Determination of Death by Neurological Criteria

Disclaimer: *This algorithm has been developed for MD Anderson using a multidisciplinary approach considering circumstances particular to MD Anderson's specific patient population, services and structure, and clinical information. This is not intended to replace the independent medical or professional judgment of physicians or other health care providers in the context of individual clinical circumstances to determine a patient's care. This algorithm should not be used to treat pregnant women.*

PRE-EVALUATION

Patient is suspected to meet criteria for neurological death[1,2]
- Patient has irreversible coma with known proximate cause
- Absence of brainstem reflexes and respiratory drive
- Neuroimaging correlates with cause of coma

→ Stop all medications that may interfere with the diagnosis of brain death, per discretion of Intensivist/Neurologist

→
- Conduct a multidisciplinary family meeting to discuss suspected brain death
- Inform nursing and initiate consults for assistance and counseling as appropriate
  - Social Work
  - Chaplain
- If any member of the clinical team feels that the diagnosis of brain death is not appropriate or is questioned/opposed by the patient's representative/family, contact Administration, Ethics, Risk Management, and Legal services as needed[3]
- Physician and clinical team must be aware of culture and trust issues raised by the family in any discussions

EVALUATION (to be performed by Attending Intensivist, Neurologist, or Neurosurgeon)

Potential brain death, notify:
- LifeGift[4]
- ICU Nurse Manager
- Hospital Administrator/Nursing Off-Shift Administrator (NOSA)

→
- Assess for **absence** of **all** of the following:
  - Pupil reaction to light in both eyes
  - Corneal reflexes
  - Ocular movement with head turning (oculocephalic reflex) when no apparent cervical spine injury exists and ocular movements after caloric testing with ice water (oculovestibular reflex)
  - Sucking and rooting reflexes for infants younger than 6 months
  - Oropharyngeal reflex (gag and cough reflex)
  - Facial movement to noxious stimuli at supraorbital nerve, temporomandibular joint
  - Motor response to noxious stimuli in all four limbs
- Perform apnea test, unless contraindicated (see Appendix E)

  Note: Apnea test should not be performed if:
  - Patient has a comorbid condition that prevents demonstration of spontaneous respiratory effort **or**
  - Patient would be placed at undue risk to develop cardiac arrest

→ See Page 2 for further testing

[1] For Death by Neurological Criteria Checklist, see Appendix A for adults and Appendix B for pediatrics. See Appendix C for Prerequisites for Physiologic Criteria Necessary Prior to Determination of Neurologic Death.
[2] See Appendix D for Conditions That May Interfere with the Clinical Diagnosis of Brain Death
[3] The family or any treating physician may request an Ethics consult under the Clinical Ethics Consultation Policy (#CLN0461)
[4] LifeGift should be notified at time of death, or when death is known to be imminent to make an independent assessment of suitability

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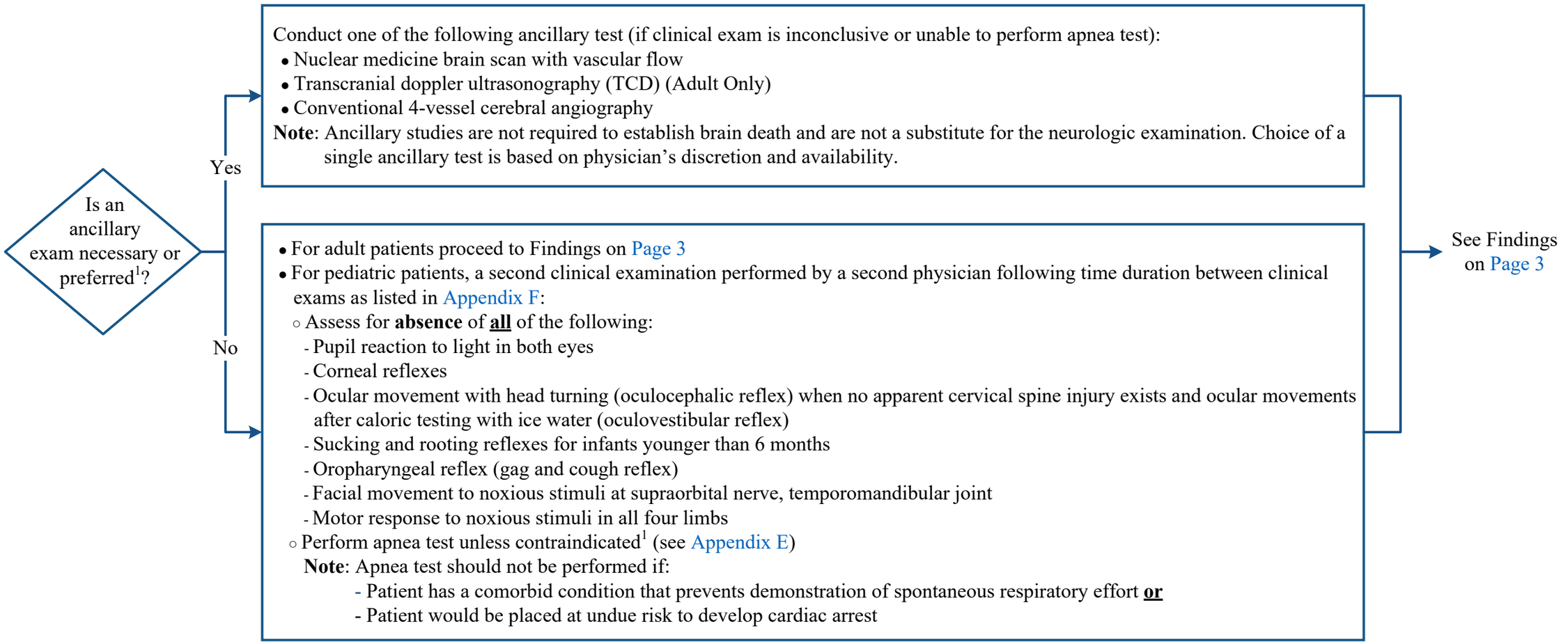
Determination of Death by Neurological Criteria

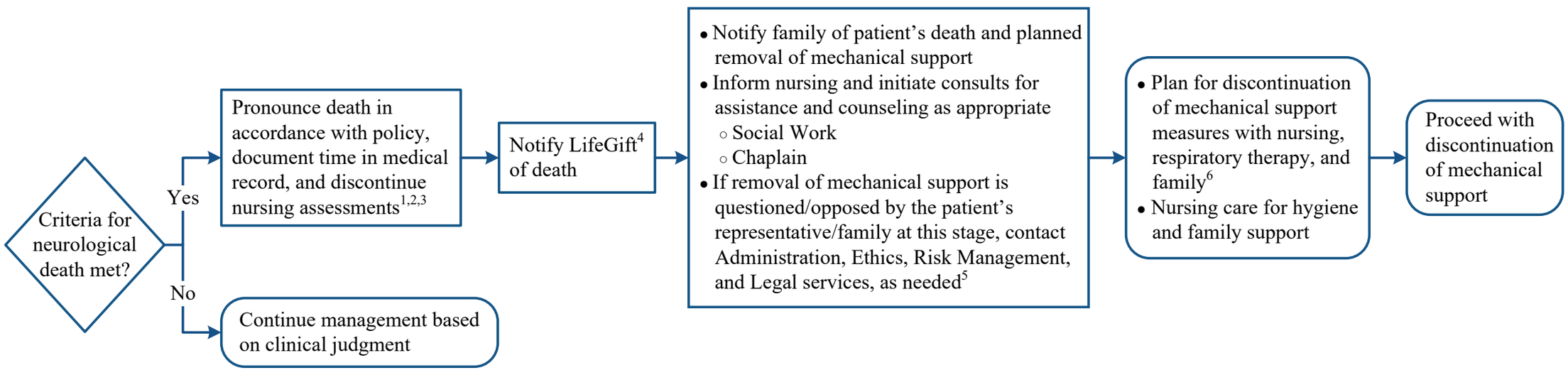
TESTING FOLLOWING EVALUATION



[1] See Appendix D for Conditions That May Interfere with the Clinical Diagnosis of Brain Death

Determination of Death by Neurological Criteria

FINDINGS **ACTIONS**



[1] If the practitioner is unwilling to pronounce the patient's death, the Medical Director and/or the appropriate hospital Executive Officer shall be notified. Refer to the Accommodating Closely Held Personal and/or Religious Beliefs Policy (#ADM0260).
[2] See the Care of the Deceased Policy (#CLN1084)
[3] See the Pronouncement of Death by an Advanced Practice Provider Policy (#CLN0509)
[4] LifeGift should be notified at time of death, or when death is known to be imminent to make an independent assessment of suitability
[5] The family or any treating physician may request an Ethics consult under the Clinical Ethics Consultation Policy (#CLN0461)
[6] The time between pronouncement of death and discontinuation of mechanical support should not exceed 6 hours. Under rare circumstances, the time period may be extended by 24-48 hours on a case by case basis, following consultation with Legal services.

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APPENDIX A: Death by Neurological Criteria Checklist - Adult

- ☐ **Pre-Evaluation**
- ☐ **Family Meeting**
  Attendees/discussed with:
  _____
  _____
- ☐ **Notify LifeGift of potential Brain Death**
- ☐ **Clinical Examination**
- ☐ **Apnea Testing**

or

- ☐ **Apnea test aborted**
  Reason:
  _____
  _____
- ☐ **Ancillary testing** (only 1 needs to be performed; to be ordered only if clinical examination cannot be fully performed due to patient factors, or if apnea testing inconclusive or aborted)
- ☐ **Continued Clinical Management**
- ☐ **Pronounce Death in accordance with policy**
  - ☐ Document time in medical record
- ☐ **Notify LifeGift of Death**
- ☐ **Planned removal of Mechanical Support**
- ☐ **Organ Donation Procedures through LifeGift**
- ☐ **Documentation of all of the above in the Medical Record**

Name of physician and signature:

_____

Date & time

APPENDIX B: Death by Neurological Criteria Checklist - Pediatric

☐ **Pre-Evaluation**

☐ **Family Meeting #1**
Attendees/discussed with:

_____
_____
_____
_____

☐ **Notify LifeGift of potential Brain Death**

☐ **Clinical Examination #1**

☐ **Apnea Testing (Pediatric Considerations)**
or
☐ **Apnea test aborted**
Reason:

_____
_____
_____
_____

☐ **Ancillary testing** (only 1 needs to be performed; to be ordered only if clinical examination cannot be fully performed due to patient factors, or if apnea testing inconclusive or aborted)

☐ **Documentation of all of the above in the Medical Record**

Name of physician and signature: (Exam 1)

_____
Date & time

☐ **Clinical Examination #2**

☐ **Apnea Testing (Pediatric Considerations)**
or
☐ **Apnea test aborted**
Reason:

_____
_____
_____

☐ **Continued Clinical Management**

☐ **Pronounce Death in accordance with policy**
- ☐ Document time in medical record

☐ **Notify LifeGift of Death**

☐ **Planned removal of Mechanical Support**

☐ **Organ Donation Procedures through LifeGift**

☐ **Documentation of all of the above in the Medical Record**

Name of physician and signature: (Exam 2)

_____
Date & time

APPENDIX C: Prerequisites for Physiologic Criteria Necessary Prior to Determination of Neurologic Death

All of the following physical criteria must be met:

- Central nervous system drug effect absent (if indicated toxicology screen; if barbiturates given, serum level < 10 µg/mL)
- No evidence of residual paralytics (electrical stimulation if paralytics used)
- Absence of severe acid-base, electrolyte, endocrine abnormality
- Normothermia or mild hypothermia (core temperature > 36°C)
- No spontaneous respirations
- Systolic blood pressure (SBP):

Adults and children ≥ 10 years old	SBP ≥ 100 mmHg
Children 1-9 years old	SBP > [70 + (2 x age in years)] mmHg
Infant < 1 year old	SBP > 70 mmHg
Newborns < 28 days old	SBP > 60 mmHg

Per American Academy of Neurology (AAN) Guidelines

APPENDIX D: Conditions That May Interfere with the Clinical Diagnosis of Brain Death

- Severe facial trauma
- Pre-existing pupil abnormalities
- Toxic levels of aminoglycosides, tricyclic antidepressants, anticholinergics, antiepileptic drugs or chemotherapeutic agents
- Anesthetic levels of opiates and sedatives
- Neuromuscular blocking medications
- Sleep apnea or severe pulmonary disease resulting in chronic retention of carbon dioxide
- Therapeutic hypothermia treatment
- Mydriatic medications, psychoactive substances, central nervous system depressants

Determination of Death by Neurological Criteria

APPENDIX E: Conducting Apnea Test[1,2]

Step 1:

A. In adults, adjust vasopressors to a systolic blood pressure (SBP) ≥ 100 mmHg and mean arterial pressure (MAP) ≥ 75 mmHg.
In children, if hemodynamically unstable prior to or during apnea test, adjust vasopressor support to maintain SBP and MAP ≥ fifth percentile for age.

Then:

B. Give patient 100% oxygen for at least 10 minutes prior to starting the test. Manage ventilator rate to achieve partial pressure of carbon dioxide ($PaCO_2$) 35-45 mmHg. If not achievable, abort apnea test.

Step 2:

Obtain baseline arterial blood gases (ABGs)[3] then disconnect the patient from the ventilator[1].

Step 3:

Once disconnected, insert oxygen source into endotracheal tube (ETT) and give patient oxygen at flow rate of 6 L/minute (loose fitting catheter through ETT).

Step 4: Observation/Evaluation

A. If patient exhibits any of the following: hypoxia, arrhythmia, or hypotension (SBP persistently < 90 mmHg in adults and children 10 years of age or older despite adjustment of vasopressors; for younger children use Appendix B for blood pressure parameters). Abort test immediately and draw ABG[3].

B. If no symptoms as listed in 'A', continue observation for required time period.

C. Observe adult and pediatric patients carefully for respiratory effort for approximately eight (8) minutes. Draw serial ABG's[3] (approximately every 2 minutes) beginning at approximately 8 minutes of apnea until the ABG results are consistent with the criteria below:

Observations	Evaluation
Unable to complete due to physical condition	→ Continue with clinically appropriate management
• No respirations or effort occurs **and** • Arterial pH level is < 7.30 **and** • $PaCO_2$ levels: ◦ In patients who are known **not to have** chronic carbon dioxide (CO_2) retention, the $PaCO_2$ level is ≥ 60 mmHg **and** ≥ 20 mmHg above the patient's pre-apnea test baseline level ◦ In patients who are **known to have** chronic CO_2 retention, and the baseline $PaCO_2$ is **known**, the $PaCO_2$ level is ≥ 60 mmHg **and** ≥ 20 mmHg above the patient's known chronic elevated premorbid baseline level ◦ In patients who are **suspected to have** chronic CO_2 retention, but the baseline $PaCO_2$ is **unknown**, the $PaCO_2$ level is ≥ 60 mmHg **and** ≥ 20 mmHg above the patient's pre-apnea test baseline level, and an ancillary test is required	→ Apnea test is satisfactorily completed and positive (supports the clinical diagnosis of brain death) → If not, result indeterminate; consider an additional ancillary test → If result is inconclusive and patient is hemodynamically stable, consider continuing the test for a longer period (11-15 minutes)

[1] **Note: Responsible attending physician (Intensivist, and/or Neurologist/Neurosurgeon) present at the bedside immediately prior to disconnecting the patient from the ventilator and during the apnea test**

[2] If the apnea test cannot be completed because of hemodynamic instability, desaturation to < 85%, inability to reach a $PaCO_2$ of > 60 mmHg, or is contraindicated, then an ancillary study should be performed

[3] Point of care testing is recommended

APPENDIX F: Minimum Time Duration Between Clinical Exams

Age	Hours Between Examination
Term newborns (37 weeks gestational age) – 30 days of life	24
Infants 31 days old – children 18 years old	12

Per American Academy of Pediatrics (AAP) Guidelines

SUGGESTED READINGS

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MD Anderson Institutional Policy # ADM0260 – Accommodating Closely Held Personal and/or Religious Beliefs Policy

MD Anderson Institutional Policy # CLN1084 – Care of the Deceased Policy

MD Anderson Institutional Policy # CLN0461 – Clinical Ethics Consultation Policy

MD Anderson Institutional Policy # CLN0557 – Determination of Medical Appropriateness Policy

MD Anderson Institutional Policy # CLN0509 – Pronouncement of Death by an Advanced Practice Provider Policy

Nakagawa, T. A., Ashwal, S., Mathur, M., Mysore, M. R., Society of Critical Care Medicine, Section on Critical Care and Section on Neurology of the American Academy of Pediatrics, & Child Neurology Society. (2011). Clinical report-guidelines for the determination of brain death in infants and children: An update of the 1987 Task Force recommendations. *Pediatrics, 128*(3), e720-e740. https://doi.org/10.1542/peds.2011-1511

Wijdicks, E. F. M., Varelas, P. N., Gronseth, G. S., & Greer, D. M. (2010). Evidence-based guideline update: Determining brain death in adults. Report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology, 74*(23), 1911-1918. https://doi.org/10.1212/WNL.0b013e3181e242a8

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