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The ethics of organ donation, donation after circulatory determination of death, and xenotransplantation from an Islamic perspective

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Abstract

Donation after circulatory determination of death (DCDD) and xenotransplantation are advanced as possible solutions to the growing gap between the number of individuals in need of organ transplantation and the pool of donors. Investigating how various publics, including religious leaders, might view these "therapies" is essential for broad public and professional support and will be needed in order to make these solutions viable. This study, therefore, presents normative Islamic bioethical perspectives on donation after circulatory determination of death and xenotransplantation. First, we will discuss foundational Islamic ethico-legal debates regarding organ donation. These debates can be grouped into three broad positions, those who consider organ donation categorically impermissible as a violation of human dignity (*ḥurma* and *karāma*), those who agree that organ donation is impermissible in principle, but allow it conditionally on the basis of dire necessity (*ḍarūra*), and those who permit organ donation based on notions of public interest (*maṣlaḥa*). Next, we will reflect upon the additional ethical dimensions DCDD and xenotransplantation add to these debates. We contend that the condition of minimal harm to the donor and the definition of death need to be accounted for within Islamic perspectives on DCDD. Xenotransplantation, on the other hand, highlights concerns about using pigs for therapeutic purposes. We conclude by commenting on additional questions that remain to be addressed in the Islamic bioethical debate over these practices and with recommendations for further research.

KEYWORDS

cultural perspectives, Islamic ethics, Muslims, theology

1 | INTRODUCTION

The gap between the number of individuals in need of organ transplantation and the pool of donors has steadily widened in the United States.[1] This disparity is multicausal; rates of organ failure, primarily kidney failure, continue to increase as the population ages and diabetes and hypertension becomes more prevalent.[2] Yet, although the number of organs procured from living and dead donors has more than doubled since 1991, the growing demand outstrips these gains.[1] Illustrating the scale of the challenge, at the start of 2018, there were over 95 000 patients on the waiting list for kidney transplantation, yet only about 25 000 kidney transplant surgeries took place in the prior year. Thus the majority of individuals awaiting transplants either continue waiting until the next year and some would inevitably die whilst waiting.[3] In light of this growing problem,

Abbreviations: DCDD, Donation after circulatory determination of death; DCD, Donation after circulatory death.

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both donations after circulatory determination of death and xenotransplantation are advanced as possible solutions to the disparity between organ supply and demand.

Donation after circulatory determination of death (DCDD), previously referred to as donation after circulatory death (DCD) or non-heart-beating donation, is defined as donation after the "permanent absence of respiration and circulation."[4] Two overarching types of DCDD can be distinguished based on the circumstances of the cardiac arrest.* In uncontrolled DCDD, the potential donor's cardiac arrest is unexpected and donation is only considered after its occurrence, while in controlled DCDD terminally ill patients are expected to have cardiac arrest, for example, after discontinuation of life support, and organ donation can be planned for.[4] In the United States, DCDD donors have increased from 41 in 1993 to 1883 in 2017,[3] although this number appears relatively modest when compared to the number of living and brain-dead donors (6186 and 8402, respectively, in 2017).[3] Scholars note however that DCDD protocols are underutilized.[5] Some estimates suggest that over 22 000 out-of-hospital cardiac arrests could qualify for DCDD per year (ie, the uncontrolled type), and that the organ supply from DCDD could be further supplemented through the use of protocols designed for use with hospitalized patients (ie, both controlled and uncontrolled DCDD types).[6] Accordingly, by increasing the number of potential donors, DCDD may reduce organ transplantation waiting lists.

Xenotransplantation refers to the transfer of cells, tissues or organs from one biological species to another.[7] Scientific knowledge about, and experience with, xenotransplantation continues to advance. Current research examines both the uptake of whole organ xenografts, for example, heart, as well as the transplantation of tissue and cells, for example, insulin-producing pancreatic cells, from pigs or primates to humans.[7,8] Scientific progress has been steady with some noting that we are on the cusp of clinical trials with human subjects.[9] The coming years herald the very real possibility of xenotransplantation entering contemporary medical practice.

As both DCDD and xenotransplantation can increase organ availability for donation, and because public and professional support is essential for their wide-scale adoption, it is critical to investigate how these "therapies" might be received by various publics. One such public is the religious leadership, as religious authorities continue to play a significant role in delineating the ethical issues related to organ donation and transplant and in motivating religious communities to consider the act of donation.[10,11] Moreover, as the science and practice of donation and transplant advances, religion provides some individuals with an ethical framework through which to assign meaning and value to these practices. Accordingly, this study seeks to advance the discourse by presenting Islamic bioethical perspectives on organ donation, DCDD, and xenotransplantation.

We will begin by outlining ethico-legal debates among Islamic jurists regarding the permissibility of organ donation.† This discussion will help place the subsequent discussion on DCDD and xenotransplantation within a broader context of deliberation and debate. Furthermore, the discussion will allow us to introduce several Islamic ethico-legal constructs and concepts that play key roles in the moral assessment of DCDD and xenotransplantation. Next, we will reflect upon the unique ethico-legal challenges DCDD and xenotransplantation present, specifically related to the definition of death, the act of receiving—and not just donating—organs, and the issue of pig-based xenografts. We will conclude by outlining several issues that remain unresolved and make recommendations for future research, both biomedical and Islamic, that can help advance our understanding of the ethical dimensions of organ donation and transplant.

2 | A FEW PROVISOS

Before proceeding, we would like to outline our approach and offer several caveats. To begin with, there are many different moral sciences within the Islamic tradition, and each of these provides insight into the "ethical."[12-14] Islamic law and its subgenres, Islamic versions of character science and virtue theory, as well as the Islamic disciplines of spirituality, all offer moral frameworks, and each of these sciences approaches the question of normativity in a slightly different way. While discussing these varied perspectives is beyond the scope of this piece, it should be noted that these sciences work in complementary ways and that a holistic Islamic ethical analysis may require working in each of these different registers. This essay largely draws upon the Sunni moral theology, which underpins ethico-legal discussions.‡ Consequently, in the next sections, we will present Islamic juridical views and bring in theological reflections to clarify these debates and decisions.

Next, we will sparingly reference scriptural source-texts. While the Qur'an and Sunnah are the foundations for all Islamic ethico-legal reflection, one must recognize that while Islamic jurists ground their arguments within scripture they also use formal techniques, for example, analogy, to derive ethico-legal positions.[15] Although Islamic schools of law (as well as juridical authorities) might have a slightly different scriptural reasoning process, ethical normativity is attached to their outputs. Consequently, we have chosen to directly cite ethico-legal opinions. Additionally, hermeneutical exercises require greater space to work through than that offered within a medical journal article and would be somewhat tangential to this study's aim.

Finally, it is important to underscore that the Islamic tradition is inherently plural. Islam does not have a central ethico-legal authority that declares orthodoxy; rather the tradition is a discursive one with an orthopraxy is informed by centuries of theological and juristic debate. Thus, there may be multiple different views on any ethical issue, and all considered legitimate to follow provided they are derived using accepted hermetical and legal methodologies. This moral pluralism helps to explain why there are many different positions on the permissibility of organ donation and transplant, and how each position is supported by a variety of scriptural sources and ethico-legal constructs.

3 | ISLAMIC PERSPECTIVES ON ORGAN TRANSPLANTATION: AN OVERVIEW

Multiple different Islamic positions on the moral status of organ donation are found in the verdicts (*fatāwa*) of individual scholars and in the resolutions of juridical councils (*qararāt*). The main difference between a *fatwa* and a *qarar* is that the fatwa represents a single jurist's view (although he/she may take in account the positions of other jurists) while the *qarar* represents the collective opinion issued by many jurists.[16] *Qararāt*, often translated into English as judicial decisions, decrees or verdicts, are thus associated with the modern practice of collective *ijtihād*[§] where groups of scholars consult together to issue joint opinions on contemporary issues.

Although both types of rulings are non-binding (unless rendered into law by a state authority), they carry substantial moral authority for many Muslims.[17,18] Importantly, jurists take both Islam's normative law judgments (*aḥkām*, singular *ḥukm*) as well as the circumstances of the individual, or group, that requests the juridical opinion into consideration when authoring *fatāwa* or issuing *qararāt*. Consequently, these rulings are typically contingent and context-specific.

In this way, one might consider *fatāwa* and *qararāt* as the end product of the process of specification.[¶] Richardson describes the specification of ethical principles as tailoring to cases, where the ethicist considers whether there are conflicting ethical principles that are relevant in a given case. If there is conflict among principles, she aims to specify (at least) one as the operative principle which leads to the most ethical action.[19] This process contrasts with simple deduction from moral theory and from an intuitive balancing between principles (or moral norms) because it places conditions on the modified principles to delineate when they are operative based on the case at hand.[19] The specified norm is formulated in relation to the initial norm (which remains), and both are subject to *existential narrowing*, meaning that when either norm (the initial or specified version) is formulated in absolute terms, its counterpart could count as the absolute counterpart of the other. The central condition for this process is that the narrowing is achieved by adding a clause that addresses the circumstances (what, when where etc.), referred to as *glossing the determinables*. In contrast, *sharpening* a previously vague norm does not constitute specification, but rather is a prerequisite of it.[20]

As an example consider the Qur'anic verse declaring the pig to be filthy, and injunctions forbidding its consumption (Quran 6:145). Based upon this verse and several others, Islamic scholars declare porcine to be *najas al-'ayn* (intrinsically impure) and that it should not be used for human benefit. This normative ruling is relaxed by some jurists when life is at stake such as when one is dying of starvation or needs to use a porcine product to sustain his life.[21] In such cases, there is a perceived conflict between the preservation of life (another Qur'anic imperative) and the prohibition on porcine use. One could consider the process of moving from the normative ruling of prohibition to a fatwa that allows the use of porcine contingently through the lens of specifying norms. In this case, one could argue that the prohibition of pork (a moral norm) is specified for use this in case as: The use of porcine is prohibited *unless* there is an immediate threat to one's life. In this way, the fatwa does not overturn the general prohibition, rather specifies the normative ruling to solve the ethical dilemma. Another way to resolve the conflict would be to invoke the Islamic construct of dire necessity, *ḍarūra*, which allows for directly overturning a normative prohibition when certain conditions are met (to be discussed in greater detail below). Indeed, there are numerous ethico-legal constructs derived from religious source-texts that are used by jurists to specify *aḥkām* to particular situations.

Proceeding with Sunni Islamic ethico-legal views on organ donation, these can be grouped into three broad positions (See Table 1). The first position considers organ donation to be categorically impermissible based on notions of the inviolability of the human body (*ḥurma*) and concerns over the potential disruption of human sanctity (*karāma*). The second position agrees that organ donation is impermissible in principle, but allows for conditional permissibility on the basis of dire necessity (*ḍarūra*). Some jurists allow for both deceased and living donation by invoking this construct and its associated maxims, while others permit living donation only. The third position argues that both living and deceased organ donation is permitted based on the ethico-legal construct of general public interest or the common good (*maṣlaḥa*).

As there is some conceptual overlap among these positions (particularly between the impermissible save for necessity and the permissible with conditions views), and because individual jurists often embellish upon these rulings to add nuance or further conditions, we provide an overview of each overarching position rather than comprehensive details on all extant rulings.

TABLE 1 Different positions on organ donation, ethico-legal constructs central to the arguments, and illustrative fatwas

Position	Ethico-legal grounds	Illustrative fatwa
Impermissible *(both living and deceased prohibited)*	Violation of Human Sanctity (*karāma*) Threats to Human Inviolability (*ḥurma*)	Mufti Muhammad Shafi'i, late Grand Mufti of Pakistan (1966)
Impermissible, unless certain conditions are met *(only living permitted, or both living and deceased permitted)*	Dire necessity (*ḍarūra*)	Islamic Fiqh Academy of India (1989)
Permissible in general with conditions *(both living and deceased permitted)*	Public interest (*maṣlaḥa*)	Dar al-Ifta al Misriyya, Egypt (1979)

3.1 | Position 1: Categorically impermissible

In 1966, the late Mufti Muhammad Shafi (then the grand Mufti of Pakistan) was one of the first Islamic jurists to pen a public fatwa against organ donation. He argued that the donation of organs violates human dignity because the utilization of sanctified human bodies devalues humans into a collection of replaceable body parts. He further claimed that since human beings do not own their bodies they do not have the authority to donate them. Lastly, he was concerned about the societal ramifications of donation and transplantation in that it could incite abuse and exploitation and thus he prohibited both living and deceased donation.[22-25] Thus for him and for many subsequent scholars, the "actual problem that arises on this issue [organ donation and transplant]…is the question of preservation of human dignity."[26] In other words, the dissenting view is largely based on arguing that human dignity is violated in one or multiple ways.

There are two theological constructs that together form an Islamic conceptual analogue to human dignity.[27] These two closely related ideas are sanctity (*karāma*) and inviolability (*ḥurma*). *Karāma* derives from the Arabic root k-r-m, which conveys the meaning of honor, and when applied to humans refers to the special status of humankind above all of God's creation.[28] The Qur'an grounds this notion stating "We [God] have honored (*karamna*) the sons of Adam… and conferred on them special favors, above a great part of our creation (17:70).[29] *Karāma* is shared by humanity in equal measure and allows for the every individual to claim positive rights of respect from each other.

The Islamic notion of inviolability, *ḥurma*, on the other hand, carries negative rights of protection and non-interference. Linguistically, the term is derived from an Arabic root h-r-m that carries the meaning of sacredness and prohibition.[30] The construct develops from many verses of the Qur'an and traditions from the Prophet Muhammad. For example, the Qur'an states "Nor take life—which Allah has made sacred (*ḥarramullah*)—except for just cause (17:33)."[29] Inviolability extends beyond one's life as the Prophet Muhammad declared to his followers "Verily your blood, your property and your honor are (as) sacred and inviolable (*ḥarām*)…"[31] and extends beyond death as another Prophetic narration reads "the dignity (*ḥurma*) of a deceased person is the same as if he or she were alive."[15,27] The terms *karāma* and *ḥurma* are closely related in that violating bodily integrity compromises human sanctity and conversely, preserving sanctity entails the preservation of bodily integrity.[32]

As the human body is conceived as a trust (*amanah*) from God, one is morally accountable for its use and his/her autonomy is somewhat restricted.[33] Accordingly, avoiding behavior that might violate its integrity (*ḥurma)* is an Islamic virtue.[32]

The violation of *ḥurma* has been classified according to three different dimensions, which clarifies how contemporary scholars apply this concept to assess the morality of organ donation. These three dimensions are as follows: (i) a violation of the body's intactness (through mutilation for example), (ii) a violation of the body's functionality (through suicide and harmful interference with bodily functions), and (iii) the objectification of the body (using body parts for unnatural purposes or commodifying them).[32]

Organ donation has the potential to violate all three of these dimensions, as it requires surgery, entails risks to one's health, and involves the removal and substitution of human organs. Notably, a disruption of human function can only occur whilst alive and thus this potential violation of *ḥurma* does not apply to deceased donation.[32] Nonetheless, jurists in this camp consider such violations of dignity on the donor side to outweigh the potential benefits on the transplantation side.[32] Indeed the Islamic ethico-legal maxim of giving priority to the repelling of harm over the procurement of benefit (*dar' al-mafāsid muqaddam 'alā jalb al-maṣāliḥ*) buttresses their argument.

Furthermore, it is important to note that a violation of bodily integrity is tolerated when it is a means to preserving the functionality of the body, thus jurists permit surgical operations, for example.[32] Yet, a high degree of certainty about the benefit of the treatment is needed to make this compromise, and those who oppose organ donation demand a higher degree of surety than those who permit donation.[32] This differentiation provides the basis for distinguishing between the moral status of surgeries performed to remove a tumor, surgeries performed to procure an organ, and surgeries performed to transplant an organ into the body, where some are considered permissible and others are not.

Finally, many scholars worry that organ donation and transplantation objectifies the body and diminishes the intrinsic honor bestowed by God to the human. The black market organ trade exemplifies this concern of turning human beings into a collection of spare parts. Illustratively, the late grand Mufti of Egypt, Shaykh 'Ali Guma'a registers his concern over trampling this aspect of human dignity by saying

> *here a human being has been relegated to the status of a spare part that can be bought and sold; a person has been rendered into something that is cut up, whose parts are distributed…why are they doing this? It is because of economic interests and the laws of the market. So we [Islamic scholars] have to get involved. And we have to say 'No, this is not permitted.*[34]

3.2 | Position 2: Impermissible unless certain conditions are met

The second, and arguably majority view, is that organ donation is contingently permitted. Critically, this camp agrees that organ donation disrupts human dignity, but nevertheless permits donation by invoking dire necessity (*ḍarūra*). As introduced earlier, the ethico-legal maxim of *ad-ḍarūrātu tubīḥ al-maḥẓūrāt*, dire necessity renders the unlawful licit, is invoked under conditions of necessity to justify the performance of normatively prohibited actions.[35] Dire necessity is often referred to in Islamic bioethics discourse, for example, many fatwas argue that the use of porcine-based vaccinations and the practice of sterilization are permitted when a life threat exists.[36-38]

Importantly, several conditions must be met to apply *ḍarūra* to a case, including the existence of a credible life threat, relative certainty the current circumstances will result in said threat (as opposed to mere suspicion) and the unavailability of alternatives to the proposed action.[21] Furthermore, the permission is granted so long as the enabling circumstances exist, and thus, permission is revoked when the threat subsides (eg, by eating a minimal amount of pork) or alternative actions present (eg, vaccines without porcine).[21]

There is some disagreement between jurists on the restriction of *ḍarūra* to the preservation of life. Islamic bioethicist Abul Fadl Mohsen Ebrahim notes, for example, that Abū Bakr al-Jaṣṣās (d. 370/981), a proponent of the *Ḥanafī* school of Islamic law, defined *ḍarūra* as the fear of injury to life, yet al-Dardīr (d. 1201/1786), a proponent of the *Mālikī* school, understood dire necessity to exist when less substantial injuries may ensue.[39] Hence, whether dire necessity is applied to organ donation depends on the particular jurists' understanding of the construct and of the clinical scenario.

The Islamic *Fiqh* Academy of India's ruling illustrates how dire necessity is applied and specified to organ donation.

> *If a healthy person, in the light of the opinion of medical experts, is sure that he/she can live with one kidney only, it will be valid for him/her to donate one* kidney *to an ailing relative, if it be* necessary to save his life *while* no alternative *is available, but without charging any price (emphasis added).*[40]

Donation here is only permitted as a last resort, when there is a strong conviction that the patient might otherwise not survive and no alternative treatment options are available. Furthermore, only donation to a relative is allowed. Most other fatwas permitting organ donation through dire necessity allow both living and deceased donation and do not restrict to relatives. Other conditions are detailed below (See Table 2).[41-43]

3.3 | Position 3: Permissible with conditions

The third position holds organ donation to be normatively permitted with several stipulations. An illustrative fatwa was issued by the *Dār al-Iftā al-Miṣriyya*, an autonomous fatwa-issuing body under the Ministry of Religious endowment and Religious Affairs in Egypt.[23] This fatwa, issued by Shaykh al Haqq (who later became rector of the prestigious al-Azhar University), addresses the prohibition due to the priority of preventing harms over pursuing benefits by citing the doctrine of permissibility; all actions are deemed ethico-legally permitted unless there is clear evidence with the scriptural source-texts for impermissibility. This view is encapsulated by the maxim *al-aṣl fil ashya al-ibāḥa*, the original ruling (state) of things is of permissibility.[23] This camp argues that the default moral stance attached to organ donation should be of permissibility, specifically because no scriptural sources speak to it directly.

They buttress their position by foregrounding the life-saving benefits of organ donation and grounding their position in the ethico-legal construct of public interest or common good (*maṣlaḥa*).[22,23] *Maṣlaḥa* is a secondary source of Islamic law and refers to public interests that are deemed worthy to secure by the Lawgiver either through their explicit mention in the Qur'an or Sunnah or because they rationally align with explicitly mentioned interests.[15] In the case of organ donation, these jurists argue that saving life is a legitimate interest (explicitly referred to in the scriptural source-texts), and because organ donation helps secure this interest, it should be considered morally permissible.[44,45] For example, the late Grand Mufti of Egypt,

TABLE 2 Major conditions placed upon organ donation by Islamic jurists

Conditions for permissibility	Underlying Concept(s)
Organ removal and transplantation should take place with great care to make the smallest incisions and least amount of procedures performed	*ḥurma;* violation of intactness prohibition of mutilation
Living donation should not endanger the donor's life and any harms should be minimized	*ḥurma;* violation of functionality
Monetary and non-monetary compensation for organ donation is prohibited (Sunni view)	*ḥurma;* objectification
The reason for donation of an organ is that an another individual (or group of individuals) have a dire need for such an organ, and organ transplantation is likely to be successful and yield great benefits	*ḍarūra*
The decision to donate is freely taken by the living donor, who is legally qualified to donate Or consented to prior to at death by the donor or his/her family members	Moral accountability for one's actions (*taklīf)* Informed consent and freedom of choice
Donating ovaries and testicles is prohibited (Sunni view) Donating a vital organ (e.g. heart) is prohibited	Protection of lineage (*ḥifz an-nasl*) Prohibition of suicide

Muhammad Sayyid Tantawi, foregrounded notions of *maṣlaḥa* to permit organ donation and transplant and address human dignity concerns of naysayers.[34] Several jurists from the second camp also incorporate considerations of public interest to declare contingent permissibility.

The moral status of organ donation is elevated to a recommended act by some jurists in this camp as they view organ donation as an ongoing charity.[22,23,46] With regard to deceased donation, scholars offer the rejoinder to those who believe the dead human body's *ḥurma* is violated by citing the ethico-legal maxim declaring the interests of the living to supersede those of the dead.[22]

3.4 | Conditions for organ donation and the clinical applicability of fatāwa

For jurists who deem organ donation to be Islamically permissible, whether by grounding their verdict in dire necessity or public interest, several conditions must be met. These stipulations largely revolve around minimizing the violation of *ḥurma* (medical cautiousness, minimal harm to the donor, and no monetary compensation), determining the necessity and successfulness of subsequent organ transplantation, and ensuring the donor's consent (see Table 2).

Beyond these conditions, it is important to recognize that not all organs are permissible to donate. Jurists declare that some organs are impermissible to donate because donating them harms the donor, for example, heart, or because donating some organs would confuse lineage, for example, ovaries and sperm.[‖ 47] In general, renewable organs, for example, blood, bone marrow, and liver are permitted across the board, as are twinned organs, for example, kidney, while ovaries and testicles are generally prohibited.[46-49] Uterine transplantation as well as vascularized composite allografts, for example, face, remains controversial and not well-discussed in the fatwa literature.

When considering the clinical applicability of the various *fatāwa* and their accompanying conditions, two more things need to borne in mind. First, the conceptual nomenclature differentiating between living and deceased donation is challenged by different understandings of brain death. Brain death remains a highly contested topic among Islamic jurists and while many have equated it with legal death, others view it as a dying state.[50-53] Thus, what biomedicine considers within the category of decedent donation, that is, donation after declaration of brain death, some jurists may consider as living donation. This ambiguity creates confusion regarding what conditions must be applied to make such donation permitted. Second, applying the concepts of *ḍarūra* and *maṣlaḥa* to a specific case can be made difficult by the need for specific knowledge about clinical harms and benefits of donation in the particular scenario. Often the patient (or surrogate decision-maker) and the advising jurist may lack the numerical or health literacy to assess these, or the clinical staff might provide general data instead of granular and specific numbers. Moreover, the Islamic concepts themselves are somewhat vague leaving the ethical assessment open to interpretation.

Given that Islamic law is plural, each of the ethico-legal views presented here is morally equivalent and actionable. In other words, there is no blame upon a Muslim who holds that organ donation is impermissible and acts accordingly, nor is there sin upon one who considers organ donation to be permitted and actively pursues it.

4 | ISLAMIC BIOETHICAL VIEWS ON DONATION AFTER CIRCULATORY DETERMINATION OF DEATH

To our knowledge, there has been little discourse on DCDD in Muslim juridical circles and there are also no research papers dedicated to the topic in the clinical ethics literature. Consequently, we draw upon the organ donation debate and highlight the added elements DCDD brings to the conversation.

4.1 | Ethico-legal stances

Harkening back to the three overarching Islamic moral stances on organ donation, Sunni jurists who deem organ donation to be impermissible would reject DCDD outright, as would those who deem only live donation to be permitted because the DCDD donor is considered to be dead (more on this assertion a bit later). Scholars who deem organ donation to be Islamically permissible, either through recourse to dire necessity or on the basis of public interest, would need to assess whether the procedural aspects of DCDD satisfy the conditions they have set for permissible organ donation.

4.2 | Conditions impacting the moral assessment

One condition worth deliberating over is the condition of minimal harm to donors. DCDD protocols often involve multiple antecedent procedures on the potential donor in order to assess the functionality and transplant viability of the potential donor's organ, for example, cardiac catheterization and bronchoscopy. Furthermore, some protocols involve administering anticoagulants or vasodilators to the patient so as to preserve organ function prior to the declaration of death.[54,55] There is lively debate among bioethicists as to whether these antecedent activities are ethically justifiable because each of these procedures and medications has the potential to harm the donor while offering no therapeutic benefit.[56-59] Some argue that respect for persons and human dignity is trampled upon because the donor is treated as a means for the benefit of "others" prior to their death, while others assert that carrying out such procedures accords with fulfilling the wishes of the patient to donate; that when informed consent was obtained the donor accepted the potential risks of such procedures. The ethical grounding for the con position might find analogous purchase in the Islamic ethico-legal tradition as one may argue that the *ḥurma* and *karāma* of the potential donor are under threat when carrying out these procedures. Recall that some jurists allowed for the bodily aspect of *ḥurma* to be sacrificed if it led to protecting the functional/physiological aspect of *ḥurma* (through surgery, eg). In this case, such an argument is moot because the functionality restored is not that of the donor but

of the recipient. Nevertheless, not every protocol involves such procedures, and there may be instances when the risk to the donor is minimal. Islamic jurists, therefore, must assess whether the specific details of the case satisfy the minimal harm criterion or alternatively offer a heuristic that allows patients (and surrogate decision-makers) to judge when it would be so that they might proceed with DCDD.

Another area that merits ethical consideration centers upon the medical construction of a "dead" individual by DCDD protocols. Recall that some Islamic jurists consider organ donation to only be permitted if the donor is alive, and others hold both cadaveric and live donation to be sanctioned. Moreover, some organs, that is, heart, can be donated if the donor is considered deceased but not when deemed alive. Consequently, the Islamic ethicist must resolve whether the DCDD donor is be treated as alive, dead, or dying when the organs are harvested because such a determination implicates whether donation is permitted as well as which organs can be involved.

Both secular and religious authorities debate whether DCDD coheres with the dead donor rule because protocols are variable and push the boundaries of convention.[60] By protocol, the donor is pronounced dead in the operating theatre once an absence of cardiac activity is documented over a certain time period. The pause time interval is believed to be sufficient enough to preclude the possibility of autoresuscitation of cardiopulmonary function.[54] In other words, the pause is a safeguard against declaring someone's heart function to have ceased irreversibly prematurely. Some protocols suggest the time interval can be as short as 75 seconds while others mandate waiting up to 5 minutes. The variable time period is highly controversial as some research detracts from the empirical validity of the claim that autoresuscitation does not occur outside of this time interval.[61] Some scholars take issue with the concept of a pause and its ethical function because they struggle with defining death based on absence of cardiac activity when it is possible to immediately restart the heart post-declaration of death in order for it to be transplanted into another person.[62-64]

It is not clear whether Islamic jurists would consider the DCDD donor to be dead. Technically, the absence of heartbeat and respiration would be sufficient to declare legal death in Islam. Although, just like with secular ethicists, the practice of restarting the heart after one is declared dead because of its cessation might give some Islamic scholars pause. Nonetheless, a precedent for deferring the ascertainment of death to clinicians can be found in the juridical debates over brain death. In these *fiqh* academy meetings, some jurists were explicit in stating that medical specialists can specify "new" indicators for death, and on this basis, they accepted brain death as legal death in Islam.[51,65,66] If jurists were once again to defer to clinicians in deciding when death can be declared, the DCDD donor could declared death by protocol regardless of the duration of heartbeat cessation. Based on the deliberations over brain death then, there appear to be some ethical grounds for allowing DCDD donors to be declared dead on the basis of medical convention and expertise.

Yet, as with brain death and organ donation, there are likely to be dissenting views as well. Jurists do appear unsettled by the possibility of restarting the heart of a person deemed dead in order to save the life of another. According to Al-Bar, the High Committee on Brain Death in Saudi Arabia expressed reservations about DCDD protocols because cessation of neurological, cardiovascular, and respiratory functions may be reversible at the time organs are procured.[67] In order to properly weigh in on the DCDD debate, it would be worthwhile for Islamic jurists to consider the difference between physiological irreversibility (or permanent cessation) and practical irreversibility (or irreversible cessation) in the context of declaring cardiac death.[68] Physiological irreversibility refers to the incapacity of the heart to autoresuscitate or to be restarted by means of clinical intervention. Practical irreversibility refers to the decision made by clinicians to not intervene when a patient's heart has stopped because of external reasons even if there is a possibility to successfully resuscitate. In the context of DCDD when the donor's heart has ceased to beat for a certain period of time, it is deemed to have done so irreversibly because the clinicians (and the patient him/herself or his/her surrogates) have decided that no interventions will be performed to restart the heart until after the patient has been declared dead. In DCDD protocols, after the donor's death is declared, the heart is restarted, thus evidencing physiological irreversibility was not met but practical irreversibility had been. The extant fatwa literature, to our knowledge, does not speak to which notion of irreversibility and cessation aligns with Islamic ethics and law, future research needs to explore this area in order to provide Islamic bioethical perspectives on DCDD.

Aside from these topics, there are other aspects of DCDD that Islamic authorities must take into account when reflecting on the ethico-legal status of DCDD. These include what level of consent is sufficient to authorize DCDD (first-person vs. surrogate vs. opt-out policies) and how to address potential conflicts of interest between patient care and organ procurement teams. To be sure Islamic juridical deliberations regarding DCDD will likely revive, and must draw upon ethico-legal discussions that largely took place decades ago in the Muslim world on brain death and organ donation. As medical technology has advanced, and the ethical frames have become more nuanced, revisiting these subjects would be a service to the developing field of Islamic bioethics.

5 | ISLAMIC BIOETHICAL PERSPECTIVES ON XENOTRANSPLANTATION

Xenotransplantation shifts our focus from the act of donating to the ethics of receiving an organ. As with DCDD, there is scant Islamic bioethics discourse to draw upon. Hence, in what follows, we outline key questions that jurists must address when making ethico-legal judgments about the permissibility of receiving organs or tissues from animals. To discern Islamic bioethical perspectives, we first need to consider views on the moral status of the act along with its intended aim, and then ascertain how the source of organs impacts these views.

5.1 | Moral status of the act

Beginning with the moral status of the act, the ethics of transplantation is distinguished from that of donation by the fact that xenotransplantation is a potential medical therapy; the act brings about health benefits for moral agent herself rather than for others as with organ donation. Accordingly the violation of human dignity, a central concern in the organ donation discussion, becomes less of an ethical obstacle because the procedure aims at restoring the functionality of one's own body even though it entails disrupting one's own bodily integrity. As noted above, jurists tolerate such infringements because of benefits accrued.[32] Additionally, Sunni Islamic law judges the seeking of medical treatment as permissible but non-obligatory.[69-71] The majority holds that seeking clinical treatment becomes obligatory only when the proposed therapy is perceived to be life-saving.[16,71,72] Currently, xenotransplantation cannot be considered a life-saving therapy because xenografts have limited survival. Illustratively, xenografted hearts (an organ that is assuredly necessary to live) have not sustained function beyond a few months.[73] Xenotransplanted tissues cannot yet be considered life-saving because they too have limited longevity and because other therapeutic options exist. Therefore, xenotransplantation should be, at present, conceived of as a stop-gap intervention with the potential to be life-saving. As a result, from an Islamic legal perspective xenotransplantation might, at best, be considered a generally permitted therapy that is not obligatory to seek.[46,49,74] Should research advances result in the greater viability and enhanced curative potential of xenotransplanted organs or tissues, a Muslim could be judged to be morally obligated to pursue it. Such determinations would need to be made on a case-by-base basis with granular data on the harms and benefits of a specific xenotransplantation in hand.

Indeed should the harms of therapy outweigh posited benefits, an ethico-legal assessment of the treatment being reprehensible or forbidden to pursue could be advanced. At present, the field of xenotransplantation struggles with estimating the harms of therapy. For example, there is a risk that a transplanted organ might carry viruses or other pathogenic substances that could harm the recipient. Other health risks include an increased risk of diseases incurred as a result of taking life-long immunosuppressive medication.[8,75] Similarly depending on whether organs, tissues, or cells are involved in xenotransplantation, there are a host of risks related to graft vs. host diseases and organ rejection. Each of these harms must be identified and weighed by the patient and family (and consulting Islamic scholar) when considering xenotransplantation and equipoise must be reached in order to make a moral assessment and determine the best course of action.

5.2 | Moral implications based on the source of xenotransplants

Classical Islamic jurists have allowed the use of animal bones to support fractures[76] and some contemporary jurists who otherwise categorically prohibit organ donation (including the late Mufti Muhammad Shafi'i) allow for the transplantation of animal organs or cells into humans.[25,26,47] These views suggest that the use of some animal organs and components for medical purposes to be generally permissible. However, the permission is bounded by important directives from the Prophet Muhammad to not make or use medicines from substances that are considered filthy (*khabīth*)** or otherwise prohibited to use, for example, wine and pork. For example, one statement declares "Allah has sent down both the disease and the cure, and He has appointed a cure for every disease, so treat yourselves medically, but use nothing unlawful (*ḥarām*)."[77] On the basis of these and other source-texts, Islamic authorities deem the use of medicines derived from juridically impure substances and proscribed foodstuffs to be normatively prohibited.

The science of xenotransplantation has largely been built-up from research using pig tissues and organs because these present fewer immunogenic challenges to human hosts. While the pig has become a clinically ideal substrate for research and therapeutic advancements in xenotransplantation, its use presents significant problems from an Islamic bioethics perspective. The pig is considered to be *najas al-`ayn*, or intrinsically impure, according to majority of Sunni scholars.[76] Therefore any part of it, be it skin, bones, or organs should not be used by Muslims for medical purposes.[36] Based on the aforementioned Prophetic directives, many jurists further specify the general rule of permissibility attached to xenotransplantation by deeming it permitted in cases where a non-porcine animal source is used.[46,49]

Some jurists do permit porcine-based therapies on the basis of *ḍarūrah*, but others remain unconvinced because of the clear language used by Prophet in his prohibiting the use of unclean substances in medicine.[36] The use of porcine components in vaccines and medicine is argued to be permissible by some jurists because they consider the porcine to have undergone essential transformation during processing such that it becomes a wholly new (non-porcine) substance. The relevant Islamic ethico-legal device used to support this argument is *istiḥala* which linguistically means to become permissible (*ḥalāl*).[36,78,79] *Istiḥala* does not appear to apply here because the genetic alteration that pigs undergo in order to make them less immunogenic as sources of organs does not change them into a "new" animal.

Given the forgoing, it appears that an overarching and definitive Islamic ethico-legal ruling on xenotransplantation remains elusive. In broad strokes, jurists could advance Islamic sanction for xenotransplantation provided that non-porcine animals are the origin of organs, tissues, and cells and that the health benefits of the treatment outweigh its harms. Other secondary conditions relevant to all medical procedures such as the need for informed consent would also likely apply. As xenotransplantation makes its way into contemporary healthcare, Islamic jurists also need to consider how societal level considerations such as whether or not xenotransplantation could be rolled out equitably and whether the animals used as sources for organs and tissues are treated with care would impact Islamic ethical stances.

6 | CONCLUDING REMARKS

The biomedical science of organ donation and transplantation continues to progress rapidly, and its evolving uptake in clinical practice leads to new ethical questions and considerations. Muslims comprise almost a quarter of the world's population, and large groups live in diasporic communities in the United States and Europe.[80] As medicine globalizes, it becomes important to consider how Muslim religious leaders morally assess newer techniques within organ donation and transplantation. Moreover, such research advances the global bioethics discourse. With a greater understanding of the ethical concerns in hand, healthcare stakeholders are better equipped to successfully navigate the moral minefield to find solutions that advance human health.

Our discussion of Islamic perspectives on organ donation, DCDD, and xenotransplantation note not only a plurality of views, but also that a complete moral evaluation necessitates specifying general rulings and ethical constructs to particular cases. Indeed, the constructs of *ḍarūra* and *maṣlaḥa*, which undergird permissive views on organ donation and transplant, reflect a certain social and biomedical reality into Islamic law. In other words, when a jurist bases a moral argument using these constructs, he is evaluating whether the social (or biomedical) context constitutes a dire need and also whether tangible benefits will accrue. However, the concepts are broad, ambiguous, and interpreted variably. Oftentimes, jurists merely outline the conditions for invoking dire necessity and leave it to the individual (or group) asking for the Islamic ruling to ascertain whether their situation sufficiently meets these thresholds. Given the imprecision in the constructs, it is important for jurists and biomedical scientists work together to clarify Islamic ethico-legal positions (as well as the accompanying conditions) on organ donation, DCDD, and xenotransplantation. For example, such discussions could generate statistical rules of thumb that clarify when a harm or risk is substantive enough to impact moral assessments, help determine when there a life threat can be considered significant enough to invoke *ḍarūra*, and identify when a proposed therapy meets the life-saving standard in Islamic law would greatly advance Islamic bioethical deliberation.

Our discussion of DCDD also highlights that Muslim scholars must revisit debates around legal death in the context of DCDD. What period of heartbeat cessation is sufficient to declare a person dead according to Islamic law? Does physiological irreversibility of autoresuscitation of heartbeat matter? Several decades ago, prominent Islamic juridical academies brought in medical experts to debate whether or not neurological criteria for death could be considered valid within Islamic law.[51,65,66,81-83] We believe it may be time to reconvene such bodies in order to consider both advances in brain death as well as nuanced biomedical constructions of the legally dead individual, as in DCDD, in clinical practice.

Finally, there is also an urgent need for greater health outcomes research on DCDD and xenotransplant, as well as critical need to develop evidence-based protocols for the use of such technologies in the healthcare system. Not only would Islamic scholars be to render more nuanced ethical opinions based on greater data on the risks, benefits, and harms associated with DCDD and xenotransplant, but the entire healthcare community needs such data so that patients, surrogate decision-makers, and potential research subjects can make sound decisions about participating in DCDD and xenotransplantation research and practice.

While our ethical commentary has strengths is also has several limitations. For one, our reflections primarily recounted Islamic ethico-legal debates and did not venture deeply into the sociocultural factors influencing the extant rulings. Islamic jurists are educated within, and work with, specific geographical, historical, and sociocultural contexts. This formation and environment necessarily influences the ways in which they draw upon, understand, and apply the Islamic ethico-legal tradition to address modern issues.[23,84] Such sociocultural and formative factors might underlie the differences between jurists from the Indo-Pak subcontinent, who mostly maintain organ donation is impermissible, and the majority of Arab and Southeast Asian jurists, who encourage it.[23,32,85-87] Indeed local moral worlds influence Islamic bioethical judgments,[88] and must be accounted for in Islamic bioethics research. Another limitation that needs to be borne in mind is that juridical rulings can change over time. For example, the religious authority of Singapore (*Maglis Ugama Islam Singapura*), which initially considered organ donation impermissible in 1973, came to judge the practice as permitted in 1986, and most recently in 2007 argued that organ donation can be seen as an meritorious form of enduring charity.[41] They explained their shifting stances as resulting from the more positive attitudes of Islamic jurists who based their arguments on upon different scriptural texts and ethico-legal devices, the increased societal need for solutions to organ failure, and the improving success rates of organ transplantation.[41] Juridical perspectives on DCDD and xenotransplantation may also undergo shifts as the reality on the ground changes. Taken together, the fact that sociocultural factors impact initial juridical assessments which further evolve in response to changes in society, and that Islamic verdicts strongly influence Muslim social views and the behaviors of Muslim patients and providers, there is a bidirectional impact between society and juridical attitudes. We advocate for greater descriptive and analytic research into how such relationships inform Muslim moral decision-making in the context of organ donation and transplantation.

It is also critical to note that this paper speaks to "Islamic" views and not to the ethical views of Muslim patients, providers, and community members. Just like any faith community, Muslims are variability influenced by the normative pronouncements of Islamic authorities and have ethical inputs that extend beyond the merely religious. There is a large body of research that examines how religiosity impacts Muslim attitudes toward organ donation,[89-95] and several detailed investigations into how notions of the Islamic inform the ways in which Muslim peoples choose to pursue donation and/or refuse transplantation.[34,87] As DCDD and xenotransplantation become viable solutions to the health challenges of organ failure, similar studies are needed to fill out our understanding of Muslim receptivity toward these procedures.

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ENDNOTES

*The original DCDD classification is the Maastricht classification and consists of four categories (dead on arrival at the hospital, dead with unsuccessful resuscitation, awaiting cardiac death and cardiac arrest while brain dead). Several modified versions of this classification have been proposed to address the controlled and uncontrolled circumstances of organ procurement. For an elaborate discussion of different classifications see Thuong M, Ruiz A, Evrard P, et al. New classification of donation after circulatory death donors definitions and terminology. *Transpl Int*. 2016;29(7):749-759. https://doi.org/10.1111/tri.12776.

†We use the term "ethico-legal" to convey that Islamic bioethics is greatly informed by Islamic law and that concurrently, Islamic law is concerned with morals and ethics. At the same time, there are distinctions between the legal and the ethical in an Islamic moral universe. For more on the role of Islamic law in Islamic ethics, see Reinhart A. Islamic law as Islamic ethics. *J Relig Ethics*. 1983:186-203.

‡We adopt Prof. Mohamed Fadel's usage of the English term moral theology to refer to the Islamic science of *uṣūl al-fiqh*, which is often alternatively termed Islamic legal theory. As Prof. Fadel notes in so far as *uṣūl al-fiqh* is concerned with the scriptural sources of moral obligation, the processes of moral assessment, and moral epistemology it is a moral science. And since *uṣūl al-fiqh* is primarily concerned with how God judges human acts it is a theological discipline. See M. Fadel, "The True, the Good and the Reasonable: The Theological and Ethical Roots of Public Reason in Islamic Law." Canadian Journal of Law and Jurisprudence, vol. 21/1, 2008.

§*Ijtihād*, or independent reasoning, is an intricate legal process whereby those qualified derive rulings on topics not directly address in the primary scriptural source texts (Quran and Sunnah).[96]

¶This is an imperfect analogy to provide some insight into the process. In addition, the Islamic ethico-legal deliberations might involve both balancing and specification.

‖Some Shia scholars, most notably the Ayatollah of Iran (Khamanei), have allowed both sperm and egg donation in fertility treatment. For an analysis of Sunni and Shia perspectives on IVF and the donation of gametes see: Inhorn MC. Making Muslim Babies: IVF and Gamete Donation in Sunni versus Shi'a Islam. *Cult Med Psychiatry*. 2006;30(4):427-450.

**Reflected in a hadith attributed to Abu Hurayrah recorded in *Sunan Abi Dawud* hadith number 3870.

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