

Medical-ethical guidelines: Determination of death with regard to organ transplantation and preparations for organ removal

Swiss Academy of Medical Sciences (SAMS)

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I. Preamble

The determination of death is a crucial prerequisite for post mortem organ removal. It is of ethical, legal and political importance and ensures that the living are not treated as if they were dead, and vice versa. What is required is not only a clearly defined, infallible criterion for the onset of death but also a reliable method for determining death.

In the Transplantation Act,¹ the criterion specified for a person's death is the irreversible cessation of all functions of the brain, including the brainstem. This involves not only the irrevocable loss of consciousness – patients in a coma are not dead – but, in addition, the irreversible cessation of the integrative functions of the central nervous system, representing the loss of any possibility of continued life. This criterion of death has a scientific basis and is also valid irrespective of questions of organ transplantation. The irreversibility of brain death has been confirmed over many decades of practice.

As regards the clinical procedure for the determination of death, the Transplantation Ordinance² makes reference to the relevant sections of the guidelines on «The Determination of Death in the Context of Organ Transplantation» issued by the Swiss Academy of Medical Sciences on 24 May 2011. The present version of these guidelines takes account of the revision of the Transplantation Act dated 19 June 2015 and is designed to clarify and harmonise various aspects of current practice.

From a scientific perspective, death is a biological process which unfolds with variable manifestations over a certain period of time; however, with regard to organ transplantation, it is essential – for ethical and legal reasons – that there should be a strictly standardised procedure for the determination of death. This means that, as well as being based on scientific facts, the determination of death is defined by society; accordingly, while the procedures applicable in different countries are fundamentally similar, they vary in certain respects.³ In each case, however, the goal is to provide the greatest possible certainty for all concerned,

in the given context, that donors are indeed dead at the time of organ removal.

To ensure that this certainty can be attained, three steps are necessary: firstly, the procedure for the determination of death – i.e. the irreversible cessation of brain, including brainstem, functions – must be precisely standardised and described. Secondly, the medical professionals involved in the procedure must receive appropriate training and support. Thirdly, the public needs to be informed in a clear and comprehensible manner.

As well as providing technical instructions for the determination of death, the present guidelines also cover in detail many other aspects of deceased organ donation, such as the procedure for ascertaining the patient's wishes, discussions with relatives, guidance for difficult decision situations, respectful management of the dying patient and the cadaver, and the performance of preparatory medical measures. The guidelines should make it easier for the care team to comply with legal requirements and to deal more effectively with the ethical issues.

II. Guidelines

1. Scope of the guidelines

These guidelines are addressed to physicians⁴ and other medical⁵ professionals caring for patients who qualify as potential deceased organ donors. They concern exclusively the requirements for organ removal and the associated preliminary investigations. They are not applicable to organ removal from living donors (living donation). Likewise, the treatment and care of organ recipients is not covered by these guidelines.

2. Ethical and legal aspects

The decision to donate an organ is a voluntary one. The medical care team must respect the patient's decision for or against donation, and relatives making a decision on the patient's behalf are not to be placed under any pressure.

Organ removal involves a breach of physical integrity and implicates the right to self-determination, which extends beyond death. Organs must not be removed contrary to the deceased person's (expressed or presumed) wishes. Con-

fidence in the organ donation process is a prerequisite for willingness to donate, and physicians and other medical professionals must always be conscious of their responsibilities in this regard.

Apart from the right to self-determination, organ donation involves tensions with the principles of beneficence and non-maleficence, under which physicians have a duty to promote patients' welfare and avoid harm until the end of their life.

Therefore, the establishment of indications in intensive and emergency medical care⁶ – in particular, the decision to withdraw life-sustaining treatment – must not be influenced by the possibility of organ donation. To ensure that organs remain functional until they are removed, preparatory medical measures need to be performed before and after the patient's death. However, these may interfere with the processes of dying and leave-taking. One of the medical team's primary responsibilities is to ensure that a death in dignity is possible and to support the relatives during this difficult time. Measures running counter to these goals must not be performed.

2.1. Discussions concerning organ donation

Discussions concerning possible organ donation are extremely demanding for all parties. But they are also of great importance, as they are often crucial in determining whether or not consent to organ donation is granted.

It is important that potential organ donors should be identified in intensive care and emergency wards, and that the topic should be raised with relatives in an appropriate and neutral manner, free of pressure. Neither the religious nor the cultural background of a patient should be a reason not to address the possibility of organ donation. Such discussions should be conducted by professionals with the necessary training⁷ and experience, as they require a high degree of empathy and consideration. A peaceful atmosphere with sufficient time to explain the situation is important, and there must be room for questions and concerns to be raised. Suitable professionals should be involved from the outset and, as far as possible, should remain available throughout the process.

In these discussions, a clear distinction must always be made between the withdrawal of life sustaining treatments, on the one hand, and organ donation, on the other. In general, it is advisable to have a number of discussions. Even if the subject of organ donation is raised at an early stage by relatives themselves, consent to organ removal and to any preparatory medical measures may only be sought after the decision to withdraw life sustaining treatment has been taken.⁸

The information provided on organ donation should cover, in particular, the nature, extent, goals and effects of any preparatory medical measures, the procedure for the determination of death and for (potential) organ removal, and what will happen if organ removal turns out not to be possible.

2.2. Organ removal⁹

Organs may be removed for purposes of transplantation if death has been determined (cf. Section 3.) and consent to organ removal has been granted by the deceased or – in the

absence of any expression of wishes – by the nearest relatives. Relatives making a decision on the patient's behalf must respect the latter's presumed wishes, i.e. decide as the patient would most likely have decided, were he or she still able to act independently. However, they may also consent to organ removal even if the patient's presumed wishes are not known.

If there are no relatives, or if they cannot be contacted in time, organ removal is not permitted.

2.3. Preparatory medical measures¹⁰

2.3.1. Before death

Preparatory medical measures may be performed if consent has been granted by the person concerned. Measures that hasten death or may lead to a permanent vegetative state are not permitted.

In the absence of the patient's consent, consent may be granted by the nearest relatives, provided that all of the following conditions are met:

1. There is no evidence that the patient would have refused the measures in question (presumed wishes).
2. The measures cannot hasten death or lead to a permanent vegetative state.
3. The measures are indispensable for successful transplantation and involve only minimal risks and burdens for the donor. Measures that do not meet these criteria are to be found in the negative list (Appendix H).

If there are no relatives, or if they cannot be contacted in time, the performance of preparatory medical measures before death is not permitted.

2.3.2. After death

If no declaration of wishes concerning donation is available, preparatory medical measures may be performed after the patient's death until a decision has been made by the relatives, but for no longer than 72 hours.

2.4. Ascertainment of the patient's wishes

In general, patients who are considered to be potential organ donors do not have capacity and can no longer express their wishes concerning organ donation and preparatory medical measures. Ideally, a declaration of wishes concerning donation / preparatory measures will be available (e.g. a donor card or advance directive / power of attorney). Via such a declaration, patients can express their wishes concerning preparatory medical measures, give their consent to the removal of any organs, restrict their consent to specified organs, or refuse organ removal. They may also delegate the decision to a designated trusted person.

If no such declaration is available, at least one¹¹ of the nearest relatives must be asked whether they are aware of a declaration of wishes or can give the name of anyone who is aware of such a declaration.

If this is not the case, then the patient's presumed wishes must be ascertained.

2.5. Representation of the patient by relatives

A decision may be made by the relatives closest to the patient. The medical team must make enquiries to find out

who this is. In the absence of evidence to the contrary, it may however be assumed that the following persons in the following order were the most closely associated if they had regular personal contact with the patient:

- a. spouse, registered partner or life partner;
- b. children (over 16 years old);
- c. parents and siblings;
- d. grandparents and grandchildren (over 16 years old);
- e. other persons close to the patient.

If there is more than one nearest relative, organ removal is permitted if consent is granted by all those who can be contacted within a reasonable time and none of the relatives who cannot be contacted are known to dissent.

If the patient has demonstrably delegated the decision on organ removal and preparatory medical measures to a trusted person, this person is to be consulted instead of the relatives.

The persons entitled to act as representatives must respect the patient's presumed wishes.

2.6. Specific considerations relating to children and adolescents

It should be noted that, under the Transplantation Act, children and adolescents can only give a binding declaration of wishes concerning donation when they have reached the age of 16.¹² However, it should be borne in mind that the presumed wishes of those under the age of 16 are relevant for the parents' decision.

2.7. Conflict situations

Particularly difficult for all parties¹³ are situations where relatives disagree as to the patient's presumed wishes and/or do not accept the decision made by the person authorised to decide on the patient's behalf. Also problematic are situations where, because of personal convictions, relatives are opposed to organ removal even though a declaration of the patient's wish to donate is available. The Transplantation Act specifies that the wishes of the deceased take precedence over the relatives' wishes, and that the most recent (verbal) declaration is valid. Even if the procedure is clear from a legal perspective, efforts should be made to reach a decision acceptable to all parties; here, it may be helpful to seek ethics support.¹⁴ If it is not possible for all parties to accept the patient's wishes, these wishes still take precedence.

2.8. Support for relatives

Relatives accompanying a patient in emergency or intensive care are in a highly stressful situation, torn between hope and fear. It is important that, from the outset, they should be able to have confidence in the medical care team. This will only be possible if they receive support in coping with bad news and complex information. They must be sure that the patient's interests are the prime concern, and that the patient's (presumed) wishes will be respected.

Relatives may be unsettled by the fact that, so long as mechanical ventilation is maintained, a patient who has died as a result of primary brain damage does not appear to be dead in the traditional sense: the chest rises and falls with ventilation, the skin is warm, the pulse can be felt,

and in some cases external stimuli may even trigger movements or circulatory responses due to spinal reflexes. At this time of leave-taking, requests for relatives to express their views, within a short period, on the presumed wishes of the deceased may be experienced as an additional burden. These points need to be taken into account.

Throughout the process, the relatives must be kept informed about all the key steps and should have a contact address which can provide or refer them for expert assistance. In particular, the relatives need to be told when and where they can say goodbye to their loved one. If the determination of death and organ removal are to take place at different hospitals, the relatives must be informed. The allocation of roles within the organ donation process must be clearly defined, as well as the tasks and responsibilities of the various people involved.

2.9. Management of the body of the deceased

Before, during and after organ removal, the body of the deceased is to be treated with the same respect as is due to any other deceased person, and in accordance with the same requirements. The cadaver must be returned to the relatives in a suitable state for the funeral rites. The relatives must be provided with all the relevant information (in particular, concerning any delays, e.g. for medicolegal investigations).

2.10. Support for the treatment team

Caring for an organ donor is particularly challenging for the medical treatment team. Coming to terms with the fate of the deceased and the relatives, as well as the various interactions between physicians, nurses, consultants, other medical professionals and relatives, demands a high level of professional, psychological, communicational and organisational skills, and may push members of the treatment team to their limits. An opportunity should be provided to review difficult situations at a debriefing session involving everyone concerned. All ICUs providing care for organ donors should offer supervision and stress management programmes.

3. Determination of death

3.1. Requirements for the diagnosis of death

Death may be due to the following causes:

- primary brain damage or disease, leading to irreversible cessation of the functions of the brain, including the brainstem (death due to primary brain damage);
- permanent cardiac arrest, which reduces or interrupts cerebral blood flow, leading to irreversible cessation of brain and brainstem function, and thus death (death after permanent cardiac arrest).

The formal procedure for the diagnosis of brain death is only to be carried out once the requirements specified in Appendix C are fulfilled.

3.1.1. Clinical requirements

The determination of death requires the demonstration of primary or secondary brain damage. This involves either irreversible brain damage of known aetiology or damage to

other organs, whose cessation of function leads secondarily to death.

Before death can be determined by clinical diagnosis of brain death, any conditions preventing correct clinical diagnosis of brain death must first be ruled out (cf. Appendix C).

3.1.2. Independence of the physicians concerned

Physicians who determine a person's death must not participate either in the removal or in the transplantation of organs, tissues or cells; nor may they be subject to the instructions of a medical professional who is directly involved in such interventions.

Physicians who remove or transplant organs, tissues or cells, and the other medical personnel involved, must not place under time pressure or otherwise seek to influence those who care for the dying patient or determine death.

3.1.3. Professional qualifications and structural requirements

The clinical assessment must be carried out by physicians with specialist training and demonstrably adequate experience¹⁵ in brain death diagnosis. The specialist training should cover, at least, brain death diagnosis in accordance with the guidelines, pathophysiological and ethical aspects of brain death, and organisational matters associated with organ donation (and transplantation).

For brain death diagnosis in adults, specialist training is required in neurology or intensive care medicine; for brain death diagnosis in children, specialist training is required in paediatric intensive care medicine or paediatric neurology.¹⁶ Additional tests must be performed by a specialist with the relevant qualifications.

Hospitals lacking the necessary specialist expertise and infrastructure should either transfer the potential donor to a central hospital or enlist the services of appropriate specialists through collaboration with a central hospital.

3.2. Clinical diagnosis of death¹⁷

3.2.1. Death due to primary brain damage

The determination of death involves a clinical examination in which all seven of the following signs must be observed (cf. Appendix D):

1. comatose condition¹⁸ (i.e. unresponsive unconsciousness);
2. pupils moderately to widely dilated, bilaterally unresponsive to light;
3. absent vestibulo-ocular reflexes (VOR);
4. absent corneal reflexes;
5. absent cerebral responses to painful stimuli;
6. absent tracheal and pharyngeal reflexes;
7. absence of spontaneous respiration (apnoea test).

The clinical examination is conducted jointly by two specialists («two pairs of eyes» principle), one of whom must not be directly involved in the patient's care. Both of the specialists diagnosing death must be appropriately qualified (cf. Section 3.1.3.).

The attending intensive care specialist – if this is not one of the two specialists making the diagnosis – is to be involved

in the assessment. If an additional test is carried out, the specialist responsible is also to be involved in the assessment.

If all the requirements specified in Appendix C are satisfied, the diagnosis is based exclusively on the clinical signs.¹⁹ However, if the cessation of brain function is not adequately explained, if potentially reversible conditions cannot be excluded as contributory factors, or if cranial nerve function cannot be clinically assessed, then – in addition to the clinical examination – cerebral circulatory arrest must also be demonstrated by appropriate additional tests (cf. Section 3.3.).

3.2.2. Death after permanent cardiac arrest

In the case of permanent cardiac arrest, death is defined as irreversible cessation of the functions of the brain, including the brainstem. It occurs as a result of cessation of the cerebral circulation. After cardiac arrest (absence of cardiac activity) has been diagnosed by means of transthoracic echocardiography (TTE)²⁰ in the subxiphoid four-chamber view, or by transoesophageal echocardiography (TOE), and a stand-off period (without resuscitation measures) of at least 5 minutes has elapsed,²¹ the following six clinical signs are assessed; they must all be observed.

1. comatose condition (i.e. unresponsive unconsciousness);
2. pupils moderately to widely dilated, bilaterally unresponsive to light;
3. absent vestibulo-ocular reflexes (VOR);
4. absent corneal reflexes;
5. absent cerebral responses to painful stimuli;
6. absent tracheal and pharyngeal reflexes.

The apnoea test as a sign of the absence of spontaneous respiration (seventh clinical sign listed in Section 3.2.1.) is not required, since the fact that spontaneous respiration is not resumed during the 5-minute stand-off period (without ventilation) provides adequate evidence of its absence.

The clinical examination is conducted jointly by two suitably qualified specialists («two pairs of eyes» principle), one of whom must not be directly involved in the patient's care. The attending physician – if this is not one of the two specialists making the diagnosis – is to be involved in the assessment.

3.2.3. Death in children

For children over 1 year old, the requirements specified in Sections 3.1. ff. apply. In post neonatal infants,²² the determination of death due to primary brain damage – provided the cause is known – involves two clinical examinations (including the apnoea test) separated by a 24-hour observation period.²³ With regard to physicians' professional qualifications, reference is made to Section 3.1.3. If the cessation of brain function is not adequately explained by the structural damage detected by imaging, if potentially reversible conditions cannot be excluded as contributory factors, or if cranial nerve function cannot be clinically assessed, then cerebral circulatory arrest must be demonstrated by means of an appropriate additional test after the second clinical examination. For the determination

of death after permanent cardiac arrest, the same requirements are applicable as for older children and adults.

In neonates²⁴ the removal of organs for transplantation is to be avoided on medical grounds.²⁵

3.3. Additional (instrumental) tests²⁶

Additional (instrumental) tests for the determination of death are used in addition to clinical examination if the requirements for the clinical diagnosis of brain death are not satisfied because cranial nerve function cannot be clinically assessed, or potentially reversible conditions cannot be ruled out as contributory factors.²⁷ The aim of the additional test is to demonstrate cerebral circulatory arrest.

The validity of the additional test depends on the mean arterial pressure during the procedure (cf. Appendix E). A mean arterial pressure of 60 mmHg at the time of the test must be recorded in the protocol.

The following additional tests are essentially suitable for demonstrating cerebral circulatory arrest and can be used to confirm the irreversibility of the cessation of brain function:

- perfusion CT and CT angiography; or
- transcranial Doppler and colour-coded duplex ultrasonography; or
- digital subtraction angiography; or
- magnetic resonance imaging (MRI).

In each case, the test chosen should be the one with which the hospital in question has the most experience and which is least invasive for the patient.

Death is a biological process which unfolds with variable manifestations over a certain period of time. It is therefore possible that clinical examination and an additional test will yield discrepant results. The diagnosis can only be made when the results agree with each other.

4. Organ removal

4.1. Preparatory medical measures

The removal of transplantable organs necessitates a variety of preparatory medical measures in the potential donor. These are designed either for organ preservation or for the assessment of donor suitability. They may be required both before and after the determination of death.

The assessment of donor suitability involves serological and immunological analyses, which are required to test for blood and tissue compatibility with potential recipients and also to screen for infectious diseases (mandatory testing in accordance with the Transplantation Act).

4.1.1. Preparatory medical measures prior to determination of death

Among the preparatory medical measures carried out before death are the continuation of existing treatments (ventilation, administration of drugs and solutions to maintain circulatory function), laboratory analyses to guide treatment, and hormone replacement to maintain the internal milieu. Existing treatments may be continued, without counting as a preparatory medical measure, as long as they serve purposes other than organ removal (e.g. palliative care, enabling relatives to say goodbye).

Preparatory medical measures may only be carried out if the requirements specified in Section 2.3. are satisfied. If the prognosis is hopeless and brain death does not occur, the DCD (Donation after Cardiocirculatory Death) procedure may be initiated if suitability and consent requirements are met.

4.1.2. Special considerations concerning death after cardiac arrest

In cases of death after cardiac arrest, organ removals are distinguished according to the circumstances in which cardiac arrest occurs, as described by the Maastricht classification (categories 1–4):

- a. Dead on arrival in hospital (Maastricht category 1)
- b. Unsuccessful resuscitation (Maastricht category 2)
- c. Death after withdrawal of life-sustaining treatment (Maastricht category 3)
- d. Cardiac arrest after death due to primary brain damage (Maastricht category 4)

a) Maastricht category 1

In category 1 donors, death has already been determined before or upon their arrival in hospital. To avoid organ damage due to warm ischaemia, organ removal must be performed as rapidly as possible.

b) Maastricht category 2

In category 2 donors, organ removal is performed after unsuccessful resuscitation. Because a reduced circulation is maintained with cardiopulmonary resuscitation (CPR), the determination of death may only be made after CPR efforts have been terminated and persistent cardiac arrest with complete cessation of circulation has subsequently been observed for a 5-minute period (under normothermic conditions).

In this context, unsuccessful resuscitation means that, despite CPR efforts being correctly performed for at least 30 minutes,²⁸ there has been no restoration of cardiac activity with spontaneous circulation. If spontaneous cardiac activity and circulation are temporarily restored during resuscitation, CPR efforts are to be pursued for another 30 minutes after the cessation of this activity. In patients with hypothermia, the core body temperature must have risen above 35°C when the diagnostic procedure is performed.

c) Maastricht category 3

In the case of category 3 donors, a decision has been taken to withdraw life-sustaining treatment on account of a condition with a hopeless prognosis, and death is foreseeable. In these patients, circulatory function is maintained (possibly with mechanical support), but only as long as life-sustaining measures (in particular, ventilation) are continued. Because the time of treatment withdrawal can be planned, preparatory medical measures may be instituted as soon as consent to organ donation and to preparatory measures is available.

If treatment is withdrawn in the intensive care unit, it is possible, firstly, after the determination of death, to move rapidly to the operating theatre for organ removal. This procedure is only feasible for organs which are less susceptible to ischaemia, such as the kidneys or lungs. Alternatively, it is possible, after the determination of death, to

cannulate the donor's femoral vessels for organ perfusion in the intensive care unit.

For purposes of organ removal (especially in the case of organs particularly susceptible to ischaemia, such as the liver), the operating theatre is the ideal setting for the withdrawal of treatment. It is in principle possible for relatives to accompany the dying patient into the theatre and remain there until cardiac arrest occurs. The following points are to be noted:

- Separation of the processes of treatment withdrawal and organ removal is more difficult to maintain.
- Palliative care must be assured after the withdrawal of life-sustaining measures.
- If death does not occur within a period suitable for organ removal, there must be no pressure on the attending physician to hasten death.

The withdrawal of life-sustaining measures, the setting where this is to take place, and the subsequent medical measures planned with a view to organ removal must be discussed with the relatives in advance, calmly and in detail. In particular, it must also be discussed whether the relatives wish to remain at the patient's bedside until death occurs. The relatives need to know that, because of the risk of damage caused by warm ischaemia, organ removal has to be performed as rapidly as possible after the occurrence of cardiac arrest and the determination of death. They must be prepared for the hectic atmosphere which can arise after the cardiac arrest as the patient is transferred to the operating theatre or perfusion catheters are placed, and they should if possible have the opportunity to say goodbye to the dying patient beforehand. It is important to inform them that permanent cardiac arrest leading to death may occur very rapidly, but that it may also only occur several hours after the withdrawal of treatment. The relatives must be informed that it may therefore not be possible to proceed with organ removal, if cardiac arrest only occurs after a prolonged period of very low blood pressure, resulting in inadequate organ perfusion and oxygenation.

d) Maastricht category 4

In category 4 donors, brain death has been diagnosed prior to cardiac arrest. Accordingly, the provisions of Section 4.1.3. apply.

4.1.3. Preparatory medical measures after determination of death

After death has been determined, measures to maintain organ perfusion (cardiac massage, placement of femoral cannulae for organ perfusion, extracorporeal membrane oxygenation (ECMO) may be required. Because these measures cannot harm the deceased, they may be carried out until the relatives' consent or refusal is available (cf. Section 2.3.2.). However, preparatory medical measures after death may only be performed for a maximum of 72 hours.

In Maastricht category 4 donors, permanent cardiac arrest occurs after the determination of death due to primary brain damage, during preparations for organ removal; there is therefore substantial time pressure. In this situation, the following options are available:

- rapid transfer to the operating theatre

- placement of perfusion catheters for organ preservation on the ward
- abandonment of organ donation.

The option adopted will depend on the circumstances. If cardiac arrest occurs en route to the operating theatre, rapid organ removal will be attempted in the theatre. If cardiac arrest occurs in the intensive care unit, there should be a rapid transfer to the operating theatre, if one is available; otherwise, the placement of perfusion catheters represents the next-best solution for organ retrieval.

4.2. Use of drugs for muscle relaxation

During the surgical procedure, problems may arise as a result of increased muscle tone, spinal reflexes mediated by the intact spinal cord (e.g. the motor response of the hand to a painful stimulus), or autonomic responses mediated by the peripheral nervous system (e.g. tachycardia, sweating, etc.). Although such reflexes and autonomic responses are imperceptible to the deceased (since brain function has irreversibly ceased), they may disrupt organ removal and be distressing for the persons involved. The use of drugs normally employed as muscle relaxants in anaesthesia is therefore recommended.

5. Documentation

Clinical findings, additional tests performed, discussions concerning organ donation and preparatory medical measures, and consent are to be documented. For this purpose, protocol templates are available in Appendix G; these may be adapted and expanded by the hospital authorities responsible.

III. Appendices

A. Glossary

Coma, comatose state

Coma is defined as a state in which the patient lies with eyes closed and is unresponsive to internal (e.g. vegetative, emotional) and external stimuli (pain, heat/cold). The term is used merely to describe a condition, with no specific pathological or prognostic implications; comatose patients may exhibit reflexes and they may recover, survive in a permanent vegetative state, or die.

Death

A definition of death can be formulated in medical, legal, philosophical, ethical or theological terms. Until the 1950s, death was defined as the absence of pulse, blood pressure and respiration over a period of several minutes (cardiopulmonary death). With modern intensive care, vital functions can be maintained even after the loss of cerebral functions (in particular, in the absence of consciousness and spontaneous respiration).

The fact that brain death does not coincide with the death of other organs in the body has not only made it possible for organs to be removed post mortem, but also necessitated a revision of the medical definition of death. Today, the irreversible loss of brain (cerebral, cerebellar and brainstem) functions is accepted medically as a definitive sign of death. Causes of death may thus be primarily cerebral

(e.g. traumatic brain injury, stroke) or extracerebral (e.g. cardiac arrest).

Death after permanent cardiac arrest: DCD/NHBD

For organ donation following death after permanent cardiac arrest, the terms «donation after circulatory death» (DCD) and «non-heart-beating donation» (NHBD) are used interchangeably.

Death due to primary brain damage: DBD/HBD

For organ donation following death due to primary brain damage, the terms «donation after brain death» (DBD) and «heart-beating donation» (HBD) are used interchangeably.

Declaration of wishes

A person's wishes concerning organ donation after death can be documented in writing (e.g. in a donor card, advance directive, power of attorney) or communicated verbally.

Dying

Dying is a process which affects different organs/cells at different rates, depending on the underlying cause of death (cf. Gardiner D, Shemie S et al., 2012) The process of dying can vary in duration and manifestations.

Neonates

Children under 28 days of age or, in the case of preterm infants, less than 44 weeks' postmenstrual age.

Preparatory medical measures

Medical measures intended solely to preserve organs, tissues or cells (cf. Art. 10 TxG).

(Nearest) relatives

The persons closest to the patient. The medical team must make enquiries to find out who this is. In the absence of evidence to the contrary, it may however be assumed that the following persons in the following order were the most closely associated if they had regular personal contact with the patient:

- a. spouse, registered partner or life partner;
- b. children (over 16 years old);
- c. parents and siblings;
- d. grandparents and grandchildren (over 16 years old);
- e. other persons close to the patient.

B. Decision trees (fig. 1 and fig. 2)

C. Requirements for the diagnosis of death

The treatment team is responsible for considering differential diagnoses with regard to the aetiology of the patient's condition, so that it can be assessed whether the determination of death is possible by means of clinical diagnosis of brain death. In particular, consideration must be given to the following diagnoses and/or conditions which compromise the evaluation of cortical and/or brainstem functions. Some of these conditions can initially mimic death but subsequently also lead to death.

Primary brain damage

- Cerebral ischaemic stroke (e.g. basilar artery thrombosis)
- Cerebral haemorrhagic stroke (e.g. primary intratentorial intraparenchymal haemorrhage)
- Subarachnoid haemorrhage
- Acute obstructive hydrocephalus
- Meningoencephalitis (e.g. rhombencephalitis)
- Acute demyelinating disease (e.g. acute disseminated encephalomyelitis/ ADEM)
- Locked-in syndrome

Secondary brain damage

- Shock
- Hypothermia (<32°C)
- Electrolyte disorder (e.g. hyperosmolarity, hypophosphataemia)
- Hypoxic encephalopathy
- Toxic-metabolic encephalopathy (e.g. hyperammonaemia, uraemia, Wernicke's encephalopathy)
- Drug-induced encephalopathy (e.g. benzodiazepines, barbiturates, other antiepileptics, psychotropics)
- Septic encephalopathy
- Traumatic encephalopathy (diffuse axonal injury)
- Endocrine encephalopathy (e.g. hypothyroidism)

Other pathologies

- Polyradiculoneuropathy (e.g. Guillain-Barré syndrome, Miller-Fisher syndrome)
- Effects of neuromuscular blocking drugs

If any of the above-mentioned conditions are present, appropriate investigations are required prior to the determination of death (e.g. electroencephalography (EEG), evoked potentials, electroneuromyographic studies, cerebrospinal fluid analysis, Doppler ultrasound, neuroradiological studies).

D. Clinical signs of death (checklist)

In the determination of death, the clinical examination of the signs of cessation of brain function is of central importance. For the results to be valid, the core body temperature must be at least 35°C. The methods used for the examination are described below:

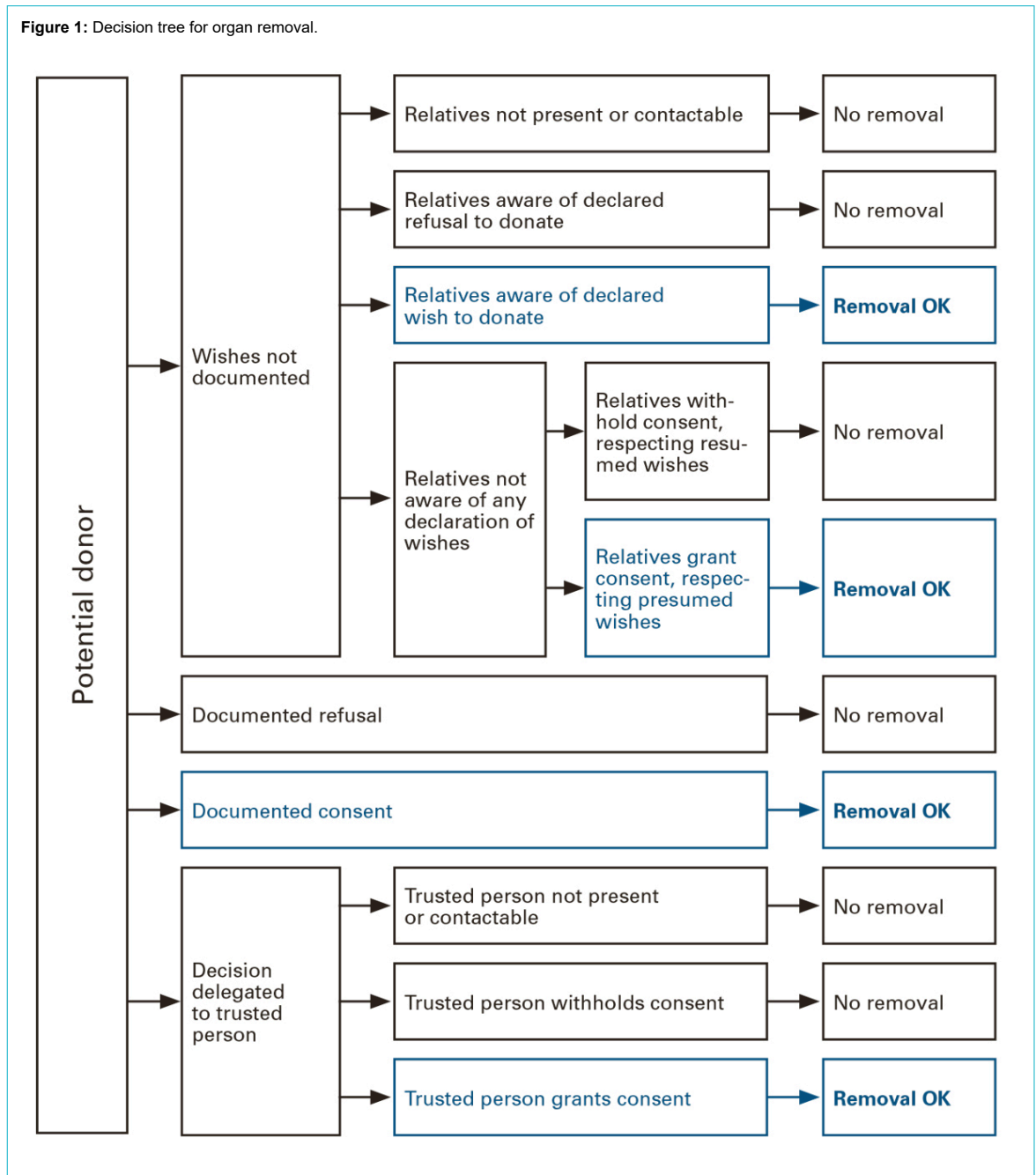
1. Comatose condition

Coma is defined as a state in which the patient lies with eyes closed and is unresponsive to internal (e.g. vegetative, emotional) and external stimuli (pain, heat/ cold).

2. Pupils moderately to widely dilated, bilaterally unresponsive to light

Partially dilated or anisocoric pupils do not preclude the determination of death, provided that they do not respond to light stimuli. (Caution: glass eye, optic and/ or oculomotor nerve lesion.)

Figure 1: Decision tree for organ removal.



3. Absent vestibulo-ocular reflexes

If in response to rapid passive head rotation, or head extension and flexion, no compensatory eye movements in the opposite direction are observed, then the vestibulo-ocular reflexes are absent. This test may only be performed if cervical spine trauma is excluded. Alternatively, the vestibulo-ocular reflex may be assessed by performing the caloric ice water test. (Caution: bilateral vestibular nerve lesions.)

4. Absent corneal reflexes

The corneal reflexes can be tested by touching the cornea with a cotton-tipped swab. (Caution: glass eyes, contact lenses.)

5. Absent cerebral responses to painful stimuli

The response to painful stimuli in the trigeminal nerve region is tested by applying pressure to the supraorbital ridge

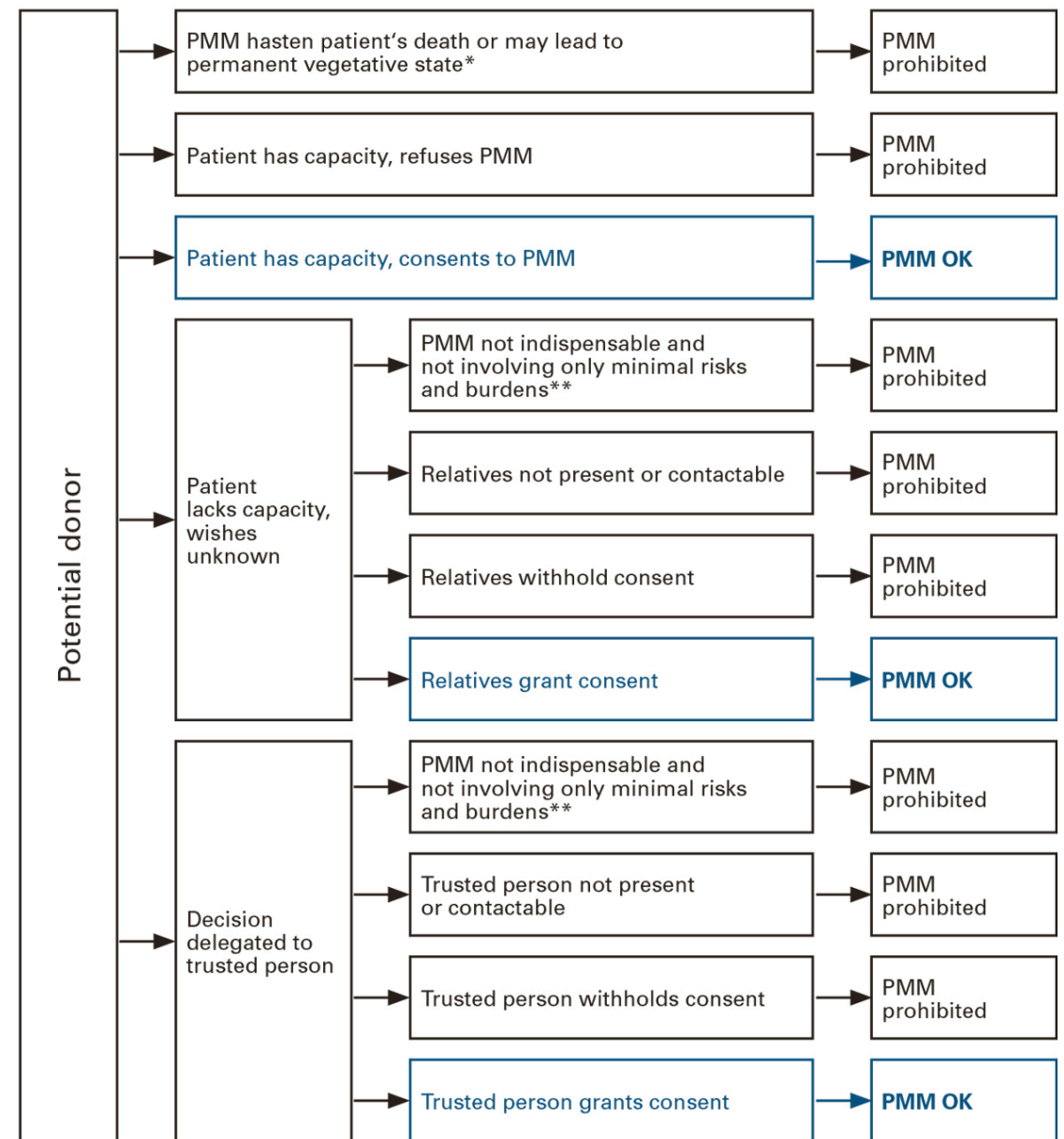
or the temporomandibular joint (auriculo-temporal nerve). Responses to painful stimuli in the non-trigeminal region are tested on the upper and lower limbs.

In a brain-dead patient, spinal reflexes with complex motor responses may still be present (Lazarus sign). Spontaneous and stimulus-provoked reflex movements (e.g. abdominal reflex, cremaster reflexes, isolated jerks of the upper extremities, unilateral extension pronation movements) do not preclude death. In case of doubt, an additional (instrumental) test is to be performed (cf. Appendix E).

6. Absent tracheal and/or pharyngeal reflexes

Cough and gag reflexes are tested by stimulating, respectively, the tracheal mucosa and the posterior pharyngeal wall with a suction catheter.

Figure 2: Decision tree for preparatory medical measures (PMM).



* All decisions made by a donor, relatives or a trusted person are subject to the proviso that these two criteria are not met: donors with capacity cannot consent to preparatory medical measures that may hasten their death or lead to them entering a permanent vegetative state. The same applies to relatives or a trusted person.

** All decisions made by relatives or a trusted person are subject to the proviso that the preparatory measures are indispensable for successful transplantation and involve only minimal risks and burdens for the donor. This is also the case if performance of the measures would be in accordance with the donor's presumed wishes.

7. Absence of spontaneous respiration (apnoea test)

The absence of spontaneous respiration must be demonstrated by the apnoea test. This test is not performed for the determination of death after permanent cardiac arrest.

Normal neuromuscular function is a prerequisite for the apnoea test. If a patient has previously received muscle relaxants, intact neuromuscular function must be confirmed by neuromuscular monitoring.

The apnoea test consists of the following steps:

- Arterial blood gas analysis to establish baseline values for partial pressure of arterial carbon dioxide (PaCO₂) and arterial pH and to determine the correlation between PaCO₂ and end-tidal CO₂.
- Ventilation with 100% oxygen.
- Continuous monitoring by O₂ saturation measurement.
- Mechanical hypoventilation, with end-tidal CO₂ monitoring, at a rate of 0.5–2 L/minute (respiratory minute volume) while maintaining a positive end-expiratory pressure (PEEP) of ≥5 mmHg until a PaCO₂ of 60 mmHg (8–9.35 kPa) or an increase of 20 mmHg (2.6 kPa) over the baseline value can be expected.
- Arterial blood gas sampling to demonstrate that the PaCO₂ has risen above 60 mmHg or 8 kPa and the pH has fallen below 7.30.
- Disconnection of the ventilator. Oxygen is supplied via a catheter inserted through the endotracheal tube at a continuous rate of 2–4 L/minute (max. 2 L/minute in children).
- Observation for respiratory movements.
- Reconnection of the ventilator, with pre-test settings.
- In patients with a severe oxygenation disturbance, the ventilator can be set to a spontaneous breathing mode, with apnoea ventilation being switched off, and PEEP being maintained. The patient is then observed for the absence of respiratory movements for 3 minutes. (Caution: if flow trigger sensitivity is too high, auto triggering of pressure support may occur.)
- Resumption of ventilation, with pre-test settings.

If O₂ saturation falls rapidly, the apnoea test is to be aborted and repeated when cardiorespiratory stability has been restored.

In children under 1 year of age, observations are made with the ventilator set to CPAP (Continuous Positive Airway Pressure); the target values are a PaCO₂ of 90 mHg (12 kPa) and a pH below 7.25, with oxygen saturation not falling below 80%. If a conclusive apnoea test cannot be performed (e.g. in severe chronic hypercapnia), then – as in the situation where cranial nerves cannot be evaluated – an additional (instrumental) test must be carried out.

E. Additional (instrumental) tests

Guidelines for the use of additional (instrumental) tests vary widely from one country to another.²⁹ In Europe, confirmatory tests of this kind are required in 50% of countries.³⁰

This variability is attributable to the following limitations of instrumental tests:

- Their sensitivity and specificity for the diagnosis of death is less than 100%. There are discrepancies between the results of different tests, with false-negative results being the most common.
- Execution and the interpretation of results depend on the operator's experience.
- Certain tests may be difficult to perform in particular clinical situations.

Potentially reversible causes of the clinical condition can be excluded by demonstrating cerebral circulatory arrest. Techniques for the visualisation of cerebral blood flow – e.g. Doppler ultrasonography, CT angiography, digital subtraction angiography and magnetic resonance imaging – can be used for this purpose. A mean arterial pressure of at least 60 mmHg in adults and at least 45 mmHg in children is required for the test. The blood pressure must be recorded in the protocol.

Doppler ultrasonography

Cerebral circulatory arrest can be detected by combined extracranial and transcranial Doppler ultrasonography. In various studies, a high specificity of Doppler ultrasonography has been reported, with variable and somewhat lower sensitivity.³¹

Cerebral circulatory arrest is proven by the following flow signals in the intracranial and extracranial arteries:³²

- early systolic peaks <50 cm/second;
- biphasic signal with equal antegrade and retrograde components.

Absent flows are not wholly reliable, since the lack of a flow signal can be caused by transmission problems.³³ Cerebral circulatory arrest must always be documented bilaterally by examination of the intracranial cerebral arteries and the extracranial arteries supplying the brain.

The value of transcranial ultrasonography depends on the operator's experience and the quality of the temporal bone window. In addition, the examination is less reliable, or cannot be fully performed, in the presence of external ventricular drainage and in craniectomised patients. This method of confirming brain death should therefore be used only by experienced sonographers in cases where other less operator-dependent methods are not available.

The qualifications required by the operator are an FMH title of specialist in Neurology or Neurosurgery and an SGKN (Swiss Society of Clinical Neurophysiology) proficiency certificate for cerebrovascular disorders or equivalent.

Computed tomography (CT) and CT angiography (CTA)

Cerebral circulatory arrest can be demonstrated by volume CT before and after intravenous administration of contrast medium for visualisation and quantification of cerebral perfusion (perfusion CT) and for visualisation of neck vessels supplying the brain and intracranial vessels (CT angiography).

The operator requires an FMH title of specialist in Radiology.

Digital subtraction angiography (DSA)

To demonstrate cerebral circulatory arrest, both common carotid arteries and at least the dominant vertebral artery have to be visualised after injection of a contrast medium. Injection of the medium into each common carotid artery should lead to filling of the external carotid artery and its branches, and to filling of the cervical and possibly the intracranial extradural portion of the internal carotid artery. If hypoplasia is suspected on the basis of the filling of a vertebral artery, then the contralateral vertebral artery must also be visualised. Cerebral circulatory arrest – and thus death due to brain damage – is considered to have been demonstrated if the cerebral (i.e. intracranial intradural) arteries and veins are not visible in either the supratentorial or the infratentorial compartment.

The operator requires an FMH title of specialist in Radiology.

Magnetic resonance imaging (MRI)

Another suitable test is MRI; however, this method is resource-intensive and technically difficult to perform.

The operator requires an FMH title of specialist in Radiology.

F. Determination of death and organ donation process (3 flowcharts)

The following flowcharts are available for download in PDF format at: www.samw.ch/guidelines

F.1. Death due to primary brain damage (DBD): adults and children over 1 year old

F.2. Death due to primary brain damage (DBD): infants

F.3. Death after cardiac arrest (DCD): adults, children and infants

G. Templates: protocols for the determination of death

The following templates are available for download in PDF format at: www.samw.ch/guidelines

G.1. Death due to primary brain damage: adults and children over 1 year old

G.2. Death due to primary brain damage: infants

G.3. Death after cardiac arrest: adults, children and infants

H. Negative list

The following preparatory medical measures are not indispensable for successful transplantation and involve more than minimal risks and burdens for the donor (the list is exhaustive):

- placement of an arterial cannula (e.g. double-balloon triple-lumen catheter) for cold perfusion;
- mechanical resuscitation.

If the donor has not consented to these measures, they are not to be performed prior to death.

IV. Footnotes

¹ Federal Act of 8 October 2004 on the Transplantation of Organs, Tissues and Cells (SR 810.21, TxG).

² Cf. Art. 7 of the Ordinance of 16 March 2007 on the Transplantation of Human Organs, Tissues and Cells (SR 810.211, TxV).

³ Cf. Gardiner D, Shemie S et al. (2012).

⁴ For the procedure to be adopted for the determination of death, Annex 1, no. 1 of the Transplantation Ordinance makes reference to the relevant sections of the guidelines. In addition, on being incorporated into the Code of the Swiss Medical Association (FMH), the other sections of the guidelines become binding for all members of the FMH.

⁵ In what follows, the term «medical» is used in a broad sense, covering the activities of physicians, nurses and therapists.

⁶ Cf. «Intensive-care interventions». Medical-ethical guidelines of the SAMS (2013).

⁷ Specific training is available for discussions of this kind.

⁸ Cf. «Intensive-care interventions». Medical-ethical guidelines of the SAMS (2013), Section 7.11. Provision of care for potential organ donors.

⁹ Cf. Flowchart «Decision tree for organ removal», Appendix B

¹⁰ Cf. Flowchart «Decision tree for preparatory medical measures», Appendix B.

¹¹ This may also be an adolescent under the age of 16 (Art. 4 para. 3 TxV). Adolescents under the age of 16 may not, however, make a decision concerning donation on the patient's behalf (Art. 5 para. 1 TxV).

¹² Cf. Art. 8 para. 7 TxG.

¹³ The term «parties» refers to relatives, physicians, nurses and other medical professionals.

¹⁴ Cf. «Ethics support in medicine». Medical-ethical recommendations of the SAMS (2012).

¹⁵ Experience is deemed to be adequate if at least one of the two specialists carrying out the diagnosis of brain death has performed brain death diagnosis under supervision in at least five patients. The relevant experience is to be documented.

¹⁶ At present, brain death diagnosis only forms part of the curriculum for these specialist training courses.

¹⁷ Cf. Determination of death and organ donation process (flowchart), Appendix F.

¹⁸ Cf. Glossary, Appendix A.

¹⁹ The reliability of the clinical signs is widely recognised (Cf. References). There is no evidence that better results are obtained if the examination is repeated after an interval for observation, provided that the initial examination is correctly performed.

²⁰ The determination of pulselessness by palpation is unreliable and therefore appears unsuitable for precise establishment of the time of cardiac arrest with a view to subsequent organ donation. Likewise, the electrocardiogram (ECG) cannot be used to determine cardiac arrest since cardiac electrical activity in the absence of mechanical contractions can often still be detected in the ECG for some time after death.

²¹ A stand-off period of 5 minutes was specified since, in Switzerland, pulselessness has to be diagnosed echocardiographically.

graphically, the requirement for subsequent diagnosis of brain death extends the stand-off period by at least another 2–3 minutes, and a 5-minute stand-off period has been specified by most other countries. The conclusive evidence of absence of contractions provided by echocardiography demonstrates that blood flow has ceased and the brain is thus no longer supplied with oxygen; in the absence of oxygen, nerve cell death occurs in less than 5 minutes.

²² I.e. children aged over 28 days but less than 1 year, or, in the case of preterm infants, more than 44 weeks' postmenstrual age.

²³ The reliability of the clinical signs and also of the additional tests for demonstrating irreversible cessation of brain function is less well studied for infants than for later age groups. A mandatory observation period appears to be advisable.

²⁴ I.e. children aged under 28 days, or less than 44 weeks' postmenstrual age.

²⁵ The determination of death in neonates involves uncertainties – regarding both clinical diagnosis of brain death and additional tests – and there is scant literature on the subject of criteria for death in neonates. Potential candidates for DCD (Donation after Cardiocirculatory Death) would be primarily neonates suffering severe perinatal asphyxia; however, DCD in the neonatal period is ruled out by the generally prolonged periods of ischaemia following withdrawal of life-sustaining measures in perinatal asphyxia.

²⁶ Cf. Additional (instrumental) tests, Appendix E.

²⁷ At certain centres, an additional test is also carried out ahead of discussions with relatives, who may be reassured by the demonstration of cerebral circulatory arrest.

²⁸ Studies have shown that the duration of in-hospital resuscitation efforts varies. One study showed that after 20 minutes the rate of successful resuscitation declines sharply and that continued efforts are of little use (cf. [Goldberger Z.D. et al. 2012](#)). In Switzerland, CPR is often considered unsuccessful and terminated after 20 minutes. In individual cases, however, more prolonged resuscitation efforts can be worthwhile.

²⁹ Cf. Busl KM, Greer DM (2009).

³⁰ Cf. Citerio G, Crippa IA, Bronco A et al. (2014).

³¹ Cf. Kuo JR, Chen CF, Chio CC, et al. (2006).

³² Cf. Heran MK, Heran NS, Shemie SD (2008)

³³ Cf. Kuo JR, Chen CF, Chio CC, et al. (2006).

V. Information on the preparation of these guidelines

Mandate

In January 2015, the Central Ethical Committee (CEC) of the SAMS appointed a sub committee to revise the 2011 guidelines on the determination of death.

Sub-committee responsible

Professor Jürg Steiger, Internal Medicine, Basel (Chair)

Professor Claudio Bassetti, Neurology, Bern

Corinne Delalay-Marti, NDS HF, General Coordinator LODP, Sion

Professor Bernhard Frey, Paediatric Intensive Care, Zurich
Professor Yvan Gasche, Intensive Care, Geneva

Eva Ghanfili, NDS HF, Intensive Care Nursing, Lugano

Professor Christoph Haberthür, Intensive Care, Zurich

Professor Samia Hurst, Ethics, Geneva

Professor Christian Kind, Paediatrics, St Gallen (CEC Chair)

lic. iur. MAE Michelle Salathé, Law, Bern (SAMS)

PD Dr Urs Schwarz, Neurology, Zurich

Permanent expert: Marcel Monnier, advocate, Bern

Consultation procedure

On 16 November 2016, the Senate of the SAMS approved a draft version of these guidelines to be submitted for consultation to professional associations, organisations and interested parties. The comments received were taken into account in the final version.

Approval

The final version of these guidelines was approved by the Senate of the SAMS on 16 May 2017. The guidelines came into force on 15 November 2017.

Original versions

English version in the original layout available at <https://www.samw.ch/en/Publications/Medical-ethical-Guidelines.html>

German version available at <http://www.samw.ch/de/Ethik/Richtlinien/Aktuell-gueltinge-Richtlinien.html>

French version available at <http://www.samw.ch/fr/Ethique/Directives/actualite.html>

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