Brain Death: Establishing the Diagnosis in Adults

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 history, examination, neuroimaging, and laboratory tests.
  - Test for CNS-depressant drug effect by history, drug screen, or 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 $\geq$ 36°C or 96.8° F.
- Achieve normal systolic blood pressure $\geq$ 100 mm Hg (may use pharmacologic support).
- 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 oculocephalic testing and oculovestibular reflex testing -- 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.*

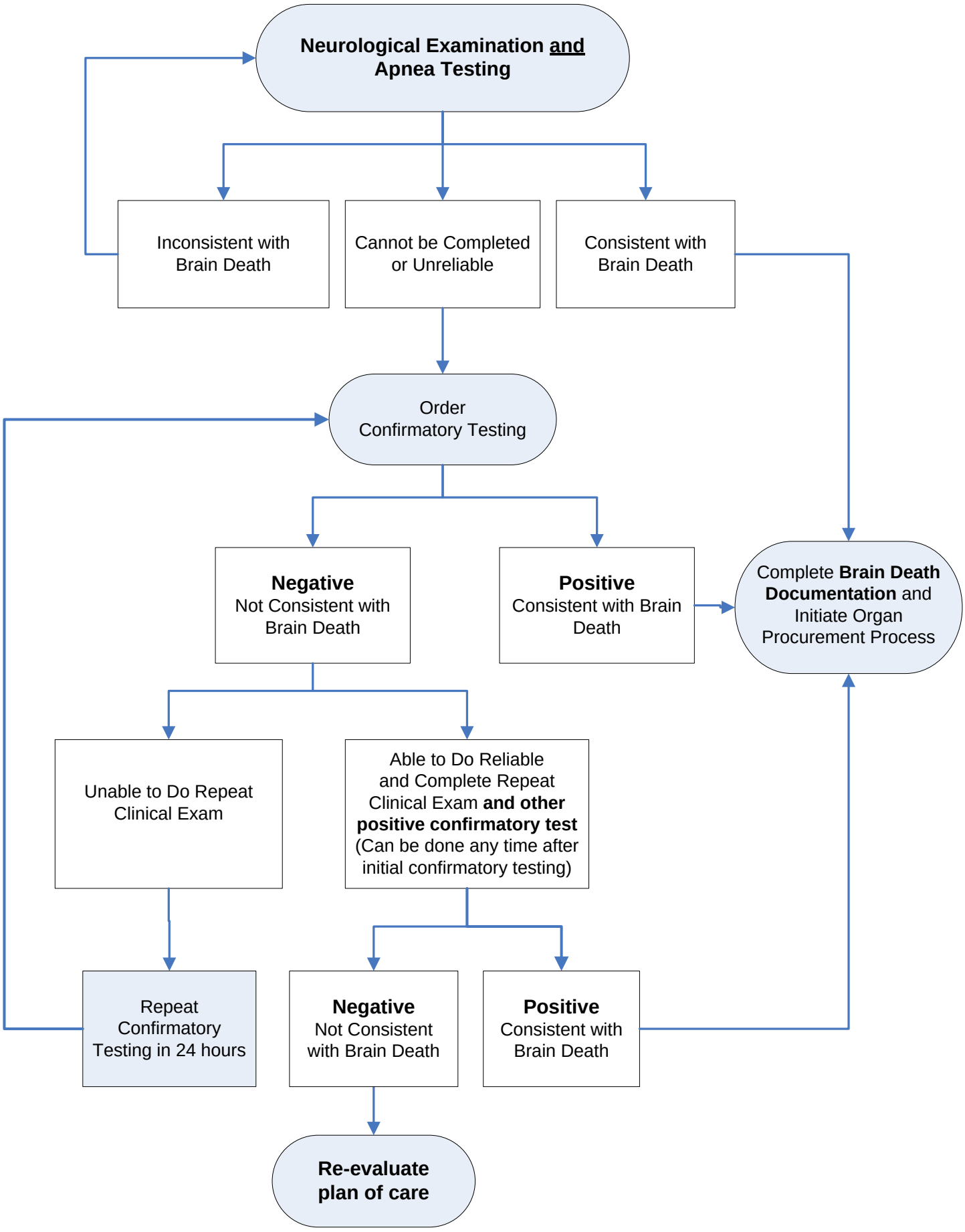
Confirmatory Testing

Any one of the following must be completed:

- 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:
  - Cerebral angiography
  - Electroencephalography (EEG)
  - Scintigraphy (nuclear scan)
- The following conditions may interfere with the clinical diagnosis of brain death; therefore, in such instances, confirmatory testing is recommended.
  - 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 CO_2.
- 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 2 for brain Death Determination Process Flowchart

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 mm Hg (may use pharmacologic support).
- Euvolemia.
- Normal PaCO2 (35-45 mm Hg).
- Normal PaO2 (or preoxygenation to obtain > 200 mm Hg).

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.

Procedure for Apnea Testing

- After pre-oxygenation for at least 10 minutes with 100% oxygen, draw a blood gas and maintain normal PCO_2 level.
- If SpO_2 remains > 95%, disconnect the ventilator, maintain pulse oximetry.
- Deliver 100% O_2 via tracheal cannula at least 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, or 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:
  - SBP drops below 90 mm Hg or
  - MAP drops below 60 or
  - O_2 saturation drops < 85% for 30 seconds or
  - 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 mm Hg or 20 mmHg or more over baseline- testing **supports** the diagnosis of brain death.
- Clinical deterioration and PCO2 does not increase over 60 mm Hg or by 20 mm Hg over baseline—testing is **inconclusive**, proceed with additional confirmatory testing.
- If inconclusive, the apnea test may be repeated with a longer period of preoxygenation, or proceed to confirmatory testing.
- In the majority of patients, brain death can be diagnosed clinically with a thorough neurologic examination and apnea testing.
- 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."

Organ Transplantation and Brain Death

- Family members who inquire about organ donation should be referred to the Lifeline of Ohio Organ Procurement (LOOP) representative.
- 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.
- First-person authorization outweighs objections by the family, both legally and ethically.
- 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, nor be responsible for the care of potential recipients.

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.
- If the patient is not a candidate for organ procurement, removal of physiologic support should occur expeditiously, with time allowed for family bereavement. 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. Some flexibility can be used in timing of the withdrawal.

Documentation Requirements

- 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. See 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.
- Completion of the "Brain Death Testing Documentation Form."
- 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

- Evidence-based guideline update: determining brain death in adults: Report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology* 2010; 74; 1911-191.

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