

## *Commentary: Defining Death: Definitions, Criteria, and Tests*

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In their essay, “Aligning the criterion and tests for brain death,” James Bernat and Anne Dalle Ave thoughtfully address what they call the test-criterion mismatch in the way that brain death is diagnosed.<sup>1</sup> They frame their analysis in terms of the tripartite approach to conceptualizing death in terms of definitions, criteria, and tests. They do not state the definition of death that they endorse, but they do claim that “[c]onsensus has been achieved throughout most countries that accept brain death that the whole-brain criterion best satisfies the definition of death.”

They review evidence, much discussed over the past several decades, that the current tests for diagnosing brain death do not fulfill the whole-brain criterion. The tests that are performed in diagnosing brain death examine only a select number of functions of the brain; while it is well-known that functions which are not a part of the battery of tests may persist. Two of the most commonly mentioned are related to intact hypothalamic function, namely temperature control and osmotic homeostasis through the regulated secretion of vasopressin, but there may be others as well. The problem may therefore be stated as follows: the whole-brain “criterion” requires the absence of ALL functions, while the whole-brain “tests” examine only SELECTED functions, and we know of at least some brain functions that may persist which are not included among the required battery of tests.

The authors propose two possible solutions to this problem—either tighten the tests or loosen the criterion. With regard to the first, they suggest that the tests used to diagnose brain death could be made more rigorous; specifically, by requiring tests that demonstrate complete circulatory arrest in the brain, thereby assuring the loss of all brain function. They are doubtful that this would be accepted by the medical community, however, since it would likely decrease the number of organ donors and because it would add additional costly procedures that would not be available in many centers around the world.

Their second suggestion is to relax the criterion, by revising the criterion to require only the loss of certain critical functions, rather than the loss of all functions. They candidly acknowledge that the risk of this approach would be “to disrupt the conceptual integrity of the whole-brain criterion by creating an ad hoc list of critical brain functions that excludes non-critical brain functions without first providing a biologically coherent and justified distinction between the two groups of functions.”

In conclusion, Bernat and Dalle Ave do not definitively state where they come down on the problem of the test-criterion mismatch, but close by acknowledging that it is a “nagging problem” that requires further analysis and refinement.

In my commentary, I suggest that this analysis must consider the full triad of definition-criteria-tests relationship, rather than just the relationship between the latter two. As noted above, the authors do not explicitly state the definition of death that they endorse. In the seminal paper that Bernat and colleagues wrote in 1981, however, he proposed that death be defined as “the permanent cessation of

the functioning of the organism as a whole."<sup>2</sup> He intended this definition to apply across the biological spectrum: "When we talk of the death of a man we mean the same thing as we do when we talk of the death of a dog or a cat."<sup>3</sup> His definition accords with the thinking of physiologists dating back to Claude Bernard<sup>4</sup> in the 1860s and Walter Cannon<sup>5</sup> in the 1920s, that life can be defined as the maintenance of homeostatic equilibrium by energy-consuming processes that oppose and balance the thermodynamic force of entropy. He recognized that life does not depend on the presence of consciousness: "Lower organisms never have consciousness and when a higher organism is comatose, proof of the functioning of the organism as a whole may still be evident..."<sup>6</sup>

The crux of Bernat's argument in 1981 was that brain death is the same as biological death because the human body requires a brain in order to maintain integrated functioning. This view, which was supported by medical knowledge and experience at the time, was that the brain functions as "command central" for the human body, and that when the brain dies, the body literally disintegrates. Given the medical facts as they were understood at the time, Bernat's theory was a perfect integration of the concepts of brain death and biological death.

Since publication of this paper, the claim that brain death is equivalent to biological death has been repeatedly endorsed in the neurology literature. In a paper titled "Why brain death is considered death and why there should be no confusion," leading neurologists wrote, "Once brainstem function is lost... blood pressure is unstable... relentlessly declining... Cardiac arrhythmias appear... Support measures are complex, often fail, and the ability to maintain a brain dead body is virtually impossible."<sup>7</sup> In 2018, Eelco Wijdicks asserted the universal acceptance of this view: "Globally, neurologic, neurosurgical, and critical care organizations now invariably equate brain death with death and do not distinguish it biologically from cardiac arrest."<sup>8</sup>

The problem with the view is that there is now overwhelming evidence that it is wrong. Brain death is not biological death. Neurologist Alan Shewmon has documented numerous cases of prolonged biological survival following the diagnosis of brain death, in one case for more than 20 years.<sup>9,10</sup> Physiologically, brain death can be compared to the phenomenon of "spinal shock" that occurs after acute high spinal cord transection.<sup>11</sup> In both cases, the body is suddenly disconnected from the modulating influence of the brain, and patients become very hemodynamically unstable. In the absence of modern ICU care, death is the most common outcome. This probably explains the assumption in 1981 that the diagnosis of brain death was invariably followed by imminent cardiovascular collapse. But in both brain death and spinal shock, after several weeks of stabilization in a modern ICU, this hemodynamic instability resolves, and in both cases, patients may go on to live for years.

This conclusion was endorsed by a President's Council in 2008 in their report on "Controversies in the determination of death." They wrote, "The reason that these somatically integrative activities continue... is that the brain is not the integrator of the body's many and varied functions... no single structure in the body plays the role of an indispensable integrator.

Integration, rather, is an emergent property of the whole organism..."<sup>12</sup>

How is this relevant to the analysis presented by Bernat and Dalle Ave? If the definition of death is the "permanent cessation of the functioning of the organism as a whole," then the fundamental disconnect is between the definition of death

and the criterion of whole-brain death. Even if whole-brain death were to be definitively determined by very accurately diagnosing circulatory arrest of the entire brain, the criterion would not be compatible with the definition of death, since it is now very clear that “functioning of the organism as a whole” can persist in the absence of any brain functioning whatsoever. In other words, while the authors aim is to resolve the disconnect between the whole-brain criterion and the current diagnostic tests, this project makes no sense in the absence of a definition of death that is compatible with the whole-brain criterion.

Is there any way to resuscitate some version of the neurological determination of death that would be compatible with the definition of death? I believe that there is, but it would require a definition of human death that is based on more than just biological considerations alone. Philosopher Robert Veatch has long advocated that death should be defined as “the irreversible loss of that which is essentially significant to the nature of man.”<sup>13</sup> In his 1981 paper, Bernat explicitly considered Veatch’s definition, yet rejected it for two reasons: first, it did not correspond with death as it is commonly understood biologically, and second, it would categorize patients in a permanent vegetative state as being dead, even though many of these patients retain spontaneous ventilation.<sup>14</sup>

In short, if we assume that the “correct” definition of death is biological, then the whole-brain criterion is a nonstarter. But why must we make this assumption? While recognizing that a biological understanding of death can be applied across the entire biological spectrum, human death involves more than just the loss of biological functioning. Many people, for example, would regard the permanent loss of consciousness as being “as good as dead.” And yet, as Bernat pointed out in 1981, we also have strongly held views that anyone who has spontaneous ventilation should be categorized as being alive, even if they are permanently unconscious.

An alternative approach would be to recognize that brain death is, and always has been, a social construct that is not limited to biological functioning. Social constructs are principles that we create, rather than discover. For example, while most foundational principles in medicine are based on empirically determined scientific facts, our entire system of laws is based on principles that have been chosen by society, on the basis of how well they meet our communal needs for common goods, such as “life, liberty, and the pursuit of happiness.”

As a social construct, the concept of whole-brain death has served our social needs very well, both by legitimating the life-saving practices of organ donation and transplantation, as well as defining a degree of neurological injury so severe that we have no societal obligation to use ICU resources in order to maintain the biological existence of these patients.

The United Kingdom does not have a statutory definition of death, but instead uses a “Code of Practice” that was endorsed by the Academy of Medical Royal Colleges in 2008.<sup>15</sup> It states that “death entails the irreversible loss of those essential characteristics which are necessary to the existence of a living human person and, thus, the definition of death should be regarded as the irreversible loss of the capacity for consciousness, combined with irreversible loss of the capacity to breathe.” Note that this definition makes no reference to biological death—it explicitly recognizes the definition of death to be a social construct built around presumably shared values on what constitutes the essential characteristics of a human person.

How might these ideas be applied to the definition-criteria-tests framework for the determination of death? Instead of defining death biologically, as the permanent loss of the functioning of the organism as a whole, we could explicitly acknowledge that the definition of death is a social construct, and adopt the criterion endorsed by the UK. Using this approach, the relationship between the definition and criterion of death might look like this:

Definition of death: The irreversible loss of those essential characteristics which are necessary to the existence of a living human person.

Criterion of death: The irreversible loss of the capacity for consciousness, combined with irreversible loss of the capacity to breathe.

How would this relate to the third part of the triad, the tests that are used to determine brain death? As Bernat and Dalle Ave suggest, rather than insisting on the loss of all brain functions, we could focus the testing on “critical” brain functions. As they discuss, however, the problem is how we determine which brain functions are “critical,” and how do we avoid, as they warn, “creating an ad hoc list of critical brain functions” that are not logically connected with the definition and the criterion.

By using the criterion proposed above, the problem is solved, since the criterion specifies exactly what functions are “critical.” At the present time, the current guidelines from the American Academy of Neurology and the American Academy of Pediatrics purport to be accurate in meeting these criteria. Hence, the tests required for diagnosing death could be:

Tests for death: Nominally, the testing endorsed by the AAN and the AAP, modified as necessary to align with the criterion.

The advantages of this structure are several-fold. First, it avoids creating an ad hoc list of critical brain functions, but rather aligns the critical brain functions with a unifying definition of death. Second, it recognizes that the specific tests can and should evolve over time, always being evaluated in terms of their alignment with the criterion. For example, a number of individual cases have been documented where patients have demonstrated spontaneous respiration after fulfilling the requirements for the apnea test.<sup>16</sup> In addition, there are concerns that the “ischemic penumbra” phenomenon may result in the return of some degree of consciousness, as has been speculated to have occurred in the case of Jahi McMath.<sup>17</sup> These findings suggest that the current guidelines need to be modified and improved so as to accurately align with the criterion. On the other hand, this structure would provide a potential rationale for not including hypothalamic functioning in the testing for brain death, so long as it continues to be the case that this functioning is not associated with either the capacity for consciousness or the capacity to breathe.

Before concluding, I mention two related points, without exploring them in detail. The first is the concern that society could never accept brain death as “real” death unless it conformed with biological death. While making analogies between brain death at the end of life and abortion at the beginning of life is fraught with hazards, I want to make one simple observation about how society views biology

when it comes to life and death. Virtually everyone agrees that an early stage embryo is biologically alive. For some, the biological status is all that matters, and the early stage embryo has the full moral status of any other human being (although this position has complex implications, such as how far we should go to prevent spontaneous miscarriage). For others, however, the biological status of the early stage embryo is only part of the story, and the principles for governing how it should be treated depend on many other factors as well, most importantly the wishes of the woman who is carrying the fetus. The position in our society right now is that both views are tolerated, and the choice is (at least theoretically) up to the woman.

Similarly, for some the biological status of the brain-dead patient may be all that matters, and as long as biological life is present, the person should be given the same legal protections as any other person with a severe neurological injury. For others, however, the biological status is not determinative, such that persons diagnosed as brain-dead should be allowed to donate their vital organs, even if it means ending their biological existence. The position in our society right now is that organ donation is not only permissible but encouraged, whereas maintenance of biological life after the diagnosis of brain death is not tolerated short of court-ordered legal injunctions that require it.

To be clear, the only point I'm trying to make with this analogy is that where we draw the lines between life and death and the legal status of entities that are on the edges of these categories are not entirely determined by their biological status, and that the claim that brain death will be socially accepted only if it is synonymous with biological death (which it is not) may not be correct.

Finally, I think the definition-criteria-test structure suggested here has potentially helpful implications for the ethics of organ donation after circulatory determination of death (DCD). One of the main questions regarding DCD is how long to wait after the onset of pulselessness before declaring death and initiating organ procurement. This question is currently addressed by asking how long we must wait to rule-out autoresuscitation, that is, the heart restarting on its own.<sup>18</sup> Under the rubric proposed above, however, the question would be reframed as: How long do we need to wait until we can be sure that the person has irreversibly lost of the capacity for consciousness and the capacity to breathe? While much more would need to be said, this approach would provide a unifying construct for determining death in both the brain death and the DCD pathway.

## Notes

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