

## Supplementary Online Content

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### **Supplement 13.** Brain Death/Death by Neurologic Criteria and the Law

This supplementary material has been provided by the authors to give readers additional information about their work.

### **Brain Death/Death by Neurologic Criteria and the Law**

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#### **Abstract**

*Introduction* Declaration of brain death/death by neurologic criteria (BD/DNC) has social, legal and economic consequences. As a result, use of neurologic criteria to declare death must be accepted as legal death.

*Methods* We conducted a review of international legislation, executive orders, decrees, legal guidelines, regulations, case law and literature. We formulated recommendations with an expert panel on laws about determination of BD/DNC. Because many sources were in languages other than English, we utilized Internet translation tools.

*Results and Conclusions* BD/DNC has been legally established in many countries, but the legal requirements for declaration of BD/DNC vary. Additionally, there have been legal controversies about the need for consent prior to declaration of BD/DNC and discontinuation of somatic support after declaration of BD/DNC. Practitioners who make determinations of death must be aware of the legislation, executive orders, decrees, legal guidelines, regulations, case law about BD/DNC in their region. We provide recommendations and suggestions for legal instructions about declaration of BD/DNC.

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#### **Introduction**

In 1968, expert committees from Harvard and the 22<sup>nd</sup> World Medical Assembly published reports stating that advances in resuscitative and supportive measures necessitated the ability to determine the death of a person based on identification of a permanently non-functioning brain.<sup>1, 2</sup> Changing the requirements for death, however, was not straightforward, as it is well acknowledged that declaration of death has personal and societal consequences such as: initiation of mourning, preparation for burial, estate administration, taxes and criminal prosecution. Because of this, the United States President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research determined that death must be defined by law, both to assure public acceptance of determination of brain death/death by neurologic criteria (BD/DNC) and to protect practitioners from being prosecuted for discontinuing somatic support after BD/DNC.<sup>3</sup>

In the fifty years since the Harvard and World Medical Assembly reports, many countries have established a definition of death through legislation, regulation, judicial formulation, executive order, decree or legal guidelines. Herein, we review both the similarities and differences in the legal requirements for BD/DNC around the world and discuss legal challenges to use of neurologic criteria to declare death.

## Methods

To acquire a better understanding of the global legal perspective on BD/DNC, we conducted a scoping review of the literature and international legislation, regulations, judicial formulations, executive orders, decrees and legal guidelines. We utilized internet translation tools as needed to translate these materials into English. We generated recommendations according to the following criteria. Strong recommendations (“It is recommended that”) were based on expert consensus that a policy should be adopted. Conditional or weak recommendations (“It is suggested that”) were generated when there were different perspectives on a policy. In cases where there was uncertainty about a given policy, no recommendations were made.

### Where is BD/DNC Legally Defined?

In the United States, the use of neurologic criteria to declare death was first incorporated into law in 1970 in the state of Kansas by a physician legislator.<sup>3</sup> Due to variance between states in the legal definition of death, the Uniform Determination of Death Act (UDDA) was proposed by the aforementioned President’s Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research, the American Bar Association and the American Medical Association in 1981.<sup>3</sup> The UDDA recognized both BD/DNC and cardiopulmonary criteria in the definition of death.<sup>3</sup> The spirit of the UDDA, if not the language itself, has been adopted by all 50 states, statutorily or judicially.<sup>4</sup>

Like the United States, other countries quickly incorporated BD/DNC into law. Finland was the first country to do this in 1971.<sup>3</sup> In a 2015 review of 91 countries, Wahlster et al. found that BD/DNC was considered legal death in 70% of surveyed countries.<sup>5</sup> They noted that countries that are most likely to support BD/DNC as legal death are located in Europe or other regions that have English speaking populations, transplantation programs and a relatively high per capita income. Their findings demonstrate that most countries that have protocols for determination of BD/DNC also consider BD/DNC legal death (see Figure 1).

We reviewed legislation, regulations, judicial formulations, executive orders, decrees and legal guidelines on death and organ donation from 49 countries (see Table 1) and found that BD/DNC was mentioned in countries from all parts of the globe (including Pan American, European, Western Pacific, Middle Eastern, Southeast Asian and African countries).<sup>6-158</sup> In some countries, death is addressed on a regional level and legal reference to, and definition of, BD/DNC is variably present. For example, in Canada, there is no legal definition of death in Ontario, but there is a definition of death (which includes BD/DNC) in Manitoba and Prince Edward Island.<sup>19, 20, 23, 149</sup> The majority of countries incorporate a definition of BD/DNC in legislation, regulations, judicial formulations, executive orders, decrees and legal guidelines about organ and tissue donation.<sup>6-13, 15, 18, 19, 28-31, 34, 36, 38, 39, 47-51, 55-60, 104, 105, 120, 121, 124-126, 130, 131, 135, 137, 141, 143, 144, 147, 148, 151, 152</sup>

The number of countries that legally accept BD/DNC as death continues to increase. Most recently, after the Vice President of Wuxi People’s Hospital campaigned for four years for BD/DNC to be incorporated into China’s legal definition of death, China’s legislative body recognized the need to do so in October 2018.<sup>159</sup>

### How is BD/DNC Legally Defined?

The legal definitions of death around the world vary both among and within countries; in Australia, Canada and the United States, the legal guidance about BD/DNC varies by region.<sup>4, 5, 8-13, 16-27, 151, 152</sup> Interestingly, we identified some countries with legal references to BD/DNC that do not provide a definition of BD/DNC (e.g. Malta, Nepal and Slovenia).<sup>45, 53, 140, 147</sup> Where there is a legal definition of BD/DNC, there is

variability across five dimensions: (1) the anatomical region of focus, (2) the medical criteria, (3) who can declare BD/DNC, (4) the number of physicians required to declare BD/DNC, and (5) the focus on irreversibility.

**1. Anatomical Region of the Brain.** One inconsistency in legal definitions of BD/DNC is the anatomical region of focus.<sup>160</sup> This legal variability reflects the conceptual differences by the medical communities in different countries, which is discussed in detail elsewhere. The legal definitions of BD/DNC in Costa Rica, Czech Republic, Hungary, Israel, Japan and Venezuela require cessation of all functions of the entire brain, including the brainstem.<sup>29, 31, 38, 41, 104, 120, 125, 130, 131</sup> The legal definitions of BD/DNC in Australia, Canada (Manitoba), Denmark, Italy and Qatar require cessation of all brain functions, but do not specifically reference the brainstem.<sup>8-13, 18, 19, 32, 42, 50, 127, 128, 132, 133, 151, 152</sup> In the United States, some jurisdictions require irreversible cessation of all functions of the entire brain, including the brainstem, while others refer to the whole brain, but do not mention the brainstem.<sup>4</sup> The legal requirements for BD/DNC in Croatia, Germany and Norway specify that there must be cessation of function of the cerebrum, cerebellum and brainstem.<sup>30, 36, 48, 126, 135, 146</sup> While there is no statutory definition of death in the United Kingdom, British courts have adopted the criteria of the Conference of Medical Royal Colleges, which require the cessation of functions of only the brainstem.<sup>62, 160-162</sup> Similarly, the legal definitions of BD/DNC in India and Trinidad and Tobago's reference only brainstem death.<sup>39, 60, 144</sup>

**2. Medical Criteria.** Another aspect of legal requirements for BD/DNC that varies is specification of the criteria by which BD/DNC should be determined. A paucity of countries that include BD/DNC in their definition of death do not mention medical standards (e.g. Bulgaria, Finland, Greece and Indonesia).<sup>15, 34, 37, 40</sup> Of those that mention medical standards, the degree of detail on these standards varies.

In the United States, most jurisdictions neither specify nor specifically identify the relevant criteria for determination of BD/DNC, and instead note that BD/DNC should be determined in accordance with "accepted medical standards," "ordinary standards of current medical practice," "generally accepted medical standards," or "usual and customary standards of medical practice."<sup>4</sup>

In some cases, legislation, regulations, judicial formulations, executive orders, decrees or legal guidelines on BD/DNC identify externally developed criteria that should be seen as authoritative.<sup>51, 163, 164</sup> For example, Russian law stipulates that BD/DNC must be determined based on procedures approved by the federal executive authorities that are responsible for development and implementation of public health policies.<sup>51</sup>

Similarly, in the United States, two states have laws that mention the medical criteria that should be employed when determining BD/DNC.<sup>163, 164</sup> The State of Nevada updated its definition of BD/DNC in 2017 after the Supreme Court of Nevada indicated that it was not clear what criteria to employ to determine BD/DNC. The Nevada definition now says that determinations of BD/DNC must be made in accordance with 1) criteria on determination of BD/DNC in adults published by the American Academy of Neurology in 2010 or 2) criteria on determination of BD/DNC in infants/children published by the American Academy of Pediatrics/Child Neurology Society/Society of Critical Care Medicine in 2012, or any subsequent revisions of either of these documents by these societies or their successor organizations.<sup>163</sup>

In New Jersey, the legal definition of BD/DNC notes that clinicians must make determinations of BD/DNC in accordance with currently accepted medical standards based upon nationally recognized sources

of practice criteria, “including, without limitation, guidelines adopted by the American Academy of Neurology.”<sup>164</sup>

In the absence of specific statutory guidance, Canadian and British courts have specified the medical criteria to be followed when a determination of BD/DNC is being made.<sup>149, 150</sup> In June 2018, the Ontario Superior Court of Justice determined that the Canadian common law definition of death includes BD/DNC as determined by medical criteria published in the Canadian Medical Association Journal.<sup>149</sup> In 2015, the medical criteria published by the Academy of Medical Royal Colleges was identified to be the accepted criteria for determination of BD/DNC in the United Kingdom.<sup>150</sup>

In many parts of the world, the clinical criteria for BD/DNC is specified in legislation, regulations, judicial formulations, executive orders, decrees or legal guidelines.<sup>30, 31, 35, 41, 42, 44, 46, 56, 58, 83, 104, 105, 116, 121-125, 128-130, 135, 136, 138-140, 145-148, 150, 155, 156, 164, 165</sup> These criteria are often determined by the Ministry of Health.<sup>44, 48, 49</sup>

Legally specified criteria for determination of BD/DNC are inconsistent. See Table 2. Some countries require assessment of more reflexes than are specified in our Minimum Clinical Criteria for Determination of BD/DNC chapter (the oculocardiac reflex is legally required in Sweden and the atropine test is legally required in Croatia and Spain).<sup>30, 56, 58</sup>

Additionally, discordant with the Beyond Minimum Criteria chapter, a few countries legally mandate the performance of non-clinical tests to make a declaration of BD/DNC.<sup>35, 41, 42, 46, 105, 135</sup> France requires either two 30-minute electroencephalograms performed at least four hours apart that demonstrate absence of reactivity or an angiogram that demonstrates absence of intracranial circulation.<sup>35</sup> Mexico similarly requires an electroencephalogram that shows electrocerebral silence or a blood flow study that shows absence of intracranial blood flow.<sup>46</sup> In Vietnam, it is necessary to perform an electroencephalogram, computed tomography scan with contrast, transcranial Doppler ultrasound, nuclear scan or angiogram to assess for intracranial blood flow.<sup>105</sup> The law in Israel broadly indicates that a test by instruments must prove the complete and irreversible cessation of neurologic function.<sup>41</sup> In Italy, an electroencephalogram is required for all determinations of BD/DNC.<sup>42</sup> In Norway, it is necessary to objectively show that there is no blood flow to the brain, but the means to do so is not specified.<sup>135</sup>

**3. Who Can Declare BD/DNC?** The legislation, regulations, judicial formulations, executive orders, decrees and legal guidelines about BD/DNC in most countries indicate who is qualified to make a BD/DNC determination.<sup>6-147, 149, 150</sup> In many countries, at least one examiner must be a physician with a particular specialty (e.g. anaesthesiology, cardiology, emergency medicine, intensive care, neurology, neurosurgery, paediatrics). In Israel, physicians who can determine BD/DNC must be accredited by a ten-person committee. This must include the chairman of the Israel Medical Association’s Scientific Council, three doctors, three rabbis, a representative from the field of ethics, a representative from the field of philosophy, and a representative from the field of jurisprudence (one who must be a doctor and one who must belong to a non-Jewish religious community).<sup>41</sup>

Some countries, such as Singapore, stipulate that the examining physician cannot be involved in the care of the person before the determination.<sup>139</sup>

Finally, to prevent concerns that the motivation behind BD/DNC declaration is the desire to obtain a person’s organs, the legislation, regulations, judicial formulations, executive orders, decrees and legal

guidelines about BD/DNC in many countries prohibit the clinician responsible for declaring death from partaking in procedures to remove the person's organs for transplantation (e.g. Canada, Israel, Qatar and the United States) and to be involved in the selection or care of the proposed recipient of the person's organs (e.g. Singapore).<sup>4, 16-27, 41, 50, 139</sup>

**4. Number of Physicians to Declare Death.** The number of physicians required to declare BD/DNC is specified in most, but not all, legislation, regulations, judicial formulations, executive orders, decrees and legal guidelines about BD/DNC.<sup>6-147, 149, 150</sup> In countries where this is delineated, the number of physicians ranges from 1-4.

In the United States, the UDDA did not mandate the number of physicians required to declare BD/DNC.<sup>3</sup> However, in some state codes such as those in California, Florida, Iowa, and Kentucky, BD/DNC requires two physicians.<sup>106-109</sup> In contrast, Alabama, Georgia, and Virginia require only a single clinician.<sup>110, 112, 113</sup> There are also some states that require “independent confirmation” or “an additional physician” for transplantation purposes.<sup>4</sup> In this vein, it is interesting to note that legislation requiring more than one physician to declare death is largely related to organ and tissue donation.

**5. Irreversibility.** The words “irreversible” and “permanent” are used interchangeably in legal definitions of death, prompting confusion. While the word “irreversible” is used in the majority of legal definitions of death, “permanent” is also used in some countries (e.g. Hungary, India and Poland), “permanent” is used without “irreversible” in Mexico, and neither word is used in Finland, Indonesia and Vietnam.<sup>6-154</sup> Both “irreversible” and “permanent” can be defined as the inability to reverse the relevant vital function, but “irreversible” could also be defined by noting that no attempt will be made to reverse the relevant vital function. While the definition of “irreversible” is salient when defining circulatory determination of death (because it is sometimes possible, if attempts are made, to restart the heart after cessation of circulation), the difference between the aforementioned interpretations of “irreversible” is less relevant when discussing neurologic injury because determination of BD/DNC is always a retrospective determination showing that an event has already occurred.<sup>4, 166</sup> However, this difference is relevant when considering whether or not all interventions that theoretically could prevent transition to BD/DNC (such as placing an external ventricular drain) should be performed before BD/DNC is declared.

### **Legislative and Judicial Response to Religious Objections to BD/DNC**

BD/DNC is not universally accepted as death by members of all religious faiths.<sup>167, 168</sup> As a result, Israel and some states in the United States have enacted laws regarding accommodation of religious objections to use of neurologic criteria to declare death.<sup>41, 115-118</sup> In New Jersey, the law is more stringent; it specifies that BD/DNC cannot be declared over the objection of a person's family member based on the person's religious or moral beliefs.<sup>119</sup> Some examples of legal accommodation of religious objections to the use of neurologic criteria to declare death are provided in Table 3.

However, religious objections to BD/DNC are not legally acknowledged universally.<sup>4</sup> In Trinidad and Tobago, the law states that “religious and cultural requests shall be met as far as possible, before and after the discontinuance,” but notes that the decision to discontinue organ support rests solely with the medical practitioner responsible for the decedent.<sup>60</sup> In Croatia and Lithuania, the law specifically notes that all

treatment should be terminated after determination of BD/DNC, unless organ or tissue donation is planned.<sup>30,</sup>  
<sup>44</sup> Additionally, a recent case in Canada resulted in the decision that a decedent cannot be religiously discriminated against, because death represents the end of personhood and thereby is associated with a loss of the rights to freedom of religion, thought, expression, liberty, security and equality; as such, an individual declared brain dead is not a person for whom treatment is required, so it is not necessary to obtain consent from a substitute decision maker to discontinue somatic support.<sup>149</sup>

A few cases that address religious objections to BD/DNC in Canada, the United Kingdom and the United States are included in Table 4.

### **Legislative and Judicial Perspective on the Need for Consent from a Substitute Decision Maker Prior to Determination of BD/DNC**

In light of religious objections to BD/DNC in the United States and Canada, there has been some discussion about whether or not consent by a person's substitute decision maker is required prior to determination of BD/DNC or removal of somatic support after declaration.<sup>169, 170</sup> See Table 5. Courts in the United States have reached conflicting decisions about this issue.<sup>171, 172</sup> In some cases, courts determined that consent is not required for determination of death or discontinuation of somatic support.<sup>172, 173</sup> In other cases, courts determined that 1) it is not legally mandated that an evaluation for determination of BD/DNC be performed if it is suspected that a person is dead by neurologic criteria, 2) it is not up to a hospital/clinician to decide whether or not to perform an assessment for declaration of BD/DNC, and 3) a person's surrogate that is of sound mind has the right to choose or refuse whether or not a medical procedure, such as determination of BD/DNC, is performed.<sup>171, 174</sup>

To eliminate uncertainty, the State of Nevada revised its definition of death in 2017 to clarify that consent is not required to perform an evaluation for determination of BD/DNC. Similarly, the New York legal guidelines on BD/DNC indicate that consent is not required for determination of BD/DNC.<sup>175</sup> Most other regions, however, do not provide legal guidance on this issue.<sup>163, 176</sup>

### **Other Legal Challenges to BD/DNC**

Legal challenges to BD/DNC address two other issues. First, some cases question whether specific medical criteria for determination of BD/DNC should be specified by law.<sup>177</sup> Second, some cases question how to handle BD/DNC in pregnancy.<sup>178</sup> See Tables 6 and 7.

### **Recommendations and Suggestions**

1. It is recommended that all countries recognize BD/DNC as legal death.
2. It is recommended that practitioners be protected from legal action for making determinations of BD/DNC.
3. It is recommended that it should be legally stipulated that while practitioners involved in determination of BD/DNC can be involved in provision of somatic support of potential organ donors, they should not be involved in organ procurement or transplantation.
4. It is suggested that it should be legally stipulated that when there are multiple practitioners who are qualified to determine BD/DNC and care for potential transplant recipients, the practitioner(s)

involved in determination of BD/DNC not concurrently be involved in the care of a potential transplant recipient.

5. It is suggested that legislation, regulations, judicial formulations, executive orders, decrees or legal guidelines about BD/DNC specify the locally accepted medical criteria written by experts involved in the process of determination of BD/DNC to be employed when making a determination of BD/DNC while allowing latitude for future versions of such criteria generated by the medical community.
6. It is suggested that legislation, regulations, judicial formulations, executive orders, decrees or legal guidelines about BD/DNC address management of objections to use of neurologic criteria to declare death.
7. It is suggested that legislation, regulations, judicial formulations, executive orders, decrees or legal guidelines about BD/DNC indicate that there is no need for consent for performance of the clinical evaluation, apnea testing or ancillary testing for determination of BD/DNC.
8. It is suggested that legislation, regulations, judicial formulations, executive orders, decrees or legal guidelines indicate that once BD/DNC has been confirmed in accordance with regional medical criteria, consent should not be required for the discontinuation of somatic support.

### Questions to Inform Research Agendas

1. How frequently is legal action taken against practitioners/medical facilities after they've made a determination of BD/DNC?
2. How frequently is legal action taken against practitioners/medical facilities to prevent determination of BD/DNC?
3. What are common characteristics of families who take legal action against practitioners/medical facilities prior to or following determination of BD/DNC?
4. Does legally stipulating the specific medical standard by which BD/DNC should be declared prevent inaccurate determinations?
5. Does legal provision for accommodation to objections to declaration of BD/DNC affect the number of objections to BD/DNC?
6. Does the absence of legal provisions for accommodation to objections to declaration of BD/DNC affect the number of objections to BD/DNC?

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**Table 1. Summary of Death legislation/regulations/legal guidelines/executive orders/decrees/ judicially accepted criteria from select countries**<sup>6-158, 179, 180</sup>

	Country	Reference/ Definition of BD/DNC				Anatomical Region in Definition					Medical Criteria			Who can declare BD/DNC?			Number of physicians to declare BD/DNNC	Irreversible vs. Permanent		
		BD/DNC defined	Definition included in ODT criteria	BD/DNC referenced but not defined	No reference to BD/DNC	Brainstem	Cerebrum	Cerebellum	Whole brain	Not specified	Medical Criteria / Standards Specified	Accepted medical	No Medical Criteria / Standards Referenced	Any physician	Physician specialist	Person declaring BD/DNC cannot		Irreversible	Permanent	Not specified
1	Argentina	•	•						•	•				•	•		2	•		
2	Armenia	•	•						•					•		•	NS	•		
3	Australia*	•	•						•					•	•		2	•		
4	Bangladesh	•	•			•				•				•			2			•
5	Brazil	•				•	•			•					•	•	2	•	•	
6	Bulgaria	•	•						•					•	•		3	•		
7	Canada*^	•	•	•	•				•	•	•			•	•		2	•		
8	Chile	•	•						•	•					•	•	2	•		
9	Colombia	•	•			•				•					•	•	2	•		
10	Costa Rica	•	•			•	•		•	•					•	•	3	•		
11	Croatia	•	•			•	•	•	•	•					•	•	2	•		
12	Czech Republic	•	•			•			•	•					•	•	2	•		
13	Denmark	•							•	•					•	•	2	•		
14	Estonia	•							•	•					•	•	2	•		
15	Finland	•	•						•						•		NS			•
16	France			•						•				•	•		2	•		
17	Germany	•	•			•	•	•	•	•					•	•	2	•		
18	Greece			•											•	•	3			•
19	Hungary	•	•			•			•	•					•	•	3	•	•	
20	India	•	•			•				•					•		4	•	•	
21	Indonesia			•											•	•	2			•
22	Israel	•				•			•	•					•	•	2	•		
23	Italy	•							•	•					•	•	3	•		
24	Japan	•	•			•			•	•					•	•	2	•		
25	Kuwait				•															
26	Lithuania	•							•	•					•	•	3	•		
27	Malta			•						•							1			•
28	Mexico			•						•					•		1		•	
29	Nepal			•					•	•					•		2	•		
30	New Zealand				•															
31	Norway	•	•			•	•	•	•	•					•	•	2	•		
32	Poland	•	•						•	•					•	•	3	•	•	
33	Qatar	•	•						•						•	•	3	•		
34	Russia	•	•						•	•					•	•	2	•		
35	Singapore	•							•	•					•	•	2	•		

	Country	Reference/ Definition of BD/DNC				Anatomical Region in Definition					Medical Criteria			Who can declare BD/DNC?			Number of physicians	Irreversible vs. Permanent		
		BD/DNC defined	Definition included in OTDT criteria	BD/DNC referenced but not defined	No reference to BD/DNC	Brainstem	Cerebrum	Cerebellum	Whole brain	Not specified	Medical Criteria / Standards Specified	* Accepted medical	No Medical Criteria / Standards Referenced	Any physician	Physician specialist	Person declaring BD/DNC cannot		Number of physicians to declare BD/DNNC	Irreversible	Permanent
36	<i>Slovenia</i>			•						•				•	•	3			•	
37	<i>South Africa</i>			•								•	•	•	•	2			•	
38	<i>South Korea</i>	•	•					•		•				•	•	3-4	•			
39	<i>Spain</i>	•	•						•	•				•	•	3	•			
40	<i>Sri Lanka</i>	•	•					•			•			•	•	NS	•			
41	<i>Sweden</i>	•						•		•				•	•	1-2	•			
42	<i>Switzerland</i>	•	•			•		•		•						NS	•			
43	<i>Trinidad and Tobago</i>	•	•			•				•				•	•	2	•			
44	<i>Turkey</i>			•						•				•	•	2			•	
45	<i>United Kingdom</i> <sup>^</sup>	•				•				•						2	•	•		
46	<i>United States</i> <sup>*^</sup>	•			•	•		•		•	•	•		•	•	1-2/NS	•			
47	<i>Uruguay</i>			•								•		•	•	2	•			
48	<i>Venezuela</i>	•	•			•		•		•				•	•	3	•	•		
49	<i>Vietnam</i>	•	•					•		•				•	•	3			•	

Data is based on the references noted here, but it is possible there is other legislation/regulations/legal guidelines/executive orders/decrees that address BD/DNC that we did not locate. \*Compilation of regional legislation. ^Includes judicially defined criteria. OTDT=organ and tissue donation and transplantation.

**Table 2. Medical criteria included in BD/DNC legislation/regulations/guidelines/executive orders/ decrees/judicially accepted criteria from select countries**<sup>30, 31, 35, 41, 42, 44, 46, 56, 58, 83, 104, 105, 116, 121-125, 128-130, 135, 136, 138-140, 145-148, 150, 155, 156, 164, 165, 179-182</sup>

	Country	Prerequisites						Coma			Brainstem Areflexia							Inability to breathe spontaneously		Ancillary testing required*	Number of Exams
		Identify etiology for injury	Exclude confounders (general)	Exclude specific confounders	Observation time specified	Temperature specified	Blood pressure specified	Noted as a requirement	Testing is described	Noted that spinal reflexes can be present	Specified broadly	Pupillary reflex	Corneal reflex	Oculocephalic reflex	Oculovestibular reflex	Gag reflex	Cough reflex	Other reflex(es)	Noted as a requirement but testing is not described		
1	Argentina	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•		•		1
2	Bangladesh	•	•		•			•		•								•			1
3	Brazil	•		•	•	•	•	•	•	•	•	•	•	•	•	•			•		2
4	Canada <sup>a</sup>	•		•		•		•		•	•	•	b	•	•	•			•		1-2
5	Chile	•		•	•	•		•		•	•	•	•	•	•	•		•		c	1-2
6	Colombia	•		•		•		•		•	•	•	•	•	•	•		•			2
7	Costa Rica	•		•	•	•	•	•		•	•	•	•	•	•	•	•	•			1
8	Croatia	•		•	•	•	•			•	•	•	•	•	•	•	•		•	•	2
9	Czech Republic	•		•				•		•				•	•	•		•			1-2
10	Denmark	•		•	•	•		•		•								•			2
11	Estonia	•		•				•		•								•			2
12	France							•		•								•		•	NS
13	Germany	•		•	•			•		•	•	•	•	•	•	•	•	•			2
14	Hungary	•		•	•	•		•		•	•	•	•	•	•	•	•		•		3
15	Israel	•	•															•			NS
16	Italy	•		•	•			•		•	•	•		•	•	•	•		•	•	2
17	Japan	•		•		•	•	•		•	•	•	•	•	•	•	•		•		2
18	Lithuania	•		•	•	•		•		•	•	•	•	•	•	•	•		•		3-5
19	Mexico			•				•		•	•		•					•		•	NS
20	Nepal	•		•		•	•	•	•	•	•	•	•	•	•	•	•		•		2
21	Norway	•		•		•		•		•								•		•	NS
22	Poland	•		•	•	•		•	•	•	•	•	•	•	•	•	•		•		2
23	Russia	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	d	1-5
24	Singapore	•		•				•	•	•	•	•	•	•	•	•	•		•		NS
25	Slovenia	•		•				•		•	•	•	•	•	•	•	•	•		e	2
26	Spain	•		•	•	•		•	•	•	•	•	•	•	•	•	•		•		1-2
27	Sweden							•	•	•		•		•			•	•			2
28	Trinidad and Tobago	•		•	•			•	•	•	•		•						•		2-4
29	United Kingdom <sup>f</sup>	•		•		•		•		•	•	•		•	•	•	•		•		2
30	United States <sup>g</sup>	•		•		•	•	•	•	•	•	•	•	•	•	•	•		•		1-2
31	Venezuela			•				•	•	•								•			3
32	Vietnam	•		•	•	•		•		•	•	•	•		•				•	•	3

Data is based on the references noted here, but it is possible there is other legislation/regulations/legal guidelines/executive orders/decrees that address BD/DNC that we did not locate. \*In circumstances other than when the clinical exam and apnea test cannot be completed. a:Judicially defined criteria in Ontario. b: Required for patients <1 year of age. c=Required for patients <15 years of age. d: Required if the observation period is shortened or the number of exams is reduced. e: Required in pediatric persons of unspecified age. f: Judicially defined criteria. g: Criteria in New York, New Jersey, Nevada



**Table 3. Examples of laws/legal guidelines about accommodation to religious objections to use of neurologic criteria to declare death**<sup>41, 115, 116, 118, 119, 183</sup>

Jurisdiction	Law/Legal Guideline
<b>California, United States</b>	<p>“A general acute care hospital shall adopt a policy for providing family or next of kin with a reasonably brief period of accommodation . . . from the time that a patient is declared dead by reason of irreversible cessation of all functions of the entire brain . . . through discontinuation of cardiopulmonary support for the patient.”</p> <p>“If the patient’s legally recognized health care decision-maker, family, or next of kin voices any special religious or cultural practices and concerns of the patient or the patient’s family surrounding the issue of death by reason of irreversible cessation of all functions of the entire brain of the patient, the hospital shall make reasonable efforts to accommodate those religious and cultural practices and concerns.”</p>
<b>Illinois, United States</b>	<p>“Every hospital must adopt policies and procedures to allow health care professionals, in documenting a patient’s time of death at the hospital, to take into account the patient’s religious beliefs concerning the patient’s time of death.”</p>
<b>Israel</b>	<p>“The aforesaid provisions of this Act notwithstanding, should cerebral-respiratory death have been determined, and this determination be incompatible with the patient’s religion or worldview according to information supplied by his family members, the patient shall not be disconnected from a ventilator, and the treatment directly supporting this respiratory procedure shall not be halted, until heart function ceases.”</p>
<b>New Jersey, United States</b>	<p>“Hospitals should establish written procedures for the acknowledgement of the patient’s religious beliefs, if the examining physician has reason to believe, on the basis of information in the patient’s available medical records, or information provided by a member of the patient’s family or any other person knowledgeable about the patient’s personal religious beliefs, that such a declaration of death by neurological criteria would violate the personal religious beliefs of the patient. In these cases, death shall be declared, and the time of death fixed, solely upon the basis of cardio-respiratory criteria.”</p>
<b>New York, United States</b>	<p>“Hospitals must establish written procedures for the reasonable accommodation of the individual’s religious or moral objections to use of the brain death standard to determine death when such an objection has been expressed by the patient prior to the loss of decision-making capacity, or by the surrogate decision-maker. Policies may include specific accommodations, such as the continuation of artificial respiration under certain circumstances, as well as guidance on limits to the duration of accommodation.”</p>

**Table 4. Legal challenges seeking accommodation of religious objections to BD/DNC**<sup>149, 161, 184, 185</sup>

Case	Region	Year	Key Points
<b>A Child, 19-months-old</b>	United Kingdom	2015	<ul style="list-style-type: none"> <li>• A Child had anoxic brain injury after choking.</li> <li>• He was declared BD/DNC, but his parents objected to discontinuation of somatic support based on their Muslim beliefs.</li> <li>• The coroner brought the case to the High Court of England and Wales when the body was not delivered to him after determination of death.</li> <li>• The High Court found that somatic support should be discontinued (2 days after determination of BD/DNC).</li> </ul>
<b>Taquisha McKitty, 27-years-old</b>	Toronto, Canada	2017	<ul style="list-style-type: none"> <li>• Taquisha had anoxic brain injury after overdosing on drugs.</li> <li>• She was declared BD/DNC, but her father objected to discontinuation of somatic support and filed a lawsuit, citing religious beliefs.</li> <li>• In June 2018, the Ontario Superior Court ruled that support could be discontinued, but Taquisha’s father filed an appeal.</li> <li>• As of March 8, 2019, no decision from the Ontario Court of Appeal has been rendered.</li> </ul>
<b>Shalom Ouanounou, 25-years-old</b>	Toronto, Canada	2017	<ul style="list-style-type: none"> <li>• Shalom had anoxic brain injury after an asthma attack.</li> <li>• He was declared BD/DNC, but his family objected to discontinuation of somatic support based on their Orthodox Jewish beliefs.</li> <li>• A lengthy legal battle ensued until he had a cardiopulmonary arrest 5 months after being declared BD/DNC.</li> <li>• The Judge did not render a decision and deferred to the appellate court hearing the McKitty case.</li> </ul>
<b>Israel Stinson, 2-years-old</b>	California, USA	2016	<ul style="list-style-type: none"> <li>• Israel had anoxic brain injury after an asthma attack.</li> <li>• He was declared BD/DNC, but his mother objected to discontinuation of somatic support based on her Christian beliefs that he could be healed.</li> <li>• After a one-month legal battle, he was transferred to a facility in Guatemala.</li> <li>• After three months in Guatemala, he was transferred back to a hospital in the US.</li> <li>• Because he had been declared BD/DNC, the hospital was given permission by the district court to discontinue somatic support shortly after he was admitted (4 months after determination of BD/DNC).</li> <li>• Israel’s family filed a federal lawsuit alleging it is unconstitutional that California does not provide a religious exemption to determination of BD/DNC. As of May 10, 2019, no decision from the U.S. Court of Appeals for the Ninth Circuit was rendered.</li> </ul>

**Table 5. Legal challenges to the administration of BD/DNC testing**<sup>172, 174, 176, 186, 187</sup>

Case	Region	Year	Key Points
<b>Allen Callaway, 6-years-old</b>	Montana, USA	2016	<ul style="list-style-type: none"> <li>• Allen had anoxic brain injury after drowning.</li> <li>• Allen’s mother consented to allow the hospital to perform procedures to determine the condition of his brain, but after an initial apnea test, she refused further testing and filed a lawsuit, stating that she has the right to make medical decisions on her child’s behalf.</li> <li>• The District Court ruled that the hospital could not perform the test because Montana law does not mandate that clinicians perform a brain death evaluation and performance of a medical procedure on a child requires parental consent.</li> </ul>
<b>Mirrandra Grace Lawson, 2-years-old</b>	Virginia, USA	2016	<ul style="list-style-type: none"> <li>• Mirrandra had anoxic brain injury after choking.</li> <li>• The hospital wanted to perform an evaluation for determination of BD/DNC, but her parents objected to apnea testing and filed a lawsuit, citing their Christian beliefs and concern that the test would be harmful.</li> <li>• The Virginia Circuit Court ruled the test could be performed, but the family appealed the decision.</li> <li>• Mirrandra went into cardiopulmonary arrest and was declared dead by cardiopulmonary criteria.</li> <li>• The appeal was withdrawn.</li> </ul>
<b>Alex Pierce, 13-years-old</b>	California, USA	2016	<ul style="list-style-type: none"> <li>• Alex had anoxic brain injury after drowning.</li> <li>• The hospital wanted to perform an evaluation for determination of BD/DNC, but his parents objected to apnea testing and filed a lawsuit, citing concern that it could be harmful and that based on her Christian beliefs, she felt he could recover.</li> <li>• A temporary restraining order was issued and the test was not performed.</li> <li>• Alex was relocated to another facility where somatic support was discontinued.</li> <li>• No legal ruling was made.</li> </ul>
<b>Brett Shively, Jr., 2-years-old</b>	Kansas, USA	2006	<ul style="list-style-type: none"> <li>• Brett had anoxic brain injury after nearly drowning.</li> <li>• The hospital wanted to perform an evaluation for determination of BD/DNC, but his parents objected to apnea testing.</li> <li>• The District Court ruled that the hospital could not perform apnea testing over his parents’ objections.</li> <li>• Brett was discharged home on somatic support.</li> <li>• The case was escalated to the Court of Appeals but they dismissed the case on the grounds that the issue was moot.</li> </ul>

**Table 6. Legal challenges to declaration of BD/DNC or management after BD/DNC<sup>4, 177, 188</sup>**

Case	Region	Year	Key Points
<b>Jahi McMath, 13-years-old</b>	California, USA	2013	<ul style="list-style-type: none"> <li>• Jahi had anoxic brain injury after a cardiac arrest.</li> <li>• The hospital declared her BD/DNC, but her mother objected to discontinuation of somatic support.</li> <li>• A lengthy legal battle ensued and somatic support was continued for one month at which point Jahi's mother found an accepting facility in New Jersey and transferred her there.</li> <li>• Support was continued and multiple lawsuits were ongoing until she had a cardiopulmonary arrest in 2018.</li> </ul>
<b>Aden Hailu, 20-years-old</b>	Nevada, USA	2015	<ul style="list-style-type: none"> <li>• Aden had an intraoperative anoxic brain injury during an exploratory laparotomy.</li> <li>• The hospital declared her BD/DNC, but her father objected to discontinuation of somatic support.</li> <li>• The district court ruled that somatic support should be discontinued because the American Academy of Neurology (AAN) criteria for BD/DNC were met.</li> <li>• The Supreme Court of Nevada ruled that it was unclear if the AAN criteria were the accepted medical standards, so somatic support should be continued.</li> <li>• The legal battle continued, but the case was dropped after Aden's cardiopulmonary arrest in early 2016.</li> </ul>

**Table 7. Legal challenges to declaration of BD/DNC in pregnant patients<sup>189</sup>**

Case	Region	Year	Key Points
<b>Marlise Muñoz, 33-years-old</b>	Texas, USA	2013	<ul style="list-style-type: none"><li>• Marlise had anoxic brain injury after a cardiac arrest.</li><li>• The hospital declared her BD/DNC, but refused to discontinue somatic support because she was 14 weeks pregnant, citing the Texas Health and Safety Code which requires continued treatment of pregnant patients with severe brain injuries.</li><li>• Her husband filed a lawsuit asking the court to direct the hospital to discontinue support.</li><li>• The court declared that this provision of the Code did not apply to brain dead people and directed the hospital to discontinue support two months after Marlise was declared BD/DNC.</li></ul>

**Figure 1: Results from Wahlster et al. 2015 review of countries with protocols and/or laws about BD/DNC<sup>5</sup>**

