

**YALE-NEW HAVEN HOSPITAL
CLINICAL ADMINISTRATIVE POLICY & PROCEDURE MANUAL**

Administrative Policy Title:	“Brain Death,” Guidelines Determination of Death by Neurological Criteria in the Pediatric Patient	Manual Code:	C:B-4
Reviewed:		Revised:	4/19/10; 10/19/12
Supersedes Manual Code:	None	Dated:	
Approved By:	Peter N. Herbert, MD		

I. PURPOSE:

The purpose of this policy is to help standardize the determination of death by neurological criteria (“brain death”) in pediatric patients at Yale-New Haven Hospital so that the relevant state, federal and clinical requirements are met. This policy will apply to patients in the Yale-New Haven Hospital who are at a gestational age of 37 weeks up to age 18 years. For patients 18 years of age and over please refer to Administrative Manual Policy C:B-3, Guidelines for Determination of Brain Death in Adult Patients.

This policy does not address Organ and Tissue Donation requirements. See Administrative Manual Policy C:O-2.

- A. Policy: Death is defined in Connecticut General Statute, section 19-279h as the total and irreversible cessation of all brain function. The latter is not defined to mean that the “heart and lungs of the donor cannot function, and are not functioning, without artificial supportive measures.” This policy sets forth the Hospital’s guidelines for the determination of death by neurological criteria (“brain death”).
- B. Definition: Death by neurological criteria “brain death” is defined as the irreversible loss of capacity for consciousness combined with the irreversible loss of all brain functions, including brainstem functions and the capacity to breathe independently. It is equivalent to the death of the individual as defined by conventional measures, even though the heart continues to beat and spinal cord functions may persist.

II. PROCEDURE:

- A. Appropriate Staff for the Declaration of Death Based on Neurologic Criteria for Pediatric Patients:

Two separate LICENSED attending Board eligible/certified physicians proficient in understanding the criteria for determination of death by neurologic criteria are required to determine and document that a patient has suffered total and irreversible cessation of all brain function. Attending physicians may be from pediatric critical care medicine, neonatology, neurology or neurosurgery. If the patient is a potential organ or tissue donor, neither of the declaring physicians can be involved in the subsequent anatomical donation process or surgery. The two physicians shall use the attached YNHH Worksheet for Determination of Death by Neurologic Criteria in Pediatric Patients (Appendix A).

The second examining physician is required to have personally examined the patient and document their exam findings. The apnea test may be performed both times by the physician managing the ventilator.

- B. Establishing Irreversibility

Irreversibility is demonstrated by:

1. Establishing an etiology of coma capable of causing widespread neuronal death;
2. Demonstrating total loss of brain function, including the brainstem;
3. Excluding any and all potentially reversible causes; and
4. Using chronologic age-based periods of observation.

C. Excluding Confounding Conditions

There are conditions that may depress or otherwise limit the assessment of neurologic function. Such conditions include:

1. Hypothermia (rectal temperature less than 36 degrees Celsius)
2. Hypotension with systolic blood pressure <5th percentile of age based normal range
3. Severe electrolyte or acid-base disturbances
4. Treatable metabolic disorders (includes hepatic or renal encephalopathy, endocrine dysfunction, hyperosmolar states)
5. Drug intoxication or pharmacologic therapy (particularly barbiturates, sedatives, benzodiazepines, narcotics and hypnotics)
6. Presence of neuromuscular blocking agents

If one of these conditions is present and cannot be corrected, an ancillary test is required AFTER the best possible efforts to correct hypothermia and/or hypotension.

D. Clinical Criteria:

1. The cause and/or irreversibility of the condition has been established.
2. There must be COMPLETE loss of brain function:

a. Coma:

The patient should be observed for spontaneous movement and response to noxious stimuli applied centrally and peripherally, including on the cranium. There must be no brain-mediated responses (e.g. decorticate or decerebrate posturing, dyskinesias, myoclonus, or seizures) either spontaneously or in response to noxious stimulation.

As the spinal cord may be intact some reflex responses may be present, including (but not limited to) deep tendon reflexes, plantar reflexes, triple flexion of the legs, superficial abdominal reflexes, Babinski's sign and reaction of the blood pressure to noxious stimulation.

b. Absence of brainstem reflexes:

- 1) Pupillary light reflex absent: pupils must be mid-size or larger and non-reactive to bright light.
NOTE: small, constricted pupils should alert the clinician to possible medication effect
- 2) Corneal reflex absent: no response to stimulation of the cornea.
- 3) Oculocephalic ("doll's eyes") reflex absent: no eye movement with both vertical and horizontal head movement
NOTE: contraindicated in suspected cervical spine injury.
- 4) Oculovestibular ("cold calorics") reflex absent: eyes do not move following instillation of cold water into the ear canal
Procedure: Elevate head of bed to 30 degrees. Approximately 25cc of ice water is infused continuously into external auditory canal for one minute and the eyes are continuously observed for movement during this time. An interval of no less than 5 minutes should occur before instillation in the opposite ear.
NOTE: contraindicated if tympanic membrane perforated/blocked, or hemotympanum present.
- 5) Cough and gag reflexes absent: no response to stimulation of the posterior pharynx, as well as deep tracheal suctioning.
- 6) No movement of the head, face or eyes in response to noxious stimulation of the periphery (nail bed pressure) and cranium (pressure to the supraorbital notch or temporomandibular joint).

c. Apnea:

- 1) Prior to apnea testing certain clinical conditions must be met:

- Rectal temperature at least 36 degrees C.
- Absence of spontaneous respirations.
- Blood pressure within normal range for age (use of vasopressors is acceptable to achieve this). If the patient is receiving high-dose vasopressors they may not tolerate apnea testing and an ancillary study may be used as an alternative.

2) Procedure for apnea testing:

-Pre-oxygenate with FiO₂ of 100% for 10 minutes. Ventilation should be adjusted to achieve a PaCO₂ of 35-45 (assuming this is the normal range for the individual patient) and a pH of 7.4 (\pm 0.05). Throughout the apnea test the patient should continue to receive 100% oxygen. Acceptable modes of delivery are a T-piece, mapleson circuit with at least 10L/min flow, suction catheter placed inside of the endotracheal tube or placing the ventilator in CPAP mode with NO backup rate. The patient should be observed for 10 minutes with blood gases drawn at initiation and every five minutes thereafter. Blood gases must be sent to the hospital lab, bedside testing is not acceptable for documentation. If the blood gas shows a PaCO₂ of greater than 60 AND a 20 point rise in the PaCO₂ with no spontaneous ventilatory effort, apnea has been established. If these blood gas criteria have not been met, the apnea test may be repeated for a longer period of time, after once again pre-oxygenating the patient and normalizing their PaCO₂.

3) Termination of apnea testing:

-Apnea test should be terminated if the patient exhibits hemodynamic instability (SBP < 5th percentile for age for longer than 30 seconds) or desaturation <85% SpO₂ for longer than 30 seconds.

3. Chronologic Age Dependent Exam Intervals and Testing

37 weeks gestational age to 30 days post natal age: Two physical exams by two different physicians separated by 24 hours of observation. The apnea tests may be performed by the same physician.

31 days to 18 years: Two physical exams by two different physicians separated by 12 hours of observation. The apnea tests may be performed by the same physician.

18 years and older: Please refer to Administrative Manual Policy C:B-3 Guidelines for Determination of Brain Death in Adult Patients.

4. Ancillary Studies

If confounding conditions such as those listed in section C above are present, or if for technical reasons such as cardiopulmonary instability or physical constraints the formal brain death examination cannot be completed, the ancillary studies that demonstrate an absence of intracranial blood flow can be used to confirm brain death after hypothermia and shock are resolved. Acceptable options include:

- a. Cerebral radionuclide scanning (preferred)
- b. Electroencephalography (EEG)
- c. Four vessel cerebral angiography

An ancillary study may also be utilized after the initial neurologic examination demonstrates brain death to shorten the observation interval. Should the study confirm absence of cerebral blood flow the patient can then be declared brain dead.

E. Communication with Families

The patient's family should be informed that evaluation for brain death is taking place and the rationale for the age-based periods of observation should be explained. Families are welcome to be present at the bedside during the evaluation and they must be informed when the determination has been made. The family is then informed that although the patient has spontaneous cardiac activity the patient is legally dead.

While family permission is not required for the removal of the ventilator when death has been

declared, clinicians should make every effort to provide the family adequate time to understand the situation and spend time with their loved one. Clinicians should be aware that while Connecticut law does not recognize a religious exemption to accepting death by neurological criteria, there are some faiths in which it may not be accepted as a means of declaring death. If conflict between a family and care providers arises in this setting, the medical team should rely on the hospital's conscientious practice policy and the Pediatric Ethics Committee.

F. Documentation of Death by Neurologic Criteria

Documentation by two separate licensed attending board eligible/certified physicians is required for the declaration of death by neurologic criteria. Exam findings will be documented on the Pediatric Death by Neurologic Criteria Examination Form. As is required for documentation of any death, the date and time of the formal final declaration of death by neurological criteria must be noted in the patient's hospital record. The time of death is the time at which the arterial blood gas results confirming the apnea test are officially reported in the medical record. When an ancillary test is used in lieu of the clinical examination, the time of death is the time that the ancillary test is formally interpreted and signed by the interpreting attending physician.

APPENDIX A

Pediatric Death by Neurologic Criteria Examination Form

Diagnosis:		Probable Cause of Coma:	
Reportable to Medical Examiner: Yes <input type="checkbox"/> No <input type="checkbox"/>		Cause of coma irreversible? Yes <input type="checkbox"/> No <input type="checkbox"/>	
Vital Signs and Data	FIRST EXAMINATION	SECOND EXAMINATION	
a) Blood Pressure (systolic/diastolic)			
b) Body temperature (at least 36°C)			
c) Toxicology results: Barbiturate Alcohol TCAs	<input type="checkbox"/> Not present <input type="checkbox"/> Present Level: <input type="checkbox"/> Not present <input type="checkbox"/> Present Level: <input type="checkbox"/> Not present <input type="checkbox"/> Present Level:	<input type="checkbox"/> Not present <input type="checkbox"/> Present Level: <input type="checkbox"/> Not present <input type="checkbox"/> Present Level: <input type="checkbox"/> Not present <input type="checkbox"/> Present Level:	
d) Mydriatic Drugs used?	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>	
e) Neuromuscular Blockade Agents used?	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>	
f) Residual neuromuscular blockade?	<input type="checkbox"/> Present <input type="checkbox"/> Not present	<input type="checkbox"/> Present <input type="checkbox"/> Not present	
g) Electrolyte/Acid-Base Abnormalities (including serum osmolality):	<input type="checkbox"/> Present (describe) <input type="checkbox"/> Not present	<input type="checkbox"/> Present (describe) <input type="checkbox"/> Not present	
h) Metabolic Disorders (hepatic/renal/endocrine):	<input type="checkbox"/> Present (describe) <input type="checkbox"/> Not present	<input type="checkbox"/> Present (describe) <input type="checkbox"/> Not present	
Cerebral Response to limb and cranium painful stimulation:			
a) Motor response:	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>	
Brainstem Response:			
a) Pupil size:	Left: _____ Right: _____	Left: _____ Right: _____	
b) Pupillary reaction:	Left: Yes <input type="checkbox"/> No <input type="checkbox"/> Right: Yes <input type="checkbox"/> No <input type="checkbox"/>	Left: Yes <input type="checkbox"/> No <input type="checkbox"/> Right: Yes <input type="checkbox"/> No <input type="checkbox"/>	
c) Corneal Reflexes:	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>	
d) Oculocephalic reflex ("doll's eye"):	Yes <input type="checkbox"/> No <input type="checkbox"/> Untestable <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/> Untestable <input type="checkbox"/>	
e) Oculovestibular reflex (cold calorics):	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>	
f) Gag reflex:	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>	
g) Cough reflex:	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>	
h) Spontaneous respiratory effort:	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>	
Apnea test 1: ABG at beginning of test: pH _____ PaCO ₂ _____ PaO ₂ _____ ABG at end of test: pH _____ PaCO ₂ _____ PaO ₂ _____		Apnea test 2: ABG at beginning of test: pH _____ PaCO ₂ _____ PaO ₂ _____ ABG at end of test: pH _____ PaCO ₂ _____ PaO ₂ _____	
Ancillary Testing Results:			
a) EEG			
b) Nuclear Blood flow study			
c) Conventional cerebral angiography			
Date/Time of Exam:			
Physician Name (Print):			
Physician Signature:			
DATE/ TIME OF DEATH:			