

A New Defense of Brain Death as the Death of the Human Organism

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This paper provides a new rationale for equating brain death with the death of the human organism, in light of well-known criticisms made by Alan D Shewmon, Franklin Miller and Robert Truog and a number of other writers. We claim that these criticisms can be answered, but only if we accept that we have slightly redefined the concept of death when equating brain death with death simpliciter. Accordingly, much of the paper defends the legitimacy of redefining death against objections, before turning to the specific task of defending a new rationale for equating brain death with death as slightly redefined.

KEYWORDS: *Alan D. Shewmon, biological death, brain death, brainstem death, concepts of death, death by neurological criteria, integrated functioning, organism as a whole*

I. INTRODUCTION

Is it legitimate to change the definition of death? In the literature on brain death,¹ two broad and related reasons have been advanced against a positive answer. The first is that, following any redefinition, we would no longer be talking about the same thing we were talking about before. The second is that redefining a term can amount to a refusal to accept that a belief or assumption has been refuted, thereby protecting the original assumption or belief from falsification (Nair-Collins, 2010). The protection comes at the cost of “distorting” the concept of death (Joffe, 2007). In this article, we shall examine both of these reasons for skepticism about changing the definition of death in the context of the debate about brain death. We shall argue that both these reasons have been overstated, and we shall defend a new rationale to justify equating brain death with the death of a human being.

II. MATTERS OF DEFINITION AND MATTERS OF FACT

In his personal statement appended to the 2008 President Council on Bioethics Report *Controversies in the Determination of Death* (hereafter, the Report), Alphonso Gomez-Lobo expresses reservations about the tendency to frame the debate about brain death as a debate concerning the definition of death (2008, 95–100). He points out that, if we accepted that the definition of death has

changed over time, “we will not be referring to the same natural phenomenon we had been trying to identify before the semantic change took place” (President’s Council on Bioethics, 2008, 95). For Gomez-Lobo, if we change the meaning of a term, we change its reference. He draws an analogy with geometry to illustrate the concern: “Thus, if we define ‘triangle’ as ‘a plane figure with three straight sides’ and the definition is changed to ‘a plane figure with four straight sides’, then the term ‘triangle’ will no longer single out triangles, but squares” (President’s Council on Bioethics, 2008, 95). Although this point is well taken, we believe the issue is not as straightforward as Gomez-Lobo’s remarks here imply. While it is certainly possible to redefine terms in such a way that they acquire a different referent, not every redefinition has this result. There may be doubts about the adequacy of his analogy with geometry for the purposes of discussing the debate about brain death but, assuming that the analogy is valid, the better version of that analogy is not that of redefining a triangle as a “plane figure with *four* straight sides” but rather redefining a “triangle” under non-Euclidean geometry. For example, if you were to draw a “triangle” on a curved ball, non-Euclidean geometry applies: there are no straight lines and the sum of all the angles of the triangle is greater than 180 degrees. In such geometry, the word “straight” in “a plain figure with three *straight* sides” has to be dropped, and the sum of the angles of the three sides will not be equal to 180 degrees. But we still have a figure with three sides.

In this case, a real conceptual question can be raised about whether we can still call such a figure a triangle at all given its definition under Euclidean geometry (as requiring *straight* sides), or whether we are dealing with a triangle as *redefined*. Unlike the example given by Gomez-Lobo—where a triangle is simply redefined as a square—it seems to be a genuine question of whether we have expanded our concept of “triangle” to include these non-Euclidean shapes. These non-Euclidean shapes have *enough* in common with the previous definition to warrant justifying the continued use of the same word (triangle), while departing significantly enough from our previous use nonetheless to raise an issue that must be decided one way or the other. We can of course say that we have a Euclidean and a non-Euclidean concept of a triangle, but we can also say that our concept of a triangle has been broadened to include both Euclidean and non-Euclidean shapes.

The question then becomes how far we can move away from the paradigm and still have what we call a triangle (presumably, we can only bend the sides so much before losing the shape of a triangle completely, so some constraints on what is possible must of course remain). Euclid could not appreciate the importance of curvilinear space and was concerned far more with a two-dimensional world. But we in more modern times have discovered that Euclidean geometry is not so much wrong as no longer satisfactory to answer the questions we need to be answered. Similarly, before the advent of life support technology and the acquisition of a detailed understanding of the physiology around death, consciousness, heartbeat, and breathing were lost seemingly simultaneously and resuscitation was not possible, so issues about the definition of death did not really arise. But new medical advances and the use of life-sustaining technologies force upon us a need for greater clarity and, arguably, new or at least refined definitions.

We can begin to illustrate our claim that new medical advances can force us to use refined definitions, by examining some remarks made by Shah and Miller (2010) in their paper, “Can We Handle the Truth? Legal Fictions in the Determination of Death.” In that paper, the authors claim that “the traditional legal consequences of death did not require determining the moment of death with precision” and that “it was only when death became a prerequisite for vital organ donation that it began to matter exactly when a person died” (Shah and Miller, 2010, 543). Both these statements are ambiguous, admitting of two different possible readings:²

1. The traditional legal consequences of death did not require determining when, applying our traditional notion of death,³ death occurred, and it was only when death, on the traditional notion, became a prerequisite for vital organ donation that it began to matter exactly when, on that definition, a person died; and
2. The traditional legal consequences of death did not require determining what events, exactly, should count as someone’s “having died,” and that it was only when death became a prerequisite for vital organ donation that it began to matter what events, exactly, should be taken to constitute a person’s death.

The first reading means that, with advances in technology enabling organ donation, we needed to determine more precisely the moment when death occurs. The second reading means that, with advances in technology enabling organ donation, we needed to revisit what, exactly, death is. These two questions need not be mutually exclusive, but we may need to answer the second question first, in order to answer the first one. To see the relevance of the second reading, one might ask: should every cell in the body have ceased to function before we say that someone is dead? Or can we call someone dead even though some of their cells are still functioning? This is a conceptual, or definitional, question, rather than an empirical question. Its answer depends mainly on the consistency of the proposal with the rest of our conceptual scheme and current medical practice. Loss of spontaneous breathing, loss of heartbeat, and loss of consciousness have long been used, in combination, to declare death. Advances in technology mean that the loss of these functions can now occur at different times. It is now possible, for example, for a person's heart to stop irreversibly while they remain conscious, as has been achieved with extracorporeal membrane oxygenation (ECMO) technology (Fux et al., 2014). Similarly, it is possible for a heart to continue beating, even after a person has irreversibly lost the capacity for consciousness and the capacity to breathe, by the use of mechanical ventilation and other intensive care technology. Before the advent of these technologies, the *joint* absence of breathing, heartbeat, and consciousness led people to consider a person dead. The existence of these technologies has raised the question of whether we might today consider the patient to have died when only some, but not all, of these functions have ceased. This is a conceptual question about what events, exactly, we should fix as criteria for declaring that death has occurred. We cannot *automatically* assume that *all* functions must be lost without already having decided that conceptual question one way rather than another. If opponents of brain death were to object that a person is not dead until all the functions are lost, they are making a recommendation to that effect without realizing it, for our concept of death as it functioned *before* the development of this technology simply does not *dictate* that this view is the only compelling view to take.

It might be objected that, even if our reply to Gomez-Lobo is sound, the issue about whether brain-dead people are dead nonetheless cannot be a matter of definition as we have just suggested. As Frank Miller and Robert Truog put it: "...it is a matter of *fact* that 'brain dead' individuals are not dead, though this fact is relative to a biological conception of death" (2012, 78).

Miller and Truog here assert that, as a matter of fact, brain-dead individuals are not dead. They do not consider the dispute to be a conceptual dispute, provided both parties adhere to a biological conception of death.⁴ Miller and Truog might say, then, that when we are seeking to determine more precisely when an individual is dead, we are looking for the point at which the cessation in the functioning of the organism as a whole is irreversible, and this might occur at a different time than we thought it did. We are, in other words, only seeking greater clarity about when death has occurred. That being so, we have not redefined death, but *discovered* when death, on our ordinary understanding of it, actually occurs. With advances in technology—so the objection may continue—we have discovered with greater accuracy that this point can be reached before the death of every cell in the human body. Indeed, according to Miller and Truog, "death occurs at the moment when the entropy-increasing forces have irreversibly exceeded those that are resisting this process" (2012, 69–70). This seems to be a factual discovery—it is a matter of fact that entropy-increasing forces, at some point, exceed those forces that resist the entropic process and, more to the point, it is surely a matter of fact when this point is. Similarly, Michael Nair-Collins states: "[B]iological death is a matter to be discovered, not stipulated" (2010, 670). And, in line with Miller and Truog's claims about the significance of the inability to resist entropy, Nair-Collins adds:

Bodies that lack brain function yet are maintained on a ventilator can maintain a large variety of biological functions involving the coordinated activities of subsystems in preserving homeostasis and resisting entropy for the organism as a whole for a very long time. Hence, assuming the standard theory of biological death, evidence shows that patients in state X (patients who would be diagnosed as brain dead) are biologically alive. (2015, 41)

Like Miller and Truog, Nair-Collins insists that death is a matter to be discovered.⁵ And, like Miller and Truog, he assumes that the maintenance of a large variety of biological functions involving the

coordinated activities of subsystems in preserving homeostasis and resisting entropy is sufficient for life, and that this falsifies the criterion of brain death as the criterion by means of which we can know that someone has died. He thereby treats the question as exclusively factual, labeling any attempt to amend the definition as being done “for the sole purpose of preserving” brain death from “empirical refutation” (Nair-Collins, 2015, 41).

In reply to these objections, we agree that empirical discoveries can change assumptions we hold both about what death is and about when it occurs. But an important qualification must be made to this concession. Such discoveries can, in some cases, spark a conceptual change so that a discovery of a *symptom* of death is then made into a defining *criterion* for it; and it is *we* who choose to elevate an empirical discovery into such a criterion, even if the facts and our conceptual scheme largely force the choice on us. For example, when we discovered that gold is a substance with the chemical element of atomic number 79, we made an empirical discovery about the chemical constitution of gold. But we then made having atomic element number 79 into a defining criterion of what we call gold from that point on, so that, from that point, it was made part of the meaning of gold (Glock, 1994, 203). In making “having 79 protons” partly constitutive of what we mean by “gold,” we do not gerrymander the definition of gold. Instead, we revise our definitions of words as prompted by empirical discoveries such as these. There is, therefore, a legitimate role for a redefinition to play in science, and not every redefinition is an attempt to preserve an empirical belief from empirical refutation.

Applying this qualification to the debate about death, return now to the Miller and Truog (and Nair-Collins) claim that “death occurs at the moment when the entropy-increasing forces have irreversibly exceeded those that are resisting this process” (2012, 69–70). While it is factually true that there is a moment when entropy-increasing forces have irreversibly exceeded resisting forces, it does not necessarily follow that it is at this moment that death occurs. The claim that this moment *is* when death occurs is merely a *recommendation* to define death in this way.⁶ It is a recommendation to elevate the moment when entropy-increasing forces irreversibly exceed the entropy-resisting ones into a defining criterion (here a necessary and sufficient condition) for death. It could be suggested, however, that the criterion for death is more conservative and that a person shall not be called “dead” until *every* cell in their body has stopped functioning. (We could imagine a hitherto uncontacted tribe with a religious rule that a dying person must not be touched until they are dead, otherwise the tribe member who touches the dying person will be cursed. This tribe might hold that a person is not dead until every cell in the body is dead, requiring weeks and even months to pass to be complete before touching can occur. Although such a belief about when death has occurred might be *impractical*, it is surely not *irrational*.) Rejecting this option in favor of Miller and Truog’s definition means we are *choosing* to define death in the way Miller and Truog recommend.

Nothing we have just said means that we ourselves endorse the definition of death which requires every cell in the body to have died. Our point is only that what death *is* is not *exclusively* a factual question, but it is sometimes a matter of *decision*. If we decide to adopt Miller and Truog’s recommendation, in terms of entropy-resisting forces irreversibly exceeding entropy-increasing forces, we then fix that recommendation into a norm of description: nobody shall now count as dead unless entropy-increasing forces irreversibly exceed entropy-resisting forces. But it should now be noted that, with respect to the discussion around brain death, the Miller and Truog and Nair-Collins recommendation necessarily rules out brain-dead people as dead, and so begs the question against those who insist that a brain-dead person *is* dead (we discuss later the claim that death is the irreversible cessation of integrated organismic function). For it is certainly the case that in a brain-dead person, the point at which the entropic forces overcome those that are resisting this process has not been reached. So, brain-dead people are excluded from the category of dead people *precisely by a stipulation*, even though Nair-Collins himself has said that death is not a matter of stipulation. The point at issue, for those who think that a brain-dead person should be classified as dead, is not whether brain-dead people fit the entropy definition of death, but whether the definition of death should be *modified* to include those we currently refer to as brain-dead. It is no answer to *this* question to cite the entropy definition, for that is nothing but a recommendation that death be defined in line with Miller and Truog’s concept of it, excluding brain-dead people by stipulative fiat. (We don’t deny that their recommendation is a plausible or a rational one, but only that it is the *only* plausible or rational one.) Furthermore, even if we *had* adopted the recommendation to define death in terms of entropy, there is no reason why we shouldn’t

still wish to revisit that definition in light of further medical advances and consider demoting it from a defining *criterion* to a *symptom* of death only. This could happen even with gold. As Hilary Putnam famously noted (his own example was water), we might discover on a twin earth a metal that looks and feels just like gold, but which is made of XYZ. Would we call such a metal gold? We might decide to do so and, if so, then having atomic number 79 would then be relegated to a symptom of being gold, the other symptom being XYZ (Putnam, 1996).⁷

Return again to the claim by Nair-Collins that any attempt to amend the definition is done “for the sole purpose of preserving” brain death from “empirical refutation” (Nair-Collins, 2015, 41). Nair-Collins cites James Bernat’s concept of *critical* functions as an example:

Bernat proposed changing the definition of “death” to “permanent cessation of the *critical* functions of the organism as a whole,” where critical functions are those that are “necessary for the maintenance of life, health and unity of the organism.” The intent behind this move was to rule out those functions that remain in state-X patients as irrelevant because they are purportedly not critical functions. (2015, 41)

We agree with Nair-Collins that it is possible to illegitimately protect core assertions or claims by redefining terms. A well-known example might be the attempt to preserve the Genesis creation story in the wake of evidence from evolution and geology about the age of the earth. These discoveries led some people to revise the meaning of the word “day” in Genesis,⁸ so that the new findings could be made compatible with the creation story. However, we believe that brain death does not fall into this category. One important difference is that there is no defensible intuition that “day” could, contrary to what we all think, be much longer than 24 h, and could include many millions of years. We agree that transplantation technology has triggered this philosophical exploration of death, but we do not think it follows that the definition of death is being “gerrymandered” for the purposes of organ transplantation. We believe that there is a defensible intuition that people are trying to rationalize, and that the motive for the rationalization is independent of the need to defend the practice of organ transplantation.

That intuition is that, in some cases, whether a concept applies or not is no longer clear. Technological advances can have this effect. In a great many cases, this will not matter. We can simply leave it open whether the concept applies or not. An example of this might be the phenomenon of blind-sight (Hacker, 2007, 257–284). Blind-sight patients claim not to be able to see, but when their visual perception is clinically tested by having objects placed in front of them, they achieve scores of 90% accuracy. Are such patients blind or can they see? No fact of the matter can provide an answer to the question, because the criteria for saying that they see or that they are blind are in conflict. We take someone’s sincere claim to be unable to see as one criterion for their being unable to see. But we also take the objective test of their ability to see as another criterion for their being able to see. Unlike blind people, who claim *both* not to be able to see *and* who would fail the test, blind-sight patients score 90% accuracy on the test. If we must answer the question, we have no other choice than to *give* the question an answer.

In the case of blind-sight, relevant experts in our society have not considered it necessary to give the question a conclusive answer, although there is a tendency to regard blind-sightedness as a form of blindness. We can imagine, however, that social needs might require us to decide whether to call these patients “sighted” or “blind,” rather than leaving the question open as we currently do (perhaps we need to know so that we can decide whether they should receive certain social security payments). Suppose we decide to say that these patients can see, and so we call them sighted. If we do this, we decide that the 90% test score should be the decisive criterion, not their sincere avowal that they can’t see, which is relegated to a symptom. In calling them sighted, we stretch our concept of “sight” to include these patients. “See” now has a slightly wider meaning. But even if we made such a decision out of social need, it does not follow that, to begin with, there was no conceptual indeterminacy as to whether they were blind or could see. A genuine conceptual question arose because of the conflict in criteria that apply—we are led to answer both ways at once.

We can make a similar claim about brain death. Before brain death was equated with death, these patients were in one sense alive, and in another, dead; they were, as Chiong states, “borderline cases”

(2005, 26–28). This is reflected in the terms “living corpses” and “heart-beating cadaver” (President’s Council on Bioethics, 2008, 8), which are akin to “blind-sight.” Brain-dead people had permanently and irreversibly lost consciousness and the ability to breathe on their own. But, if attached to a ventilator and given other intensive care technology, their heart would keep beating and their organs would remain functioning. Criteria for being dead in such a case conflicted. The decision was then taken (and enacted into the Uniform Determination of Death Act 1981 (UDDA)) to call these patients “dead” (National Conference of Commissioners on Uniform State Laws, 1981).⁹ In deciding to classify brain-dead people as dead, our concept of death was thereby stretched to include these patients.¹⁰ We contend that it would be a mistake to claim that, if we had decided to call these patients alive, we would not have stretched our concept of being alive to include these patients; these patients were genuinely in neutral territory, a gray zone, between life and death. The fact that these patients were not breathing and were permanently unconscious, but the heart was beating and blood circulating, made the question of whether they were dead or alive reasonable, because all these functions would in the past have ceased at the same time. Our critics might, of course, deny the analogy with blind-sight. But even if the analogy is less apposite, it remains true that this technology throws up conceptual questions about how many functions must be lost before we can say that someone has died. The main argument for our position is in Section III.

In summary, the central thesis for which we are arguing (and will continue to argue in Section III) is: before making the decision to count brain-dead patients as dead, the challenges thrown up by the technological advances we have referred to meant that what today we call a brain-dead patient was, under our unmodified “Euclidean” notion of death, *neither alive nor dead*—but was in a metaphorical no-man’s land between life and death. We have resolved that indeterminacy by adopting a “non-Euclidean” definition of death, thereby deciding that these patients should now be classified as dead. Our concept of death is thereby *slightly* modified, as now reflected in the current UDDA. The *rationale* on which we thought this move to be defensible—that the brain was the integrator of the organism as a whole—has proven to be false (see below). But this does not *necessarily* mean that the intuition that these people *are* in a metaphorical no-man’s land is also false and that they are clearly alive. It may be possible to find a better rationale. It is to this task we now turn, applying some of the points we have just made in defense of our position.

III. FORMULATING A STRONGER RATIONALE FOR ADOPTING A “NON-EUCLIDEAN” NOTION OF DEATH

The Relevance of Breathing and Consciousness

In 1998, Shewmon (1998a, 1998b) published his seminal works demonstrating that the brain is not the integrator of the body, and that previous justifications for taking brain death to be the death of the organism—viz, that the brain integrates the functioning of the whole organism and so the whole organism dies when the brain dies—were flawed. In 2008, The President’s Council Report acknowledged that this former dominant account of brain death can no longer be sustained (2008, 54–58). This represents a significant advance on the discredited position, and the Report sought to remove from the definition of death the problematic features of the previous account.

The Report proposes the concept of total brain failure in place of brain death. This concept (itself a misnomer¹¹ because, as the Report contradictorily concedes, some functions in the brain can remain operative at the time total brain failure is declared) allows that some functions of the brain and the body are retained, and indeed that the body retains integrated functioning, but defines death in terms of the loss of the organism’s “vital work.” Although this notion of vital work has itself been criticized by Shewmon (2009) and others, the rejection of the irreversible loss of integrated functioning as the correct definition of death is a step forward because there are some difficulties with defining human life as requiring integrated functioning. Firstly, integrated functioning is not sufficient for life, since many artifacts such as a car possess integrated functioning but are not regarded as being alive. Secondly, integrated functioning is not necessary for life, since one can retain consciousness and lose integrated functioning. Chiong (2005, 22) gives the example of someone who has an irreversible cardiac arrest and stops breathing, but who momentarily retains consciousness to experience these

events for microseconds thereafter. And there is the example of Robert J. White's monkey head transplants, where the monkey heads were transplanted onto the headless torsos of different monkeys, and retained consciousness for 36 h (Lamba, Holsgrove and Broekman, 2016, 2242–2243).¹² Some thought experiments used to draw the same conclusion have been criticized by D. Alan Shewmon and we address these briefly below. The fact that integrated functioning is neither necessary nor sufficient for human life means that Shewmon's (2001, 457–458) criticisms of the old rationale for brain death—that the brain is the integrator of all the organism's vital functions—are not sufficient to refute the claim that brain death should be considered the death of the human organism.

Breathing and consciousness (which includes, for reasons we shall later see, the “felt need” to eat and drink) are the functions that constitute what the authors of the Report call vital work. The crucial statement in the Report is: “If there are no signs of consciousness *and* if spontaneous breathing is absent *and* if the best clinical judgment is that these neurophysiological facts cannot be reversed, [we can] conclude that a once-living patient has now died” (2008, 64). In this respect, the Report promotes a view that is also taken in the United Kingdom; the permanent absence of consciousness and the capacity to breathe spontaneously are jointly sufficient for declaring death. Our claim is that the Council *can* rationally justify recommending a revised concept of death under which these patients can be declared dead, but that it did not successfully arrive at a sound and workable revision. Since the Report and criticisms of it are well known (Shewmon, 2009), we aim in what follows to indicate the direction in which such a sound revision would need to go.

The first point to note is a general, schematic one which we shall flesh out as we proceed. Those who accept the definition of death including brain-dead patients are committed to arguing for a hierarchy among the body's functions. Typically, this is conscious awareness and capacity for voluntary conduct at the top; wakeful arousal and breathing beneath; then functions such as cellular respiration, heart-beat, digestion, etc., and, finally, functions that are not strictly necessary to life such as the gestation of a fetus at the bottom. Along with the Report, we would recommend drawing the line between life and death under breathing and arousal.

Although it is true that, as Shewmon would be quick to point out, all physiological processes are vital processes, and there is a homeostatic balance among these functions, the reality is that we are looking for a point, or a concurrent constellation of points, in that homeostatic balance where we can reasonably characterize the organism as dead rather than alive. If indeed we can characterize some of these functions as more important than others, we can justify drawing such a line. For reasons we shall see, our recommendation is a conservative one, in two ways we shall explain.

Returning to what we called above the crucial statement of the report about breathing and consciousness, Franklin Miller and Robert Truog object that the Council's conclusion is “a non sequitur”:

According to the Council, neither loss of the capacity for consciousness (as in PVS) nor loss of the capacity for spontaneous breathing (as in cervical quadriplegia) by itself makes the patient dead. Why, then, does the combination of losing both these capacities constitute death in patients with total brain failure when a host of other biological functions of the organism as a whole are maintained? (2012, 75)¹³

It is not clear why Miller and Truog believe it is a non sequitur to hold that, while alone neither the loss of the capacity for consciousness nor loss of capacity for spontaneous breathing are sufficient to constitute death, taken jointly they are.¹⁴ There are many examples of medical diagnoses where certain features must co-exist to diagnose a particular condition. For example, to be diagnosed with sepsis, a patient must have a documented or suspected infection *and* have significant organ dysfunction (defined as an acute increase of two or more points in the Sequential Organ Failure Assessment (SOFA) score) (Singer et al., 2016, 804–805). A patient *with* an infection who does *not* have organ dysfunction cannot be categorized as having the clinical syndrome of sepsis, nor can a patient with organ dysfunction *without* suspected or confirmed infection. It is only when the two things *co-exist* that we diagnose sepsis. A brief flick through any textbook of general medicine will quickly reveal numerous other diagnoses that all rest on the concept that certain features must co-exist for a diagnosis to be made. In diagnosing death, it is in keeping with usual medical practice to require that relevant features co-exist in order for the diagnosis to be made.¹⁵

More critical is Miller and Truog's statement regarding the Council's and the UK's definition of death. They hold that both "must be defended against the question of why loss of these two functions should constitute the death of the person when a host of other basic biological functions indicative of life persist in patients with loss of brainstem functioning maintained on mechanical ventilation" (Truog and Miller, 2012, 131). Why do the current definitions consider the capacity for spontaneous breathing and for consciousness to be more important than other capacities such as growth, wound healing, control of water balance, excretion of wastes, and temperature regulation?

The Relevance of Breathing

Let us begin with breathing. We agree with the Report's authors that breathing has four components: (1) the appetitive drive to breathe, (2) inflation and deflation of the lungs through movement of the diaphragm and chest wall, (3) gas diffusion at the alveoli, and (4) cellular respiration (which occurs in mitochondria throughout the body) (2008, 63). In the presence of functioning respiratory muscles and nerves, an appetitive drive to breathe will result in spontaneous breathing. Spontaneous breathing, the Council asserts, is an indicator of openness to the world, as it means the organism is "experiencing a felt inner need to acquire oxygen ... and perceiving the presence of oxygen in its environment" (2008, 62). Second, the drive to breathe indicates the desire to "act upon the world," which will lead to respiratory muscle contraction and self-ventilation, followed by gas exchange and cellular respiration.

It is important in this discussion not to confuse a function with the appearance of a function. For example, it is common to describe a patient on a mechanical ventilator, making no spontaneous breaths, as breathing.¹⁶ This is wrong, as it confuses the capacity to breathe with mere inflation and deflation of the lungs by a machine. This becomes clearer if we remember the first "ventilators" were people using bellows. If one were to observe someone pumping bellows into someone's mouth one would not be tempted to say that it is the patient who was breathing as one might when the bellows are hidden by a quiet mechanical ventilator as we have today. A ventilator is simply a machine that pumps air into and out of the lungs of the patient (replacing only component 2 of "breathing"). To our minds, Miller and Truog are mistaken when they suggest that the bearer of the function is not relevant to whether the organism as a whole has died.¹⁷ This is because the capacity to breathe is not just the lungs' capacity to expand and deflate, nor is it just the capacity for gas exchange at the alveoli and cellular respiration (components 3 and 4), but encompasses the capacity for an appetitive drive to breathe. Does this mean that a ventilator-dependent quadriplegic is not breathing but merely appearing to breathe? Yes. This is in fact what would be emphasized to any carer—the patient can't breathe so the ventilator must never become accidentally disconnected. Yet the ventilator-dependent quadriplegic patient continues to have an appetitive drive to breathe (component 1) which includes the capacity to experience a felt need for breath and to drive the taking of a breath.¹⁸

Respiratory centers in the brainstem regulate the rate and depth of breaths by responding to levels of carbon dioxide and acid in the bloodstream and then communicating with the diaphragm and some components of the chest wall. Some ventilators are designed to respond to a rise in carbon dioxide levels, and so these ventilators could be said to replace this aspect of component 1, and in that sense, there is an overlap between components 1 and 2. Nonetheless, the "felt need" to breathe is itself different from the brainstem's ability to be sensitive to, and respond to, rises in carbon dioxide.¹⁹ So while it is true that we have the capacity to replace the functions of the brainstem that respond to rises in carbon dioxide, as well as the mechanical components of inflation and deflation with some ventilators, and even alveolar diffusion with ECMO, we cannot replace what the Report describes as the "felt need" to breathe. We will come back to this point shortly.

It seems to us that the reasoning that lies behind the abiding appeal to the irreversible loss of breathing as one of the critical functions that must be lost for death to be declared is partly as follows. The brain-dead organism cannot get air or dispose of carbon dioxide for itself, and so cannot provide the air for its cells to metabolize or dispose of carbon dioxide. Likewise, it cannot get itself food. Normally, the organism can bring air in and out voluntarily and involuntarily, and food only voluntarily. Since it can't get these for itself, this inability might, the Report reasoned, be considered one of the criteria for death. The Report talks of need-driven commerce with the surrounding world (2008, 90). We can express this as meaning that the organism has fundamental ends of its own: to bring in air and food. A single cell does not need to bring in oxygen or dispose of carbon dioxide as these just diffuse across

the membrane, but an animal needs to bring air in, otherwise, the oxygen does not get to the cell. The human organism is too big, too multicellular, for diffusion to work at the organism level. If the organism does not bring in air, the cells have nothing to respire with. True, if the cells do not respire, the organism will stop bringing in air, but nonetheless bringing in the air can be regarded as a key point in the *interface* between the organism's homeostasis and its interaction with the outside world.²⁰ It provides the major conduit via which the ingredients needed from outside to fuel respiration come into the organism, and the major waste product of respiration goes back out of the organism. Furthermore, those, like Shewmon, who object that cellular respiration is equally as necessary as breathing, forget that a ventilator is not similarly dependent on cellular respiration but could in principle keep going until someone turns it off. This is another reason why we said above that a ventilator in an important sense does not *replace* breathing. We shall return to the relationship between cellular respiration and breathing later.

Though important, we do not think that these arguments (aside from remarks about the “felt need” to breathe to which we will return) alone can succeed in defending the loss of breathing as a critical function against Shewmon's criticisms and those of others such as Nair-Collins and Miller and Truog. As these critics have pointed out, most of these components of breathing are just as replaceable as the lungs and the kidneys (Shewmon, 2009; Nair-Collins and Miller, 2017). Yet no one would say that the loss of a lung or kidney yields the loss of such an important function that we can (together with the loss of other functions) call the patient dead. The *only* way of defending the idea that we can privilege the loss of breathing over the loss of other functions is to return to the idea of a felt need to breathe. However, the authors of the Report are far from clear about what this “felt need” is. Since, as we have seen, the brainstem is capable of responding to a rise in carbon dioxide levels, thereby triggering the mechanisms necessary for the organism to take a breath, it might seem that this “felt need” is not doing any work on the Report's account of breathing. If that is so, the brain's regulation of breathing becomes just another involuntary neural reflex arc in the human body, like a knee-jerk reflex.

What the authors of the Report were, in our view, effectively doing when referring to this “felt need,” was emphasizing the *feeling* of the need more than the *need*. This, in our view, is the right way to defend the irreversible loss of breathing as a sound criterion of death. Emphasizing the *felt* need to breathe amounts to defending the loss of the most rudimentary form of consciousness—the capacity for subjective experience—as the true criterion for death.

According to Liotti et al. (2001), research into breathlessness (air hunger)—the sensation of not being able to take a breath or an adequate breath—provides an avenue to aid in understanding the origins of consciousness. Certain vegetative states (hunger, thirst, pain, extreme temperature change, and air hunger) will generate primal emotion. A primal emotion leads to a singular compelling sensation and, some have claimed, rudimentary intention in the organism.²¹ The development of primal emotion may have led to the evolutionary emergence of primary consciousness by providing a signal that the creature is immediately threatened (Liotti et al., 2001, 2038). Anatomically these basic vegetative systems are centered with the other ancient systems of arousal and wakefulness in the brainstem and the limbic system (which has a key role in emotion and behavior). This may suggest that the anatomical location for rudimentary consciousness is also found in these areas of the brain. Theories of consciousness are discussed further in Section IV.

Therefore, in addition to the involuntary carbon dioxide-regulated breathing performed by the organism, the organism, including PVS patients,²² can experience breathlessness; and it is the *latter* that cannot be replaced (if it were replaced, it wouldn't be *you* having the feeling) (Bernat, 1998). The feeling of breathlessness may accompany the rise in carbon dioxide levels that trigger breathing, but it is not itself identical to the latter. It is important that breathing is not left fully to automaticity like the heart, possibly because of the need to eat, speak, and hold one's breath under water. Imagine what would happen if we breathed automatically (in the way that our heart beats automatically). To be sure, our breathing rate automatically increases when we are stressed. But the voluntary nature of breathing is essential and, although the *voluntary* aspect of breathing is not itself governed by the brainstem (the exercise of voluntary conduct requiring the cerebral cortex), the *involuntary* mechanisms, including this “felt need” to breathe, are based in the brainstem and other lower brain structures, and these serve as the foundations for that voluntary exercise of the

function, making it possible as a further extension of those rudimentary processes. In breathing and eating, the organism interacts with the outside world in ways that the heart, in beating, does not. In that sense, we can regard a felt need to breathe as the manifestation of a *minimal* kind of agency in the sense emphasized by the Report, in which its authors refer to “the organism’s need driven commerce with the surrounding world” (2008, 60).²³

In referring to a desire or felt need to breathe, then, we are actually referring to the possibility of a very rudimentary form of consciousness in the brainstem and other lower brain structures, a consciousness that at least takes the form of having the desire to breathe. The presence of breathing is therefore only significant because it is the sign of the possible presence of this minimal conscious activity that is a criterion of life (here, the possible felt need to breathe, or air hunger). In short, that part of breathing that is irreplaceable is this felt need to breathe, yet the loss of *this* is actually part of the consciousness, not the breathing, criterion of brain death or brainstem death. In other words, the true criterion is the loss of a rudimentary level of consciousness whose presence would be incompatible with death.

If instead, we interpret the drive to breathe as referring only to the respiratory centers firing off in response to signals such as high carbon dioxide levels, it seems that this could be replaced as we argued above. We noted above that some ventilators can already take on this function, and we can imagine future technology which allows implanting a sensor in the brainstem that reacts to carbon dioxide and leads to stimulation of the brainstem breathing centers which would act on the phrenic and other nerves causing the diaphragm to contract and bring in air. From this point of view, breathing would again have no real significance in its own right over and above the significance of other functions, such as mitochondrial respiration, and critics like Shewmon would therefore be right to insist that the absence of breathing cannot be privileged over the absence of other functions.

But even if we accepted this interpretation of the drive to breathe, natural breathing would arguably retain a diagnostic role for possible conscious experience, because the foundational nuclei (control centers) for breathing are anatomically located in the brainstem. A brainstem, as we will see in Section IV, has an essential role in generating rudimentary conscious experience. On this view, where breathing plays only a diagnostic role of being a sign of the possible presence of consciousness, breathing is no more important than blinking: by demonstrating the loss of brainstem-controlled functions (e.g., blinking and breathing) in brain death tests, we can reveal something about brainstem function overall. Natural breathing—and its permanent loss—would retain this significance, but our imagined implanted sensor case would not. We would not take the restoration of breathing via the sensor to indicate the presence of consciousness or conscious activity in the brainstem in the way that we do with natural breathing, and so we could still declare a patient dead only if we were sure that any such rudimentary consciousness was permanently gone. But technology has not yet advanced so far, and so the presence of breathing capacity can be seen to play a diagnostic role in the presence of brainstem function.

In this subsection, we have attempted to mount a defense of the permanent loss of breathing as a codependent criterion alongside the permanent loss of consciousness for death. We could not do so. Instead, our conclusion is that breathing is either a rudimentary part of consciousness in and of itself (the felt need to breathe) or, if it is not part of consciousness itself, it remains diagnostically important for the presence of consciousness. Future scientific developments may help decide this question leading to further refinements in the criteria of death.

The Relevance of Consciousness

These points now raise the question of why we should privilege the loss of consciousness as a criterion of death over other somatic functions. Advocates of brain death, including the Council, give special significance to the centrality of consciousness in human life, and its role in the public psyche as a necessary feature of human life.²⁴ We can ask: is there any organ in your body that you would *hesitate* to have removed so you could receive a substitute? And most of us would hesitate to say that, were it possible and should we need it, we would have a brain transplant. Most other functions can be replaced, at least for a time. Heart and lung bypass machines, dialysis, ventilation, human organ transplantation, etc., are options most of us would not hesitate to accept if they could save our lives and if we wanted to go on living. But if you had a cancerous brain and had the option of having your brain replaced by

an artificial brain or another person's brain, and you were told that your own brain was going to be destroyed, you would very seriously wonder if it would really be you who would survive. These facts can prompt us to give prominence to the brain (more precisely, the parts of the brain responsible for consciousness) and, in particular, to the capacity for conscious experience, as that which is essential to who we are. There are well-known thought experiments discussed by Sidney Shoemaker, David Wiggins, and Derek Parfit that support these claims and that have been discussed by others in the context of brain death debates. Although those thought experiments are about personal identity, they are also about the situations in which we would say that I survive or I die.²⁵ We may therefore use this fact about how we would regard a brain transplant and the destruction of our own brain to justify the claim that a brain-dead person is dead.

In the brain death literature, some well-known and senior writers have rejected the relevance of these thought experiments. Shewmon (1998b), whilst initially being persuaded by them, changed his view when considering high cervical cord transection. According to Shewmon, in this condition, the brain's relation to the body is not relevantly different from some of the thought experiments that others have relied on to claim that brain death is death, yet the person suffering from high cervical cord transection retains both integrated functioning and consciousness. However, this point is not in our view decisive, since the integrated functioning is retained only in the torso and in the head separately, and we might still reach a different view if these patients permanently lost consciousness (in the wider sense we give to that term in this article which includes arousal and primal emotion such as the capacity to feel air hunger)—in spite of the fact that the head remains attached to the body in high cervical cord transection and so differs from the thought experiments in this respect.

The strongest objection to our claims is that they do not seem to justify claiming that the *organism* has died. At best, leaving aside for the moment our claims about the anatomical location of rudimentary consciousness, the arguments using these thought experiments seem only to support the higher-brain or a personhood standard. Consider, in this regard, an interesting version of the argument made recently by Stephen Holland. Holland (2010, 113) has pointed out that our ordinary, or non-technical, notion of death has ideas about human life built into it that suggest the centrality of consciousness to our understanding of human life. For instance, Holland points out that, in works of art and everyday life, death is referred to in such ways as “the lights going out forever,” “the great night of consciousness,” our “spotlights turning off suddenly,” “dreamless sleep” and “the night” (2010, 113–114). In addition, Holland quotes Schopenhauer who writes that “*for the subject* death itself consists merely in the moment when consciousness vanishes ... Therefore in a subjective respect, death concerns only consciousness” (emphasis added; 2010, 114). Holland takes these claims to suggest that we can understand death in both an objective and a subjective sense, with the objective sense constituting the biological sense—which would include all the functions that Shewmon would emphasize. These would have to be lost on the biological, but not the subjective, sense of death.

Holland's position here highlights a tension between two dimensions of human existence. However, the way that he has described this tension falls prey to the objection we have just introduced, concerning why we should regard these claims about consciousness to constitute the death of the *organism*. By conceding that the organism is biologically alive (because it is alive in the “objective” sense), Holland is ultimately committed to espousing two senses of death—a biological sense and some other sense, presumably to be cashed out in terms of personhood or subjective experience. In this view, a brain-dead person would be biologically alive but subjectively dead. Yet, ideally, we need to claim that it is reasonable to regard the loss of subjective experience as sufficient *for biological death itself*, and not death in some other, non-biological, sense to maintain public confidence in our death declaration practices.²⁶ Is there a way to do this?

We can begin to solve this problem and answer the objection by noting that Holland is only partly right. The idea that this subjective sense of death is not a biological sense is wrong, because *consciousness itself is a biological phenomenon*.²⁷ Consciousness is not a free-floating, non-biological phenomenon that comes to the organism from the outside.²⁸ So we need not accept Holland's view that, when we distinguish between the first-person subjective perspective and the third-person objective perspective, we are distinguishing between a non-biological and a biological notion of death. Instead, we take Holland's remarks to support the weight we attribute to consciousness—including its most

rudimentary form of intransitive consciousness, and the retained capacity to feel hunger, thirst, and air hunger in PVS—following our argument that some functions are more important than others and can therefore form a *reasonable* line at which to distinguish life from death. If we reject Holland's opposition between the biological and "subjective" notion of death and claim instead that the subjective element is itself a biological element rooted in the brain, then we can claim that the contrast Holland is describing is not between a biological concept, and some rival, non-biological concept, but rather between *two rival biological concepts* of death.

These remarks are not yet sufficient, however, to justify privileging the loss of consciousness over the retention of other functions such as the capacity for mitochondrial respiration, the capacity for wound healing, and proportional growth. Even if we accept that these are all biological functions, we still have to explain why it is reasonable to privilege the loss of the former functions as sufficient for declaring death, when the latter functions are retained, albeit with ventilation and artificial nutrition and hydration, and other interventions. As a first step towards doing this, consider a hypothetical case. Imagine that there is no hierarchy in biological functions, but that human organisms all reached a point, when dying, at which 50 % of their functions had ceased. In such a case, we could say that people in this state are *partially dead* and *partially alive*. Now, we could of course say that a *partially* dead organism isn't a *dead* organism. But we could equally say that a *partially* alive organism isn't an *alive* organism.²⁹ This case is therefore another example where we would have to make a decision about which term to use to designate the condition, just as we did with blind-sight, which is now mainly considered a form of blindness. We could either stretch "dead" to cover someone who has lost only 50% of their functions, or we could stretch "alive" to cover someone who has retained 50% of their functions. And it may be factors other than biological ones that will determine which way we go. This hypothetical case proves that our recommendations in this article are at least possible in principle.

But of course, in brain death, there is no such neat mathematical counting of functions to yield an equivalent answer. We would argue, however, that, in addition to this *quantitative* example involving the loss and retention of 50 % of functions, there can be a *qualitative* case too. The *importance* of some functions can offset the difficulty of not having a neat quantitative measure. By assigning some functions greater weight than others, we can arrive at a similar result to the one given in our imaginary example. We can take into account that conscious experience is ultimately what matters to us,³⁰ that it is the only function that is truly irreplaceable, and thereby accord its loss far greater weight than the loss of other functions, such as kidney function or mitochondrial respiration. We can remind ourselves that the brain is the one organ in our bodies that we would not want to have transplanted should it ever become possible to transplant the brain. We can reconsider the experiments of Brukhonenko where dog heads were connected to an "autojektor" (Morris, 2018, 93–94), a precursor to ECMO,³¹ or Robert White's experiments with monkey heads whose heads retained consciousness for 36 hours after being transplanted onto the torso of another monkey (Lamba, Holsgrove and Broekman, 2016, 2242–2243), and claim that the loss of brain function (rather than function in the rest of the body) is enough to warrant calling a brain-dead person partially dead. Holland's distinction between the subjective and the objective point of view becomes important here. Thinking about death from the *first-person* standpoint, when I am brain-dead, I am unambiguously dead because I have permanently lost all consciousness. It is only when we think of ourselves from the third-person standpoint that we are pulled in the opposite direction. But the greater weight accorded to consciousness, that is, our first-person perspective, can justify our privileging of its loss amongst the functions that are lost, and over functions that are retained. This allows us to say that the organism is *partially* dead—doing justice to both the subjective and objective standpoints highlighted by Holland—and we can then take the second step of claiming that this partially dead organism *should be classified* as dead or as alive (to reflect the greater importance to us of the subjective standpoint and the role of the brain in making us the individuals we are).

Although we are endorsing a biological notion of death when making these claims, it is essential to emphasize that there are two steps involved here. We are not claiming that, by privileging the loss of consciousness as the decisive criterion of death, the patient *is* dead in the biological sense *as hitherto understood*—in the Euclidean notion. Instead, we are recommending that the irreversible absence of consciousness be taken to mean that the patient is *neither* dead *nor* alive in this traditional sense (the first step),³² and that we ought to *decide* whether to call these patients dead or alive under a revised,

non-Euclidean notion (the second step). Brain death is like blind-sight: the fulfillment of two criteria (the subjective and the objective) that normally coincide for claiming that someone has died now conflict, and there is no true answer to the question of whether a brain-dead person is alive or dead. That is our first step. The second step is that we then make a decision as to which we shall call a brain-dead person. Returning to our revisions of Holland's remarks, we can regard the criterion of the disappearance of any first-person perspective on the world, and any activity in the brainstem, as one biological criterion for death, and the criterion of the presence of the other functions to which Shewmon refers as one biological criterion for life, and regard the conflict between these two criteria as placing these patients, prior to our conceptual revision, in the gray zone between life and death. Our appreciation of the importance of consciousness and breathing, and therefore our singling out the loss of these as the criterion that should henceforth prevail to count these people as dead, can justify the *revised*, non-Euclidean concept of death that supporters of brain death advocate—in just the same way that we might classify the phenomenon of blind-sight as a form of blindness.

Suppose our opponents reject this move. Then our opponents make a decision no less than we do, when they decide to claim that the continued existence of other biological functions is a decisive reason to claim that these patients should be regarded as still alive. They single out Holland's objective criterion as the more important of the two conflicting criteria for life. This is like claiming that the patient's scoring 90 % accuracy on tests is a decisive reason for claiming that blind-sighted patients can see in the ordinary sense of "see", despite the fact that they sincerely avow that they cannot see objects placed in front of them. What we are doing is equivalent to selecting the sincere avowal that they cannot see as decisive instead, as though we thought this was more important than the fact that the patient has scores of 90% accuracy when tested by placing objects in front of them. In the case of brain death, we are claiming that irreversible loss of consciousness, itself a biological phenomenon, should be more important than the retention of other functions compatible with life and we are *recommending* that the concept of death be stretched to accommodate these patients, in just the way that the concept of blindness was stretched in designating blind-sight as a form of blindness. We are claiming that there are reasonable grounds to stretch the biological concept of death in this way, even though there are equally reasonable grounds for refusing to stretch it in this way, and for adopting the Shewmon, Truog, and Miller, Nair-Collins proposal instead.

These writers might object that they are not making any recommendations at all and that it is only we who are doing so. They might claim that blind-sight is not an apposite analogy. They could point to well-documented cases of patients who "survive" brain death (Shewmon, 1998a; Truog, 2018a), and claim that it makes no sense to regard a body that is growing, fighting infection, and healing wounds as anything other than alive. The idea that such a body could be a corpse or a "living corpse" is patently false, they may claim. If this were not so, what on earth would be the status of these artificially sustained bodies? Surely at the very least, they are living tissue. What is more, they function in an integrated way, albeit with the input of ventilation and artificial nutrition and hydration. In reply, however, we would claim that we have conceded that these organisms are *partially* alive. What we are claiming is that they are also partially dead. Leaving aside debates here concerning how much brain activity must have ceased for us to say that the brain is dead, and assuming we can all agree on a point at which the patient is brain-dead, we rely on our earlier points — about the difference between being offered a liver transplant (if I have liver cancer) and a brain transplant (if I have brain cancer), the real empirical experiments (as opposed to thought experiments) involving dog heads, dog torsos and monkey heads, Holland's distinction between the first-person (subjective) perspective and the third-person (objective) perspective — to justify our second step in claiming that this degree of partial death should be considered enough to call these people dead in our new non-Euclidean sense.

All these points might be conceded, but it might be objected that our position supports advocates of a higher-brain or personhood standard, who could make similar moves to the ones we are making here and equally rely on the blind-sight analogy to support their claim.³³ In reply to this objection, we would make two points. First, our main objective in this article is to respond to Shewmon and Miller and Truog, and other leading writers such as Nair-Collins, who all share the view that it is irrational to claim that brain death can constitute the death of the organism as a whole. On their view, brain death, *or any variant on it*, cannot amount to somatic death. We have offered arguments for why it is rational to decide that the human organism is dead on brain death. However, our arguments for this position

can indeed be used to claim that the line could be drawn in a different place from the place we have recommended that it be drawn. It could be argued that the loss of personhood, for example, should be considered the death of the organism. We do not see the availability of this argument as undermining our main claim that it is not irrational to draw the line in a different place than that recommended by these writers whose views we are rejecting. But, second, we believe that although this argument is, in principle, available, the higher-brain standard is not the optimal place to draw the line. We have already given reasons why this is so, in relying on the work of Liotti. In the next section, we draw further on Liotti and some other research on consciousness to offer additional support for our own recommendation, which requires the loss of brainstem function.

IV. THE CAPACITY FOR SUBJECTIVE EXPERIENCE—BEGINS IN THE LOWER BRAIN

As noted throughout, traditionally consciousness has been divided between cortical (awareness) and brainstem (wakeful arousal), where awareness is understood as representing the content of consciousness while the brainstem's wakeful arousal is relegated to an on/off switch for cortical awareness, an essential precondition for consciousness but not truly regarded as consciousness per se. Some philosophers have used this distinction to claim a higher-brain or a personhood standard, such that the loss of cortical awareness regardless of persistence of wakeful arousal, as can occur in PVS, should be regarded as a criterion for death (Veatch 1993; McMahan 2002).³⁴ The estimated misdiagnosis in PVS of 40% is one good reason for rejecting the higher-brain proposal and maintaining the conservative position which includes wakeful arousal and persisting brainstem function as part of consciousness (Monti et al., 2010, 2).

There are three other reasons why proponents of brain death need not be committed to holding that a PVS patient is dead on the basis of having permanently lost the capacity for *awareness*. The first reason is that they can regard the presence of features such as arousal and sleep/wake cycles as consciousness—or at least as “openness to the world” as proposed in the Report. The Report specifically states that PVS patients *are* conscious, albeit in a rudimentary way (2008, 61). It is essential to note that, on this position, contrary to the views of other critics of brain death (Sadovnikoff and Wikler, 2014), a brain-dead person is not a PVS person *plus* the absence of the capacity to breathe spontaneously.

Second, pathologically there is no reason why PVS patients lose the capacity to feel thirst, hunger, and air hunger—and therefore can experience primal emotion—it is just that the brainstem signal cannot go through to the relevant damaged parts of the cerebral cortex (higher brain) for these desires to be actioned (Laureys et al., 2002; Panksepp et al., 2007; Kuehlmeier et al., 2014, 4–5). As discussed earlier, felt needs are anatomically centered with the other ancient systems of wakeful arousal and this suggests that the anatomical location for rudimentary consciousness is also be found in this area of the brain (Liotti et al., 2001, 2038).

The third reason takes into account emerging, though controversial, neuroanatomical research. This research further suggests that the historic boundaries between brainstem wakeful arousal and cerebral cortex awareness are more blurred than previously appreciated. Bjorn Merker (2007) has argued that the centralized functional design of the brainstem is anatomically organized to play a key role in conscious function. This could explain the observations that purposive, goal-directed behavior can be exhibited by mammals after experimental decortication, as well as evidence that children born without a cortex can display conscious behavior. The latter clinical cases were identified by Shewmon et al. (1999). Conscious function, according to Merker, cannot be confined to the cortex alone. He suggests that the central convergence in the brainstem of massive numbers of neural inputs and outputs allows for the emergence of a body-world interface organized around an ego-center, and evolutionarily predates the invention of the cortex in mammals. Merker's view is supported more recently by Barron and Klein (2016) who have proposed that structures in the insect brain perform analogous functions to the vertebrate midbrain in creating an integrated and egocentric simulation of the world which theoretically allows insects to have the capacity for the most rudimentary aspect of consciousness: subjective experience.

Subjective experience, according to both Merker and Barron and Klein (2016, 4901), requires the ability to produce an integrated simulation of the state of the organism's own mobile body within the

environment. Evidence for the capacity for subjective experience requires more than just observing the reflexive action of an organism to its environment. [Barron and Klein \(2016, 4905\)](#) illustrate this with the example of the hungry nematode (roundworm). A hungry nematode will respond to starvation with increased locomotion and dispersal in a random, rather than directed, search. There is no evidence that nematodes actively hunt for things beyond their immediate sensory environment. By contrast, hungry ants, bees, and rodents will actively navigate to places where they previously encountered food. Nematodes possess enough adaptive plasticity leading to forms of memory that change how they react to sensory stimuli in their environment, but nematode behavior is organized by reference to their primary sensory input, whereas rodent and insect behavior is organized in response to an integrated and spatial simulation of their environment. The conclusion of [Barron and Klein \(2016, 4905\)](#) is that insects and vertebrates but not nematodes are capable of subjective experience.³⁵

Barron and Klein stress the importance of not conflating subjective experience with higher levels of consciousness, found in humans and higher mammals. Subjective experience is a simpler, more rudimentary form of consciousness compared to the capacity for higher self-reflexive consciousness (awareness) and “can exist in the absence of self-reflexive consciousness, and ... the two are supported by different neural structures” ([Barron and Klein, 2016, 4901](#)). Because subjective experience is a simpler phenomenon, [Barron and Klein \(2016, 4901\)](#) argue, and demonstrate from their neuroanatomical examination of insects, that the capacity for subjective experience is more widespread in the animal kingdom and should be considered evolutionarily older.

If the work of Liotti, Merker, Barron, and Klein is correct, the impact on our understanding of animal consciousness will be profound, and will potentially transform our attitude toward patients in PVS. The key point is that this neuroanatomical controversy, added to the well-described risk of misdiagnosis in PVS, should lead a prudent decision maker who was trying to provide criteria for death, to classify patients in PVS as possibly conscious, and therefore alive. It is important also to note that, although the emerging neuroanatomical claims are controversial, our definition of death ought to take seriously the possibility that the brainstem does indeed play a key role in the conscious function and draw a conservative line. If we ignore Merker’s research, we risk declaring some people dead who could be alive; whereas if we take Merker’s research seriously, we instead risk failing to declare someone dead who is dead. It is better to take the latter risk than the former. It is in this sense that our position is doubly conservative. Even if our emphasis on subjective experience, felt need, and the possibility for rudimentary consciousness is rejected on the basis that it does not have the significance that awareness has, this point could not apply to Merker’s claims (and those of Barron and Klein) that conscious function can no longer be confined to the cortex alone.³⁶

So, our defense of consciousness as the key criterion for human death does not entail the adoption of a higher-brain standard and does not entail that PVS patients dead. Instead, conservative prudence and emerging neuroanatomical research in consciousness support the adoption of a lower brain standard, where the brainstem (lower brain) is both essential for the generation of conscious awareness (via arousal) and where, perhaps, the rudimentary “I” in subjective experience begins.

V. CONCLUSION

Our claim, as we have emphasized above, is only that it is reasonable to draw the distinctions we have drawn and make them markers of the line between life and death. We acknowledge, however, that Shewmon and those sympathetic to his criticisms of brain death as death can reject these claims, and insist that cellular respiration, and the other functions they cite, are signs of life, and therefore are reasons for insisting that the brain-dead organism is still alive. Shewmon can insist, for example, that the drive to breathe and cellular respiration are codependent and so are on a par, even if we are right that breathing can be seen as diagnostic for a rudimentary level of consciousness in the brain. However, we don’t see Shewmon’s contrary view as a reason to reject, as we have argued above, our own, which privileges consciousness and breathing (on the basis that the felt need to breathe is an irreplaceable rudimentary form of conscious activity). At most, we have equally reasonable views—and this is what you would expect if we are dealing here with a case where it is an open question of how we should classify these patients. In this regard, we would endorse a remark by Winston Chiong, who points out that a certain degree of arbitrariness exists in our concept of an adult if we define an adult as aged 18 or

over—because it is equally reasonable to pick the age of 17.5 or even 16 or 19. But, as he notes, there is a determinacy in this indeterminacy, in the sense that we cannot also state that an adult could be 5, or a child aged 29 (Chiong, 2005, 28). In the same way, Shewmon is free to draw the line in a different place, emphasizing the features he does, but he does not thereby show that our own choice is akin to choosing to define an adult as 5 years or older.³⁷

With the advent of mechanical ventilation, our standard definitions were no longer fully relevant as a new non-Euclidean world was revealed. A choice had to be made. Our argument remains that a non-Euclidean concept of death is a reasonable one and therefore we accept brain-dead and brainstem-dead patients as dead.

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NOTES

- 1 We are aware of, and sympathetic to, the growing worldwide move away from the term “brain death” (Shemie et al., 2006; Academy of Medical Royal Colleges, 2008; Shemie et al., 2014). “Death using neurological criteria” is our usual preferred terminology. However, no new terminology has gained worldwide precedence and we acknowledge that attempts to alter the terminology are exactly what critics would oppose as the terminology change can appear to be an attempt to alter the definition. For these reasons in this article, we will use the term most commonly used in this debate, that is, “brain death” but we will use brain death as a catch-all for brain-based definitions of death irrespective of variations in specific criteria between jurisdictions. Where required we will differentiate between whole brain death (e.g., USA), higher-brain death (advanced by some philosophers), and brainstem death (e.g., UK) criteria for death.
- 2 Franklin Miller has denied that these statements are ambiguous, claiming that he meant the first of the two options we present (personal communication). But our claim is that Miller has not appreciated there might be two possible readings.
- 3 By “traditional notion” here we mean merely the understanding of death as “the total stoppage of the circulation of the blood, and a cessation of the animal and vital functions consequent thereon, such as respiration, pulsation, etc” (Death, Black’s Law Dictionary, n.d.). More on how death was understood before the advent of the modern ICU is provided just below.
- 4 By “relative to a biological conception of death” they just mean that they are dealing with death as defined under the modern understanding, rather than the philosophical understanding of death in terms of personhood.
- 5 His “standard theory of biological death” is analogous to Miller and Truog’s “biological conception of death.” See previous note.
- 6 James Bernat, for example, has argued that the entropy recommendation is appropriate at the level of cells and perhaps in unicellular organisms. But he claims that it is the wrong level for determining death in human beings (personal communication). Bernat’s claim shows that there is room for argument and debate on this issue, and so supports our claim that discovering the point at which entropy-increasing forces have irreversibly exceeded the forces resisting this process is *not* tantamount to *discovering* that this is when death occurs. To say otherwise is to stipulate it to be so, to recommend a *decision* to that effect. For Bernat’s recent analysis on the relationship between cells, organs, and the organism as a whole, see Bernat (2019) and Huang and Bernat (2019).
- 7 Putnam himself claimed we would not call XYZ gold, but this is a *recommendation* on his part. See also Glock (1994).
- 8 We exclude from this example those who read “day” metaphorically, or who otherwise understand the passage outside the context of biblical literalism.
- 9 Note that this does not mean that terms such as “living corpse” or “heart-beating cadaver” would now stop being used after this decision. These terms may continue to be used, signaling as they do the special category of the case into which these patients fall. If we stretched our concept of “sight” to cover blind-sight people, this doesn’t mean that we would stop using the term blind-sight.
- 10 Note also that we do not claim that the writers of the 1981 Commission Report or the UDDA, or the writers of the later President’s Council Report (2008), would themselves acknowledge that they were stretching the concept of death, or appreciated the arguments we are presenting here in defense of what they were doing. We can distinguish between the *best description* of what they were doing, and what the writers themselves thought they were doing. These writers would not have appreciated the analogy with blind-sight, or that brain death can be fruitfully compared with it. Nonetheless, we contend that brain death should be understood in the same way as blind-sight—that deciding brain death is death is equivalent to deciding that blind-sight is a form of blindness.
- 11 An anonymous reviewer points out that “total brain failure” is only a misnomer if we read “total” anatomically where every last vestige of functioning fails. The reviewer points out that it has long been recognized (as with “whole brain death” beforehand) that it is a functional concept identifying certain critical functions as completely failing, rather than requiring every last cell in the brain to disintegrate, citing Youngner et al. (1999). We agree, and we accept the critical functional definition (following James Bernat), but the words “total” in “total brain failure” remain misleading to the extent that “total” qualifies the word “brain” and so does, without clarifying remarks, imply an anatomical reading. In this respect, the phrase “total brain failure” is not an advance on “whole brain death,” since qualifying words can equally be applied to “whole brain death” to make it clear that it, too, should be given a functional rather than anatomical reading.
- 12 It might be thought that, in these cases, integrated functioning is retained in the head. But this still challenges the currently accepted definition in terms of the loss of integration in the organism as a whole. For a head is not an organism, but, at best, a partial organism, and if, as with dog heads, the head is attached to a machine, are we dealing with an animal or a cyborg? We cannot avoid these questions because they are no longer hypothetical, but in answering them, we will have to move beyond the integrated functioning of the organism as a whole definition.
- 13 See also Shewmon (2009, 22).
- 14 Miller and Truog’s reference to PVS patients having lost consciousness is also unclear. The Report, in line with usual medical definitions of consciousness, specifically states that PVS patients are conscious, albeit in a rudimentary way. We explore the definition of consciousness and its relevance to PVS in more detail in Section IV. At this point, it is worth noting that traditional thinking is that

- PVS patients have lost cortical function (awareness) but not brainstem function (wakeful arousal). There are other, more controversial, grounds for claiming that subjective experience is retained in PVS patients which we discuss in Section IV.
- 15 How does this position deal with the “counterexample” of the embryo? An embryo can neither breathe nor is conscious, but is alive (McMahan, 2002, 437). The embryo, unlike the brain-dead person, is not an entity to whom the concepts of “breathing” or “consciousness” apply at all. A person is supposed to be able to breathe and maintain consciousness, but things have gone so drastically wrong that they can no longer do so. Whereas with the embryo, it is not expected that it *should* be able to do these things. Even if these points are rejected, there is another difference between the embryo and the brain-dead person: the embryo’s incapacity to breathe and be conscious is *not permanent*. It is therefore not dead.
 - 16 In several places in their book, Miller and Truog expressly claim that brain-dead patients are not dead because “they are breathing” (2012, 73, 94).
 - 17 This point is implicit in Miller and Truog’s repeated descriptions of these patients as “breathing” (see note 16), and in their claim that nobody would regard “kidney death” as death (2012, 59).
 - 18 Theoretically the drive to take a breath could be detectable by identifying the neural signals coming out of the brainstem trying to signal a breath, even if, as in our example of the ventilator-dependent quadriplegic patient, spinal cord injury prevents the signal from being transmitted to commence lung expansion (component 2). Note that rarely some ventilator-dependent quadriplegics have additionally lost lower brainstem function, so they have lost the drive to breathe but still retain consciousness (which is higher in the brainstem).
 - 19 We defend this claim about the difference below.
 - 20 Human beings eat things, and take in oxygen and interact with the world, which is part of its homeostatic balance. Loss of the capacity to breathe is one point at which you lose your balance as a functioning interacting organism with the external world.
 - 21 “A primal emotion might be proposed as one where there is sustained complete occupancy of the stream of consciousness with a singular compelling sensation and intention. Such states arise from vegetative systems and may be largely interoceptor-driven as, for example, with extreme thirst or hunger for air, and reflect that the existence of the creature is immediately threatened. Control of basic vegetative systems is centered in the phylogenetically ancient areas of the brain, as is also the case with arousal and sleep.” (Liotti et al. 2001, 2038)
 - 22 A PVS patient, unlike a brain-dead patient, is breathing spontaneously, even if unaware of himself or herself breathing. PVS patients have intact brainstems, and many will also have intact other lower brain structures which help to regulate the capacity for emotion and other drives such as hunger, thirst, and air hunger. Thus, the common dictum for PVS patients “wakefulness without awareness” may be misleading, because “awareness” here means transitive consciousness—consciousness of a separate object, the consciousness of things outside you. This kind of awareness is not what is meant when we speak of feeling hunger and thirst in PVS. “Hunger” and “thirst” are not physical objects outside the subject, capable of forming objects of consciousness in that sense. In the case of hunger and thirst, awareness that I am hungry or thirsty would actually be a form of self-consciousness as it would be consciousness of one’s own state, but nobody is saying that a PVS patient may be self-conscious. While controversial there is no structural reason a PVS patient is not capable of having affective experiences (Panksepp et al., 2007). Thanks to Franklin Miller for prompting this clarification. Further discussion of PVS can be found in Section IV.
 - 23 Feeling the need to take a breath should not be conflated with being consciously aware of oneself as having the feeling of needing to take a breath—spontaneous breathing does not necessarily require awareness of oneself having the need.
 - 24 Franklin Miller has suggested to us that we need to be wary here of a slide from being alive to having a human life (personal communication). However, we are not guilty of any such slide. We claim that, in our wide sense of consciousness that includes forms of arousal such as the sleep/wake cycles of a PVS patient, a PVS patient is alive but are not obligated to claim that the patient is therefore living a human life.
 - 25 In his 2012 paper, “We are Not Human Beings,” Parfit imagines cases of cerebrum-only transplants (with the brainstem left behind). He expressly states that “it is our cerebrum on which all of our distinctive mental activity depends (Parfit, 2012, 11). However, if Merker and Barron and Klein, and others who make similar arguments are right (see Section IV), Parfit’s claims here may well be false. For criticism of Parfit on this issue, see McGee (2016).
 - 26 Though we note that it is worth carrying out empirical research to check that this is indeed the case.
 - 27 When we claim that consciousness is a biological phenomenon, we are not committed to claiming that other types of entities couldn’t also have consciousness (e.g., aliens, future computers). By analogy: the heartbeat is a biological phenomenon, but perhaps we could build synthetic, non-biological creatures that would have a synthetic heart and heartbeat (with synthetic blood, etc.). This wouldn’t falsify the claim that, in human beings, the heartbeat is a biological phenomenon. For more comments on what we mean by our claim, see the following note.
 - 28 An anonymous reviewer objected: biological in what sense? The reviewer then points out that dualist theories of consciousness persist in some scholarly quarters and much of the non-scholarly world. In reply, we do not believe that we must answer the hard problem of consciousness, in order to reject these dualist conceptions. It is beyond the scope of this article to examine dualism (whether Cartesian or some other version), but we doubt that dualism, when thought through, can emerge as a leading contender in an account of consciousness and it does not have scientific respectability today (it is not clear to us that it is even coherent if consciousness is conceived, as dualism implies, to be a separate substance interacting with the body, but we cannot argue this point here). Following Anthony Kenny (1988) and Peter Hacker (2007), we regard consciousness to be a capacity exercisable and exercised by the human organism and it is biological only in the sense that it is exercised by biological organisms. This claim is not the same claim as reductionism, with which it can be confused. The horsepower of an engine is not the engine, but not a separate entity from it either (Hacker 2007, 104). We can claim that the loss of function in those parts of the brain that enable consciousness is a biological phenomenon without *identifying* consciousness with those parts of the brain, just as we can say that the loss of function in those parts of the engine enabling horsepower is a mechanical (or physical) phenomenon without *identifying* horsepower with those parts of the engine). For a detailed discussion of the relationship between a power and its vehicle, see Hacker (2007, 90–121). Thanks also to James Bernat for pressing us on the possible reductionism point.
 - 29 An anonymous reviewer objected to this as follows: “If it is true that to be partially dead is to *not be dead*, and to be partially alive is to *not be alive*, and if one is partially alive and partially dead, then does it not follow that one is not dead and not alive (i.e., dead)?” The reviewer then points out this conclusion would be a contradiction. However, it would only be a contradiction if it is logically impossible for a person to be partially alive and partially dead. To say that someone is partially alive and partially dead does not have the same meaning as the unqualified statement that they are alive and dead (or not alive and not dead), and it is only the latter statement, unqualified by the word “partially,” that would be contradictory. We have given a reason, however, to make the claim that the patient is *partially* alive and *partially* dead, on the basis that the patient has lost exactly 50% of their vital functions. What follows is that it is indeterminate, under our *unrevised* concept, whether this person is alive or dead. The blind-sight analogy is meant precisely to show that we are pulled in two opposing directions at once. This patient is in a no-man’s land between life and death and a decision is required about which predicate we should apply—a decision that will mean that, from that point on, “dead” and “alive” will have a slightly different meaning to the extent that they will now incorporate this case and provide an answer.
 - 30 It might be objected that if our argument concerns what matters to us, then we can only privilege consciousness in the narrow sense, and not consciousness in the broader sense that includes arousal. However, we would reply that, in classifying PVS patients and others who are above the brain-dead threshold as alive, we are adopting a sufficiently conservative position that takes into account the

- risk of misdiagnosis that is well documented in the case of PVS patients (Monti et al., 2010; Machado et al., 2016). As we will note in Section IV, there is evidence Merker (2007) and Barron and Klein (2016) on the capacity for conscious experience beginning in the lower brain. A related but different objection is that what matters to us is one thing, death another. In losing consciousness, we lose what matters to us, but we do not die. Robert Truog has made this suggestion in correspondence. In reply, consciousness matters to us because it is part of what and who we are: think again of why you would want a kidney transplant, but not a brain transplant. We cannot separate what matters to us from our identity in this sense. For this reason, we can decide to call the loss of consciousness in our wide sense death precisely because consciousness matters so much to us.
- 31 Or the experiments of Demikhov, where two dogs were cut in half and the one half of one dog paired with the other half of the other dog, and where puppy heads were attached to the neck of a fully grown dog, creating a two-headed animal that lived for up to 4 weeks (Morris, 2018).
 - 32 Or, which comes to the same thing, dead in one sense, but alive in another.
 - 33 We are grateful to two anonymous reviewers, who both independently raised this point.
 - 34 Note that both Veatch and McMahan distance themselves from the expressly philosophical notion of personhood which may imply self-consciousness in the sense that, on some views, only human beings can attain. Veatch (1993), for example, claims that he is only committed to the notion that the loss of higher-brain function signals the loss of a living human *individual*.
 - 35 Barron and Klein do refer to the “hungry” nematode. Whether this is a subjective experience or a simple nervous response to falling levels of nutrients, is not clearly articulated by Barron and Klein, but consistency with their general claim seems to require that we attribute the latter meaning of “hunger” to them when speaking of the nematode.
 - 36 It might be objected that we ought to be even more conservative and admit that the presence of spinal cord reflexes means that we should consider the patient still to be alive. Indeed, our emphasis on human death as requiring the loss of subjective experience may seem to commit us to the absurd view that the nematode is dead, because, accepting Barron and Klein’s argument, it does not have subjective experience, and we are relying on the absence of subjective experience as the criterion of death in human beings. In reply, recall our claim that, in the case of human beings, under our *Euclidean* notion of death, they are neither alive nor dead because somatic life is retained but the subjective point of view has completely and irreversibly gone. We then claimed that, given the centrality of consciousness to human life (conservatively defined), we make a decision to adopt a *non-Euclidean* concept of death under which we decide these patients are dead (according to more importance to the loss of subjectivity), rather as we decided that blind-sight should be classified as a form of blindness, even though, behaviorally, a blind-sighted person manifests a partial ability to respond to objects. As we have argued, we are drawing the line between life and death for human beings in a way that acknowledges the conflict between two different criteria for death: the loss of subjective experience and the loss of somatic existence. We do not need to make this decision in the case of the nematode, because (as Barron and Klein argue) it does not have subjective life at all, and having a subjective experience is not central to what it is to be a nematode. We can rely exclusively on somatic existence to claim that the nematode is alive.
 - 37 Robert Truog has recently made remarks that appear to support these claims, when arguing that the law at least needs bright lines, and a certain amount of arbitrariness is unavoidable at least at law. Our arguments can be taken to at least support a legal concept of death. See Truog (2018b).

REFERENCES

- Academy of Medical Royal Colleges. 2008. *A Code of Practice for the Diagnosis and Confirmation of Death*. London, United Kingdom: Academy of Medical Royal Colleges.
- Barron, A. B., and C. Klein. 2016. What insects can tell us about the origins of consciousness. *PNAS* 113(18):4900–8.
- Bernat, J. L. 1998. A defense of the whole-brain concept of death. *Hastings Center Report* 28(2):14–23.
- Bernat, J. L. 2019. Refinements in the organism as a whole rationale for brain death. *The Linacre Quarterly* 86(4):347–358.
- Black’s Law Dictionary. n.d. DEATH definition and legal meaning. *The Law Dictionary* [On-line]. Available: <https://thelawdictionary.org/death/#:~:text=The%20extinction%20of%20life%3B%20the,as%20respiration%2C%20pulsation%2C%20etc.&text=law> (accessed March 21, 2022).
- Chiong, W. 2005. Brain death without definitions. *Hastings Center Report* 35(6):20–30.
- Fux, T., A. Gabrielsen, K.-H. Grinnemo, J. van der Linden, P. Svenarud, and L. H. Lund. 2014. Emergency parallel mechanical circulatory support for ventricular fibrillation. *Circulation: Heart Failure* 7(1): 229–30.
- Glock, H. 1994. Wittgenstein v Quine on logical necessity. In *Wittgenstein and Contemporary Philosophy*, ed. S. Tegharian, 211–20. Bristol, United Kingdom: Thoemmes Press.
- Hacker, P. M. S. 2007. *Human Nature: The Categorical Framework*. Malden, MA: Blackwell.
- Holland, S. 2010. On the ordinary concept of death. *Journal of Applied Philosophy* 27(2):109–22.
- Huang, A. P., and J. L. Bernat. 2019. The organism as a whole in an analysis of death. *Journal of Medicine and Philosophy* 44(6):712–31.
- Joffe, A. 2007. The ethics of donation and transplantation: Are definitions of death being distorted for organ transplantation? *Philosophy, Ethics, and Humanities in Medicine* 2(28):1–7.
- Kenny, A. 1988. *Self (The Aquinas Lecture)*. Milwaukee, WI: Marquette University Press.
- Kuehlmeier, K., N. Palmour, R. J. Riopelle, J. L. Bernat, R. J. Jox, and E. Racine. 2014. Physicians’ attitudes toward medical and ethical challenges for patients in the vegetative state: Comparing Canadian and German perspectives in a vignette survey. *BMC Neurology* 14(119):1–9.
- Lamba, N., D. Holsgrove, and M. L. Broekman. 2016. The history of head transplantation: A review. *Acta Neurochirurgica* 158(12):2239–47.
- Laureys, S., M. E. Faymonville, P. Peigneux, P. Damas, B. Lambermont, G. Del Fiore, C. Degueldre, et al. 2002. Cortical processing of noxious somatosensory stimuli in the persistent vegetative state. *Neuroimage* 17(2):732–41.
- Liotti, M., S. Brannan, G. Egan, R. Shade, L. Madden, B. Abplanalp, R. Robillard, et al. 2001. Brain responses associated with consciousness of breathlessness (air hunger). *PNAS* 98(4):2035–40.
- Machado, C., M. Estévez, R. Rodríguez, M. Carballo, J. Pérez-Nellar, J. Gutiérrez, M. Fleitas, et al. 2016. Vegetative state and the outer world. In *Functional Neurology: Considering Consciousness Clinically*, eds. G. Leisman and J. Merrick, 99–120. New York: Nova Science Publishers, Inc.

- McGee, A. 2016. We are human beings. *Journal of Medicine and Philosophy* 41(2):148–71.
- McMahan J. 2002. *Ethics of Killing*. Oxford, United Kingdom: Oxford University Press.
- Merker, B. 2007. Consciousness without a cerebral cortex: A challenge for neuroscience and medicine. *Behavioral Brain Science* 30(1):63–81.
- Miller, F., and R. Truog. 2012. *Death, Dying, and Organ Transplantation: Reconstructing Medical Ethics and the End of Life*. Oxford, United Kingdom: Oxford University Press.
- Monti, M. M., A. Vanhaudenhuyse, M. R. Coleman, M. Boly, J. D. Pickard, L. Tshibanda, A. M. Owen, and S. Laureys. 2010. Willful modulation of brain activity in disorders of consciousness. *New England Journal of Medicine* 362(7):579–89.
- Morris, T. 2018. *The Matter of the Heart*. London, United Kingdom: Bodley Head.
- Nair-Collins, M. 2010. Death, brain death, and the limits of science: why the whole-brain concept of death is a flawed public policy. *Journal of Law, Medicine and Ethics* 38(3):667–83.
- Nair-Collins, M. 2015. Taking science seriously in the debate on death and organ transplantation. *Hastings Center Report* 45(6):38–48.
- Nair-Collins, M., and F. Miller. 2017. Do the brain dead merely appear to be alive? *Journal of Medical Ethics* 43(11):747–53.
- National Conference of Commissioners of Uniform State Lawyers. 1981. *Uniform Determination of Death Act*. Available: http://www.lchc.ucsd.edu/cogn_150/Readings/death_act.pdf (accessed June 12, 2019).
- Panksepp, J., T. Fuchs, V. A. Garcia, and A. Lesiak. 2007. Does any aspect of mind survive brain damage that typically leads to a persistent vegetative state? Ethical considerations. *Philosophy, Ethics, and Humanities in Medicine* 2(32):1–11.
- Parfit, D. 2012. We are human beings. *Philosophy* 87(1):5–28.
- President's Council on Bioethics. 2008. *Controversies in the Determination of Death: A White Paper by the President's Council on Bioethics*. Available: <https://bioethicsarchive.georgetown.edu/pcbe/reports/death/> (accessed May 25, 2019).
- Putnam, H. 1996. The meaning of “meaning”. In *The Twin Earth Chronicles: Twenty Years of Reflection on Hilary Putnam's “The Meaning of ‘meaning’”* eds. A. Pessin and S. Goldberg, 3–52. London, United Kingdom: M.E. Sharpe.
- Sadovnikoff, N., and D. Wikler. 2014. Brain dead patients are still whole organisms. *American Journal of Bioethics* 14(8):39–40.
- Shah, S., and F. Miller. 2010. Can we handle the truth? Legal fictions in the determination of death. *American Journal of Law and Medicine* 36(4):540–85.
- Shemie, S. D., L. Hornby, A. Baker, J. Teitelbaum, S. Torrance, K. Young, A. M. Capron, J. L. Bernat, L. Noel. 2014. International guideline development for the determination of death. *Intensive Care Medicine* 40(6):788–97.
- Shemie, S. D., H. Ross, J. Pagliarello, Baker AJ, Greig PD, Brand T, Cockfield S, et al. 2006. Brain arrest: The neurological determination of death and organ donor management in Canada: Organ donor management in Canada: Recommendations of the forum on medical management to optimize donor organ potential. *Canadian Medical Association Journal* 174(6): S1–30.
- Shewmon, D. A. 1998a. Chronic “brain death”: Meta-analysis and conceptual consequences. *Neurology* 51(6):1538–45.
- . 1998b. “Brainstem death,” “brain death” and death: A critical re-evaluation of the purported equivalence. *Issues in Law and Medicine* 14(2):125–45.
- . 2001. The brain and somatic integration: Insights into the standard biological rationale for equating brain death with death. *Journal of Medicine and Philosophy* 26(5):457–78.
- . 2009. Brain death: Can it be resuscitated? *Hastings Center Report* 39(2):18–24.
- Shewmon, D. A., G. L. Holmes, and P. A. Byrne. 1999. Consciousness in congenitally decorticate children: Developmental vegetative state as self-fulfilling prophecy. *Developmental Medicine and Child Neurology* 41(6):364–74.
- Singer, M., C. S. Deutschman, C. W. Seymour, M. Shankar-Hari, D. Annane, M. Bauer, R. Bellomo, et al. 2016. The third international consensus definitions for sepsis and septic shock (Sepsis 3). *Journal of the American Medical Association* 315(8):801–10.
- Truog, R. D. 2018a. Defining death—Making sense of the case of Jahi McMath. *JAMA* 319(18):1859–60.
- . 2018b. Lessons from the case of Jahi McMath in defining death: Organ transplantation and the fifty-year legacy of the Harvard report on brain death, special report. *Hastings Center Report* 48(6):S70–3.
- Truog, R. D., and F. Miller. 2012. Brain death: Justifications and critiques. *Clinical Ethics* 7(3):128–32.
- Veatch, R. M. 1993. The impending collapse of the whole-brain definition of death. *Hastings Center Report* 23(4):18–24.
- Youngner, S. J., R. M. Arnold, and R. Schapiro (eds.) 1999. *The Definition of Death: Contemporary Controversies*. Baltimore: John Hopkins University Press.