Brain Death/Death by Neurologic Criteria (BD/DNC)
FAQs for Healthcare Professionals

Question 1: *There can often be a significant time lag between when BD/DNC occurs physiologically and when BD/DNC is determined. The longer this gap is, the less stable the patient can become, the more anxious the family can become, and the less viable the organs can become if the patient does become a donor. How does one approach this time lag?*

BD/DNC determination should always be carried out in the most meticulous manner, erring on the side of conservatism, i.e., not completing a BD/DNC evaluation unless all prerequisites are appropriately met. The determination should never be rushed or performed under uncontrolled circumstances. Additionally, the family should be appropriately educated about the evaluation and its implications. Once this is done and there are no confounding factors, the evaluation should proceed expeditiously. BD/DNC determination requires champions at individual hospitals to change the culture and advocate for proactive physiological management. Another important step would be to institute a Devastating Brain Injury Protocol with the help of leaders in the institution.

Question 2: *What is the appropriate blood pressure for a BD/DNC evaluation in adults and children?*

In adults, the systolic blood pressure must be $\geq$100mmHg and the MAP must be $\geq$75mmHg for clinical and apnea testing. In children, the systolic blood pressure and MAP must be $\geq 5^{th}$ percentile for age. If a patient has significant valvular disease or distributive shock, they may have an appropriate systolic blood pressure, but the low diastolic blood pressure may impair perfusion. For example, a patient with aortic valve insufficiency may have a blood pressure of 100/10 (MAP=40), which is not sufficient to perfuse the brain. During the apnea test, these blood pressure goals must be maintained, or the test should be aborted, so it is helpful to have pressors available at the bedside.

Question 3: *The terms "Confirmatory" and "Ancillary" testing are both used but can be confusing. Can you explain the difference?*

The term ancillary test is more appropriate in reference to BD/DNC determination. First and foremost, BD/DNC determination is clinical, and the evaluation must be made by an appropriately credentialed clinician. There is no test that can confirm BD/DNC, but rather additional tests support the diagnosis when all portions of the clinical examination that can be performed have been done and found to be consistent with BD/DNC, but one of the indications for ancillary testing is present. Ancillary tests should be considered additional data to help the clinician make a diagnosis, as opposed to a confirmation of death. It is important to note that even when it is clear that ancillary testing will be required, the clinical examination must still be completed to the fullest extent possible, including apnea testing, and if there are any signs of brain function, the patient is clearly not brain dead and ancillary testing is not indicated.

Question 4: *How do you explain BD/DNC to a family who has no understanding of medical terminology or BD/DNC?*

The concept of BD/DNC must be explained in terms that are simple and geared toward the level of education of the family/loved ones. It should be explained to the family that death can be diagnosed when the heart and lungs stop functioning, or when the brain stops functioning. Therefore, BD/DNC equals death, both medically and legally. Furthermore, it should be explained that BD/DNC means the complete and permanent loss of function of the entire brain, including the most rudimentary functions, such as initiating a breath. Families should be told that the purpose of the evaluation is to look to see if there is any function of the brain, which would be evidence of life, rather than that the purpose of determining BD/DNC.

Question 5: *Are there any requirements that the clinician ordering the apnea test be present at the bedside during the entire test?*

There is some variation between institutions, but most feel that the declaring clinician should be present throughout the apnea test to ensure it is done correctly and the patient is stable throughout the assessment (and testing is aborted if needed). Remember, the variable that is being tested in the apnea test is whether the patient takes a breath, NOT the rise of the $PaCO_2$ or drop in pH. The $PaCO_2$ rise and acidosis ensure that the stimulus for the patient to take a breath is strong enough. The requirement that the declaring clinician be present is not often stipulated in hospital protocols; however it is intuitive that they should be there to assess whether a breath has been taken. This is a medical-legal diagnosis of significant importance and therefore the clinician should be present.

Question 6: *Why do we still use a cannula placed at the level of the carina for O_2 delivery when we have so many sophisticated ventilators for delivering 100% O_2?*

O_2 can be delivered by a variety of means. One of the concerns about leaving a ventilator attached during an apnea test is that if someone bumps the ventilator, the patient, or the bed the ventilator might register the movement as a breath. This would result in ambiguity as to whether the patient initiated the breath or not, and the test may need to be repeated without this confounder. On modern ventilators, there is a setting for an apnea back-up rate that is difficult to override. If there is no air going in, the flow-sensed ventilators will create a sufficient draw back from the peep valve in order to register a breath. With a cannula, you can control the amount of flow better than with the other methods available.

Question 7: *How long does one have to wait after therapeutic hypothermia is utilized and the patient is rewarmed before initiating BD/DNC testing?*

The temperature must be a minimum of 36°C. Hypothermia can depress neurologic function. Additionally, sedatives and paralytics are often utilized during therapeutic hypothermia, and their clearance can be delayed by the hypothermia itself, or by concomitant liver or kidney injury, particularly with cardiac arrest. In a patient who has been hypothermic <35.5°C (medically induced or spontaneous), they need to be rewarmed to 36°C for at least 24 hours before BD/DNC evaluation can commence.

Question 8: *Some have questioned that an SBP >100mmHg is inappropriately high as a minimum blood pressure, and that a BP of over 90mmHg should be adequate. Which is correct?*

When developing the guidelines, a line had to be drawn somewhere regarding the BP. The 2023 AAN/AAP/SCCM/CNS guidelines also stipulate a MAP goal of >75mmHg. If a patient has a known baseline of 90mmHg, it may seem counterintuitive to have to raise the pressure simply to perform BD/DNC testing. However, it is important to have a standard, and a minimum SBP of 100mmHg and MAP >75mmHg in adults is reasonable. In children, the minimum blood pressure is based on age (>5th percentile). The new guidelines also stipulate that in patients who are known to be chronically hypertensive, their goal blood pressures should be at their known chronically elevated levels.

Question 9: *What is your experience in patients on ECMO when declaring BD/DNC as technically the flow studies may not show the decreased flow?*

According to the 2023 guidelines, the proper technique for patients on ECMO is as follows: Preoxygenate by using 100% FiO_2 on the ventilator and through the membrane lung. For adults supported by venoarterial (VA) ECMO, clinicians should target a MAP ≥75mmHg; and for children supported by VA ECMO, clinicians should target MAP ≥5th percentile for age. To achieve an adequate increase in $PaCO_2$ level, either titrate exogenous CO_2 into the ECMO circuit or adjust the sweep gas flow rate to 0.2-1L/min. Sample ABGs from both the patient's distal arterial line and the ECMO circuit post oxygenator for patients on VA ECMO. $PaCO_2$ and pH levels from both locations are required to meet BD/DNC criteria for the apnea test to be consistent with BD/DNC. This ensures that, independent of the mixing point, the $PaCO_2$ and pH levels in the cerebral circulation meet BD/DNC criteria. For patients on venovenous ECMO, sample ABGs only from the patient's distal arterial line. Avoid hypotension during apnea testing on ECMO by increasing ECMO flows, intravenous fluid administration, or vasopressor/ionotropic support.

Question 10: *How does one handle BD/DNC determination when pentobarbital has been given and the level is unknown?*

BD/DNC evaluation should never be undertaken in haste, and sometimes it is necessary to wait for hours or even days for certain medications to metabolize adequately so that a clinical determination can be performed. Remember that ancillary testing is not a substitute for a clinical determination, and any time that a clinical determination can be performed, it should be, even if it requires waiting. The 2023 guidelines indicate that if a patient has received pentobarbital, they must have a level <5ug/mL or below the lower limit of detection for the laboratory before BD/DNC evaluation.

Question 11: *How does one handle the issue of introducing the family to the organ procurement organization (OPO) representative, but not bring up organ donation themselves?*

One of the best approaches is to discuss the situation with the OPO representatives prior to initiating the conversation with the family and determine how best to bring them in. It is an awkward transition and there is not a "one size fits all" solution. The clinician often feels conflicted in these situations, as they have commonly established a relationship with the family, and yet they may be perceived as having a conflict of interest if organ donation is brought up, specifically by the clinician. Sometimes the family will bring up organ donation, or simply ask, "What's next?" We recommend that the clinician explain that their job is to make the medical and legal determination

of death, and that there are others who will be speaking to them separately to discuss potential next steps. Some clinicians feel more comfortable having donation conversations with families, or being present when the OPO representative has the discussion. This is however the exception and not the rule. Often, clinicians feel awkward discussing organ donation, even when asked directly by families. Remember, studies show that families have a better experience when a specially trained person requests organ donation. This does not mean that the physician cannot discuss organ donation. One approach when the family asks "What is next?" is to lay out all the options: "The deceased person may be disconnected from the machines, or, if it is consistent with their wishes, organ donation may be a possibility. There is a representative of our organ donation organization who can answer your questions about what is involved in the second option."

Question 12: How does one handle difficult interactions with OPO staff concerning possible organ donation?

These situations are commonly emotionally charged and stressful and there can be tensions between the treating team and the OPO staff. It is important to take a step back, reassemble, and clarify the stage and the process for the individual patient. Sometimes, it can be helpful to involve the ICU Director, the Director for the local OPO, and even the ethics committee or hospital administration.

Question 13: What do we do if we're concerned about variability of BD/DNC determination in our hospital?

BD/DNC determination is a medical-legal diagnosis with strict criteria. The 2023 AAN/AAP/SCCM/CNS guidelines are very specific and detailed and provide a useful checklist for ensuring proper determination of BD/DNC. One option is to contact your hospital administrator to discuss your concerns, and advocate for the implementation of standardized practice in concordance with the 2023 guidelines. Additionally, the NCS has a course on BD/DNC determination, so you can advocate for all clinicians involved in BD/DNC evaluation to be required to complete the course.

Question 14: What do we do if the patient is a registered donor but the family declines donation?

We strongly advocate working with families in these situations to understand their reluctance in the face of their loved one's wishes. In most states, the designation of 'organ donor' is seen as an anatomical gift akin to a last will. Just as a family cannot say that they are going to reallocate a loved one's assets against the will of the deceased, there is an obligation to respect the person's wishes for organ donation. The difference between organ donation and a will is that a will can be contested for years in the courts, but organ donation occurs in a more time-constrained manner that does not lend itself to protracted court battles. We do not advocate forcing the issue and proceeding to organ donation without coming to a resolution with the family, but we also do not advocate relenting to a family's wishes as a convenience if there is clear evidence that the deceased meant to will their organs to others.

Question 15: *If a clinician suspects that the patient is brain dead but they're still in the Emergency Department, how should they proceed?*

It is very difficult to determine BD/DNC in the ED, and even if it can be done, evaluation in this setting would be very rushed, limiting the opportunity for families to be prepared emotionally for the evaluation and for OPOs to facilitate organ donation discussions. We strongly advocate for patients to be brought to an ICU to do the BD/DNC evaluation.

Question 16: *Who can determine BD/DNC?*

The 2023 guidelines provide guidance about the credentials for physicians and advance practice providers to complete BD/DNC evaluations. It is important that the clinician has demonstrated competence and experience in BD/DNC determination The NCS has a formal training and credentialing course.

Question 17: *What is an appropriate amount of time to allow the family to come to terms with the diagnosis of BD/DNC? And how long should they be given to decide about organ donation?*

Again, there are no hard and fast rules about these issues, but common sense would dictate that families be given several hours to accept that their loved one has died via neurological criteria, particularly if there is additional family coming in. However, hospitals are under no obligation to ventilate a corpse, and there is no withdrawal of "life support" in this situation as the patient is medically and legally dead. It is simply removing artificial organ support. In terms of how long to wait for a decision regarding organ donation, it needs to be emphasized to the family that the longer they wait, the less viable the organs will be for the recipients, should they eventually decide on donation.