

# Guidelines for the Determination of Death

Report of the Medical Consultants on the Diagnosis of Death to the President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research

The guidelines set forth in this report represent the views of the signatories as individuals; they do not necessarily reflect the policy of any institution or professional association with which any signatory is affiliated. Although the practice of individual signatories may vary slightly, signatories agree on the acceptability of these guidelines: Jesse Barber, MD; Don Becker, MD; Richard Behrman, MD, JD; Donald R. Bennett, MD; Richard Beresford, MD, JD; Reginald Bickford, MD; William A. Black, Jr, MD; Benjamin Boshes, MD, PhD; Philip Braunstein, MD; John Burroughs, MD, JD; Russell Butler, MD; John Caronna, MD; Shelley Chou, MD, PhD; Kemp Clark, MD; Ronald Cranford, MD; Michael Earnest, MD; Albert Ehle, MD; Jack M. Fein, MD; Sal Fiscina, MD, JD; Terrance G. Furlow, MD, JD; Eli Goldensohn, MD; Jack Grabow, MD; Phillip M. Green, MD; Ake Grenvik, MD; Charles E. Henry, PhD; John Hughes, MD, PhD, DM; Howard Kaufman, MD; Robert King, MD; Julius Korein, MD; Thomas W. Langfitt, MD; Cesare Lombroso, MD; Kevin M. McIntyre, MD, JD; Richard L. Masland, MD; Don Harper Mills, MD, JD; Gaetano Molinari, MD; Byron C. Pevehouse, MD; Lawrence H. Pitts, MD; A. Bernard Pleet, MD; Fred Plum, MD; Jerome Posner, MD; David Powner, MD; Richard Rovit, MD; Peter Safar, MD; Henry Schwartz, MD; Edward Schlesinger, MD; Roy Selby, MD; James Snyder, MD; Bruce F. Sorenson, MD; Cary Suter, MD; Barry Tharp, MD; Fernando Torres, MD; A. Earl Walker, MD; Arthur Ward, MD; Jack Whisnant, MD; Robert Wilkus, MD; and Harry Zimmerman, MD.

The preparation of this report was facilitated by the President's Commission but the guidelines have not been passed on by the Commission and are not intended as matters for governmental review or adoption.

THE ADVENT of effective artificial cardiopulmonary support for severely brain-injured persons has created some confusion during the past several decades about the determination of death. Previously, loss of heart and lung functions was an easily observable and sufficient basis for diagnosing death, whether the initial failure occurred in the brain, the heart and lungs, or elsewhere in the body. Irre-

**For editorial comment  
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versible failure of either the heart and lungs or the brain precluded the continued functioning of the other. Now, however, circulation and respiration can be maintained by means of a mechanical respirator and other medical interventions, despite a loss of all brain functions. In these circumstances, we recognize as dead an individual whose loss of brain functions is complete and irreversible.

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To recognize reliably that death has occurred, accurate criteria must be available for physicians' use. These now fall into two groups, to be applied depending on the clinical situation. When respiration and circulation have irreversibly ceased, there is no need to assess brain functions directly. When cardiopulmonary functions are artificially maintained, neurological criteria must be used to assess whether brain functions have ceased irreversibly.

More than half of the states now recognize, through statutes or judicial decisions, that death may be determined on the basis of irreversible cessation of all functions of the brain. Law in the remaining states has not yet departed from the older, common-law view that death has not occurred until "all vital functions" (whether or not artificially maintained) have ceased. The language of the statutes has not been uniform from state to state, and the diversity of proposed and enacted laws has created substantial confusion. Consequently, the American Bar Association, the American Medical Association, the Na-

tional Conference of Commissioners on Uniform State Laws, and the President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research have proposed the following model statute, intended for adoption in every jurisdiction:

## UNIFORM DETERMINATION OF DEATH ACT

An individual who has sustained either (1) irreversible cessation of circulatory and respiratory functions, or (2) irreversible cessation of all functions of the entire brain, including the brain stem, is dead. A determination of death must be made in accordance with accepted medical standards.

This wording has also been endorsed by the American Academy of Neurology and the American Electroencephalographic Society.

The statute relies on the existence of "accepted medical standards" for determining that death has occurred. The medical profession, based on carefully conducted research and extensive clinical experience, has found that death can be determined reliably by either cardiopulmonary or neurological criteria. The tests used for determining cessation of brain functions have changed and will continue to do so with the advent of new research and technologies. The "Harvard criteria" (*JAMA* 1968;205:337-340) are widely accepted, but advances in recent years have led to the proposal of other criteria. As an aid to the implementation of the proposed uniform statute, we provide here one statement of currently accepted medical standards.

## INTRODUCTION

The criteria that physicians use in

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determining that death has occurred should (1) eliminate errors in classifying a living individual as dead; (2) allow as few errors as possible in classifying a dead body as alive; (3) allow a determination to be made without unreasonable delay; (4) be adaptable to a variety of clinical situations; and (5) be explicit and accessible to verification.

Because it would be undesirable for any guidelines to be mandated by legislation or regulation or to be inflexibly established in case law, the proposed Uniform Determination of Death Act appropriately specifies only "accepted medical standards." Local, state, and national institutions and professional organizations are encouraged to examine and publish their practices.

The following guidelines represent a distillation of current practice in regard to the determination of death. Only the most commonly available and verified tests have been included. The time of death recorded on a death certificate is at present a matter of local practice and is not covered in this document.

These guidelines are advisory. Their successful use requires a competent and judicious physician, experienced in clinical examination and the relevant procedures. All periods of observation listed in these guidelines require the patient to be under the care of a physician. Considering the responsibility entailed in the determination of death, consultation is recommended when appropriate.

The outline of the criteria is set forth below in boldface letters. The lightface text that follows each heading explains its meaning. In addition, the two sets of criteria (cardiopulmonary and neurological) are followed by a presentation of the major complicating conditions: drug and metabolic intoxication, hypothermia, young age, and shock. It is of paramount importance that anyone referring to these guidelines be thoroughly familiar with the entire document, including explanatory notes and complicating conditions.

#### **THE CRITERIA FOR DETERMINATION OF DEATH**

An individual presenting the findings in *either* section A (cardiopulmonary) *or* section B (neurological) is

dead. In either section, a diagnosis of death requires that *both* cessation of functions, as set forth in subsection 1, and irreversibility, as set forth in subsection 2, be demonstrated.

**A. An individual with irreversible cessation of circulatory and respiratory functions is dead.**

**1. Cessation is recognized by an appropriate clinical examination.**

Clinical examination will disclose at least the absence of responsiveness, heartbeat, and respiratory effort. Medical circumstances may require the use of confirmatory tests, such as an ECG.

**2. Irreversibility is recognized by persistent cessation of functions during an appropriate period of observation and/or trial of therapy.**

In clinical situations where death is expected, where the course has been gradual, and where irregular agonal respiration or heartbeat finally ceases, the period of observation following the cessation may be only the few minutes required to complete the examination. Similarly, if resuscitation is not undertaken and ventricular fibrillation and standstill develop in a monitored patient, the required period of observation thereafter may be as short as a few minutes. When a possible death is unobserved, unexpected, or sudden, the examination may need to be more detailed and repeated over a longer period, while appropriate resuscitative effort is maintained as a test of cardiovascular responsiveness. Diagnosis in individuals who are first observed with rigor mortis or putrefaction may require only the observation period necessary to establish that fact.

**B. An individual with irreversible cessation of all functions of the entire brain, including the brain stem, is dead. The "functions of the entire brain" that are relevant to the diagnosis are those that are clinically ascertainable. Where indicated, the clinical diagnosis is subject to confirmation by laboratory tests, as described in the following portions of the text. Consultation with a physician experienced in this diagnosis is advisable.**

**1. Cessation is recognized when evaluation discloses findings of a and b:**

**a. Cerebral functions are absent, and . . .**

There must be deep coma, that is, cerebral unresponsiveness and unresponsiveness.

Medical circumstances may require the use of confirmatory studies such as an EEG or blood-flow study.

**b. brain stem functions are absent.**

Reliable testing of brain stem reflexes requires a perceptive and experienced physician using adequate stimuli. Pupillary light, corneal, oculocephalic, oculovestibular, oropharyngeal, and respiratory (apnea) reflexes should be tested. When these reflexes cannot be adequately assessed, confirmatory tests are recommended.

Adequate testing for apnea is very important. An accepted method is ventilation with pure oxygen or an oxygen and carbon dioxide mixture for ten minutes before withdrawal of the ventilator, followed by passive flow of oxygen. (This procedure allows PaCO<sub>2</sub> to rise without hazardous hypoxia.) Hypercarbia adequately stimulates respiratory effort within 30 seconds when PaCO<sub>2</sub> is greater than 60 mm Hg. A ten-minute period of apnea is usually sufficient to attain this level of hypercarbia. Testing of arterial blood gases can be used to confirm this level. Spontaneous breathing efforts indicate that part of the brain stem is functioning.

Peripheral nervous system activity and spinal cord reflexes may persist after death. True decerebrate or decorticate posturing or seizures are inconsistent with the diagnosis of death.

**2. Irreversibility is recognized when evaluation discloses findings of a and b and c:**

**a. The cause of coma is established and is sufficient to account for the loss of brain functions, and . . .**

Most difficulties with the determination of death on the basis of neurological criteria have resulted from inadequate attention to this basic diagnostic prerequisite. In addition to a careful clinical examination and investigation of history, relevant knowledge of causation may be acquired by computed tomographic scan, measurement of core temperature, drug screening, EEG, angiography, or other procedures.

**b. the possibility of recovery of any brain functions is excluded, and . . .**

The most important reversible conditions are sedation, hypothermia, neuromuscular blockade, and shock.

In the unusual circumstance where a sufficient cause cannot be established, irreversibility can be reliably inferred only after extensive evaluation for drug intoxication, extended observation, and other testing. A determination that blood flow to the brain is absent can be used to demonstrate a sufficient and irreversible condition.

**c. the cessation of all brain functions persists for an appropriate period of observation and/or trial of therapy.**

Even when coma is known to have started at an earlier time, the absence of all brain functions must be established by an experienced physician at the initiation of the observation period. The duration of observation periods is a matter of clinical judgment, and some physicians recommend shorter or longer periods than those given here.

Except for patients with drug intoxication, hypothermia, young age, or shock, medical centers with substantial experience in diagnosing death neurologically report no cases of brain functions returning following a six-hour cessation, documented by clinical examination and confirmatory EEG. In the absence of confirmatory tests, a period of observation of at least 12 hours is recommended when an irreversible condition is well established. For anoxic brain damage where the extent of damage is more difficult to ascertain, observation for 24 hours is generally desirable. In anoxic injury, the observation period may be reduced if a test shows cessation of cerebral blood flow or if an EEG shows electrocerebral silence in an adult patient without drug intoxication, hypothermia, or shock.

Confirmation of clinical findings by EEG is desirable when objective documentation is needed to substantiate the clinical findings. Electroencephalographic silence verifies irreversible loss of cortical functions, except in patients with drug intoxication or hypothermia. (Important technical details are provided in "Minimal Technical Standards for EEG Recording in Suspected Cerebral Death" [*Guidelines in EEG 1980*. Atlanta, American Electroencephalographic Society, 1980, section 4, pp 19-24].) When joined with the clinical findings of absent brain stem functions, electrocerebral silence confirms the diagnosis.

Complete cessation of circulation to the normothermic adult brain for more than ten minutes is incompatible with survival of brain tissue. Documentation of this circulatory failure is therefore evidence of death of the entire brain. Four-vessel intracranial angiography is definitive for diagnosing cessation of circulation to the entire brain (both cerebrum and posterior fossa) but entails substantial practical difficulties and risks. Tests are available that assess circulation only in the cerebral hemispheres, namely radioisotope bolus cerebral angiography and gamma camera imaging with radioisotope cerebral angiography. Without complicating conditions, absent cerebral blood flow as measured by these tests, in conjunction with the clinical determination of cessation of all brain functions for at least six hours, is diagnostic of death.

#### COMPLICATING CONDITIONS

**A. Drug and Metabolic Intoxication.**—Drug intoxication is the most serious problem in the determination of death, especially when multiple drugs are used. Cessation of brain functions caused by the sedative and anesthetic drugs, such as barbiturates, benzodiazepines, meprobamate, methaqualone, and trichloroethylene, may be completely reversible even though they produce clinical cessation of brain functions and electrocerebral silence. In cases where there is any likelihood of sedative presence, toxicology screening for all likely drugs is required. If exogenous intoxication is found, death may not be declared until the intoxicant is metabolized or intracranial circulation is tested and found to have ceased.

Total paralysis may cause unresponsiveness, areflexia, and apnea that closely simulates death. Exposure to drugs such as neuromuscular blocking agents or aminoglycoside antibiotics, and diseases like myasthenia gravis are usually apparent by careful review of the history. Prolonged paralysis after use of succinylcholine chloride and related drugs requires evaluation for pseudocholinesterase deficiency. If there is any question, low-dose atropine stimulation, electromyogram, peripheral nerve stimulation, EEG, tests of intracranial circulation, or extended

observation, as indicated, will make the diagnosis clear.

In drug-induced coma, EEG activity may return or persist while the patient remains unresponsive, and therefore the EEG may be an important evaluation along with extended observation. If the EEG shows electrocerebral silence, short latency auditory or somatosensory-evoked potentials may be used to test brain stem functions, since these potentials are unlikely to be affected by drugs.

Some severe illnesses (eg, hepatic encephalopathy, hyperosmolar coma, and preterminal uremia) can cause deep coma. Before irreversible cessation of brain functions can be determined, metabolic abnormalities should be considered and, if possible, corrected. Confirmatory tests of circulation or EEG may be necessary.

**B. Hypothermia.**—Criteria for reliable recognition of death are not available in the presence of hypothermia (below 32.2 °C core temperature). The variables of cerebral circulation in hypothermic patients are not sufficiently well studied to know whether tests of absent or diminished circulation are confirmatory. Hypothermia can mimic brain death by ordinary clinical criteria and can protect against neurological damage due to hypoxia. Further complications arise since hypothermia also usually precedes and follows death. If these complicating factors make it unclear whether an individual is alive, the only available measure to resolve the issue is to restore normothermia. Hypothermia is not a common cause of difficulty in the determination of death.

**C. Children.**—The brains of infants and young children have increased resistance to damage and may recover substantial functions even after exhibiting unresponsiveness on neurological examination for longer periods compared with adults. Physicians should be particularly cautious in applying neurological criteria to determine death in children younger than 5 years.

**D. Shock.**—Physicians should also be particularly cautious in applying neurological criteria to determine death in patients in shock because the reduction in cerebral circulation can render clinical examination and laboratory tests unreliable.