

May 1971

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Recommended Citation

Collins, Vincent J. (1971) "Considerations in Defining Death," *The Linacre Quarterly*: Vol. 38 : No. 2 , Article 5.
Available at: <http://epublications.marquette.edu/lnq/vol38/iss2/5>

CONSIDERATIONS IN DEFINING DEATH

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THE PROBLEM: Phenomenal technological advances in medical science make it possible to prolong threatened life to an incredible degree. We have the capacity on the one hand to sustain vital life functions by extraordinary artificial means and on the other to make a composite man by the transplantation of organs. There exist apparent dilemmas in the medical, moral,

and legal area in regard to these practices in medicine. An essential question arises as to whether at times we are dealing with a true human life.

Although we may be able to use extraordinary means to sustain the biological activities or simple life processes of organs and provide the semblance of existence (vegetative), an organ-integrated,

Presented at the XIIIth International Congress of the International Federation of Catholic Medical Associations, Washington, D.C., October 16, 1970.

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spontaneously existing rational man may be unattainable. Too often medical efforts are ineffective in deep coma and when pursued are irrational. This then is a time of decision and for decision. The decision must be made as to whether only biological life is possible and that meaningful existence is impossible or indeed clinical death exists. Medical efforts to prolong life or in fact delay death must then cease.

Yet, there is an exception. It is at this very critical time of decision concerning one patient that hope exists for the full life of another person in need of a new organ. If meaningful human existence is impossible for one, it may be proper to sustain the life of the individual organs by extraordinary means until they can be appropriately used in transplantation to another threatened person. Thus, the hopelessness of one becomes the salvation of another. The identification of this phase in the dying process between clinical death and biological death is paramount.

The challenge actually concerns the recognition of life potential versus the need to conclusively diagnose death either at the clinical phase or the biological phase. It is asserted that the solution to the dilemmas faced in prolonging life, delaying death, or of recognizing each is the responsibility of the medical profession. The guides to making the decision are elemental.

THE PRIMARY DETERMINANTS. — The basic obligation of the physician is to ensure man's existence as a whole human being with a meaningful

life. In confronting the problem of death or of life the physician is challenged by the need for differential diagnoses.

For any course of action there are three determinants for him. These are: 1) contractual (patient - physician relationship); 2) ethical; and 3) scientific.

The first principle of action stems from the physician - patient contract. In the physician - patient contract, care is implied. The rights and duties of the physician are correlative to those of the patient. The patient expects the physician to do everything for his benefit.

The second principle governing a physician's fulfilling his contract is his adherence to a professional code of ethics. Such a code has been expressed in the Hippocratic Oath, the Declaration of Geneva of the World Medical Association, and the Nurenberg 10 points. All of these codes have a common denominator and embody a universal command. Love thy Neighbour; Do Unto Others As You Would Have Them Do Unto You.

The third principle guiding a physician is his competence. In catastrophic circumstances, in the situation of trauma or disease ordinarily lethal, the physician must exercise his skill and science, being guided by his ethics to fulfill his obligation to his patient.

In a pluralistic society many other factors may be recognized but essentially they are merely components of the above three principles. However, we recognize

them and have them in an accompanying table. They are not primary determinants.

NATURE OF LIFE. — To identify the nature of human life is the first obligation. Fundamentally, life is the *integration* of the biological functions of at least nine organ systems (Angrist). The integration of these systems is emphasized. Life is not the mere function of these organs independently nor is human life represented by the independent simple biological life processes in each organ (TABLE I). Blood cells, organ tissues, and even a whole organ may be maintained alive *in vitro* but such independent existence does not represent a human being.

It is the whole organism representing the sum of the structural parts, all integrated functionally which when present establish the existence of life. To these are added a supreme integrative action by the central nervous system manifested by the capacity to reason and abstract. This capacity identifies human life as against all other forms of life. Thus, by the total integrative process, there emerges a being greater than the parts called man.

DEFINITION OF DEATH. — It is worthwhile that we briefly define death and refer to the kinds of death which in different professional areas may be appropriately identified. Death is the cessation of life functions. There are three forms of death to be recognized: clinical death, biological or organ and cell death, and theological death. Of importance to our text is clinical death which is the cessation of in-

tegrated life functions.

Clinical death may appropriately refer to the cessation of integrated life functions. Biological death refers to the cessation of the simple life processes of organs and tissues. Theological death may designate the time when the soul is no longer present.

THE NATURE OF DYING. — Dying is a progressive process. Each part of the body in each organ system deteriorates progressively at different rates. Each organ has a vulnerability index to stress and a revival time. Thus, the brain has a high degree of vulnerability to lack of oxygen and/or nutrition. It is more sensitive in this regard than the next most vulnerable organ, namely, the heart. The time during which the brain may recover if restoration of circulation is achieved is approximately 4 minutes (0. Sugar). This is a period of relative vulnerability and deterioration. Recovery is probable, but after 4 minutes becomes improbable, and after 8 minutes is usually impossible. The heart can withstand loss of circulation upwards of 8 minutes but thereafter the revival of the heart becomes improbable, if not impossible. The revival period to which we refer is therefore dependent upon several factors: 1) time; 2) temperature; 3) perfusion; 4) oxygen tension; 5) total circulation. (A reduction in total cardiac output to 12% is critical for the brain.)

THE DYING PROCESS. — That such occurs is recognized by Biologists, Clinicians and Pathologists alike. Three phases of

deterioration leading to absolute clinical death can be recognized. These are modified from Kramer and are designated as: 1) disordered function, (disequilibrium); 2) disintegration; 3) deanimation.

In the first phase of disordered function each organ system or part of the body functionally deteriorates, insofar as it is integrated with and coordinates with other organ systems of the body. This may be considered as a period of early clinical death. It is reversible and complete recovery is possible if direct injury with destruction of the tissue has not occurred at the brain or heart levels.

The second phase of intrinsic disintegration represents deterioration of an organ itself with regard to its capacity to respond. In a sense this is the loss of intrinsic regulation and leaves only an automatic, vegetative or intrinsic cellular auto-regulation. This is a critical period, and revival, indeed, complete reanimation of the entire person is not possible. This is a period of intermediate clinical death.

The third phase of deanimation is actually one of structural and tissue disintegration. It is the period of progressive deanimation in which structural damage begins and has been referred to as annihilation as evidenced by the isoelectric electroencephalogram. During this time there is a progressive loss of auto-regulation. Some injuries or causative factors, however, may be directly and immediately destructive of cellular integrity. This is not a reversible situation. Complete reanimation

is not possible. A semblance of life may be attained artificially from 24 to 72 hours. But this is vegetative existence. Human life or, indeed an organized life is not possible. However, some organs may be kept alive at the cellular or biological level, if the resuscitation technics are applied effectively and before complete loss of autoregulation occurs. Individual organs may be alive at the simple tissue level but the sum of all these does not result in an integrated whole.

Cessation of life functions or clinical death at the organ-system level, leads to cellular death or what is more appropriately called, biological death.

Some cells may be kept alive as noted in a primitive sense by perfusion technics. This is done *in vitro* in the laboratory but can occur clinically by artificial means and represents a heart-lung preparation.

As a consequence of late institution of resuscitation procedures, many organs and tissues may show cellular dissolution or complete structural destruction when examined post-mortem. With respect to the brain, a tissue - culture - preparation may in fact exist, when the artificial methods of resuscitation are continued during this phase after clinical death has occurred and after any hope of restoration to spontaneous function or total reanimation is possible. This is irrational and unscientific!! Such a period of time during which cellular autolysis is progressing is often called the incubation-brain and produces the phenomenon of

respirator brain syndroms (Kimura).

DIAGNOSIS OF DEATH. — The imminence of death or a conclusive set of circumstances leaving no alternative or hope is a medical decision. The recognition of death is one of *diagnosis based on logical thinking*. The diagnosis of conclusive death and the decision that there is no likelihood of recovery must be established on customary medical - scientific observations and tests. This may be done in consultation or by a "Committee on Reanimation" of two or three physicians in a hospital with expertise in these matters. Such a group might well consist of a Resuscitologist (Anesthesiologist), Neurologist, Cardiologist, and Cardiac Surgeon. Having identified the physician's responsibility, how can he make a decision?

As with any diagnosis, the patient must be examined by a physician. Death is dependent upon observations and signs or lack thereof. Five physiologic components are observed and indeed tested, namely, mental; sensory; motor, reflex and autonomic activity. These are the criteria and determinants. No single clinical factor, indeed, no single observation such as stoppage of respiration or stoppage of cardiac action or cessation of nervous system activity as seen on EEG can today be considered sufficient or adequate by itself to establish a diagnosis of death. No single factor can stand alone in the differential diagnosis of any disease and be the final determinant. To arrive at a point in time when it must be

considered that all efforts are hopeless and should, therefore, be abandoned must rest on many signs and observations. To be sure, the diagnosis or decision is initially presumptive and may be reversible and without reasonable doubt. But with current techniques the decision can be made conclusive.

The task is first to establish the *Fact of Death*. The pronouncement of this will then identify the time when clinical death is certified, or conclusive. Any resuscitation procedures should then have no possibility of reanimating the life processes of the organ systems to a spontaneous and integrated whole with a full human potential. Yet the individual life processes of many organs may be present and biological death should not have occurred or is only beginning.

THE DYING SCORE. — To assist the physician in this serious matter of determining the end point of life and the separation of clinical from biologic death (vital from biologic) the concept of a score to establish death is proposed. To a degree this score parallels the Apgar Score of living score for newborn babies.

It is asserted as a basic premise that no single sign or function can or should be used to assess the capacity to live nor establish the state of death. No single sign is adequate to determine total capability for human existence or the lack thereof. Patients should be evaluated according to several signs of life.

Therefore, five physiologic functions have been selected to be assessed as to their presence, their potential, or their absence. An arbitrary scoring system of 0, 1 and 2 is used. The physiologic functions selected are all of critical and vital importance. However, they are not all of equal importance but are interdependent for spontaneous life (TABLE III). Nor are they listed in their order of importance but to some degree there is an increasing order of dependence of one function upon the other. These functions are:

1. Cerebral
2. Reflex
3. Respiratory
4. Circulatory
5. Cardiac

The irrevocable absence of one of these functions or the lack of capacity to perform spontaneously precludes the ability of the others to perform spontaneously.

In applying the score, an initial value is obtained as soon as the artificial resuscitation procedures have been instituted and the requirements of emergency care satisfied. It is then recommended that serial determinations of a score be made at least every 15 minutes over a period of at least 1 to 6 hours. Such a working plan will show trend and be of predictive value. A score of 5 or more points represents potential life. A score of under 5 points represents impending or presumptive death. A score of 0 is conclusive death. It is further noted that an increasing score over a period of 1 to 2 hours indicates failing therapy and patient deterioration.

To the clinical observations, there may be added laboratory, pharmacologic and monitoring tests of function and responsiveness.

COMMENTARY. — It is beyond the scope of the present paper to present the precise details of the specific parameters to be utilized in determining a death score. Thus, TABLE III represents a "model" score sheet currently being utilized, but this will undoubtedly be modified as experience is gained in multiparameter scoring.

It is the purpose of this paper to present the concept of "multiparameter scoring" to provide an *endpoint defining* irreversible clinical death at a time when biological organ death has not occurred. As the science of organ transplant has progressed, the need for such an endpoint has become increasingly apparent, as most recently pointed out by Beecher. At least three objectives may be realized.

- I. It is hoped that such a concept, and a precise scoring system that must be developed, will allow progress in homotransplantation which will be based on sound moral and ethical principles and protect the potential donor from even the slightest possibility of homicide.
- II. Such a scoring system will also help the physician to decide when *efforts at resuscitation* should be abandoned and thus permit the

patient to die peacefully and not in pieces.

III. It also permits the Anesthesiologist to quantitate the stages of *recovery from anesthesia* or the physician to assess the degree of recovery from coma.

IN CONCLUSION. — Medical progress has been magnificent and although there appears to exist considerable confusion, yet the order of human values and professional ethics remain the same. The natural moral virtues are unchanging, valid, and have withstood the test of time.

In the determination of death, the medical responsibility is clear. The limits of this responsibility in prolonging life are determined by an implicit contract, the code of ethics and competence of the physician. To assist him, we have proposed a Dying Score to determine the endpoint of life and to establish the fact of death.

In prudent application of knowledge and skill, wise men of every age have recognized a universal yardstick as a single measure of our relationship with our fellow man. It is clearly enunciated by all religions.

If we follow this in our practice, there will be no dilemmas and the rights of man to a peaceful death will be realized.

Death comes but once — let it be easy, said Carl Sandburg. In its

proper place it is a friend. We must not let man die in pieces. The right of a patient to make a peaceful death however is part of life. We must let men die in dignity.

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TABLE I
LIFE — INTEGRATION OF PHYSIOLOGICAL FUNCTIONS (After Angrist)

- Locomotion — Musculo-Skeletal System
- Digestion — Gastro Intestinal
- Metabolism — All cells
- Excretion — Renal
- Endocrine — Glands
- Coordination — Nervous System
- Respiration — Pulmonary
- Circulation — Cardio-circulatory
- Reproduction — Genital System

TABLE II
FACTORS INFLUENCING DETERMINATION OF DEATH

- Nature of Human Being
- State of Unconsciousness
- Prognosis-Decision
- Means to Manage
- Patient's Rights — Wishes of Patient
- Physicians Responsibility
- Economics
- Emotional — Sentimentality and Pity
- Societies Demands
- Legal Implications
- Morality
- Nature of Death.

DYING SCORE IN COMATOSE PATIENT
TABLE III

SIGN	2 NORMAL	1 ABNORMAL	0 ABSENT
CEREBRAL FUNCTION	NORMAL	DEPRESSED	ABSENT
EEG	Alpha	Spikes	Isoelectric
STIMULUS-Light Temp		EVOKED RESPONSE	NO EVOKED RESPONSE
REFLEX ACTION	PRESENT	DIMINISHED	ABSENT
Eyes	Constricted Pupils	Pupillary Response	Dilated
Laryngeal Tendon Reflexes	Pharyngeal Reflex	Laryngeal-Carinal	NO EVOKED RESPONSE
Nerve Stimulus		AN EVOKED RESPONSE	NO EVOKED RESPONSE
RESPIRATION	NORMAL	ABNORMAL	ABSENT
	Spontaneous	Assisted	Controlled
Doxapram Test	Adequate	EVOKED RESPONSE	NO RESPONSE
CIRCULATION	NORMAL	DEPRESSED	ABSENT
	Pulse	No Pulse	
		No Pressure	
		Artificial Support	
Vasopressor Test		EVOKED RESPONSE	NO EVOKED RESPONSE
CARDIAC Action	NORMAL	INEFFECTIVE	ABSENT
	Heart Sounds	Assisted	
ECG	Normal	Abnormal	Isoelectric
Pacemaker	Not Needed	EVOKED RESPONSE	NO EVOKED RESPONSE

- Initial evaluation as soon as artificial resuscitation procedures have been instituted.
- Serial determinations at least every 15 minutes.
- A score of 5 or more indicates potential life. A score of under 5 indicates *impending or presumptive death*.
- A score of 0 is *conclusive death*.
- An increasing score over a period of 1 hour represents effective therapy and patient recovery.
- A decreasing score over a period of 1 hour represents failing therapy and patient deterioration.