The determination of brain death is to be made ONLY by an attending physician who is a Neurologist, Neurosurgeon, or Critical Care specialist, and who has successfully completed the Core Privilege on “Determination of Brain Death.”

Preliminary Criteria

- Patients who meet the following preliminary criteria must be evaluated:
  - Apparent coma
  - Lack of brain stem reflexes
  - Not over-breathing the ventilator

Evaluation of Coma

- Establish irreversible and proximate cause of coma
- The cause of coma can usually be established by:
  - Patient history
  - Clinical examination
  - Neuroimaging
  - Laboratory tests
- Test for CNS-depressant drug effect through patient history, drug screen, calculation of clearance using 5 half-life’s of the drug (assuming normal hepatic and renal function); or, if available, drug plasma levels below the therapeutic range. (If barbiturate given, serum level < 10 mcg/ml).
- Rule out sedating drugs, neuromuscular blocking agents, intoxication (blood alcohol level < 0.08%) or poisoning as cause of coma.
- Rule out severe acid-base, electrolyte, or endocrine abnormalities.
- Achieve core temperature ≥ 36° C or 96.8° F
  - Note: If patient has been treated with induced hypothermia post cardiac arrest, evaluation for brain death should NOT be performed until a minimum of 72 hours after rewarming unless neuro-imaging modality is suggestive of brain death (i.e., Complete loss of CSF flow around the brain stem - massive herniation with brain stem compression).
  - See OSUWMC induced hypothermia guideline for additional information.
- Achieve normal systolic blood pressure ≥ 100 mmHg (may use pharmacologic support)
  - For patients on ECMO, achieve MAP >60mmHg.
- Exclusion or correction of complicating medical conditions that may confound clinical assessment.

Perform Neurologic Assessment

- Coma: Patient lacks all evidence of responsiveness
- Brainstem reflexes- absence of all the following:
  - Pupillary response to bright light, documented in both eyes
    - Pupils must be midrange to dilated (4 mm to 9 mm)
  - Ocular movements using oculovestibular or vestibulo-ocular reflex testing (oculocephalic reflex testing is not required if oculovestibular testing can be successfully performed)
    - Deviation of the eyes to irrigation of ear with 50 mL of cold water
    - Allow up to 1 minute for response; allow 5 minutes between testing of ears
  - Corneal reflex
  - Facial muscle movement to a noxious stimulus
  - Pharyngeal and tracheal reflexes
- Apnea testing- if able to be performed:
  - See page 3 for conditions required, procedure, and interpretation of apnea testing.

Ancillary Testing

- The following confirmatory tests can be used when uncertainty exists about the reliability of parts of the neurologic examination or when the apnea test cannot be performed:
  - Scintigraphy (nuclear scan)
  - Electroencephalography (EEG)
  - Trans Cranial Doppler (TCD)
  - Cerebral angiography
- The following conditions may interfere with the clinical diagnosis of brain death; therefore, in such instances, confirmatory testing is recommended:
  - High cervical spine injury or other condition that would otherwise prevent normal ventilation (i.e., severe neuromuscular disease)
  - Severe facial trauma
  - Pre-existing pupillary abnormalities
  - Presence of sedative drugs or neuromuscular blocking agents, or toxic levels of aminoglycosides, tricyclic antidepressants, anticholinergics, antiepileptic drugs, or chemotherapeutic agents
  - Sleep apnea or severe pulmonary disease resulting in a chronic retention of CO₂
- If initial confirmatory testing fails to confirm brain death, but a complete and reliable repeat clinical exam can be performed and is consistent
with brain death, the diagnosis of brain death can be made without repeat confirmatory testing.
  - However, if a repeat clinical exam cannot be done, confirmatory testing should be repeated in 24 hours.

- To determine the appropriate confirmatory test, consider:
  - Specialist availability
  - Need to transport a critically ill patient to a diagnostic suite
  - Clinical factors that may interfere with test interpretation

- See page 4 for brain Death Determination Process Flowchart

**Repeat Clinical Assessment**

- When the full clinical examination, including both assessments of the brain stem reflexes and the apnea test is conclusively performed, *no* additional testing is required to determine brain death.
- If testing is *not* consistent with brain death, repeat the assessment at a clinically appropriate interval.

**Apnea Testing**

- Obtain apnea testing **only** if these conditions are present:
  - Core temperature > 36° C or 96.8° F
  - Systolic blood pressure ≥ 100 mmHg
    - May use pharmacologic support
  - Euvolemia
  - Normal PaCO₂ (35-45 mmHg)
  - Normal PaO₂ (or preoxygenation to obtain > 200 mmHg)

- If these conditions are *not* present, defer apnea testing until these conditions are met, or use confirmatory test.
- If patient is on ECMO, other confirmatory tests should be used rather than the apnea test.
  - See OSUWMC ECMO guideline for additional information.
- Refer to other conditions that may interfere with apnea testing under Ancillary Testing section.

**Procedure for Apnea Testing**

- After pre-oxygenation for at least 10 minutes with 100% oxygen, draw a blood gas and maintain normal PCO₂ level.
- If SpO₂ remains > 95%, disconnect the ventilator, maintain pulse oximetry.
- Deliver 100% O₂ via tracheal cannula ≥ 6 L/min.
- Watch for respiratory movements that produce abdominal or chest excursion and this may include a brief gasp. This does not include:
  - Reflexive shoulder movement
  - Back arching
  - Intercostal movement without significant tidal flow.

- After approximately 8 minutes (or as soon as adequate respirations observed), obtain arterial blood gas and resume ventilation.
- Obtain arterial blood gas and reconnect ventilator if any of the following occur:
  - SBP drops below 90 mmHg
  - MAP drops below 60
  - O₂ saturation drops < 85% for 30 seconds
  - Cardiac dysrhythmias develop

**Interpretation of Apnea Testing**

- Respirations observed the patient is not brain dead.
- Repeat as clinically indicated.
- No respirations observed, and PCO₂ ≥ 60 mmHg or 20 mmHg or more over baseline supports the diagnosis of brain death.
- Clinical deterioration and PCO₂ does not increase over 60 mmHg or by 20 mmHg over baseline
  - Testing is inconclusive, proceed with additional confirmatory testing
- If inconclusive, the apnea test may be repeated with a longer period of pre-oxygenation, or proceed to confirmatory testing.
- In the majority of patients, brain death can be diagnosed clinically with a thorough neurologic examination and apnea testing.

**Organ Transplantation and Brain Death**

- Family members who inquire about organ donation should be referred to the Lifeline of Ohio Organ Procurement (LOOP) representative.
- Per Ohio law, brain dead patients who have provided first-person authorization through the Ohio Donor Registry are eligible for organ donation, provided that medical screening by LOOP shows no contraindications.
- Ohio law recognizes first-person authorization as the highest evidentiary standard.
- To avoid a conflict of interest, the physician who determines and/or certifies the death of a potential organ or tissue donor should not be involved in the organ or tissue removal, nor in subsequent transplantation procedures.

**Physiologic Support and Brain Death**

- If a brain dead patient is a candidate for organ procurement, maintain physiologic support as needed until the organ procurement screening process is complete.

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• Per Ohio law, if the patient is not a candidate for organ procurement, removal of physiologic support should occur expeditiously, with time allowed for family bereavement.
• Per Ohio law, if the patient is not a candidate for organ procurement, explain to the family, with compassion, that the decision to withdraw physiologic support is a requirement, not an option.
  o Some flexibility can be used in timing of the withdrawal.

Note: For additional information regarding anatomical gifts and the donor registry in Ohio please see the Ohio UAGA (Uniform Anatomic Gift Act), codes 2108.01-2108.29.

Documentation Requirement
• All phases of the determination of brain death should be documented in IHIS.
• There is a “Brain Death Exam Flowsheet” and a “Brain Death Documentation” Note Type to assist with documentation.
  o See IHIS Brain Death Documentation Tip Sheet for more information.

Quality Measures
• Appropriate use of confirmatory testing (e.g., when apnea test cannot be completed).
• Brain death determination in a timely manner (e.g., within 6 hours of preliminary evidence of brain death).
• Patients suspected of brain death are appropriately assessed prior to withdrawal of life-sustaining treatment.
• Brain death documentation in IHIS.
• Determination of brain death is made ONLY by an attending physician who is a Neurologist, Neurosurgeon, or Critical Care specialist, and who has successfully completed the Core Privilege on “Determination of Brain Death.”

Reference

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Guideline Approved

Disclaimer: Clinical practice guidelines and algorithms at The Ohio State University Wexner Medical Center (OSUWMC) are standards that are intended to provide general guidance to clinicians. Patient choice and clinician judgment must remain central to the selection of diagnostic tests and therapy. OSUWMC’s guidelines and algorithms are reviewed periodically for consistency with new evidence; however, new developments may not be represented.
Brain Death Determination Process Flowchart

- **Neurological examination and apnea testing**
  - Results **not consistent** with brain death
  - Examinations cannot be completed or results are unreliable
  - Results **consistent** with brain death

- **Order confirmatory testing**
  - Negative
    - Results **not consistent** with brain death
    - Unable to perform repeat clinical exam
      - Repeat confirmatory testing or alternative confirmatory exam in 24 hours
  - Positive
    - Results **consistent** with brain death
    - Able to perform reliable and complete repeat clinical exam and apnea test.
      - Reevaluate plan of care
      - Complete Brain Death Documentation and initiate organ procurement process

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