Does Death Determination by Neurologic Criteria Require Irreversible or Permanent Cessation of Brain Functions?

Andrew McGee and Dale Gardiner

> *All words have the 'taste' of a profession, a genre, a tendency, a party, a particular work, a particular person, a generation, an age group, the day and hour. Each word tastes of the context and contexts in which it has lived its socially charged life; all words and forms are populated by intentions* [1].
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> *—M.M. Bakhtin, The Dialogic Imagination*

Does death require permanent or irreversible cessation of function? There are different views. This chapter explores those views, focusing ultimately on their application to determination of death by neurologic criteria.

As can be seen in Table 1, at the time when neurologic criteria for the determination death were first proposed, the words "permanent" and "irreversible" were being used interchangeably. It is perhaps only by chance that "irreversible" became the term of legal choice in the Uniform Determination of Death Act (UDDA) and other similar descriptions of death [2].[1]

> 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, the brain stem, is dead. A determination of death must be made in accordance with accepted medical standards [2].

[1] In Australian legislation the wording is "irreversible cessation of circulation in the body" (see McGee and Gardiner [3]). The words "in the body" might have been added to prevent the claim that, when the heart is restarted in the *recipient's* body, circulation is proven not to be irreversible.

A. McGee (✉)
Queensland University of Technology, Brisbane, Australia
e-mail: a.mcgee@qut.edu.au

D. Gardiner
Adult Critical Care, Nottingham University Hospitals NHS Trust, Nottingham, UK
e-mail: dalegardiner@doctors.net.uk

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Table 1 Historical uses of the terms "irreversible" and "permanent" in landmark determination of death statements from the 1960s to 1980s [4–7]

Document	Example statements of the use of the term "irreversible" and "permanent"
Ad hoc committee of the Harvard Medical School, 1968, the United States	"Our primary purpose is to define irreversible coma as a new criterion for death" "Our first problem is to determine the characteristics of a permanently nonfunctioning brain" "We suggest that responsible medical opinion is ready to adopt new criteria for pronouncing death to have occurred in an individual sustaining irreversible coma as a result of permanent brain damage"
Conference of Medical Royal Colleges and their Faculties, 1976, the United Kingdom	"Permanent functional death of the brainstem constitutes brain death"
Conference of Medical Royal Colleges and their Faculties, 1979, the United Kingdom	"Whatever the mode of its production, brain death represents the stage at which a patient becomes truly dead, because by then all functions of the brain have permanently and irreversibly ceased"
President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research, 1981, the United States	"An individual with irreversible cessation of circulatory and respiratory functions is dead" "The accepted standard for determining death has been the permanent absence of respiration and circulation" "Before tissues are removed, the following signs of death… must be present: permanent cessation of the activity of the brain or of the heart" "For most lay people—and in all probability for most physicians as well—the permanent loss of heart and lung function (for example, in an elderly person who has died in his or her sleep) clearly manifests death" "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, the brainstem, is dead. A determination of death must be made in accordance with accepted medical standards"

The debate about whether "irreversible" or "permanent" is the more appropriate term arose as a direct consequence of the reemergence of organ donation after determination of death by circulatory–respiratory criteria (DCD) in the 2000s. For DCD to result in successful organ transplants, the time after the commencement of circulatory–respiratory arrest must be as short as possible. Every minute that the organs do not have an oxygenated circulation increases warm ischemic damage. The question became: What is the minimum amount of time after circulatory–respiratory arrest that must pass before the donor can be determined to be dead? The generally accepted standard developed in DCD practice worldwide is that the minimum time is 5 min, though some advocate for times as short as 75 s and others favoring periods as long as 30 min [8–11].

The ethical and conceptual challenge is that a person whose circulatory–respiratory function has only been inactive for 5 min can sometimes still have that function restarted by means of cardiopulmonary resuscitation (CPR) [12]. Some therefore

hold that in DCD we do not know whether, at just 5 min after circulation has ceased, the cessation is irreversible—as required by the UDDA [13–15]. Even 30 min may not be enough time in the right circumstances and with enough resuscitation effort [12, 16–18]. Indeed, given that we normally would only consider attempting CPR and other resuscitative measures if we think that the brain would not be too damaged from the lack of oxygen, it is actually unknown how long we would have to wait before it was no longer feasible to restart circulation. Restarting circulation enabling good brain function is one thing, but restarting circulation regardless of brain function quality is quite another. Since we normally stop CPR once we know that good function will not be restored to the brain, we just do not know how long we could continue CPR and still eventually recover some circulation.

Whereas "permanent" and "irreversible" might once have been used interchangeably, they have now, in this area of debate at least, taken on very different meanings, where "permanent" is defined as *will not return* and "irreversible" as *cannot return* [19]. Two main arguments support the use of "permanent" in the circulatory–respiratory determination of death. The first is that permanent cessation is the established medical practice standard for determining death [19]. To know that circulatory–respiratory function cannot return, one must either attempt CPR or other forms of resuscitation and fail, or wait a long enough duration for CPR or other forms of resuscitation to always fail. In most modern death determinations, doctors do neither. Most death determinations do not follow an attempt at CPR which fails, and even if they did, the success of CPR is effort and technology dependent as already noted. Nor do doctors necessarily wait a long enough duration to know that CPR would always fail (even when we stop, we could have had a different result if we had carried on for longer, however unlikely) [20]. And this is not even taking into account other resuscitative measures such as extracorporeal cardiopulmonary membrane oxygenation (ECMO), which can begin, in some cases, after conventional CPR fails. Therefore, despite the use of the word "irreversible" in the UDDA and similar instruments, doctors in practice only apply the standard of *permanence*. The UDDA specifically allows for this situation because it provides that a "determination of death must be made in accordance with accepted medical standards [2]." That standard is permanence.

The second argument is that permanent cessation is the meaning of "irreversible" in the UDDA. The point just made (that the UDDA requires death determination to be made in accordance with good medical practice) provides a legal argument that "irreversible" must be interpreted—as a matter of "statutory interpretation," as the lawyers say—to mean permanence, since otherwise it would be difficult to give the wording about determining death in accordance with medical practice any meaning. So, permanent cessation of function will become irreversible cessation of function provided function will not be restored because it will neither return spontaneously nor will it return as a result of medical intervention because resuscitation efforts will not be attempted, these being prohibited [19]. The word "permanent" relies primarily on intent and action to be realized [19], while "irreversible function," at least for advocates of a strong distinction between the two, is function that cannot be restored by any known technology. On this latter view: "'Irreversible' is an absolute and univocal

condition that implies impossibility (with currently available technology) and does not rely on intent or action [19, p. 974].” By contrast, for those who reject such a strong distinction between irreversible and permanent, “permanent” records an epistemic limitation that, in the circumstances, has been defanged. When we declare death based on permanent loss of function, it is possible the cessation of functions is biologically irreversible. However, we cannot know for sure without trying resuscitation. This epistemic limitation, however, is irrelevant where trying is itself ruled out. It is defanged because we know all we need to know to declare death in these cases.

Criticism of the modern practice of relying on permanence has been strong and fierce. We will examine one of the most influential and strongest criticisms made in the literature below.

Before we explore the language and meaning of the word “irreversible” in depth, however, we need to preview how the argument for permanence in the determination of death by circulatory–respiratory criteria relates to the determination of death by neurologic criteria. Notwithstanding criticism, the international medical community has found itself advocating for a unified neurologic criterion of death (see Table 2). One is not dead because one’s circulation has ceased, but because, when circulation ceases, brain function ceases. If this cessation of brain function is permanent, then, according to the international medical community, death has occurred.

Table 2 Modern determination of death statements which seek to unify determination of death by circulatory–respiratory and neurologic criteria [25–27]

Academy of Medical Royal Colleges, 2008, the United Kingdom	“Death entails the irreversible loss of those essential characteristics which are necessary to the existence of a living human person and, thus, the definition of death should be regarded as the irreversible loss of the capacity for consciousness, combined with irreversible loss of the capacity to breathe … The irreversible cessation of brainstem function whether induced by intra-cranial events or the result of extra-cranial phenomena, such as hypoxia, will produce this clinical state and therefore irreversible cessation of the integrative function of the brain-stem equates with the death of the individual and allows the medical practitioner to diagnose death”
The International Guidelines for Determination of Death phase 1 participants, in collaboration with the World Health Organization, 2014	“Operational definition of human death: Death is the permanent loss of capacity for consciousness and all brainstem functions. This may result from permanent cessation of circulation or catastrophic brain injury. In the context of death determination, ‘permanent’ refers to loss of function that cannot resume spontaneously and will not be restored through intervention”
World Brain Death Project, 2020	“[Brain death/death by neurologic criteria (BD/DNC)] is defined as the complete and permanent loss of brain function as defined by an unresponsive coma with loss of capacity for consciousness, brainstem reflexes, and the ability to breathe independently. This may result from permanent cessation of oxygenated circulation to the brain and/or after devastating brain injury. Persistence of cellular-level neuronal and neuroendocrine activity does not preclude the determination. In the context of death determination, ‘permanent’ refers to loss of function that cannot resume spontaneously and will not be restored through intervention”

Does determination of death by neurologic criteria require irreversible or permanent cessation of function? There has been much less debate on this issue compared to the determination of death by circulatory–respiratory criteria. In the determination of death by neurologic criteria, the tests required to confirm death are not carried out until all preconditions are satisfied (e.g., absence of confounding conditions). This can lead to a time gap from when the cessation of the relevant neurologic functions is judged to be irreversible (and so death is strongly suspected to have occurred) to the actual declaration that death has occurred. Typically going from suspicion of death to determination of death through the relevant tests can take many hours to days. This can give the impression that death by neurologic criteria is a *retrospective* determination. Correlatively, since the determination of death by circulatory–respiratory criteria is more temporally immediate to the cessation of function and occurs before neuronal damage is complete, this creates the impression that the determination of death by circulatory–respiratory criteria is a *prospective* determination of what will happen [21–22]. However, the impression regarding the retrospective nature of death by neurologic criteria is misleading because it is not conceptually sustainable, as we will show in more detail below. For reasons we shall see, we can only suspect that death has occurred if we mean "permanent cessation of function" by "death." Suffice it to say at this point that technological and medical advances such as therapeutic decompressive craniectomy, deep brain stimulation probes, and the BrainEx machine, which restored some cellular and synaptic activity in pig brains 4 h after decapitation, all demonstrate that even when determining death by neurologic criteria, it remains the case that it is the intention to resuscitate and treat (or not to do so) that remains paramount, and this decision precedes a determination of death by neurologic criteria. As with the use of circulatory–respiratory criteria, the use of neurologic criteria relies on the accepted medical standard of permanence, not irreversibility [23].

Our aim in this chapter is not to defend a unified, brain-based, definition of death, but instead to defend the medical community's endorsement of permanence rather than irreversibility as the necessary precondition to accurate determination of death by both circulatory–respiratory and neurologic criteria.

But can permanence really be defended? As critics claim, it is obvious that death is irreversible and reliance on the alternative criterion of permanent cessation is "little more than [a] medical charade" [24]. We turn now to the criticisms.

1 Arguments from Language: The Meaning of Irreversible

Death was irreversible, he suspected, and he began to think he was going to lose.
—Joseph Heller, Catch-22

Don Marquis, in a well-cited paper in the *Hastings Center Report*, claimed that reversibility is a dispositional property and that, at the time death is declared, this dispositional property still obtains [28]. People declared dead for whom resuscitative measures are not appropriate (such as those who have do-not-resuscitate orders) are therefore not known to be dead at the point at which death is declared. This

claim has been endorsed by other critics, such as Ari Joffe, Michael Nair-Collins, Franklin Miller, and Robert Truog [13–15, 29, 30].

In this section of the chapter, we argue that some of these criticisms can be answered, and that the focus on irreversibility, if interpreted to exclude rules about what is appropriate, is beset by problems that are equally as serious as those that critics claim beset the focus on permanence. Adopting permanence instead of irreversibility (or construing "irreversible" and "irreversibility" to include rules about whether it is permitted to attempt resuscitation) as the prerequisite threshold for accurate death determination is rational and defensible.

What does "irreversible" mean? Defenders of determination of death by circulatory–respiratory criteria have claimed that "irreversible" need not entail that a person can only be declared dead if they cannot, as a matter of fact, be resuscitated by human effort [19, 31, 32]. The claim is that it can *also* mean that a person can be determined dead if circulation and respiration have ceased and resuscitation is not ethically appropriate. This allows practitioners to declare death much earlier than would be the case where resuscitative measures are applicable—on the basis that, without such resuscitative measures, the cessation of circulation and respiration will be permanent.

Don Marquis disagrees with these defenders of determination of death by circulatory–respiratory criteria. In developing his influential criticisms in the context of DCD, Marquis discusses separately what he calls "the appeal to permanence" and "the appeal to a norm" [28].[2] However, we treat these together because they are related. The reason why the cessation of circulation and respiration is permanent for those endorsing DCD protocols or, more generally, protocols applying to those with a do-not-resuscitate order, is that there is a norm in place that precludes the use of resuscitative measures. Because this norm exists, those who declare death under such protocols believe that they do not need to wait for a second period of time to pass, once the possibility of auto-resuscitation has passed, before declaring death. For that second period of time is *only* required for those cases where resuscitation may be attempted, and which may therefore bring the patient back—but resuscitation is inapplicable if there is do-not-resuscitate order. We have all the knowledge we need to declare death.

We should therefore understand the appeal to permanence as partly relying on what Marquis calls "the appeal to a norm" (we say "partly" because it is *also* reliant on auto-resuscitation no longer being possible at the point of death declaration). Aside from its reference to the impossibility of auto-resuscitation, where death is declared for patients with a do-not-resuscitate order, "irreversible" means "normatively irreversible," in the sense that, say, it is not possible to reverse a legal decision if one has no power to reverse it. However, this, Marquis claims, is clearly not what is meant by the word "irreversible" when speaking of the cessation of circulation in a patient's body [28, pp. 27–30]. Marquis instead insists that what we mean is that it is not *physiologically* possible to restart circulation, and only when we know that this is so can we declare death *knowing* it to have occurred.

[2] Marquis, "Are DCD Donors Dead?", 26, 27.

To explain this point, Marquis claims that "reversible" refers to what he calls a "dispositional property" that has a corresponding "occurrent" manifestation. To illustrate "dispositional" and "occurrent" with a simple example, a sugar cube is "disposed" to dissolve when put in water. It manifests this disposition when it *actually* dissolves in the water—its disposition is then "occurrent."

The correlative term for "reversible"—"irreversible"—means that the entity in question has no such dispositional property. We can perhaps bring out the force of Marquis's criticisms of DCD death declaration if we start with examples where the relevant dispositional property is absent. Consider the term "non-combustible," an example of our own but one which nicely illustrates Marquis's point.[3] A non-combustible substance is one that is fire-resistant. That property of being fire resistant is an inherent property of the entity in question, part of its physical nature. It would be absurd to say that a substance that *does* have the relevant dispositional property of being combustible is fire resistant when there is a rule about keeping the substance away from fire to prevent it from being ignited. The rule exists precisely because the substance is combustible, and so *cannot* mean that the substance is non-combustible. When the substance is in fact ignited, the property of being combustible becomes occurrent, or realized. However, if it is never ignited, all that this means is that the dispositional property of being combustible is never realized, or never becomes occurrent. It does not mean that it does not *have* the property of being combustible.

Other examples given by Marquis himself include the properties of being breakable and soluble [28]. A rule against breaking a china cup, or against dissolving a ring in *aqua regia*, does not mean that the china cup is non-breakable, or that the ring is insoluble [28].[4] It is precisely because the cup is breakable and the ring is soluble that we have these norms in the first place. Marquis concludes that "in these contexts, in which moral norms apply, ethical interpretations of these dispositional terms seem incorrect" [28, p. 27]. By analogy with these terms, Marquis claims that "reversible" and "irreversible" are dispositional properties. For the purpose of determining death, they refer to whether, as a matter of fact, a person's circulation can be physiologically restored.

We should note, however, a difference here that Marquis ignores. The terms "non-combustible," "insoluble," and "non-fragile" never have normative meanings (i.e., they never embody rules about what we are allowed to do or prohibited from doing). These terms are *never* used in a normative sense. We cannot refer to a legal prohibition on the use of some combustible material as making this material "non-combustible." This fact is partly what makes Marquis's claims here seem so compelling. In contrast, "irreversible" clearly has both a dispositional and a normative meaning. We can refer to President Obama's decision at the end of his Presidency to

[3] The term "flammable" is mentioned by Marquis, as a dispositional term, but the term "non-combustible" is that which mirrors the term "irreversible," and the example we give is our own because we think it brings out his point more clearly. Marquis's own example to mirror "irreversible" is "non-fragile." These differences are not relevant to the issues discussed.

[4] Marquis,, "Are DCD Donors Dead?", 27.

commute the Chelsea Manning sentence as "irreversible", and so as not capable of being undone by the incoming President. "Irreversible" clearly has this normative meaning, and not merely a dispositional meaning. Of course, these are separate meanings of "irreversible." However, the point for now is that there are two meanings of "irreversible," whereas there is only one meaning of "non-combustible" or "insoluble." It is therefore too quick for Marquis to conclude, from his dispositional analysis of these other terms alone, that the "assumption" that "irreversible" can be given a normative meaning "does not seem to be true" [28].[5] For the moot question is whether there is a legitimate basis on which we can read "irreversible" as having its normative meaning, and the appeal to terms that are *entirely* dispositional, and do not bear any normative meaning at all, does not answer *this* particular question. It begs it.

Consider reversible T-shirts. These are T-shirts that can be worn inside out or back to front, without anyone else noticing a difference; the labels of the T-shirt are removed and the seams are stitched in such a way that they are not showing, whichever way the T-shirt is worn. Does this mean that so-called "non-reversible" T-shirts are really non-reversible? Physically speaking, all T-shirts can clearly be worn inside out or back to front, or reversed, and so *any* T-shirt is reversible. However, there is a social norm about not wearing one's clothes with the labels or seams showing, which explains why only a subset of these are called "reversible" T-shirts, rather than all T-shirts being so. Now, are we to say here that, in the case of T-shirts, they have the dispositional property of being reversible, and so all T-shirts should be called reversible, and we therefore should not have a special class of so-called reversible T-shirts? This seems to us to be absurd, but why isn't Marquis committed to this claim?

Of course, Marquis can reply that people are not T-shirts and "irreversible" must bear its physiological meaning, but this argument cannot be established solely by reference to these other dispositional terms that do not have a second, normative sense in the way that "irreversible" does. On the contrary, the points about these other dispositional terms already presuppose that he has *independently* established that it is not legitimate to give "irreversible" a partly normative meaning when describing death [32].[6]

We must therefore turn to the question of whether it is legitimate ever to give "irreversible" its normative sense when speaking of whether someone is dead, or whether we must always mean it in its dispositional sense.

[5] Marquis here refers to John Robertson's assumption, who is an early proponent of the view Marquis is criticizing, but for convenience we leave that wording out here.

[6] Elsewhere we claim that "irreversible" might be more like "inoperable," "irreparable," and "irretrievable" than like "insoluble," inasmuch as it carries an intrinsic reference to someone acting on intentions (see McGee and Gardiner [32]).

1.1 Can "Irreversible" Legitimately Be Given a Normative Construal?

So, *is* it ever legitimate to give "irreversible" its normative sense when speaking of whether someone is dead? At first glance, there seems to be a very strong argument against giving it this sense. Whether someone is dead must surely depend entirely on their physical state, and not on decisions made which affect that physical state or prevent actions capable of changing that physical state. Death is a physiological state, and anyone in that same state must therefore be dead. As Marquis puts it, "if an individual is dead in virtue of being in state S, then all other individuals in state S are also dead" [28]. It cannot be the case that some people are in state S and known to be dead, while others are in state S and alive or not known to be dead. Yet permanence advocates seem to be committed to precisely this possibility, to the extent that they seem to accept that two people can be in state S, yet one is known to be dead (if there is a valid do-not-resuscitate order which applies to them and it is between 2 and 5 min after asystole), while the other is *not* known to be dead because there is no such order.

Consider now the following case. This case is imaginary, but we will later present a real-life case that, in our view, highlights the same issues. Suppose today that our practice is to declare death in a person after about an hour following asystole, when, let us suppose,[7] we can be confident that neither CPR nor any other resuscitative technology such as ECMO could work—even if it is not appropriate to try it. Suppose this has been accepted and a standard practice for decades. Imagine now that new technology is announced that is capable of restarting circulation in some people after a downtime[8] of 2 days but works best in people under the age of 30. Nevertheless, even though circulation can be restarted after 2 days, the condition to which such people can be restored means that they would not have a sufficient quality of life to make it appropriate to use this technology. On Marquis's dispositional account, it seems that nobody now would be known to be dead until after the point at which even this new technology would definitely fail to restart circulatory–respiratory function, that is, until at least the end of the 2-day period. This would be so even though it is not appropriate to use it on anyone (the quality of life to which people could be restored being too low).

Would Marquis's view be the *only* plausible view to take of this case? Let us consider all the possible alternative views available and how they may impact on our interpretation of the meaning of "irreversibility" and "permanence." These are:

1. We say that the case is a mere thought experiment that bears no relation to the current situation and practice, and so is irrelevant to his criticism of DCD protocols, or protocols based on cessation of brain function;

[7] In reality, nobody actually knows when the first point of irreversibility is reached, but we can leave that complication aside here for now.

[8] "Downtime" refers to the period of time that the heart has stopped before any resuscitative effort has been attempted.

2. We insist that people really *would* be dead (and so known to be dead) only after the 2 days, and could no longer be known to be dead prior to the end of that period, thereby maintaining the dispositional account;
3. We claim that, if this or any other such imagined scenario should occur, our concept of death would change at that point, and so people today known to be dead after a few hours would tomorrow not be known to be dead until after 2 days, but "dead" would be indexed to what is possible given the new technology, and so would have a slightly different application than it has now, given only our current technology;
4. We concede that we might have different standards of death, depending on the category of patient, so that it remains appropriate to consider people to whom this technology is not applicable to be dead, and only those to whom it may be applicable to potentially be still alive.

Marquis's view, given the commitments of his dispositional account of reversibility, is most closely aligned with view 2, but he might adopt one of the other views. Let us look at each possibility in more detail.

View 1: This is a mere thought experiment having no bearing on current DCD practice and protocols.

The first possible view would, in our view, be weak. It is a standard philosophical practice to examine the implications of an idea by examining imaginary cases to see whether those implications are acceptable. Imaginary cases may be better than real cases, since we can vary the possible range of facts more to work out what we really believe, or how our beliefs would change with a particular variation—and the implications of any such change in beliefs for what we currently believe under the status quo. Since, on current practice, a distinction is drawn between the time at which death is determined for patients for whom resuscitation is appropriate and those for whom it is not, our thought experiment is relevant, for it tests how far Marquis and those who endorse his view may be willing to go to defend his criticism of the standard practice, and to defend his own position and his dispositional account of "irreversible". Our claim is that the dispositional account commits him to the view that we have discovered that people are now not known to be dead until after 2 days. Our thought experiment can be used to test whether this is an acceptable conclusion, or at least the only rational conclusion, and one which Marquis himself would accept—or whether there may be another, equally rational view to take.

It is also worth briefly noting here that in a recent English case,[9] the court decided to permit the cryopreservation of a 14-year-old girl who died from cancer; the prospect of such technology becoming realized is not so fanciful as to make courts reject applications from minors who seek judicial approval to have themselves cryopreserved in cases where there is disagreement between the minor's parents about

[9] *JS* [2016] EWHC 2859 (Fam).

cryopreservation. The questions we raise in our imaginary case are equally raised by this technology and need to be faced. We return to this case later.

View 2: If this technology succeeded, we really would have discovered that people were not dead at the time we had originally assumed.

On the second view, if the technology succeeds in restarting circulation in people who were otherwise (thought to be) dead an hour after asystole, we have discovered that people were not dead at the time we originally assumed they were. This second possible view is plausible. The question is whether it is the *only* plausible view. Why can't we say that, since nobody can be revived with this new technology to a condition that makes reviving them appropriate, we shall continue to consider people to be dead at the time we always have? Why would it be "a medical charade" to declare these people to be dead at the time we currently declare them to be, and then change our practices when the technology is developed to such an extent that it is appropriate (because worthwhile) to use it on those patients for whom it was formerly considered to be inappropriate? Suppose we develop the technology further, so that the quality of life to which people can be restored is good, but that the technology still works better on people under age 30—we do not try it on people over age 60 because it is deemed unlikely to work and, even if it did, it will not restore them to a worthwhile state. Why should an external factor that is inapplicable to a 60-year-old woman (the fact that it can restart circulation in those under 30) make a physiological difference to this 60-year-old woman?

A general problem with this second possible view is that it seems to entail that we are never in a position really to know when someone is dead, because new technology may be invented that enables us to restart circulation much later than we currently can, or currently believe to be possible. Although this is only an epistemic limit under this second possible view (there is a fact of the matter about when someone is dead, and it may be that we just don't know, as yet, when that point is), Marquis's point against those who rely on *normative* irreversibility is that the donor (in DCD) is not known to be dead when organ recovery proceeds, and this point applies to his own view (a version of this second possible view). On the logic of this view, we may well be engaging in many practices on people who are not known to be dead, including burial and autopsies, at the time we declare them to be dead. If this is right, then this undermines the criticism that, in current death determination practice, we may be engaging in other practices (such as organ donation) when the patient is not known to be dead. For on this view, we never truly know the point at which anyone is dead (save after putrefaction and decomposition have set in) because new technology capable of restarting circulation at times much further after asystole than is currently possible may be invented. Note that, on this view, it is not possible for Marquis to say that these people are known to be dead, given *current* technology (but not given any *future* technology), as that is possible view 3, which we will discuss shortly (under possible view 2, we are instead discovering that people were not known to be dead when we thought they were).

Another problem with this second view is that it ignores a different possibility. Instead of saying that we have discovered people are not known to be dead until after 2 days have passed, we may instead say that we have discovered ways of bringing people back from the dead. Return to our imaginary case, and suppose we take the option of saying that we have discovered ways of bringing people back from the dead after 2 days. It follows that we could still consider people to be dead whether we use the technology on them or not. Those on whom we use the technology would be dead but brought back to life. And those on whom we do not use the technology would also be dead but would not be brought back to life. And we may adopt a whole host of new rules for this kind of case.[10] On this position, DCD candidates or people declared dead based on the permanent cessation of brain function, on neither of whom it is appropriate to use the technology, would be dead, and so organ retrieval from them would not violate the dead donor rule.

What is it that would stop us from adopting the option of saying that, in our imaginary case, we have discovered ways of bringing certain people back from death? It seems to us that no fact of the matter could restrain us from adopting this option. Only external constraints—the implications for practical matters such as the disposition of property under a will, the status of marriages, and the concept of bigamy—would have a say about which is the better option out of the two possible ways of proceeding (saying we bring people back from death or saying that we have discovered people are not dead at the time we thought they were). Furthermore, choosing which is the *better* of the options is itself a normative exercise, and this might undermine the claim that normative considerations have no place in declaring death—we return to this criticism again later.

These two difficulties, then, perhaps undermine some of the criticisms of the other options (views 3 and 4 we turn to next) that someone inclined to adopt view 2 would make.

View 3: If this technology were discovered, our concept of death would shift at that point, but, at present, it is merely a logical possibility we can ignore.

Consider now a third possible view. On this view, what counts as "death" is indexed to what is possible given *current* technology. To say, as Marquis does, that "death is, as a matter of fact, irreversible" contemplates the *logical* possibility that new technology could emerge that allows us to restart circulation much later than we are currently able to do with our existing technology. However, the restriction to *factual* (rather than logical) irreversibility considers the concession of the logical possibility to be irrelevant, because death by circulatory–respiratory criteria is irreversible once *current* technology is no longer able to reverse the cessation of circulation. Suppose, then, that we adopt view 3. Returning to our imaginary case, this

[10] To give one example, we could reject Marquis's view that, if death were reversible, a woman who married after her husband had died and before he had been brought back from the dead, would be guilty of bigamy once he is brought back (p. 28). We may instead refuse to count this as bigamy, on the basis that the husband had truly died, and was dead when the woman remarried.

means that, prior to the technology being developed, people really were dead after about an hour, whereas, once the new technology is used, people are now not dead—hence not known to be dead—until after 2 days. However, "dead" has a slightly different meaning[11] in each case on this possible view. Because death, on this view, is indexed to what is possible given current technology, and because we are not denying (on this view) that people who were declared dead after an hour *really were* dead after an hour (on the basis that the new technology had yet to be invented), death is instantiated by different paradigms of irreversibility as technology improves and, like different colors used as paradigms to illustrate the meaning of color words, "dead" in each case necessarily has a slightly different meaning. (This would be akin to having a concept of red before having the concept of magenta, and then introducing the new concept of magenta when we decide to distinguish between red and the shade we now call "magenta." Prior to introducing the concept of magenta, what we now call magenta would simply have been called red even if we could discriminate between shades. Similarly, prior to introducing this new paradigm of irreversibility, what we are now calling reversible would beforehand have been called irreversible.)

Could Marquis and those influenced by him choose this third possible view? If they choose this view, they face the same objection Marquis raises against those who rely on normative irreversibility (permanence). In that objection against normative irreversibility, Marquis pointed out that two people could be in exactly the same physiological state, but one person (on whom resuscitative measures remain appropriate) could be alive, while the other one (on whom resuscitative measures are not appropriate) would be dead.[12] In addition, Marquis said that this consequence of normative irreversibility "is unacceptable" (p. 29). However, accepting view 3 leads to an equivalent difficulty. It means that someone could be in the same physiological state today and tomorrow yet be dead (and be known to be dead) today and not be dead (nor known to be dead) tomorrow. (Remember that, on this view, what counts as "irreversible" depends on the technology that exists at the time). That being so, what is the objection to those who choose to adopt permanence in death determination protocols, and who thereby interpret "irreversible" normatively? True, "dead," under view 3, now has a slightly different application, since it applies now to paradigms of irreversibility that were not previously in existence (it not being possible to revive someone after the end of 2 days, rather than it not being possible to revive someone after the end of the 1-h mark). However, this is precisely the claim that is made now by those who endorse permanence: when determining death in those patients with a do-not-resuscitate order, we do not need to wait for a second period of time to pass, where that time is only necessary to rule out the

[11] Alternatively, it might be said that "dead" does not have a slightly different meaning because it means what it always means: the irreversible cessation of circulation (or brain function). Rather, death might be instantiated at later points in the future, given future technology, to the points at which it is currently instantiated given existing technology. We can accept this alternative analysis here as well, as nothing turns on the analysis we choose.

[12] Marquis, "Are DCD Donors Dead?", 29.

possibility of reversal via resuscitation, given that resuscitative measures do not apply. On the permanence view, we arguably already operate with a two-tiered understanding of death, one tier of which applies to those people for whom resuscitation is appropriate, and the other of which applies to those for whom it is not.[13] The only difference between the permanence view, and view 3, is that the permanence understanding applies contemporaneously (we therefore adopt different paradigms of "irreversibility" at the same time), whereas the different paradigms of "irreversibility" under view 3 apply *across* time, rather than at the same time. However, we see no reason why this difference should be relevant.

So, as with view 2, it appears that the opting for view 3 also undermines the critique of normative irreversibility (permanence).

View 4: We can have different standards of death, depending on the category of patient we are dealing with. The permanence view.

In our imaginary case, we discover new technology that can restart circulation after 2 days following mechanical asystole. Prior to this, we could only restart circulation after about an hour from mechanical asystole. View 3, just discussed, accounts for this by claiming that what counts as death is always indexed to what it is possible to do, given our current technology. On that view, prior to the development of the technology, someone really was dead and known to be dead after an hour from mechanical asystole, since it was not at that time possible to reverse the cessation of circulation after an hour. However, once the technology developed, anyone now in the physiological state of asystole after an hour would no longer be known to be dead, since technology might be used to restart circulation for up to 2 days following mechanical asystole. We pointed out that this means that someone could be in the same physiological state today and tomorrow yet be dead (and be known to be dead) today and not be dead (nor known to be dead) tomorrow. We claimed that this seems to be an equivalent problem to that pointed out by Marquis and followers, where A and B could be in the same physiological state now and A be dead because it is not appropriate to try to reverse the cessation of circulation while B is alive (or not known to be dead) because it is appropriate to try to reverse the cessation of circulation. If that is right, then the same criticism could be leveled at proponents of view 3 as is leveled against advocates of permanence or normative irreversibility in current death declaration practice. This might mean that Marquis and followers should retreat to option 2. However, we have seen that there are problems with this option too. Which option to choose depends ultimately on how serious we consider these problems to be. Returning to our imaginary case, given that

[13] For reasons we shall see later, everyone, including Joffe, adopts permanence even as they claim to endorse irreversibility (assuming these concepts are distinct—they are not if "permanence" means normative irreversibility). This is because even when we attempt CPR or other resuscitative measures and fail, we do not know whether we could have succeeded if we had tried for longer. The main reason we do not try for longer is that the brain would be too damaged for the efforts to be worthwhile. However, that is a different point to the point about whether we know we have reached biological irreversibility.

level of function to which we could restore someone after 2 days is acceptable only in people under age 30, we might claim that, although theoretically possible to restore circulation in a 60-year-old, it is not appropriate to try to do so, and so these people should continue to be considered dead. We see no reason to think it differs from current practice for death determination in those for whom resuscitation is not appropriate.

If we can have different paradigms of irreversibility and there is no difference whether that is synchronic or diachronic, view 3 leads us to view 4: Marquis should concede that we might have different standards of death, depending on the category of patient, so that it remains appropriate to consider people to whom this technology is not applicable to be dead, and only those to whom it may be applicable to potentially be still alive. Why can't we choose view 4? View 4 is effectively the position of those who endorse normative irreversibility or permanence, now.

It is important to consider what the remaining objection to this option might be. The objection is that death is a biological, and so a physiological, phenomenon, a "matter of fact" and therefore normative considerations of the kind appealed to under view 4 (which we were led to in considering the full implications of view 3) cannot enter into the issue. However, this reply ignores the point we made earlier in this chapter when discussing view 2; that is, that what counts as someone's having died can become an open question when technological advances are made. We need only consider here what we might say if cryopreservation technology does allow us to revive people in the future. Marquis and his followers can object, of course, to our discussion of cryopreservation on the basis that we do not yet know if we will ever be able to revive such people. However, as noted earlier, this does not prevent us from exploring the logic of his position by imagining what would be the case if we succeeded and revived a cryopreserved person for the first time, and others who endorse his position have taken up a position in respect of this case [30].

What, then, would be the analysis applicable to cryopreservation? If cryopreserved people could have their circulation restarted in the future, do we say these people have been brought back to life, or do we assume instead that they were never really dead? These are not factual but conceptual questions to be determined if, indeed, the technology does become a success. Our point, however, can still be made. If the technology does become a success, and the question of whether we say these people were dead, or were never dead, is raised, the issue about which option to choose (were they dead and brought back to life, or were they never dead) is no longer purely biological, nor purely a matter of fact. Furthermore, the definition of death, if it is tied to what counts as "irreversible" given the then current technology, is no longer strictly biological, but carries an intrinsic reference to human capabilities ("irreversible" in that case would be like "irreparable" rather than "insoluble") [32]. As we have noted, this opens the door to normative considerations forming part of our understanding of what it is possible to do to a patient, including the ones we currently adopt in death declaration practice in people with a do-not-resuscitate order. For example, our decision about what it is *better* to say would partly appeal to other normative considerations such as rules about bigamy, burials, autopsies, the administration of wills, etc. However, if that is so, why can't we also allow

normative considerations to partly determine what is better to say of those people for whom it is not ethically appropriate to apply CPR or current forms of resuscitation such as ECMO? Where is the fundamental difference between these cases?

There is also a wider sense in which normative considerations intrude into our determination of when someone is dead. Consider the choice between view 2 and view 4. Under view 2, someone is not dead unless they are not revivable given *any* technology, current *or* future. Under view 4, someone is dead if they are not revivable given *current* technology, even if they *would* be revivable given *future* technology. The choice between these two views is not based on a matter of fact but is normative in the wide sense of fixing the meaning of the term "death." Furthermore, whichever view is chosen, it will then be true that we are committed to saying that "irreversible" *must* or *should* mean "irreversible given *any* technology" (if we choose view 2) or "irreversible" *must* or *should* mean "irreversible given *current* technology" (if we choose view 3 or 4). As the words "must" and "should" imply, this recommendation is a normative one. It may not be *ethically* normative—although there are grounds, indicated in the previous paragraph, for thinking that some ethical considerations inform the recommendation we advance—but it is at least *conceptually* normative in so far as it is a recommendation about how we should apply the concepts of death and irreversibility. Since Marquis and followers would *themselves*, in recommending or promoting one of these options, be relying on normative considerations, this undermines their criticisms of those who *also* rely on normative considerations when they say that a person to whom CPR and other resuscitative efforts are inapplicable is dead after the possibility of auto-resuscitation has passed.

2 Arguments from ECMO and the Reality of Permanence

> *[S]hall we say to them they are dead?; or should we not rather speak of different meanings of the word 'dead' and distinguish between say, 'heart-dead' and 'dead' in some other way?*
> *—F. Waismann, The Principles of Linguistic Philosophy (written between 1929–1936)* [33].

We have discussed the extent to which normative considerations can enter even the accounts of those who favor strict irreversibility, noting that this fact (that normative considerations can enter these accounts) seems to undermine criticisms of normative irreversibility. One immediate difficulty with the analogy with non-combustible properties, and dispositional properties such as the property of being dissolvable in *aqua regia*, is that, in the case of human beings, the point at which the dispositional property of being reversible will no longer obtain depends on the specific physiology in the patient (no two patients are ever exactly the same, unlike a sugar cube in water), and on the technology used. In reality, a dispositional account of reversibility presupposes certain background conditions in order to ascertain the point at which the loss of function is no longer reversible. However, these background conditions mean that this point will vary, depending on: (a) whether we are

attempting resuscitation or not, (b) the technology that is widespread in the country concerned, (c) the resuscitation technique used, and (d) physiology and pathology of the patient.

To make this point very clear, we can consider the current medical practice that, once again, is challenging our concept of irreversibility: extracorporeal cardiopulmonary resuscitation (ECPR). This uses an extracorporeal cardiopulmonary membrane oxygenation (ECMO) technology which, over the last decades, has developed to be more portable and easier to instigate in patients following unexpected cardiac arrest. While outcomes are debated, its use and availability is growing [12, 17]. The question for today's medical practitioner evaluating a patient with circulatory–respiratory arrest is: (a) whether to attempt resuscitation or not (e.g., do-not-resuscitate order, other injuries); (b) whether ECPR is available or could be made available; (c) whether the patient should have standard CPR, with higher effort and sustained CPR (e.g., it is typical in younger patients to sustain the attempt for longer before "calling it"), or have ECPR; and (d) how the physiology and pathology of the patient would impact on the above decisions. In each of these decisions, the claim of irreversibility cannot escape the normative elements of intention, decision, technology available, and the often-unknowable elements of individual patient physiology and pathology.

The problem faced by Marquis and others who agree with his argument is this. Suppose we say that a person first becomes irreversible only when the very best technology, like ECPR, would not achieve reversal. We could *theoretically* carry out ECPR on every single patient prior to determining death. In practice, we would never dream of doing so—it not being *appropriate*, in many cases. This is because the ischemic damage to neurologic function would be too severe to achieve a recovery compatible with a patient's values, wishes, or beliefs. The limits of modern ECPR are yet to be fully elucidated [12] but historic animal work suggests the limit for restoring some neurologic function is very long—hours at least [34–37]. However, if mere return of circulation (rather than *good* function) is the goal desired—which when considering death by circulatory–respiratory criteria indicates the patient is still alive—this historic work suggests ECPR (and other resuscitative efforts) can restore circulation way beyond the point at which we normally declare someone to be dead under modern death determination practice [20, 38].

So, on a dispositional account, why aren't we committed to indexing the time of death to when someone would be dead if ECPR had been used but the circulation could not be restored? If we rely on the fact that it is not appropriate to use ECPR on a great many patients, then normative considerations are feeding into the point at which we consider the cessation of circulation to be irreversible—and if normative considerations can come in here, then why can't they come in at the point of auto-resuscitation no longer being possible, as permanence supporters would claim? It would not be appropriate to commence ECPR on an elderly patient with a do-not-resuscitate order in a nursing home once their heart stops. It is not clear what the objection can be to determining death at the point just beyond which auto-resuscitation would no longer be possible, once we accept that all forms of resuscitation are not permitted in the case of those with a do-not-resuscitate order. If we

rely, however, on what it is appropriate to do, then we have not exploited the dispositional potential of the patient in the way that we could have done, notwithstanding that it would not have been appropriate to exploit that dispositional potential. It means that we cannot legitimately declare this elderly patient dead because we do not actually know the point at which their circulation has truly irreversibly ceased. This seems to be an unacceptable consequence of the dispositional view.

A standard move in response to this type of problem is to claim that "it does not matter" that death is declared early because "nothing of any ethical significance" is done to the patient [14]. In contrast, in organ donation contexts—where this debate has been played out—it has been said that "lethal acts" will be performed [14]. The problem with this standard move is that there are other contexts where such "lethal acts" would also be performed (prior to the putative point of irreversibility), such as in warm autopsies. Are we to stop these practices too [32]? And there are many other contexts where the time of death *is* ethically and legally significant. One such context is precisely the one involving the elderly patient: if we know, at the time their heart stops, that they are not *really* dead and could theoretically be revived up to many hours later with ECPR, then their loved ones are being falsely told that they have died. Why isn't this an ethical problem [22]?[14]

3 Irreversibility and Death by Neurologic Criteria

To die: to sleep–
No more—and by a sleep to say we end.
—William Shakespeare, Hamlet Act III, Scene 1

As we indicated in the introduction, determination of death by neurologic criteria has largely avoided the "irreversible" or "permanent" debate. This is changing as new therapies and technological advances make questions on intent to resuscitate just as relevant as in determination of death by circulatory–respiratory criteria. While the mode of resuscitation and treatment may vary, current and future medical practice impacts determination of death by neurologic criteria in similar ways to the alternative views of "irreversible" for death by circulatory–respiratory criteria we outlined above (see Table 3).

Is then a brain resuscitable after a determination of death by neurologic criteria just as a heart is resuscitable after a determination of death by circulatory–respiratory criteria? There is every reason to suspect that it is. In a postmortem case series, Wijdicks and Pfeifer examined the brains of patients following a determination of death by neurologic criteria. They concluded that "No distinctive neuropathologic features were apparent in our series of patients with brain death. Neuronal ischemic changes were frequently profound, but mild changes were present in a third of the examined hemispheres and in half of the brainstems… Neuropathologic

[14] 14. See Gardiner, McGee, and Bernat for other examples, including determining inheritance under a will, which cannot rely on irreversibility but requires permanence [20].

Table 3 How the possibility of current and future medical practice similarly impact the way we might view the meaning of "irreversible" in the determination of death by both circulatory–respiratory and neurologic criteria[a]

View	Explanation
View 1: This is a mere thought experiment having no bearing on current practice and protocols	Thought experiments are standard philosophical practice to help examine the implications of an idea Some of the example medical practices are possible now
View 2: If this technology succeeded, we really would have discovered that people were not dead at the time we had originally assumed	Raises the general problem that it seems to entail that we are never in a position really to know when someone is dead Raises the option to say that we have discovered ways of bringing people back from the dead
View 3: If this technology were discovered, our concept of death would shift at that point, but, at present, it is merely a logical possibility we can ignore	On this view, what counts as "death" is indexed to what is possible given *current* technology Death is instantiated by different paradigms of irreversibility as technology improves. Someone could be in the same physiological state today and tomorrow, yet be dead today and not be dead tomorrow. The definition of death, if it is tied to what counts as "irreversible" given the then current technology, is no longer strictly biological, but carries an intrinsic reference to human capabilities
View 4: We can have different standards of death, depending on the category of patient we are dealing with. The permanence view	It remains appropriate to consider people to whom this medical practice is not appropriate to be dead, and only those to whom it may be appropriate to potentially be still alive Recognizes and accepts an intrinsic reference to human intention and capabilities

[a] Examples of current and future medical practices that might allow for the return of function beyond the time when death by circulatory–respiratory criteria would have been determined by accepted medical standards include cardiopulmonary resuscitation (for patients with do-not-resuscitate orders), sustained standard cardiopulmonary resuscitation, extracorporeal cardiopulmonary resuscitation, and cryopreservation. Examples of current and future medical practices that might allow for the return of function beyond the time when death by neurologic criteria would have been determined by accepted medical standards include therapeutic decompressive craniectomy, BrainEx, and future technologies

examination is therefore not diagnostic of brain death" [39]. While neurologic function may have ceased in the brain for the determination of death by neurologic criteria to be made, there is no pathological reason to suppose that, with enough effort, it could not be theoretically restorable—at least for hours or even days.

Therapeutic decompressive craniectomy is a surgical intervention which removes part of the skull in patients with severe brain swelling in an attempt to reduce life-threatening intracranial pressure. Decompressive craniectomy can be lifesaving, though debate persists as to the quality of outcome, making the decision to use it nuanced [40–43]. Given that neuropathologic changes are not universal in patients determined to be dead by neurologic criteria, it is entirely feasible that were decompressive craniectomy performed in such patients, return of function might occur, reversing their determination of death. An example from the circulatory–respiratory criteria debate is the patient with a do-not-resuscitate order who is resuscitated more than 5 min after cardiac arrest by a

clinician who is unaware the order exists [14, 44, 45]. We now have a similar example case using death by neurologic criteria (although harder to imagine actually happening as decompressive craniectomy requires a whole theatre team) where an unsuspecting neurosurgeon carries out a decompressive craniectomy minutes or even hours after the determination of death. Clearly, the other medical doctors had ruled out decompressive craniectomy as a treatment option prior to their determination of death. They could have based this decision on the availability of decompressive craniectomy in their institution, a judgment on the physiology and pathology of the patient, and the likely impact of this intervention on achieving an outcome consistent with the values, wishes, and beliefs of the patient. If the only gateway to reversibility is an intervention, but that intervention is not appropriate, then we know all there is to know to determine death [32]. This is the permanence standard.

We mentioned above that our imaginary case may be vulnerable to the objection that it is merely a hypothetical case, and that we would later discuss a real-life case. We have done this with ECPR, but there is another interesting real-life case that parallels our imaginary case. Using a custom-made extracorporeal pulsatile–perfusion system and a hemoglobin-based cryoprotective perfusate, scientists and clinicians in Yale School of Medicine restored some cellular functions (specifically vascular and glial responsiveness to pharmacological and immunogenic interventions) in pig brains 4 h after decapitation in a food production slaughterhouse [23]. They also observed spontaneous synaptic activity and active cerebral metabolism during this period. The scientists named their technology, BrainEx.[15]

While a completely different mechanism to what might lead to death by neurologic criteria, some debate arose about whether this new technology undermines the concept of death by neurologic criteria [46–49]. From the above discussions in this chapter, it can be seen that even if BrainEx or a future technology could restore consciousness in a decapitated head, a decision will need to be made about whether to use this technology. BrainEx is to brain function as ECPR is to cardiac arrest. Just as we do not need to await the point at which ECPR could not succeed in order to determine death—because that would be applying a time frame that is inapplicable to this category of patients—so we would not need to await the point at which BrainEx could no longer work before we could determine death on the basis of brain arrest [22]. The BrainEx experiment does not mean we now need to wait a minimum of 4 h to determine death

[15]The authors distinguished between restoring brain function and cellular activity in the brain, being careful to describe the activity as postmortem activity. However, one reason for this is that they were very careful to emphasize that consciousness was not restored (which might imply the authors regarded awareness or consciousness as the criterion of life, which is controversial). Regardless of how the authors themselves describe the results of the study, it is reasonable to regard them as having restored life at least in a minimal sense, but we can in any event imagine that, in future, a greater level of function is restored.

by neurologic criteria. BrainEx technology is discussed further elsewhere in this book.[16]

It is essential to understand, then, that the mere existence of these possibilities, imagined or real, does not throw any doubt on the utility of our current concept of death, which caters perfectly well for the demands of current practice. A relevant factor in this claim is that, in current practice, no person ever recovers from a proper determination of death by neurologic criteria. However, our current concept of death as it stands cannot be expected to budget for every imaginable case in advance, and it makes sense to explore, to a limited degree, the options we have for dealing with new advances in technology enabling us to resuscitate people we cannot resuscitate now. A successor of BrainEx that could restore brain function 2 days after the time at which we currently consider it impossible to bring someone back might call for such a decision to revise the concept, for example (to say either that we have discovered people are not dead when we thought they were, or we have discovered a way to bring people back from death). This decision from that point then determines whether, in a particular case, someone has had their life saved, or has been brought back to life from having been dead. In addition, whatever decision society takes, it remains true that, as with all our previous examples, doctors and families will invariably choose not to use this technology on *each and every* patient because function might be too limited or might not reach an acceptable quality, making it inappropriate to use. We may in that case continue to say that those on whom we do not use the technology are dead at the time we have always declared them to be. The mere introduction of new technologies, then, does not imply that patients who were determined dead before this technology was invented, or who are declared dead at the current applicable timeframes when the technology is not appropriate to use, are no longer known to be dead at the time of that death determination.

Returning to death by neurologic criteria, while we may once have been tempted to consider death by neurologic criteria a retrospective diagnosis, in contrast to a prospective determination of death by circulatory–respiratory criteria, this temptation should be resisted. Medical practice and technological advances raise the same issues of intention and decision for death by neurologic criteria as are raised in the case of death by circulatory–respiratory criteria [22]. A strictly biological concept of "irreversible"—at least if that does not take into account what we consider it appropriate to do to patients—appears poorly positioned to respond to some of the challenges in these shifting technologies. Table 4 shows how the impression of retrospectivity regarding death by neurologic criteria is misleading and, in light of our arguments above, no longer conceptually sustainable.

[16] The same point applies if recent reports about researching the possibility of restoring function to brain-dead people are realized. See https://www.thestatesman.com/lifestyle/health/biotechnology-company-attempts-reverse-state-brain-death-1503044180.html and https://urldefense.com/v3/__https:/www.labroots.com/trending/neuroscience/6401/brain-death-reversed__;!!NVzLfOphnbDXSw!WhN4amr7M17AUI80LPgdOLwl7scACNOBhrhgi8-u-ytXRD0txGb4v-kkb0kkJuqd6Q$

Table 4 Application of "permanent" and "irreversible" perspectives to the typical steps for the determination of death by accepted medical standards

Death by circulatory–respiratory criteria (A prospective determination)	Death by neurologic criteria (The retrospective belief)	Death by neurologic criteria (The prospective reality)
1. Circulatory–respiratory arrest leading to cessation of circulatory and respiratory and neurologic function 2. Decision made not to attempt resuscitation or that further attempts are futile (permanence) 3. Five minutes elapse 4. **Determination of death by accepted medical standard** 5. Restoration of circulatory and respiratory and neurologic function still theoretically possible (permanence) 6. In the absence of resuscitation, organ and cellular injury ensue 7. Restoration of circulatory and respiratory and neurologic function are no longer possible (irreversible)	1. Severe devastating brain injury in an apneic and comatose patient who has absent brainstem reflexes 2. Brain arrest—cessation of neurologic function 3. Neurologic injury judged to be "irreversible" **4. Death suspected** 5. Testing takes time to organize and carry out 6. Even more brain injury **7. Determination of death by accepted medical standard**	1. Severe devastating brain injury in an apneic and comatose patient who has absent brainstem reflexes 2. Brain arrest—cessation of neurologic function 3. Decision made that further attempts at resuscitation or treatment are futile (permanence) **4. Death suspected** 5. Testing takes time to organize and carry out 6. Even more brain injury 7. **Determination of death by accepted medical standard** 8. Restoration of neurologic function still theoretically possible (permanence) 9. In the absence of resuscitation, organ and cellular injury ensue 10. Restoration of neurologic function is no longer possible (irreversible)

4 Conclusion: The Source of Disagreement: Two Rival Conceptions of Death

In our view, the source of the disagreement between those who insist that death requires irreversibility and those who defend permanence is that the former tend to see death as an event, like a flash of lightning, after which there is no way back for the patient. Franklin Miller and Robert Truog, who are sympathetic to the criticisms by Marquis and who have extensively criticized death determination practice, have claimed that death is an event, and that the event is the "moment…when the forces tending to increase entropy irreversibly overcome those that are opposing it…" [15, pp. 70–71]. This is, however, a recommendation that death be understood as an event, and that the event in question be identified with this moment of entropy overcoming the forces that resist it. While it is certainly a plausible recommendation, it is no less a stipulation than the recommendation of those who claim that death by neurologic criteria is death.

It is possible, however, to understand death (and not merely dying) as a process, or a question of degree. For example, all sides in this debate agree that it is not necessary to wait until putrefaction has set in before we can determine there is irreversible loss of function. It is also agreed by all sides that not every cell in the body need have died in order to claim that the organism has died. Yet, in a perfectly innocuous sense, we can claim that a person is "more dead" when putrefaction has set in than they are at the time rigor mortis begins to occur, and even more dead again weeks after putrefaction. If we accept that being dead is a matter of degree, it makes more sense to say of a group of patients for whom resuscitative measures are not even appropriate that the degree of cessation of bodily function shall be considered sufficient for a valid determination of death in their case. It is true that, on this view, a theoretically resuscitable patient can be in the same physiological state as a potential organ donor, yet in one further resuscitative measures are appropriate and in the donor they are not.

Where death is construed as a process rather than as an event, this situation is entirely plausible and expected, since resuscitation, if *successful*, would involve changing the physiological state of a person from the state they are currently in to one they were in earlier (see Fig. 1). However, the mere *possibility* of changing the physiology is not itself such a change. Further, for reasons we have already explored, the situation where one person can be in the same physiological state as another, yet one be alive and the other dead, can also arise with irreversibility at the point at which new medical practice or technology extends the time at which someone can be brought back, so this objection to permanence is not sufficiently strong if the alternative to permanence is irreversibility. We have also seen above that irreversibility is not essential to our concept of death.

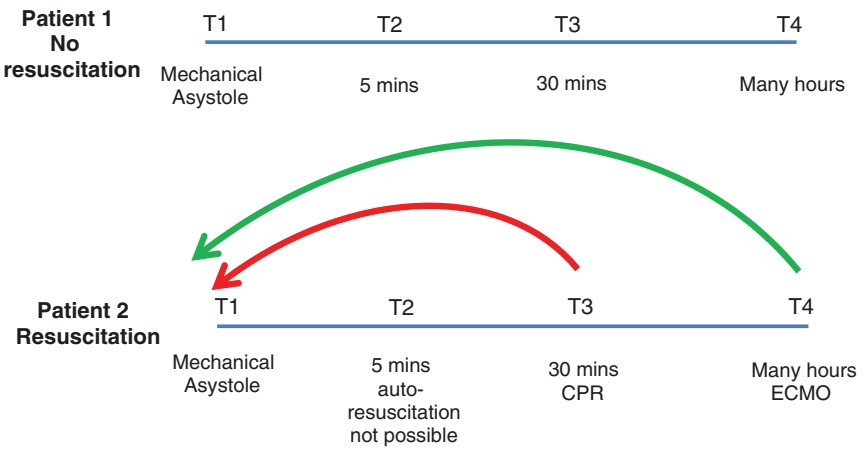

Fig. 1 Gradual loss of functions after mechanical asystole. Illustrating the role of resuscitation and how death is a process

Once we accept that death is a more process than an event, we can say that, during the first few hours of death, death is, in some cases, potentially reversible. Only after many hours does it become irreversible. However, since there is an element of human choice about what we shall call death, society has in practice adopted a compromise between two extremes: the extreme of the layperson (and resuscitation researchers such as Parnia) who claim that someone with a cardiac arrest "died three times" on the way to hospital, and the irreversibility proponents such as Marquis, Joffe, and Nair-Collins who, to be strictly consistent, would require many hours to pass before we could truthfully know that circulation could not be restarted [18, 28–30]. It is this that allows us to wait only 5 min when we know that patients with a do-not-resuscitate order will not be resuscitated, while also not allowing us to say that a person with *no* do-not-resuscitate order is dead at 5 min: the adoption of permanence is a rule about what it is appropriate to do to the patient, and its application is context dependent (in truth, even the irreversibility proponent will declare death before many hours with people who do not have a do-not-resuscitate order).

A final point should be emphasized. Permanence is a defeasible concept, which means permanence obtains *unless* something else occurs. We can compare the logic of declaration by permanence to a vicar's declaration that a couple is now husband and wife in a marriage ceremony. When does the couple become married? When the ceremony is over. However, if the marriage is not consummated, then the marriage is void from the beginning, not merely from the time consummation fails to occur. It is the same with permanence. If resuscitation were attempted and succeeded after a declaration of death, the death declaration would be invalid from the time of the declaration, not the time the resuscitation succeeded. Permanence advocates are not committed to the claim that someone is raised from the dead when the death declaration is overturned—it would not be permanent cessation if the patient were brought back [17]. Yet if resuscitation is not attempted, or attempted and fails, the person is dead from the time of death declaration, not from the time resuscitation is attempted and fails.

Why does permanence have this strange logic? Consider, by analogy, two living-room lights controlled by an automatic dimmer switch. In one room, the light becomes gradually dimmer so that, at some stage, we can uncontestably describe the light in the room as "dim." In the other room, someone overrides the automatic control and turns the light back up again. It is no longer dim in this second room. However, it *was* dim. The light has been brought back from the state of being dim to that of being bright. However, we would neither conclude: (a) that it never *was* dim, nor (b) that the light in the first room never became dim because it, too, *could* have been made brighter by someone overriding the automatic control to turn it up.

This is where dimness, and death, differ. With the dim room, if we bring back the bright lights, the room is no longer dim. In contrast, with the dead person, if we bring back that person through resuscitation, the person never was dead in the first place. Why is there this difference? Death is *sui generis* here. We never say that no object can be called "red" unless it is irreversibly so. Even with the related concept of extinction, bringing back the woolly mammoth would not mean that the woolly

mammoth had never gone extinct. Few predicates require irreversibility as a precondition of their application.

We believe that the difference can be explained by the fact that the requirement of irreversibility reflects an ethical rule in standard cases: everything should be done to try to bring a patient back. People have been dying for 200,000 years but genuine possibilities of reversal (as opposed to early fantasies) only became real in the 1700s. The idea of reversing death is a recent achievement, and we made the decision that reversing what used to be sufficient for death should not be called reversing *death* but instead should mean that death has not occurred. The reason for this is understandable. We do not want to give up on people prematurely, and we do not want to be buried before we are dead. However, this norm is not appropriate in all contexts—e.g., in patients with do-not-resuscitate orders. This is why this debate has arisen: there is a tension between two conflicting practical requirements, and permanence is the perfect solution to it.

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