**Determination of Death by Neurological Criteria**

This practice algorithm has been specifically developed for MD Anderson using a multidisciplinary approach and taking into consideration circumstances particular to MD Anderson, including the following: MD Anderson’s specific patient population; MD Anderson’s services and structure; and MD Anderson’s clinical information. Moreover, this algorithm is not intended to replace the independent medical or professional judgment of physicians or other health care providers. This algorithm should not be used to treat pregnant women.

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### PRE-EVALUATION

Patient is suspected to meet criteria for Neurological Death 1, 2, 3:
- Patient is in a comatose state or unresponsive to all stimuli:
  - No spontaneous movement other than spinal reflexes
  - Cessation of Brainstem Function
  - Irreversibility of Spontaneous Brain Function Cessation
  - Cerebral imaging that correlates with suspicion of brain death. Stop all medications that may interfere with diagnosis of brain death, per discretion of Intensivist/Neurologist.

Conduct multidisciplinary family meeting to discuss suspected brain death. Inform nursing and initiate consults for assistance and counseling as appropriate:
- Social work
- Chaplain

If questioned/opposed by patient representative/family, contact administration, ethics, risk management, and legal services, as needed. Physician and clinical team must be aware of culture and trust issues raised by the family in any discussions.

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

1st Assessment:
- Absence of pupil reaction to light in both eyes
- Absence of corneal reflexes
- Absence of ocular movement with head turning (oculocephalic reflex) when no apparent cervical spine injury exists, and absence of ocular movements after caloric testing with ice water (oculovestibular reflex)
- Absence of bulbar function (jaw reflex)
- Absence of oropharyngeal reflex (gag & cough)
- Absence of pain reflex
- Perform apnea test (See Appendix D) for patients under 18 years, unless contraindicated.

**Note:** Apnea test should not be performed if:
- Presence of co-morbid condition that prevents the patient from demonstrating spontaneous efforts
- It would place the patient at undue risk to develop cardiac arrest

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1 See Appendix A for Death by neurological criteria checklist
2 See Appendix B for Neurological criteria for brain death
3 The following conditions may interfere with the clinical diagnosis of brain death:
   - Severe facial trauma
   - Pre-existing pupil abnormalities
   - Toxic levels of sedatives, aminoglycosides, tricyclic antidepressants, anticholinergics, antiepileptic drugs, chemotherapeutic agents, neuromuscular blockade, sustained 50 Hz tetanic contraction
   - Sleep apnea or severe pulmonary disease resulting in chronic retention of CO2
   - Therapeutic hypothermia treatment
   - Midriatic medications

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3 If the practitioner is unwilling to pronounce the patient's death, the Medical Director and/or the appropriate hospital Executive Officer shall be notified (Policy UTMDACC #ADM0260)
4 The family or any treating physician may request an ethics consultation under Institutional Policy #CLN0461 Clinical Ethics Consultation Policy
5 LifeGift should be notified at time of death, or when death is known to be imminent to make an independent assessment of suitability (UTMDACC Institutional Policy #CLN0557)
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TESTING FOLLOWING EVALUATION

Conduct ancillary tests (if clinical exam is inconclusive or unable to perform apnea test):
- Cerebral Angiography
- Cerebral scintigraphy Technetium-99m hexamethylpropylene oxideime (Tc-HMPAO)
- Brain Death Protocol Electroencephalogram (EEG)
- Transcranial Doppler ultrasonography (TCD)

Note: Ancillary studies are not required to establish brain death and are not a substitute for the neurologic examination. Choice of a single ancillary test is based on physician discretion and availability.

Second clinical examination performed by a second physician following time duration between clinical exams in Appendix C:
- Absence of pupil reaction to light in both eyes
- Absence of corneal reflexes
- Absence of ocular movement with head turning (oculocephalic reflex) when no apparent cervical spine injury exists, and absence of ocular movements after caloric testing with ice water (oculovestibular reflex)
- Absence of bulbar function (jaw reflex)
- Absence of oropharyngeal reflex (gag & cough)
- Absence of pain reflex
- Perform apnea test unless contraindicated¹ (see Appendix D)

¹ The following conditions may interfere with the clinical diagnosis of brain death:
- Severe facial trauma
- Pre-existing pupil abnormalities
- Toxic levels of sedatives, aminoglycosides, tricyclic antidepressants, anticholinergics, antiepileptic drugs, chemotherapeutic agents, neuromuscular blockade, sustained 50 Hz tetanic contraction
- Sleep apnea or severe pulmonary disease resulting in chronic retention of CO₂
- Therapeutic hypothermia treatment
- Midriatic medications

Is an ancillary exam necessary or preferred?

Yes

No

See Findings on Page 3

¹ The following conditions may interfere with the clinical diagnosis of brain death:
- Severe facial trauma
- Pre-existing pupil abnormalities
- Toxic levels of sedatives, aminoglycosides, tricyclic antidepressants, anticholinergics, antiepileptic drugs, chemotherapeutic agents, neuromuscular blockade, sustained 50 Hz tetanic contraction
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**FINDINGS**

- **Were criteria for neurological death met?**
  - Yes
  - No

**ACTIONS**

- **Pronounce Death in accordance with policy, document time in medical record and discontinue nursing assessments**
- **Notify LifeGift**
- **Continue management based on clinical judgment**

**FINDINGS**

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 (Policy UTMDACC #ADM0260)
2. See Care of the Deceased Policy #CLN1084
3. See Pronouncement of Death by a Mid-Level 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 (UTMDACC Institutional Policy #CLN0557)
5. The family or any treating physician may request an ethics consultation under Institutional Policy #CLN0461 Clinical Ethics Consultation Policy
6. This time between pronouncement of death and discontinuation of mechanical support should not exceed 6 hours. Under rare or unusual circumstances, this time period may be extended 24 to 48 hours on a case by case basis with consultation by legal services.

**Actions**

- Planned removal of life support
- Nursing care for hygiene and family support

Proceed with plan
### APPENDIX A: Death by neurological criteria checklist (Used in Conjunction with the Determination of Death by Neurological Criteria Algorithm)

<table>
<thead>
<tr>
<th>Pre-Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Family Meeting #1</strong></td>
</tr>
<tr>
<td>Attendees/discussed with:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Notify LifeGift of potential Brain Death</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Clinical Examination #1</strong></td>
</tr>
<tr>
<td><strong>Apnea Testing (Pediatric Considerations)</strong></td>
</tr>
<tr>
<td>OR:</td>
</tr>
<tr>
<td>Apnea test aborted</td>
</tr>
<tr>
<td>Reason:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Ancillary testing OPTIONAL</strong> (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)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Documentation of all of the above in the Medical Record</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Name of physician and signature</strong> (Exam 1)</td>
</tr>
<tr>
<td><strong>Date &amp; time</strong></td>
</tr>
</tbody>
</table>

| OR:                                                                                                     |
|                                                                                                         |
| **Clinical Examination #2**                                                                            |
| **Apnea Testing (Adult and Pediatric Considerations)**                                                 |
| OR:                                                                                                     |
| Apnea test aborted                                                                                    |
| Reason:                                                   |
|                                                                                                         |
| **Continued Clinical Management**                                                                     |
| OR:                                                                                                     |
| Pronounce Death in accordance with policy                                                             |
| Document time in medical record                                                                       |
|                                                                                                         |
| **Notify LifeGift of Death**                                                                           |
|                                                                                                         |
| **Family Meeting #2**                                                                                  |
| Attendees/discussed with:                                                                             |
|                                                                                                         |
| **Planned removal of Life Support**                                                                    |
| OR:                                                                                                     |
| Organ Donation Procedures through LifeGift                                                             |
|                                                                                                         |
| **Documentation of all of the above in the Medical Record**                                            |
|                                                                                                         |
| **Name of physician and signature** (Exam 2)                                                            |
| **Date & time**                                                                                         |
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APPENDIX B: Criteria for neurologic death, all the following physical criteria must be met:

- Patient over seven (7) days of age
- Rule out drug intoxication and reversible metabolic conditions that may obscure brain function (patient needs to be off all sedative medications or medications that reduce brain metabolic rate (e.g. propofol, fentanyl, midazolam, barbiturates, etc) which might obscure the exam.
- Patient’s body temperature greater than 32.2° Celsius (90° Fahrenheit)
- Systolic blood pressure (SBP):
  - Adults and children greater than or equal to 10 years: SBP greater than or equal to 90 mm Hg
  - Children 1-9 years old: SBP greater than 70 mmHg plus age times 2
  - Children less than 1 year old: SBP greater than 70 mmHg
  - Newborns less than 28 days old: SBP greater than 60 mmHg

APPENDIX C: Minimum Hours Duration Between Clinical Exams

<table>
<thead>
<tr>
<th>Age*</th>
<th>Hours between Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term birth (37 weeks gestation) – 1 month</td>
<td>24</td>
</tr>
<tr>
<td>1 month – 18 years</td>
<td>12</td>
</tr>
<tr>
<td>Greater than 18 years</td>
<td>6</td>
</tr>
</tbody>
</table>

* Per AAP and AAN Guidelines.
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APPENDIX D: CONDUCTING APNEA TEST

Step 1:
- a. In adults, adjust vasopressors to a systolic blood pressure greater than or equal to 100 mm Hg. In children, if hemodynamically unstable prior to or during apnea test, adjust vasopressor support to acceptable mean arterial pressure for age. Then:
  - b. Give patient 100% oxygen for at least 10 minutes prior to starting the test. Manage ventilator rate to achieve PaCO₂ 35 - 45 mm Hg. If not achievable, abort apnea test.

Step 2:
Obtain baseline arterial blood gases (ABGs) then disconnect patient from ventilator.

Step 3:
Once disconnected, insert oxygen source into endotracheal tube, and give patient Oxygen 6 L/minute (loose fitting catheter through ETT for children).

Step 4: Observation/Evaluation
- a. If patient exhibits any of the following: hypoxia, or arrhythmia or hypotension (systolic blood pressure persistently less than 90 mm Hg in children greater than or equal to 10 years and adults despite adjustment of vasopressors. For younger children use Appendix B blood pressure parameters). Abort test immediately and draw ABGs.
- 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 ten (10) minutes. Draw ABG’s at end of observation time period and review results:

<table>
<thead>
<tr>
<th>Observations</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unable to complete due to physical condition.</td>
<td>➔ Continue with clinically appropriate management.</td>
</tr>
<tr>
<td>Respiratory movements absent and PCO₂ greater than or equal to 60 mm Hg or increase of 20 mm Hg greater than baseline normal PCO₂</td>
<td>➔ Apnea test satisfactorily completed and is positive (supports the clinical diagnosis of brain death). ➔ If not, result indeterminate; consider an additional ancillary test. ➔ If result inconclusive and patient is hemodynamically stable: consider continuing test for longer period (10-15 minutes).</td>
</tr>
</tbody>
</table>

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 Children: if the rise in PCO₂ fails to reach 60 mm Hg, perform the test again for a duration of 15 minutes.
3 Point of care testing is recommended.
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**SUGGESTED READINGS**


DEVELOPMENT CREDITS

This practice consensus algorithm is based on majority expert opinion of The Neurologic Death Task Force of the ICU Best Practice Committee Members at the University of Texas MD Anderson Cancer Center. It was developed using a multidisciplinary approach.

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