond circulatory arrest.
- Death is confirmed by clinical examination (e.g. absence of spontaneous movement, breathing, heart sounds and central pulse).
- Post-mortem interventions that may restart the circulation should not be undertaken e.g. mechanical ventilation, chest compression.

(ECG = electrocardiography)

Following the determination of death, organ donation procedures and retrieval surgery can commence. Minimising any delay between the time of death determination and commencement of surgery is important for reducing warm ischaemic times and optimising donation and transplantation outcomes. Families may be guided to use the period following loss of circulation to say their final goodbyes so that upon death determination they are ready for their deceased relative to be moved to the operating theatre. It is important that this period is planned for in order to minimise unnecessary time delays. Although the needs of the family must take precedence over the interests of organ retrieval, most families at this stage in the process are well-informed and committed to donation occurring and will have had the opportunity to spend time with their family member.

Infrequently there may arise the possibility of autoresuscitation in which case it is important to cease activity and fully explore any concern. Staff may require reassurance that persisting ECG activity without pulsatile blood flow or, rarely, discoordinate non-ejecting cardiac contraction, is not circulation.

10 Warm ischaemic time and stand down process if death does not occur

Following WCRS a fall in blood pressure, reduced cardiac function and impaired respiration can lead to inadequate organ perfusion and oxygenation resulting in 'warm ischaemia'. This is more severe if there is a prolonged time to death with an extended period of low blood pressure and oxygenation. Consequences of warm ischaemic organ damage include delayed graft function, primary non-function, and organ specific ischaemic injury such as biliary strictures in liver grafts. Organs are variably susceptible to ischaemic injury with the heart, liver, and pancreas being most at risk.

Although not well defined, the most crucial period is considered to be the time from when there is a sustained drop in the systolic blood pressure resulting in inadequate organ perfusion until the time at which the organ undergoes cold organ perfusion, known as the 'functional warm ischaemic time'.[11]

Box 2 summarises current acceptable warm ischaemic times in Australia, although individual donor and recipient factors may influence this. Advances in transplantation techniques such as expansion of the utilisation of machine perfusion may also influence acceptable warm ischaemic times.[28]

Box 2
DCDD acceptable warm ischaemic times for individual organs in Australia

Liver
< 30 minutes from WCRS to cold perfusion

Pancreas
< 30 minutes from WCRS to cold perfusion

Heart
< 30 minutes from a sustained fall in systolic BP below 90 mmHg following WCRS, to cold perfusion

Kidneys
< 60 minutes from a sustained fall in systolic BP below 50 mmHg following WCRS, to cold perfusion

Lungs
< 90 minutes from a sustained fall in systolic BP below 50 mmHg following WCRS, to cold perfusion

(WCRS = withdrawal of cardio-respiratory support; BP = blood pressure)

The other important time consideration in the DCDD process is the time from WCRS until circulatory arrest, sometimes called the agonal period.[11] In Australia it is usual to stand down the DCDD process if the agonal period has exceeded 90 minutes, although other countries accept longer agonal periods (e.g. 3 hours in the UK; 2 hours in Spain, the Netherlands and Canada).[23,29]

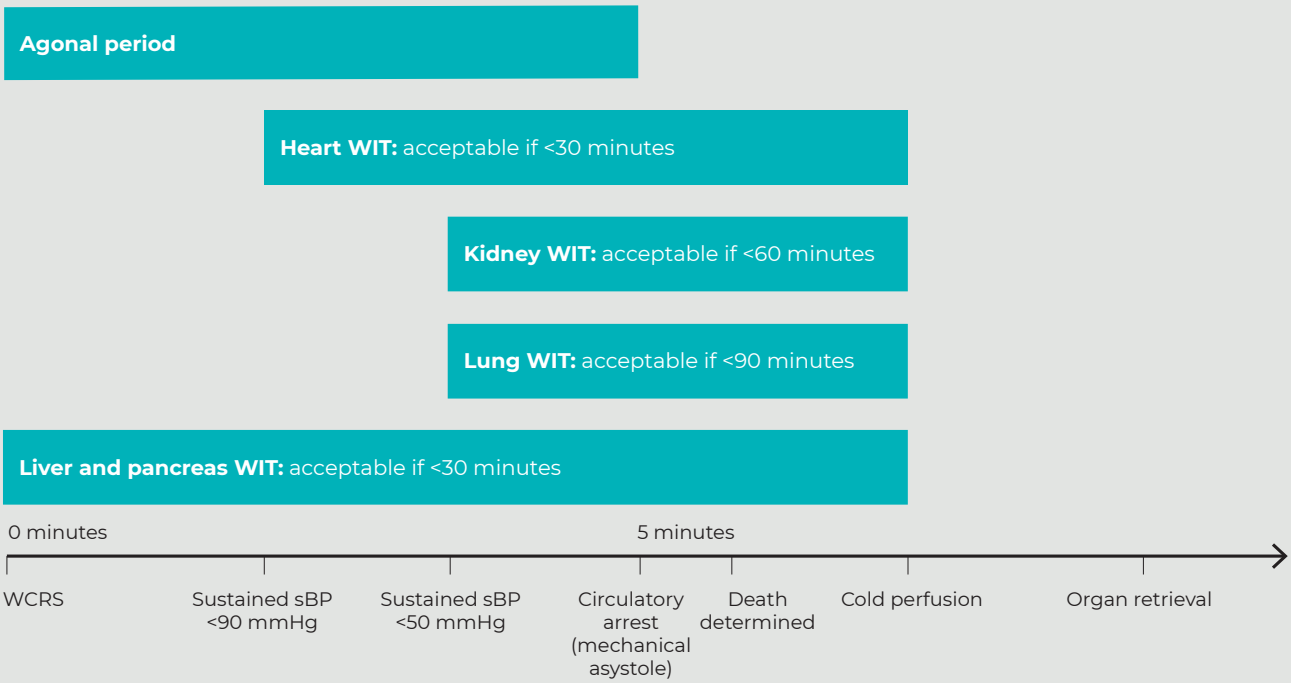
It is sometimes possible for lung and kidney donation to occur even if death occurs > 90 minutes following WCRS. Following WCRS, if spontaneous respiration continues and blood pressure is maintained for some time, followed by a late occurrence of cardio-respiratory arrest, warm ischaemic times may still be acceptable.

It is important that there is ongoing communication between the donation, ICU, and operating theatre staff prior to, during, and following WCRS. The use of synchronised clocks for all staff involved may reduce any confusion around critical time points. Standing down of a donation case should only occur after discussion between the donation and intensive care staff who are monitoring the dying patient and the operating theatre staff.

The DCDD process is usually stood down if death has not occurred within 90 minutes of WCRS. Prior to standing down the process there should be communication between the surgical retrieval team and staff attending the potential donor in case death is imminent with acceptable ischaemic times still possible e.g. for kidney and lung retrieval and transplantation.

If death has not occurred in the timeframes that permit organ donation, tissue donation may still occur depending upon medical suitability and with the consent of the family.

Figure 1 Key time points in DCDD post WCRS up until organ retrieval



(WCRS = withdrawal of cardio-respiratory support; WIT = warm ischaemic time; sBP = systolic blood pressure)

11 Post-mortem procedures, retrieval surgery and family viewing

After death has occurred no interventions should be undertaken that might inadvertently restore circulation, in particular, mechanical ventilation or chest compressions.

To facilitate lung donation, it is permissible to re-intubate the deceased patient without ventilation to prevent the aspiration of gastric content, which is usually undertaken before transfer onto the operating theatre table. If the WCRS has occurred on the operating theatre table, for example, in the operating theatre room, anaesthetic bay or recovery area, re-intubation can occur simultaneously with prepping and draping, which can shorten the time to organ retrieval and perfusion. This is important for minimising warm ischaemic times for liver and heart transplantation.

After re-intubation, one to two gentle lung insufflations with a bagging circuit are used to establish that the endotracheal tube is in the correct position and the airway protected from aspiration. Subsequently it is essential for lung insufflation to be initiated as part of the surgical retrieval of the lungs to facilitate distribution of preservation solution (flushed simultaneously via the pulmonary artery) to all areas of the lungs thus preventing poor preservation that may otherwise occur in atelectatic lobes/segments. Current Australian and international practice recommends that lung insufflation can be initiated at or after 10 minutes post the declaration of death or at the time of surgical lung retrieval without risk of cardiac reanimation.

Other interventions may also occur such as bronchoscopy, administering heparin and performing intercostal cannulation.

The principle of organ retrieval surgery in the context of DCDD is to achieve rapid and effective cold organ perfusion with minimisation of risk of organ injury. The organs that can be retrieved will depend on the warm ischaemic times and suitability upon inspection at surgery. The surgical process varies according to whether a single or multi-organ retrieval is to be performed. Care and respect to the deceased patient is shown by surgical retrieval and operating theatre staff, as in any other operative procedure.

At completion of the retrieval surgery the operating theatre staff and donation specialist nurse will ensure the deceased is clean and appropriate dressings are in place.

The deceased is transferred to the mortuary or other suitable viewing area where the family can spend time with their relative if they have elected to do so. As per the usual approach to family viewings post donation surgery, the family should be advised about the donor's appearance before the viewing and provided with support at the time of the viewing by hospital or donation staff. If the death falls within the coroner's jurisdiction, the formal identification of the deceased may also be required.

Post donation family follow up and support is offered as per the 'National DonateLife family support service[30] and managed by the DonateLife Agency.

12 Post donation process review and support for ICU and operating theatre staff

As part of any quality improvement practice, it is strongly recommended that all staff involved in an organ donation case are given the opportunity to discuss the donation event, whether it be DNDD or DCDD. This is equally important in DCDD when the donation process did not lead to retrieval of organs. Each jurisdiction and hospital should have their own procedures in place to support all staff involved in all organ donation cases.

It is recommended these sessions should take place soon after the donation case has concluded. It is an opportunity for attendees to constructively provide feedback on what went well and what may have been done better or differently.

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Version control

Version #	Changes made	Approved by	Release date	Review date
1.0	Creation of guideline	OTA National Medical Director A/Prof Helen Opdam	October 2021	September 2023