

GUIDELINES FOR DEATH DETERMINATION BY NEUROLOGIC CRITERIA (DNC) FOR THE PURPOSES OF ORGAN DONATION IN ONTARIO: ADULT AND CHILDREN GREATER THAN OR EQUAL TO ONE YEAR OF AGE

Overarching Principles

In accordance with the *Gift of Life Act*, Ontario Health (Trillium Gift of Life Network [TGLN]) has aligned clinical protocols with *A Brain-Based Definition of Death and Criteria for its Determination After Arrest of Circulation or Neurologic Function in Canada: A 2023 Clinical Practice Guideline*. For the purposes of post-mortem donation for transplantation, two physicians must confirm death with the legal time of death recorded as the time of completion of the last test required to fulfill death determination criteria by the first physician. The two determining physicians may complete the clinical assessment concurrently, however, if performed at different points in time, the clinical assessments, including the apnea test, must be performed by both to the fullest extent.

Physicians Determining Death

Physicians performing DNC must hold full and current licensure for independent (non-educational) medical practice in Ontario. The physician must have skill and knowledge in the management of patients with severe brain injury, as well as in DNC. For the purpose of donation for transplantation, clinicians determining death must not have an association or active involvement in transplant procedures, organ allocation, or care of the intended transplant recipient.

Clinical Requirements for Death Determination by Neurologic Criteria

There must be an established cause of devastating brain injury severe enough to cause death and supported by neuroimaging evidence. Potential confounders of an accurate clinical assessment must have been considered and excluded. Death has been determined when all components of the clinical assessment are fully performed, complete, and consistent with DNC. The clinical assessment for DNC must fulfill the following criteria: (1) absence of consciousness demonstrated by a lack of arousal and awareness in response to stimuli, (2) absence of brainstem function as demonstrated by cranial nerve testing, and (3) absence of the capacity to breathe demonstrated by formal apnea testing. For patients with isolated brainstem or infratentorial brain injury without supratentorial involvement, a clinical assessment is necessary but does not fulfill DNC. An ancillary test is required to determine death in this scenario, or a period of observation and reimaging demonstrating whole-brain involvement. If any portion of the clinical assessment for DNC cannot be complete and/or confounding factors cannot be excluded, expert consultation with the Ontario Health (TGLN) Donation Support Physician (DSP) and ancillary testing should be considered.

Confounding Factors and Other Clinical Situations Requiring Special Consideration

Confounding factors may prevent the observation of neurologic responses and/or mimic death, therefore, where feasible, the DNC clinical assessment should be performed in the absence of confounding factors. Potential confounding factors include, but are not limited to, less than 48 hours from the return of spontaneous circulation following cardiac arrest, unresuscitated shock, hypothermia, drug intoxications, administration of cycloplegic or muscle relaxant drugs, neuromuscular disorders, recent decompressive craniectomy, spinal cord injury, isolated brainstem or infratentorial brain injury and severe metabolic disorders such as hypoglycaemia, severe hypophosphatemia, hypernatremia, and/or liver or renal dysfunction (see page 2). Confounding factors must be reviewed by the Most Responsible Physician (MRP) in the context of the primary etiology and the clinical assessment. In the context of donation, Ontario Health (TGLN) will collaboratively review confounding factors with the MRP prior to initiating DNC testing.

Ancillary Testing to Support Clinical Requirements for Determining Death by Neurologic Criteria in the Presence of Confounding Factors

Any ancillary test is considered supportive, not confirmatory, for DNC. The only accepted ancillary tests at present are a radionuclide brain perfusion study employing a lipophilic radiopharmaceutical, CT angiography, transcranial Doppler, or CT perfusion. If performed, the test must be interpreted by test-specific qualified imaging physician specialists. Written confirmation of the ancillary test result must be documented by a physician for donation to proceed and the time of death is documented as the time that the ancillary test was completed.

DEATH DETERMINATION BY NEUROLOGIC CRITERIA CONFOUNDING FACTORS CHECKLIST

This tool has been developed to address potential confounding factors prior to the examination of death determination by neurologic criteria. No worksheet can adequately address all confounding factors. After reviewing concerns raised here with the Most Responsible Physician, please call the Donation Support Physician as needed.

Laboratory & Physiologic Values (results within last 6-12hours)	Patient Value	Recommended Limits for DNC
All Patients	Sodium (Na)	125 – 159 mmol/L
	Phosphate (PO ₄ ³⁻)	Above 0.4 mmol/L
	Glucose	3 – 30 mmol/L
	pH	7.28 – 7.50
	PaCO ₂	Below 60
Renal Function	Blood Urea Nitrogen (BUN)	Below 40 (if available)
	Creatinine	Below 400
	Estimated Glomerular Filtration Rate (eGFR)	Above 30
Liver Function	Bilirubin (total)	Less than 100

What is the mechanism of devastating brain injury that has led to suspected death?	<input type="checkbox"/> Elevated ICP/Hydrocephalus <input type="checkbox"/> Anoxic brain injury <input type="checkbox"/> Infratentorial Brain Injury	Is the mechanism indicated, supported by imaging?	<input type="checkbox"/> Yes <input type="checkbox"/> No
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Any existing high-risk conditions identified below, require consultation with the Donation Support Physician

- Determination of death less than 6 hours from the loss of the last brain stem reflex
- Determination of death less than 48 hours from a cardiac arrest
- Cardiac arrest thought to have resulted from drug exposure or ingestion **AND** has never had brain stem reflexes
- Patient has a neuromuscular disorder (e.g. ALS, Myasthenia Gravis, etc.) or cervical spinal cord injury
- Brain injury isolated to brainstem or posterior fossa without herniation
- The patient has had a decompressive craniectomy
- Central venous sinus thrombosis with ongoing treatment
- N/A

Does the patient have a positive toxicology screen in the last 48 hrs or on admission AND BOTH of:	<input type="checkbox"/> A positive that is <u>not</u> marijuana (THC) or cocaine or methamphetamine AND <input type="checkbox"/> A positive that is <u>not</u> explained by drugs given in the emergency department or critical care unit <input type="checkbox"/> N/A
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Has the patient had prolonged sedation or analgesia infusions in the last 48 hours (see definitions)?

Drug	Propofol	Midazolam	Fentanyl	Other
Cumulative Dose	Off < 6 hrs or Duration ≥ 48 hours	Any duration	≥ 24 hours	
Duration				
	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No

Other comments

Does the patient have severely abnormal organ function that may affect the DNC examination?	<input type="checkbox"/> No severe organ function impairment <input type="checkbox"/> Yes – Severe liver dysfunction <input type="checkbox"/> Yes – Severe renal dysfunction <input type="checkbox"/> Yes – Respiratory function (e.g. COPD, chronic elevated Co ₂)
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Does the patient have severe unresuscitated shock?	<input type="checkbox"/> Yes <input type="checkbox"/> No
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Does the patient have uncorrectable electrolyte abnormalities?	<input type="checkbox"/> Yes <input type="checkbox"/> No
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Is the patient’s core temperature (esophageal, rectal, bladder, central venous or arterial catheter monitoring) <u>below</u> 36 degrees Celsius?	<input type="checkbox"/> Yes <input type="checkbox"/> No
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Confounding factors reviewed by _____ (name of Specialist - Organ and Tissue Donation) with Dr. _____ (name of Most Responsible Physician).

Date: (DD/MM/YYYY): _____ Time: _____

**CONFIRMATION OF DEATH DETERMINATION BY NEUROLOGIC CRITERIA (DNC):
 ADULTS AND CHILDREN GREATER THAN OR EQUAL TO ONE YEAR OF AGE**

TGLN ID:				
Prerequisites				
What is the mechanism of devastating brain injury that has led to the suspected death?	<input type="checkbox"/> Elevated ICP/Hydrocephalus <input type="checkbox"/> Isolated Infratentorial Brain Injury		<input type="checkbox"/> Anoxic Brain Injury <input type="checkbox"/> Other (please explain):	
Is the mechanism of devastating brain injury indicated above supported by imaging?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
Potential confounders of an accurate clinical assessment have been considered and excluded. If confounders cannot be excluded, the clinical assessment must be completed to the fullest extent possible and ancillary investigation is recommended. If no, please explain:			<input type="checkbox"/> Yes	<input type="checkbox"/> No
Core Body Temperature (esophageal, bladder, central venous, or arterial catheter monitoring)	°C			
Clinical Assessment	Exam 1		Exam 2	
Absent motor responses (excluding spinal reflexes)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Absent cough (tracheal) reflex	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Absent gag (pharyngeal) reflex	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Absent (bilateral) corneal reflexes	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Absent (bilateral) vestibulo-ocular reflexes	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Absent (bilateral) pupillary response to light	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Apnea Testing				
Apnea testing should be the final element of the clinical assessment.				
Baseline	pH _____		pH _____	
	PaCO ₂ _____ mmHg		PaCO ₂ _____ mmHg	
At completion of apnea test	pH _____		pH _____	
	PaCO ₂ _____ mmHg		PaCO ₂ _____ mmHg	
PaCO ₂ ≥ 20 mmHg above the baseline level and pH ≤ 7.28	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Absent breathing/respiratory efforts	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Date/time blood sample was taken when PaCO ₂ reached targets:	(DD-MM-YY):		(DD-MM-YY):	
	(00:00)		(00:00)	
Criteria: pH less than or equal to 7.28, PaCO ₂ greater than or equal to 60 mmHg and greater than or equal to 20 mmHg rise from baseline CO ₂				
Ancillary Testing				
If any portion of the clinical assessment cannot be completed and/or potential confounders of an accurate clinical assessment cannot be excluded, an ancillary test should be performed. For isolated infratentorial brain injury, an ancillary test is required or a period of observation and reimaging demonstrating whole-brain involvement.				
Date/time ancillary test performed:	(DD-MM-YY):		(00:00):	
Ancillary Test Performed:				
<input type="checkbox"/> Radionuclide Perfusion	<input type="checkbox"/> Transcranial Doppler	Read by (PRINT):		
<input type="checkbox"/> CT-Angiography	<input type="checkbox"/> CT Perfusion (on hold)			
Absent intracerebral blood flow/perfusion			<input type="checkbox"/> Yes	<input type="checkbox"/> No
Time of Death				
The legal time of death is recorded as the time of completion of the last test required to fulfill death determination criteria (typically, the time the blood sample was taken when the PaCO ₂ reached the apnea test targets, or the time ancillary test was performed). When death is determined independently by two physicians, the legal time of death is the time of completion of the first physician's assessment.				
This patient fulfills the criteria for death determination by neurologic criteria			<input type="checkbox"/> Yes	<input type="checkbox"/> No
Date of Death (DD-MM-YY):	Time of Death (00:00):			
Physician 1 (PRINT):	Signature:			
Physician 2 (PRINT):	Signature:			

Physician 1 and physician 2 determinations may be performed concurrently. If performed at different times, a full clinical examination including apnea test must be performed, without any fixed examination interval, regardless of the primary etiology.

Recommended Procedure for DNC

- Physicians performing Death Determination by Neurologic Criteria (DNC) must hold full and current licensure for independent (non-educational) medical practice in Ontario.
- The physician must have skill and knowledge in the management of patients with severe brain injury, as well as in DNC.
- The cause of devastating brain injury should be supported by neuroimaging evidence consistent with the established cause.
- A 48-hour delay after return of spontaneous circulation post-cardiac arrest in patient with hypoxic-ischemic injury who do not have imaging evidence consistent with devastating brain injury before conducting the clinical assessment for DNC.
- Minimal core body temperature at 36°C. (esophageal, bladder, rectal, central venous or arterial catheter monitoring)
- Rule out the presence of any confounding factor that would interfere with the clinical exam
- Assess level of consciousness (Glasgow coma scale = 3)
- Observe the lack of response to painful central stimulation (E.g.: supraorbital pressure)
- Movements should be examined closely to be distinguished from intact spinal reflexes
- Insert a suction catheter into the endotracheal tube and stimulate the trachea
 - Any effort to cough excludes DNC
- Insert a Yankauer or tongue depressor to stimulate the back of the pharynx;
 - Any gag excludes DNC
- Check pupils for direct and consensual reaction
 - Any reaction or dilation at < 3 mm, excludes DNC
- Caloric/ vestibular-ocular response
 - Position head at 30° horizontally, irrigate the auditory canal with at least 50 mL of ice water, and observe both eyes; any eye movement excludes DNC
 - Five minutes should be observed before the other auditory canal is irrigated
 - The caloric test may be performed even if there is a basal skull fracture or damage to the auditory canals is present or suspected

Apnea Test

- The physician must continuously observe the patient for respiratory effort
- Pre-oxygenate the patient with O₂ at 100% for 10 minutes
- Check ABG and disconnect the ventilator when PaCO₂ / pH thresholds for initiation are met. A PaCO₂ between 35 – 45 mmHg and the arterial pH ≥ 7.35 is recommended. If thresholds are not achievable, then discussion with Ontario Health (TGLN) Donation Support Physician is recommended.
- Attach the patient to positive pressure (such as a bag-valve device with a PEEP valve), connected to oxygen or an alternative established method for providing oxygenation. For a period of 5 - 15 minutes, observe for the absence of any respiratory movement.
- Draw an ABG after 5, 10 and 15 minutes. **Thresholds for completion of apnea test include PaCO₂ ≥ 60 mmHg and ≥ 20 mmHg above the pre-apnea test level and pH ≤ 7.28 as determined by arterial blood gases.**
- Caution must be exercised in considering the validity of the apnea test in cases of chronic respiratory insufficiency or dependence on hypoxic respiratory drive. If the above criteria are met, the test is documented as “absence of respiratory effort”
- If the patient becomes unstable it is recommended to draw an ABG before putting the patient back on the ventilator as they may have met the requirements outlined above
- Resume initial respiratory parameters to optimize lung strategies
- If any of the minimum clinical criteria cannot be completed or confounding factors cannot be corrected, a repeat exam, ancillary testing or both may be recommended.
- Discussion with the Specialist - Organ and Tissue Donation (S-OTD) or the Ontario Health (TGLN) Donation Support Physician on-call is recommended