Commentary

Commentary: False Positives in the Diagnosis of Brain Death

MICHAEL NAIR-COLLINS AND FRANKLIN G. MILLER

According to the United States Uniform Determination of Death Act of 1981, "An individual who has sustained either (1) irreversible cessation of circulatory and respiratory functions, or (2) irreversible cessation of all functions of the entire brain, including the brain stem, is dead. A determination must be made in accordance with accepted medical standards."[1] Nevertheless, it has been known for decades that the standard diagnostic tests for brain death, such as those recommended by the American Academy of Neurology,[2] routinely generate false positives. Many patients are erroneously labeled "brain dead" in spite of exhibiting preserved brain function, the most common of which is hypothalamic regulation of plasma osmolarity—the balance of salt and water in the body necessary for survival.[3] More recently, cases have been reported in which patients who had been diagnosed as brain dead according to standard guidelines later showed evidence of preserved brain function other than osmoregulation, such as spontaneous breathing or brainstem reflexes.[4]

For as long as these findings have been known, defenders of the status quo in the practice of diagnosing brain death have either ignored them, or attempted to explain them away. For example, hypothalamic regulation of salt and water balance has been dismissed as allegedly not being a "critical" function;[5] as irrelevant because it is allegedly not a "clinical" function;[6] or as mere activity but not a function at all.[7] In their most recent practice recommendations, the American Academy of Neurology typifies this pattern, by making the bald assertion that the persistence of such brain function is consistent with the absence of all brain function; which of course cannot be true because it's a logical impossibility.[8]

Given the longstanding pattern of ignoring or not taking seriously the evidence that "brain death" is not reliably diagnosed, it is refreshing and encouraging to read the analysis by James Bernat and Anne Dalle Ave of potential mismatches between the legally established whole brain criterion of death and standard diagnostic tests.[9] They acknowledge that the underlying pathophysiology of brain death—a positive feedback cycle of increasing intracranial pressure and decreasing cerebral perfusion—does not, in fact, always eventuate in complete intracranial circulatory arrest. They acknowledge that clear cases exist in which patients were diagnosed as brain dead by accepted guidelines, but subsequently demonstrated brain function, thus invalidating the previous diagnosis. They acknowledge that preservation of neurohormonal function is not consistent with the whole brain criterion of death. And they acknowledge, as a general principle, that the accepted tests are not specific for detecting the absence of all brain function: "even when the brain death tests are performed and interpreted correctly, inevitably, cases will occur in which some brain functions persist."[10]

Accordingly, one might think that Bernat and Dalle Ave offer a strong critique of standard determination of death by neurological criteria, showing, as they do, that the diagnosis of brain death has both poor specificity and poor reliability.

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However, the main focus of the paper by Bernat and Dalle Ave is to explore options for improving the reliability and specificity of the diagnosis, including: (i) creating standardized training and credentialing of physicians who are authorized to make the diagnosis; (ii) adding a required neuroimaging test to demonstrate intracranial circulatory arrest to the standard battery of tests; or (iii) revising the nosological category of brain death to allow the preservation of certain brain functions, particularly neurohormonal function.

While commending our colleagues for taking seriously the long-known evidence that brain function can be preserved after the diagnosis of brain death, their attempt to justify brain death diagnostic practices does not succeed, as we argue below.

Criteria and Tests for Diagnosing Brain Death

Diagnostic tests can be evaluated in several ways. First, any set of tests should be *reliable*: Repeated applications of the tests by different examiners, or at different time points, should yield the same diagnostic result. Second, tests should ideally be perfectly *specific*, yielding a negative result for all cases in which the patient does not have the condition in question. Third, tests should ideally also be perfectly *sensitive*, yielding a positive result for all cases in which the patient does have the condition in question. Fourth, tests should be *valid*, meaning that they actually test for what they purport to. Our main focus here is reliability and specificity.

Each of these test characteristics can only be examined relative to an ordered pair of a specified set of tests, and a specified physiologic condition (or a criterion, in Bernat's and Dalle Ave's language). In the case of brain death, there are actually several such criteria that the (same) battery of tests have been alleged to identify. We begin by simply noting the different criteria to enable more precise analysis.

The established whole-brain criterion for determining death is the condition of *irreversible cessation of all functions of the entire brain*. A second category, proposed by Bernat in earlier work, is the *irreversible cessation of all clinical functions of the brain*, where clinical functions are those that are assessable via bedside tests alone.[11] Third, in their recent article Bernat and Dalle Ave propose a *brain-as-a-whole* criterion, which is not meaningful unless characterized more precisely. Bernat and Dalle Ave gesture toward such a characterization, noting that it will consist of a specified list of brain functions that are either consistent or inconsistent with the new diagnostic category, but they don't provide or justify that list.[12] We discuss this criterion further below. Fourth and finally, in the United Kingdom (and elsewhere), the condition allegedly identified is that of *irreversible cessation of the capacity for consciousness and breathing*.[13]

The standardly accepted tests for brain death involve demonstrating complete lack of responsiveness to verbal or painful stimuli (allowing spinally mediated reflexes); lack of brainstem reflexes as demonstrated by a number of bedside tests; and apnea as demonstrated by lack of spontaneous inspiration for a period of several minutes when challenged by elevated levels of carbon dioxide in the blood. When the cause of coma is known and confounds, such as sedative intoxication or hypothermia are ruled out, then the patient is said to satisfy tests for brain death. In other words, this would be a positive test for brain death.[14]

Confirmatory tests are not typically required, though are often used in practice at the discretion of the clinician, and may be legally required in some jurisdictions. In an effort to reduce false positive misdiagnoses, Bernat and Dalle Ave advocate for mandating, in all cases, a neuroimaging test demonstrating undetectable blood flow to the brain.

Poor Reliability and False Positives

The diagnostic tests described above are well accepted in the medical literature. But in practice, there is variability in how brain death is actually determined.[15] This means that in the actual practice of diagnosing brain death, there is no assurance that the same patient, if presented to different examiners, would actually be examined according to the same set of diagnostic protocols, and therefore no assurance the patient would receive the same diagnosis. Furthermore, even if the standard battery of tests were applied, there is no assurance that the physicians responsible for diagnosing brain death are competent in doing so. For example, one might fail to exclude confounding conditions, or misinterpret brainstem reflex testing. Although we cannot state the incidence of diagnostic error from these factors, we share Bernat's and Dalle Ave's suspicion that it is more common than previously assumed.[16] Regardless, diagnostic practices for brain death are not sufficiently reliable on the basis of the documented variability in diagnostic practices. This damages the credibility of the diagnosis.

To address this concern, Bernat and Dalle Ave propose mandatory checklists, along with standardized training and credentialing of physicians authorized to make the diagnosis. This is a reasonable suggestion, and if well implemented, should help to increase reliability. However, even perfect reliability entails nothing regarding specificity.

The whole-brain criterion is the legal standard that physicians in the United States are required to identify. While Bernat and Dalle Ave have acknowledged that brain function can be preserved after the diagnosis of brain death, they misleadingly characterize such instances as "isolated cases."[17] However, in a review of over 1800 patients diagnosed with brain death, Michael Nair-Collins and colleagues found that roughly half demonstrated evidence of hypothalamic osmoregulation.[18] In other words, using the whole brain criterion as our reference condition, roughly half of the patients reported in this review were false positive misdiagnoses.

Revising the Criteria to Fit the Tests

By contrast to the whole-brain criterion, the cessation of *clinical* functions of the brain was devised in order to rule out hypothalamic functioning as not relevant since, allegedly, assessing the function of the hypothalamus requires laboratory testing and brain death is a clinical diagnosis. We note, first, that the assertion that "brain death is a clinical diagnosis" is erroneous. According to the standard guidelines published by the American Academy of Neurology (and others), brain death cannot be diagnosed without ruling out confounds, which requires laboratory analysis for sedatives as well as evaluation of acid-base status. Furthermore, the standard apnea test requires measuring arterial carbon dioxide both before and after the apnea challenge to demonstrate a sufficient rise in arterial carbon dioxide partial pressure.[19] Arterial blood gas analysis is a laboratory test.

In any case, the "clinical functions" criterion yields the same poor specificity as the whole-brain criterion does, because the function of the hypothalamus is clinically assessable at the patient's bedside by observation of urine output. In the absence of a functioning hypothalamus the patient would exhibit voluminous urine output, easily assessable by observation of the urine collection and measurement bag that is hung at the patient's bedside. Normal urine output is just as much a clinically observable sign of brain function as is a cough in response to deep suctioning. Therefore, although there is no scientifically valid reason to exclude brain functions whose assessment requires technology, hypothalamic osmoregulation is a clinically assessable brain function anyway.

The third criterion we mentioned is the "brain-as-a-whole," which would be specified by differentiating those brain functions that are allegedly "critical" functions of the brain-as-a-whole, from those which are not. Predictably, Bernat and Dalle Ave suggest that critical functions of the brain-as-a-whole "could conceivably exclude arguably less critical brain functions such as vasopressin neurosecretion."[20] We disagree that the homeostatic capacity to regulate salt and water concentration in the extracellular fluid could conceivably be considered not a critical function, of either the brain or the organism. All metabolic activities, including those that support brain function, depend on an extracellular fluid whose composition is tightly regulated, including its sodium concentration. There is no independent scientific justification to propose that osmoregulation is not a "critical function."

Intracranial Circulatory Arrest and Neuroimaging

Mandating neuroimaging testing of cerebral blood flow would not obviate the problem of false positive misdiagnoses. Bernat and Dalle Ave acknowledge that if such a test is to prove that the whole-brain criterion has been met, the test needs to be validated "by proving that zero forward blood flow measured by the neuroimaging procedures correlates perfectly with complete intracranial circulatory arrest."[21] This would require an independently validated and reliable modality for detecting complete intracranial circulatory arrest in the setting of continued general circulation. But there is no such modality. Necessarily, every imaging modality will have a detection limit below which the test cannot differentiate between undetectable flow and no flow.

Because this is the case, neuroimaging cannot rule out ischemic penumbra, a state of low blood flow that is too low to support neural function, but is sufficient to sustain the viability of neural tissue for some time, which may then potentially recover some function after the acutely elevated intracranial pressure diminishes.[22] This is not a merely theoretical concern. In the case of Jahi McMath, which we discuss below, a radionuclide scan showing undetectable flow was performed as a part of the initial diagnosis, and nine months later, a magnetic resonance angiogram was also performed, again showing undetectable flow.[23] Yet, Jahi subsequently demonstrated signs of brain function, which we discuss in Section VI.

Moreover, undetectable cerebral blood flow does not suffice to rule out the contemporaneous preservation of some brain function. Christine Nygaard and colleagues reported on 114 patients declared to be brain dead, all of whom were examined using standard clinical tests, in addition to radioisotopic brain blood flow testing.[24] Of those, 54 (47 percent) did not develop diabetes insipidus and

therefore were false positive misdiagnoses, owing to preserved hypothalamic activity, contrary to the whole-brain or clinical functions criteria. Panayiotis Varelas and colleagues reported on 36 patients declared brain dead by a single examination following standard guidelines, in addition to a mandatory cerebral blood flow test aimed at demonstrating intracranial circulatory arrest.[25] The majority of patients received a Single Photon Emission Computerized Tomography evaluation while others received a transcranial Doppler, or Computerized Tomographic Angiogram. All had documented absence of flow in their charts. Of these 36 patients with (allegedly) no blood flow to the brain, 13 (36 percent) did not have diabetes insipidus and therefore were false positive misdiagnoses.

The United Kingdom Criterion: Irreversible Loss of Consciousness and Breathing

The fourth criterion mentioned above is the irreversible less of the capacity for consciousness and breathing. This is the criterion used in the United Kingdom.[26] Recently, Andrew McGee and Dale Gardiner reviewed brain death laws and practices internationally, and argued that legal challenges to a diagnosis of death by neurological criteria are more likely to be successful in the United States, due to its legal framework built on the whole-brain criterion.[27] But in jurisdictions that have adopted the criterion of irreversible loss of consciousness and breathing, successful legal challenges are less likely, as preserved hypothalamic function does not entail a false positive on this criterion. This is correct: the United Kingdom criterion does not require irreversible cessation of hypothalamic function. Nonetheless, false positives remain.

Alan Shewmon reported a pediatric case of return of spontaneous breathing after meeting the accepted tests (which are the same as in the United Kingdom). This is a false positive on the United Kingdom criterion as well; and, though rare, there are similar cases reported in the literature.[28]

The case of Jahi McMath, that has received considerable recent attention, poses a distinct challenge. Jahi McMath was declared to be brain dead in December 2013, and given the multiple expert physicians and court involvement in her case, we must assume that standard brain death diagnostics were correctly applied and interpreted. Furthermore, a radionuclide scan showing undetectable flow was also performed as part of the diagnosis.[29] Her parents did not agree that their daughter was dead, and successfully sought court intervention to allow continued treatment. She was transferred from California to New Jersey, a state that permits exemption from determination of death on neurological criteria, and lived almost 5 additional years, mostly on home care, until she died in June, 2018.

Before she died in 2018, Jahi's family had compiled a video catalogue of multiple movements she made, seemingly in response to verbal command. After a comprehensive analysis of these videos, including analysis by forensics experts showing they were not altered, pediatric neurologist Alan Shewmon declared in sworn legal testimony that Jahi did not meet the accepted diagnostic criteria for brain death, and that her intermittent responsiveness to specific verbal commands demonstrated that, at the time the videos were taken, Jahi was in a minimally conscious state.[30]

Many physicians refuse to accept this video evidence, but this is dubious. Why would videos not be admissible, when video recordings are paradigmatically

intersubjectively verifiable? If Jahi's family were to consent to further dissemination of the video catalogue,[31] then other physicians and other specialists can observe exactly the same evidence Dr. Shewmon has, and pose rebuttals if warranted. Indeed, several videos are in the public domain and available for analysis and rebuttal if warranted.

Furthermore, it is of critical importance to emphasize that Shewmon has also reported personally witnessing a right arm movement in response to verbal command to move her right arm.[32] A practicing neurologist declaring that he personally observed a movement in response to verbal command arguably invalidates the brain death diagnosis, by invalidating the first component: complete lack of responsiveness to verbal or painful stimuli. Thus, Jahi's case poses the same problem for the United Kingdom criterion as it does for the whole-brain criterion: namely, we have yet another false positive misdiagnosis.

This case gets at the heart of the United Kingdom criterion, which allows some brain function to persist so long as the individual has suffered irreversible cessation of the capacity for consciousness and breathing. Because she responded to a specific command—even once—it is no longer reasonable to claim to know that Jahi was at all times completely and irreversibly unconscious. But Jahi apparently did not respond to command one time only; according to the video evidence, she responded around 100 times, moving several specific body parts to specific instruction.[33] Although we do not claim any certainty about Jahi McMath's state of consciousness one way or the other, we do insist that if anything is to count as evidence of consciousness, responsiveness to command surely must.

It might be objected that the case of Jahi McMath is an isolated exception, which should not call into question the validity of neurological determination of death according to the United Kingdom standard. Given that it is the diagnosis of death that is at stake, a single validated false positive is a matter of concern. Furthermore, Jahi McMath is not the only false positive: cases in which spontaneous breathing returned after the diagnosis of brain death are false positives on the United Kingdom criterion. Finally, because maintaining life support after a brain death diagnosis is exceptionally rare, there is no way of knowing how many patients might recover to the minimally conscious state.

Jahi's case poses a serious problem for all criteria based on irreversible cessation of consciousness, including the many variants of the "higher-brain" concept of death;[34] the United States President's Council's vital work theory, which they operationalize in terms of absence of the capacities for consciousness and breathing;[35] recent international guidelines for the determination of death;[36] and the United Kingdom criterion. All depend on the possibility of accurately diagnosing the irreversible cessation of consciousness. The McMath case puts severe pressure on all of them. Finally, it is worth noting that the literature on disorders of consciousness over the last twenty or thirty years has had one clear message: we've been far too blithe about declaring people to be "irreversibly unconscious."[37]

Implications

Diagnostic practices surrounding brain death are unreliable and have poor specificity. Misdiagnoses as a result of examiner error in following standard guidelines can and do occur, with unknown regularity. Even with perfect adherence to guidelines, false positives in the diagnosis of brain death are common. Indeed, if the

whole-brain or clinical functions criteria are taken as our reference condition, then brain death is misdiagnosed so often that potentially something like half of all brain death diagnoses are false positive misdiagnoses. Mandating a test showing undetectable intracranial blood flow will not solve these problems: We already have many documented cases in which such tests were used but brain function continued or returned. Finally, a patient who was diagnosed as brain dead, including an intracranial circulation test, later demonstrated a single response to command that was observed by a neurologist in person, as well as dozens of responses to commands that were captured on video.

Clearly, there are evidence-based challenges to the claim that brain death is a credible, reliable diagnosis. It does not deserve the infallible status that many practitioners seem to believe it has. This has important implications for practice, which we briefly mention to conclude the essay.

First, heart-beating organ donation rests on the principle that brain death is biological death and constitutes, in the United States, the irreversible cessation of all brain functions. This practice, relying on "the dead donor rule," presumes that brain death can be diagnosed with the appropriate confidence. Leaving aside the issue of *whether* brain death is biological death, if its diagnosis is neither reliable nor specific, then we cannot justifiably communicate to the general public, potential organ donors, surrogate decision-makers, or the many clinicians involved in organ procurement, that heart-beating organ donors are actually dead, consistent with the legal standard, when organs are removed. Continuing to procure organs from heart-beating patients without disclosing the relevant information that brain death is not a reliable diagnosis, means that consent for organ procurement occurs on the basis of false information (again, setting aside the identification of brain death with death). Elsewhere we have discussed in detail the ethics of vital organ procurement and transplantation from heart-beating donors.[38]

Second, it is worth emphasizing that the majority of high-profile cases of brain death controversies do not involve permission to remove organs. Rather, they involve rejection of the diagnosis itself, along with assertions of the right to continued physiological support for the brain-injured patient. While we cannot do justice to a comprehensive ethical analysis of this issue here,[39] we simply note that prominent defenders of the concept and practices surrounding brain death have acknowledged that the tests are not always followed and interpreted correctly; and that even when they are, some brain functions inevitably persist in some patients; and not all patients declared brain dead have intracranial circulatory arrest. In light of this information, it is hardly unreasonable for some families to resist or mistrust the diagnosis. The evidence shows that it is not a credible diagnosis. And this is the case even if we assumed that "brain death" is a legitimate construct in the first place, an assumption that we, and others, have challenged elsewhere.

Notes

1. See President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research. *Defining Death. Medical, Ethical, and Legal Issues in the Determination of Death*. Washington, DC: US Government Printing Office; 1981, at 55–84.
2. Wijdicks EF, Varelas PN, Gronseth GS, Greer DM. Evidence-based guideline update: Determining brain death in adults: Report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology* 2010;74(23):1911–8. Pediatric guidelines are detailed in Nakagawa TA, Ashwal S, Mathur M, Mysore M, Society of Critical Care Medicine, Section on Critical Care and

Section on Neurology of American Academy of Pediatrics, Child Neurology Society. Guidelines for the determination of brain death in infants and children: An update of the 1987 Task Force Recommendations. *Pediatrics* 2011;128(3):e720–e740.
3. Halevy A, Brody B. Brain death: Reconciling definitions, criteria, and tests. *Annals of Internal Medicine* 1993;119(6):519–25. For a recent review of hypothalamic function in patients diagnosed as brain dead, see Nair-Collins M, Northrup J, Olcese J. Hypothalamic-pituitary function in brain death: A review. *Journal of Intensive Care Medicine* 2016;31(1):41–50.
4. Dalle Ave AL, Bernat JL. Inconsistencies between the criterion and tests for brain death. *Journal of Intensive Care Medicine* 2018:1–9 (epub before print.) PMID 29929410. See also Shewmon DA. False positive diagnosis of brain death following the pediatric guidelines: Case report and discussion. *Journal of Child Neurology* 2017;32(14):1104–17.
5. Bernat JL. The whole-brain concept of death remains optimum public policy. *Journal of Law, Medicine, and Ethics* 2006:35–43.
6. Wijdicks EF. The case against confirmatory tests for determining brain death in adults. *Neurology* 2010;75(1):77–83. See also note 5, Bernat 2006.
7. Shemie SD, Hornby L, Baker A, Teitelbaum J, Torrance S, Young K, et al. International guideline development for the determination of death. *Intensive Care Medicine* 2014;40(6):788–97.
8. Russell JA, Epstein LG, Greer DM, Kirschen M, Rubin MA, Lewis A, et al. AAN position statement. Brain death, the determination of brain death, and member guidance for brain death accommodation requests. *Neurology* 2019;92:1–5. In this "position statement" by the American Academy of Neurology (AAN), the authors write on page 3: "The AAN endorses the perspective of the UDDA that brain death has occurred when the irreversible loss of all functions of the entire brain including the brainstem has been determined. However, the AAN endorses the belief that preserved neuroendocrine function may be present … and is not inconsistent with the whole brain standard of death." The assertion that some brain function may persist while remaining consistent with the whole brain standard that requires all brain function to cease is a logical contradiction and therefore is necessarily false.
9. Bernat JL, Dalle Ave AL. Aligning the criterion and tests for brain death. *Cambridge Quarterly of Healthcare Ethics* 2019;28(4):635–641.
10. See note 9, Bernat, Dalle Ave 2019, at 9.
11. See note 5, Bernat 2006.
12. See note 9, Bernat, Dalle Ave 2019, at
13. Academy of Medical Royal Colleges. *A Code of Practice for the Diagnosis and Confirmation of Death*. 2008; available at http://www.aomrc.org.uk/reports-guidance/ukdec-reports-and-guidance/code-practice-diagnosis-confirmation-death/ (last accessed 27 Feb 2019).
14. See the articles listed in note 2.
15. Wijdicks EF. Brain death worldwide: Accepted fact but no global consensus in diagnostic criteria. *Neurology* 2002;58(1):20–5; Greer DM, Varelas PN, Haque S, Wijdicks EF. Variability of brain death determination guidelines in leading US neurologic institutions. *Neurology* 2008;70(4):284–9.
16. See note 9, Bernat, Dalle Ave 2019.
17. See note 9, Bernat, Dalle Ave 2019, at 4.
18. See note 3, Nair-Collins et al. 2016.
19. See the articles listed in note 2.
20. See note 9, Bernat, Dalle Ave 2019, at 11.
21. Note 9, Bernat, Dalle Ave 2019, at 9.
22. Coimbra CG. Implications of isch[illegible]umbra for the diagnosis of brain death. *Brazilian Journal of Medical and Biological Research* 1[illegible]2(12):1479–87.
23. Shewmon DA. Truly reconciling the case of Jahi McMath. *Neurocritical Care* 2018;29(2):165–70.
24. Nygaard CE, Townsend RN, Diamond DL. Organ donor management and organ outcome: A 6-year review from a Level I trauma center. *Journal of Trauma* 1990;30(6):728–32.
25. Varelas PN, Rehman M, Abdelhak T, Patel A, Rai V, Barber A, et al. Single brain death examination is equivalent to dual brain death examinations. *Neurocritical Care* 2011;15(3):547–53.
26. Note 13, Academy of Medical Royal Colleges 2008.
27. McGee A, Gardiner D. Differences in the definition of brain death and their legal impact on intensive care practice. *Anaesthesia* 2019:doi:10.1111/anae.14568.
28. See the articles listed in note 4.
29. See note 23, Shewmon 2018.
30. Declaration of D. Alan Shewmon, M.D. in the case of Jahi McMath; available at http://www.thaddeuspope.com/images/Shewmon_Decl._12-2017.pdf (last accessed 2 Mar 2019).

31. We respect the family's right to control dissemination of their private videos and do not suggest that they have any obligation to release them further. Additionally, several videos are available in the public domain already.
32. See note 23, Shewmon 2018, at 169.
33. Note 23, Shewmon 2018, at 167.
34. For example, see McMahan J. *The Ethics of Killing: Problems at the Margins of Life.* New York, NY: Oxford University Press; 2002.
35. President's Council on Bioethics. *Controversies in the Determination of Death: A White paper by the President's Council on Bioethics.* Washington, DC; 2008.
36. See note 7, Shemie et al. 2014.
37. Giacino JT, Fins JJ, Laureys S, Schif ND. Disorders of consciousness after acquired brain injury: The state of the science. *Nature Reviews Neurology* 2014;10(2):99–114.
38. Miller FG, Truog RD. *Death, Dying, and Organ Transplantation. Reconstructing Medical Ethics at the End of Life.* New York, NY: Oxford University Press; 2012. Nair-Collins M. Can the brain-dead be harmed or wronged? On the moral status of brain death and its implications for organ procurement. *Kennedy Institute of Ethics Journal* 2017;27(4):525–59.
39. But see Du Toit J, Miller FG. The ethics of continued life-sustaining treatment for those diagnosed as brain-dead. *Bioethics* 2016;30:151–8, and note 38, Nair-Collins 2017.