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Inconsistency between the circulatory and the brain criteria of death in the Uniform Determination of Death Act

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Abstract

The Uniform Determination of Death Act (UDDA) provides that "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." We show that the UDDA contains two conflicting interpretations of the phrase "cessation of functions". By one interpretation, what matters for the determination of death is the cessation of spontaneous functions only, regardless of their generation by artificial means. By the other, what matters is the cessation of both spontaneous and artificially supported functions. Because each UDDA criterion uses a different interpretation, the law is conceptually inconsistent. A single consistent interpretation would lead to the conclusion that conscious individuals whose respiratory and circulatory functions are artificially supported are actually dead, or that individuals whose brain is entirely and irreversibly destroyed may be alive. We explore solutions to mitigate the inconsistency.

Keywords: death determination; functions; conceptual analysis; whole-brain death

Introduction

Since 1968, a brain-based criterion of death has been adopted in medical practice and passed into law or national guidelines in most countries worldwide (Wahlster et al. 2015; Wijdicks 2002). In some countries, such as Australia, Spain, and the United States, death can be determined either by the circulatory and respiratory criterion or by the neurological criterion. This practice corresponds to recommendations by the World Health Organization (WHO Technical Expert Consultation 2014) and the World Medical Association (World Medical Association 2016).

In the United States, the Uniform Determination of Death Act (UDDA) provides that:

> 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. (President's Commission 1981)

Each criterion of the UDDA alone is sufficient to determine human death. Both criteria mention the irreversible cessation of particular functions as a criterion of death: circulatory and respiratory functions for the first, and all functions of the entire brain for the second.

We detect a conceptual inconsistency with the two criteria of the UDDA resulting from the two conflicting interpretations of the concept of "cessation of functions." By one interpretation, what matters for death determination is the cessation of *spontaneous* functions only, regardless of their production by artificial means. By the other interpretation, what matters is the cessation of *both spontaneous and artificially supported* functions. In this paper, we argue that the UDDA's brain criterion of death implicitly uses the first interpretation—spontaneous functions— while the circulatory and respiratory criterion implicitly uses the second interpretation—both spontaneous and artificially supported functions.

If only one of these two interpretations of the cessation of functions were consistently used for the two criteria, it would lead to the absurd conclusion that conscious individuals on respiratory and circulatory artificial support are actually dead, or that some individuals whose brain is entirely and irreversibly destroyed are actually alive. Both consequences are problematic and raise conceptual and ethical issues.

From the definition of death to the criteria of death

The UDDA is a model death statute resulting from an analysis of the medical, legal and ethical issues in the determination of death by the United States President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research book *Defining Death*, published in 1981. The commission was faced with "the need to clarify and update the 'definition' of death in order to allow principled decisions to be made about the status of comatose respirator-supported patients" (President's Commission 1981, 37). Several concepts of death were examined by the Commission. Among them, the "whole-brain" formulation of death was found to be conceptually sound and was used as a basis for the UDDA (Capron 1988).

The whole-brain formulation of death takes a biological approach to the problem of determining death. According to its proponents, death is a unique biological phenomenon common to all organisms (Bernat, Culver, and Gert 1981). Under the whole-brain formulation, death is understood

as the cessation of ‘the integrated functioning characteristic of a living body as a whole’ (Grisez and Boyle 1979), meaning the cessation of ‘the spontaneous and innate activities carried out by the integration of all or most subsystems’ (Bernat, Culver, and Gert 1981). All living organisms have the capacity to organize and regulate themselves, and to function as an integrated whole (President’s Commission 1981). When death occurs, the organism disintegrates into a collection of independent organs and individual cells subject to decomposition. Although many parts of the organism may continue to function for variable amounts of time given technological support, their functioning is usually not sustainable.

The whole-brain formulation of death also claims that the entire brain is necessary for integrating the organism as a whole. According to its proponents, although many organs and bodily structures are necessary for life, none is arguably more central than the brain because of its overarching role in integrating and regulating the functioning of the organism as a whole. The brain is responsible for initiating respiration, regulating blood pressure, regulating temperature, and several other integrative functions. The cessation of any of these functions may cause other organs to fail and may initiate a cascade of reactions leading to the collapse of the entire organism. The complete and irreversible loss of the functioning of the brain is thus deemed incompatible with life:

> The criterion for cessation of functioning of the organism as a whole is permanent loss of functioning of the entire brain. This criterion is perfectly correlated with the permanent cessation of functioning of the organism as a whole because the brain is necessary for the functioning of the organism as a whole. (Bernat, Culver, and Gert 1981)

According to the whole brain formulation of death, death is a unique phenomenon, defined by the cessation of integrated functioning of a living organism, while the integrated functioning depends on a functioning brain. This definition is the basis for the UDDA criteria of death. If death is a unique phenomenon, it can happen in two different situations: the cessation of circulatory and respiratory functions, or the cessation of all functions of the entire brain, including the brainstem.

The two criteria are thus conceived as merely different ways to recognize that the same phenomenon of death—the collapse of psycho-physical integrity—has occurred (President’s Commission 1981).

Two interpretations of ‘the cessation of functions’

Both criteria of death mention the irreversible cessation of certain functions: circulatory and respiratory functions in the first criterion, and all functions of the entire brain in the second. However, the “cessation of functions” has two distinct meanings. On the one hand, it can mean the cessation of *spontaneous* functions, i.e. the cessation of the organ’s *spontaneous* functioning. On the other hand, it can mean the cessation of *either spontaneous or artificially supported* functioning of the systems to which the organs contribute (Bernat, Culver, and Gert 1982).

Irreversible cessation of circulatory and respiratory functions

Traditionally, death was determined by the cessation of spontaneous functioning of the heart and lungs. Advances in life-sustaining therapies now permit sustaining the life of patients whose heart and lungs are not able to function spontaneously. For instance, patients can live with assisted devices such as ventilators, pacemakers, or even devices replacing circulation and ventilation, such

as extracorporeal membrane oxygenation (ECMO). These patients are undoubtedly alive despite the cessation of spontaneous circulatory and respiratory functions. Therefore, for the purposes of death determination, the first interpretation of the criterion—cessation of *spontaneous functions*— does not apply for circulatory and respiratory functions in current medical practice.

In the circulatory-respiratory criterion of death, what in fact matters is not the cessation of the functioning of the *organs* (heart and lungs), but the cessation of the functioning of the *systems* to which these organs contribute, i.e. the circulatory and respiratory systems. These two systems are vital systems because of their finality, which is to enable the oxygenation of the cells, as well as the transportation of nutrients to and wastes from the cells.

Whenever the circulatory or respiratory system functions are performed, either spontaneously or through artificial means, the finality is achieved so the individual cannot be declared dead by the circulatory-respiratory criterion of death. For instance, a patient with a respiratory insufficiency who cannot breathe spontaneously and has his respiratory function artificially sustained by mechanical ventilation, cannot be determined dead by the circulatory-respiratory criterion of death. Similarly, another patient, with terminal cardiac failure, with no spontaneous heart function, but who has his circulatory function supported by the use of an ECMO, cannot be determined dead by the circulatory-respiratory criterion.

Thus, under the first criterion of death, respiratory and circulatory functions can be performed by different means, either biological or artificial. Therefore, death is determined by the irreversible cessation of the circulatory and respiratory functions, and not by the cessation of the functions of the heart and lungs. Whether the functions are *spontaneously* supported by the organ or *artificially* assisted by a machine is irrelevant. What matters for death determination purposes is the cessation of the *function* itself, and not the cessation of the organ that ordinarily spontaneously performs it.

Irreversible cessation of all functions of the entire brain

By contrast, in the whole-brain criterion of death in the UDDA, what matters is the cessation of functioning of the *organ* itself (the entire brain, including the brainstem), not the cessation of *functioning* of the systems to which this organ contributes. The brain contributes to a number of systems, particularly the respiratory system activated by the respiratory centers in the brain stem that initiate breathing. An individual with a severe brain damage, whose entire brain has ceased functioning, including the respiratory center, cannot breathe spontaneously. Under the brain criterion of death, such an individual is considered to be dead, even if respiratory and circulatory functions are sustained by artificial means, such as by mechanical ventilation.

Under the second criterion of death, death is determined by the irreversible cessation of the functioning of the brain itself, although some of its functions (e.g. respiration) may be replaced by the use of artificial means.

How did the inconsistency arise?

We believe that the inconsistency between the UDDA's two criteria was unintentional. We hypothesize that the inconsistency derives from the conceptual assumptions underlying the whole-brain criterion of death. To explain it, in a series of logical steps we will deconstruct the path that leads from the brain-oriented definition of death to the whole-brain criterion of death. The logical argument that follows is a hypothesis based on our analysis of the President's Commission report.

Our purpose is to understand the origin of the inconsistency between the two criteria of death. However, the existence of the inconsistency itself does not depend on this logical argument.

The first premise (*1*) of the argument comes from the idea, formulated by proponents of the brain-oriented definition of death, that all living organisms function as a spontaneously integrated whole (Table 1). Thus, if an organism is alive, it must be spontaneously integrated. In simpler words, life (*L*) requires spontaneous integration (I_S).

The second premise (*2*) comes from the idea that, in all animals with a brain, the functioning of the brain is necessary for the functioning of the organism as a whole. Thus, the spontaneous integration of the organism of an animal with a brain requires the spontaneous functioning of that animal's brain. In simpler words, spontaneous integration (I_S) requires brain's spontaneous functioning (B_{SF}).

From these two premises, it is possible to derive the conclusion (*3*) that if an animal with a brain is alive (*L*), then its brain is spontaneously functioning (B_{SF}). The contraposition of this statement (*4*) is that if the animal's brain is not spontaneously functioning ($\neg B_{SF}$), then the animal is not alive ($\neg L$). This conclusion corresponds to the second UDDA criterion of death, the brain criterion.

Table 1: Logical argument for criterion 2 (cessation of all functions of the brain)

Criterion 2 (*cessation of all functions of the entire brain, including the brainstem*)			
1.	If	Life requires spontaneous integration	$L \rightarrow I_S$
2.	and if	Spontaneous integration requires spontaneous brain functioning	$I_S \rightarrow B_{SF}$
3.	then	Life requires spontaneous brain functioning	$L \rightarrow B_{SF}$
4.	then	**No spontaneous brain functioning implies no life (death)**	$\mathbf{\neg B_{SF} \rightarrow \neg L}$

To derive the UDDA first criterion of death from these logical steps (Table 2), we assume the conclusions that the brain is necessary for life (*3*) and that the irreversible loss of all spontaneous brain functions is death (*4*). Then, we take as premise (*5*) that the brain's spontaneous functioning (B_{SF}) requires oxygen and nutrients, which are provided by circulation and respiration (*Circ. & Resp.*). As mentioned earlier, the circulatory and respiratory functions can be performed either by the organism itself or by mechanical ventilation and other medical techniques.

Without oxygen and nutrients, brain cells can maintain their activities for a limited amount of time, after which they start to deteriorate and die. If this situation was sustained for a long period of time, the destruction of the entire brain would be inevitable and irreversible. In absolute terms, this means that (*6*) if there is no circulation and no respiration ($\neg$*Circ. & ¬Resp.*), then there is no spontaneous functioning of the brain ($\neg B_{SF}$).

Since the irreversible cessation of brain's functioning is death, we can take it as premise (*7*). From there, we can conclude (*8*) that the irreversible cessation of circulation and respiration ($\neg$*Circ. & ¬Resp.*) is also death ($\neg L$). This corresponds to the first criterion of the UDDA.

Table 2: Logical argument for criterion 1 (cessation of circulatory and respiratory functions)

Criterion 1 (*cessation of circulatory and respiratory functions*)			
5.	If	Spontaneous brain functioning requires circulation and respiration	$B_{SF} \rightarrow$ (Circ. & Resp.)
6.	then	No circulation and respiration implies no spont. brain functioning	$\neg$(Circ. & Resp.) $\rightarrow \neg B_{SF}$
7.	and if	No spontaneous brain functioning implies no life (death)	$\neg B_{SF} \rightarrow \neg L$
8.	then	**No circulation and respiration implies no life (death)**	**$\neg$(Circ. & Resp.) $\rightarrow \neg L$**

Is the argument valid?

From a biological standpoint, all living organisms function spontaneously as complex integrated wholes. In humans, before the 20th century, the failure of any vital organ inevitably led to the disintegration of the organism as a whole because of the interdependence of the vital functions. However, medical technology disturbed this interdependence and now can prevent the breakdown of the organism by supporting or replacing the function of many failing organism subsystems. For example, a patient suffering from poliomyelitis, who cannot breathe spontaneously, can have his life sustained by artificial mechanical ventilation. That individual's organism can still function as a whole but doing so requires artificial support. Therefore, the integration of his organism is no longer entirely spontaneous. In such circumstances, the first premise of the argument —life requires spontaneous integration— is contradicted. Indeed, although life requires spontaneous integration in the natural world, with medical technology, an organism that has lost some spontaneous integrative functions can remain alive if artificial means are used to sustain the organism's integrative functions.

Does this dependence mean that the UDDA's criteria are invalid? The answer to this question depends on the existence of some brain functions necessary for the integrative functioning of the organism that could not be artificially replaced.

If any irreplaceable and necessary integrative functions of the brain existed, their functioning would be necessary for the functioning of the organism as a whole. Thus, in case of total brain failure, some integrative functions might be replaced by artificial means, while others might not be replaceable. In such situation, the integration of the organism would be lost. As a consequence, life would always require the spontaneous functioning of the brain —or part of it— and the UDDA's criteria would be valid.

In an influential article published in 1981, prior to the President's Commission report, James Bernat, Charles Culver, and Bernard Gert stated that "a patient on a ventilator with a totally destroyed brain is merely a group of artificially maintained subsystems since the organism as a whole has ceased to function" (Bernat, Culver, and Gert 1981, 391). This statement was supported by empirical evidence at that time, because the medical condition of individuals with total brain failure was unstable and could not be maintained in intensive care units for more than two to ten days (President's Commission 1981). Thereafter, this claim became established as the standard rationale for equating "whole brain death" with human death (The President's Council on Bioethics

2008). But while this statement was justified at the time it was written, contemporary advances in life-support technology have rendered it untrue.

The claim that individuals with a cessation of all brain functions are not integrated organisms but merely a group of artificially maintained subsystems has been challenged by several authors from different perspectives (S. J. Youngner and Bartlett 1983; Gervais 1986; Halevy and Brody 1993; Lizza 1993; Seifert 1993; Veatch 1993; Taylor 1997; Truog 1997; Brody 1999; Halevy 2001; Potts 2001; Byrne and Weaver 2004; Zamperetti et al. 2004; Joffe 2007; Shemie et al. 2014; Brugger 2016; Verheijde, Rady, and Potts 2018). In particular, Alan Shewmon has shown that human bodies who have suffered from a total brain failure can be stabilized and their functions sustained by the use of artificial means for weeks, months or even years (Shewmon 1998), as in the case of Jahi McMath (Shewmon 2018). Moreover, several integrative functions of the organism are not performed by the brain and can continue even after a medically documented total brain failure (Shewmon 2001).

If Shewmon is right, then individuals without spontaneous brain functions may nevertheless be integrated organisms. In other words, there would exist no spontaneous brain function necessary for the integration of the organism. All necessary integrative functions of the brain would be replaceable by artificial means, while irreplaceable functions are not necessary for the organism's integration. Therefore, the UDDA brain criterion would be invalid.

However, denying the integration rationale does not exclude other possible justifications for a brain-based criterion of death. The United States President's Council on Bioethics in 2008 rejected prior rationales for a brain-oriented criterion of death and the "assumption that the brain is the 'integrator' of vital functions" (The President's Council on Bioethics 2008, 60), but they accepted the validity of a brain criteria for death and proposed a new rationale based on the cessation of the organism as a whole. According to this rationale, the *wholeness* of an organism depends on its ability to perform its fundamental vital work, which is "the work of self-preservation, achieved through the organism's need-driven commerce with the surrounding world" (The President's Council on Bioethics 2008, 60). They concluded that "total brain failure can continue to serve as a criterion for declaring death—not because it necessarily indicates complete loss of integrated somatic functioning, but because it is a sign that this organism can no longer engage in the essential work that defines living things" (The President's Council on Bioethics 2008, 64).

Other advocates of a brain-oriented criterion of death have also decreased dependence on the "somatic integration" justification. Using concepts from theoretical biology, Andrew Huang and James Bernat proposed a more refined rationale based on the idea that the organism as a whole is the organism's critical emergent functions (Huang and Bernat 2019; Bernat 2019). In humans, these critical emergent functions include conscious awareness and control of respiration and circulation, which are performed by the brain. According to their account, when the brain permanently stops functioning, the organism's emergent functions are lost and the individual is dead.

To summarize our analysis of the President's Commission logical argument so far, we have seen that the first premise (*1*)—*life requires spontaneous integration*—is false, because medical technology now permits supporting or even replacing some integrative functions. For example, in the case of a patient suffering from poliomyelitis, who is unable to breathe spontaneously, the integration of his organism is not entirely spontaneous but supported by mechanical ventilation. Since premise (*1*) is false, we cannot draw the conclusion (*4*) that the irreversible cessation of all spontaneous functions

of the entire brain is death. Life may require the integration of the organism, but it does not necessarily require *spontaneous* integration. Next, we have seen that the second premise (*2*) also would be false even if we set aside the requirement of spontaneity: “integration requires spontaneous brain functioning.” Indeed, as claimed by Shewmon and others, and as acknowledged by the President's Council in 2008, individuals with no spontaneous brain functioning may nevertheless be integrated organisms receiving artificial support. Hence, the integration of the human organism (dead or alive), does not necessarily require *spontaneous* brain functions, but it does require the performance, by any means available, of those functions that are normally performed spontaneously by the brain. Therefore, the logical steps that lead to the UDDA brain criterion of death are not valid, as its two premises are wrong.

To make a correct logical argument, all spontaneity requirements should be removed as follows (Table 3):

Table 3: Alternate logical argument for criterion 2 (cessation of all functions of the brain)

Criterion 2 (*cessation of all functions of the brain, including the brainstem*)		
1’. If	Life requires ~~spontaneous~~ integration (by any means)	$L \rightarrow I$
2’. and if	~~Spontaneous~~ integration requires ~~spontaneous~~ brain functions *(either performed by the brain or by other means)*	$I \rightarrow B_F$
3’. then	Life requires ~~spontaneous~~ brain functions *(either performed by the brain or by other means)*	$L \rightarrow B_F$
4’. then	**No ~~spontaneous~~ brain functions *(either performed by the brain or by other means)* implies no life (death)**	$\mathbf{\neg B_F \rightarrow \neg L}$

As a result of the modified premises (*1’*) and (*2’*), we can conclude that life requires spontaneous or artificially replaced brain functions (*3’*) and thus, it is the cessation of all brain functions, either spontaneous or artificially replaced, that implies death (*4’*).

This analysis also affects the UDDA circulatory-respiratory criterion of death. In the first criterion of death, the first premise (*5*)—*spontaneous brain functioning requires circulation and respiration* —is valid. Then, it is correct to claim (*6*) that no circulation and respiration implies no spontaneous brain functioning. However, the second premise (*7*)—*no spontaneous brain functioning implies no life (death)*— is wrong, as the cessation of spontaneous brain functioning does not necessarily imply death (*4’*). Therefore, one cannot infer the conclusion (*8*) that the cessation of circulation and respiration implies death.

Yet, the circulatory-respiratory criterion could remain valid if viewed through a different lens (Table 4). Circulatory and respiratory functions are vital because of their finality, which is to enable the oxygenation of all body cells (including those of the brain), as well as the transportation of nutrients and wastes to and from the cells. When the finality is not achieved by any means, either naturally or artificially, the organism as a whole cannot long survive. In addition, both circulation and respiration are necessary for life, so the loss of any of these two functions leads to the breakdown of the whole. What matters for life is that both functions are performed, either by natural or artificial

means. In simpler words, if life (L) requires both circulation and respiration ($C_{irc.}$ & $R_{esp.}$), the irreversible loss of circulation ($\neg C_{irc.}$) or respiration ($\neg R_{esp.}$) is death ($\neg L$).

Table 4: Alternate logical argument for criterion 1 (cessation of circulatory and respiratory functions)

Criterion 1 (*cessation of circulatory and respiratory functions*)		
5'. If	Life requires circulation and respiration	L → (Circ. & Resp.)
6'. then	**No circulation or no respiration implies no life (death)**	**¬Circ. or ¬Resp. → ¬L**

Under this reasoning, the circulatory and respiratory criterion would be valid independently of the whole-brain definition of death and independently of the brain criterion of death.

Bringing consistency to the law

We have identified three major ways to address the inconsistency between the circulatory and the brain criteria of the UDDA: (1) ignore the problem; (2) amend the statute by using the same interpretation of function for both criteria; or (3) amend the law by using a single criterion of death.

The first solution would be simply to ignore the problem. The UDDA has several objectives, such as guiding physicians in their medical practice, fostering national uniformity in the determination of death, facilitating organ transplantation, "protect[ing] patients against ill-advised idiosyncratic pronouncements of death", and "replac[ing] artificial support with more fitting and respectful behavior when a patient has become a dead body" (President's Commission 1981, 24). Hence, the achievement of these objectives could be favored over trying to fix the conceptual inconsistency of the UDDA wording. Indeed, a legal determination of death does not necessarily require a scientific or philosophical justification. Consistency between a law and an underlying reality might seem necessary to ensure public trust but it is not necessarily the case, as in legal fictions (Charo 1999).

A second solution would be to amend the law by rephrasing its criteria according to one of the following two interpretations:

> (*A*) An individual, who has sustained irreversible cessation of the system's spontaneous and artificially supported functioning, regardless of the functioning of the organ itself, is dead.
>
> *(B)* An individual, who has sustained irreversible cessation of the organs' spontaneous functioning, regardless of the functioning of the systems in which the organ participates, is dead.

However, both options have drawbacks that make this second solution inapplicable. Interpretation *(A)* corresponds to the circulatory-respiratory criterion of death. If applied to the brain criterion of death, it would mean that an individual cannot be declared dead, although his/her brain has irreversibly ceased functioning, if any of the systems to which the brain contributes continued to function by the use of artificial means. In other words, individuals with total brain failure would be

legally alive as long as their circulatory and respiratory functions were performed with technical assistance. As a consequence, death could be declared only by irreversible cessation of circulatory and respiratory functions, making the brain criterion useless.

Interpretation (*B)* corresponds to the brain criterion of death. If applied to the circulatory-respiratory criterion, it would mean that an individual who has sustained irreversible cessation of his heart and lungs' spontaneous functioning is dead. For instance, a conscious patient whose heart and lungs are not functioning spontaneously would be determined dead, even if the circulatory and respiratory functions were actually performed by other means, such as artificial heart and mechanical ventilation, or extracorporeal membrane oxygenation. This conclusion obviously is absurd.

A third solution would be to amend the law leaving a unique criterion under one of the two interpretations above. This approach yields four options:

> 1.A. – Circulatory-respiratory criterion alone, interpreted as the irreversible cessation of the circulatory and respiratory *systems*' functioning. This option would mean that individuals with total brain failure could not be declared dead as long as their circulatory and respiratory systems were maintained through artificial support. Therefore, death could be declared only by irreversible cessation of circulatory and respiratory functions, and brain death would not be equivalent to human death.
>
> 1.B. – Circulatory-respiratory criterion alone, interpreted as the irreversible cessation of the heart's and lungs' *spontaneous* functioning. This option corresponds to the traditional cardiopulmonary standard, prior to the development of mechanical ventilation and other life-support techniques. Although this criterion remains useful when death occurs outside of an intensive care unit, it could also lead to the absurd conclusion that some conscious patients with an artificial heart or under respiratory assistance should be declared dead.
>
> 2.A. – Brain-based criterion alone, interpreted as cessation of the functioning of the *systems* to which the brain contributes. This option means that an individual with total brain failure whose vital systems are artificially supported cannot be declared dead as long as artificial means sustain circulatory and respiratory functions. Therefore, death could be declared only after the irreversible cessation of circulation and respiration, and brain death (as currently understood) would not be equivalent to human death. This option is similar if not identical for practical purposes to option 1.A.
>
> 2.B. – Brain-based criterion alone, interpreted as cessation of all *spontaneous* brain functions. This option corresponds to the current medical practice of death determination by the UDDA brain criterion. It would mean that the two main medical situations – circulatory and respiratory cessation on the one hand, and brain damage on the other hand – will both lead to a cessation of all spontaneous brain functions. Here there would be a single unique phenomenon of death, with two medical scenarios that can lead to it.

If a single criterion solution were retained, option 2.B is the only one that is consistent with death as the cessation of the organism as a whole and that would not disrupt current medical practice, including organ procurement. Different formulations may be considered, such as the operational

definition of human death developed by a forum of international experts in collaboration with the World Health Organization: “the permanent loss of capacity for consciousness and all brainstem functions, as a consequence of permanent cessation of circulation or catastrophic brain injury” (Shemie et al. 2014).

The simplest solution for a death statute was proposed in 1982 by Bernat, Culver and Gert. Their model death statute is consistent with Option 2.B. and similar to that proposed by the Law Reform Commission of Canada in 1981.[1] Their model statute offered a single criterion of death clarifying that death is the irreversible cessation of all brain functions but provided two clinical testing contexts for the determination of death, depending on the absence or presence of artificial means of cardiopulmonary support.

Conclusions

Death is described by the Uniform Determination of Death Act as the irreversible cessation of some specific biological functions: either circulatory and respiratory functions in the first criterion, or all brain functions in the second criterion. However, “cessation of functions” has two distinct meanings. On the one hand, it can mean the cessation of *spontaneous* functions, i.e. the cessation of the organ’s *spontaneous* functioning. On the other hand, it can mean the cessation of *either spontaneous or artificially supported* functions. Each criterion of the UDDA uses implicitly a different meaning of the “cessation of functions”. Thereby, the UDDA is conceptually inconsistent. The inconsistency derives from the conceptual assumptions underlying the whole-brain conception of death. This theory claims that (1) life requires the spontaneous integration of the organism, and that (2) the integration of the organism requires the spontaneous functioning of the brain (or part of it). Both claims are false in the context of contemporary medicine. This is yet another indication that the whole-brain conception of death is unsustainable. After exploring several ways to address the UDDA’s inconsistency, we found three viable solutions. The first one is to leave the UDDA as it is, acknowledging that death as defined by the law may not necessarily be equivalent to biological death and thus may be considered a legal fiction. The second solution is to opt for a broad interpretation of “function” that includes both spontaneous and artificially supported functions. This implies that death could only be declared after the irreversible cessation of circulatory and respiratory functions—both spontaneous and artificially supported. In other words, it would imply that brain death is not necessarily equivalent to human death. The third solution is to opt for a narrow interpretation of “function” restricted to spontaneous functions. This implies that death could only be declared after the irreversible cessation of spontaneous brain functions, although the cessation of circulatory and respiratory functions could be used as a test for the cessation of brain functions. This third solution would not disrupt current medical practice but it would require a new scientific and philosophical justification—different than the whole-brain rationale.

1 An individual who has sustained irreversible cessation of all functions of the entire brain, including the brainstem, is dead. (a) In the absence of artificial means of cardiopulmonary support, death (the irreversible cessation of all brain functions) may be determined by the prolonged absence of spontaneous circulatory and respiratory functions. (b) In the presence of artificial means of cardiopulmonary support, death (the irreversible cessation of all brain functions) must be determined by tests of brain function. In both situations, the determination of death must be made in accordance with accepted medical standards.

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