

## Xenotransplantation: A Bioethical Inquiry from Islamic Perspectives

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### ABSTRACT

Health, sickness, or diseases in man are part and parcel of human existence. Islamic bioethics cover all these life time events from before birth to death and after death. Islamic thought has indispensable contributions in and is inseparable from Islamic bioethics. Major organ failures are increasingly prevalent and affect the quality of life and survival of enormous number of patients. Allotransplantation gives the 'second' life to these patients. However, the supply gap human organs result in phenomenal bioethical and legal problems. Xenotransplantation, especially porcine xenotransplantation, can solve this supply gap and those consequential problems. A systematic analysis using English publications is done to ascertain various bioethical aspects of xenotransplantation as applicable from the Islamic perspectives. The authors argue that the prohibition of pork in Islam is metaphysical. The current permissibility for PXT may be premature and over-simplifies a much-complicated issue. Public interest is often under-considered in organ transplantation deliberation. The contributions of Islamic thought and Islamic bioethics in health, sickness, treatment, PXT and theological objections to PXT are analysed and discussed. Muslim countries may have the obligation of promoting and ensuring the success of PXT especially for the interests of under-privileged Muslims.

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## INTRODUCTION

The importance of Sicknesses or Diseases is often brushed away lightly as part and parcel of human existence. They have far more significance for Muslims, from creation and divine blessing to spirituality and religiosity. The determination to receive treatment is also central to their faith and belief. These encompass all the religious and cultural values of the believers in Islam. It is a duality of duties and obligations being built upon the wills and rights of Allah in the person, his family and the community at large (Shomali, 2008 p4).

There are two sources that help Man to make decisions based on ethical principles: reasoning and revelation (Ay, 2012 p117). Each of the Islamic Bioethics (IBE) deliberations is an event-based discourse that deals with wide and varied issue from life to death, handling and management of the (human) body at times of Health and Sickness, the relationship between Man and other living creatures and the environment. These discourses are founded from an Islamic normative tradition in the domains of theology (divine revelation and limitation of human rationality), law (Shari'ah laws on ethico-legal determinations: prohibitions, permissions and obligations etc.), philosophy (power of human reasoning) and mysticism (religious value of health and illness, faith and treatment) (Shabana, 2014 p337-344).

The present-day IBE (from 1420 AH - 1999 CE) belongs to the third era as proposed by Kasule (quoted in Fadel, 2022 p7). This period is dominated by the 'Western' bioethicists with a number of significant declarations e.g. the Helsinki Declaration that emphasize on protection of subjects in researches (Chamsi-Pasha & Albar, 2013; Musa & Nordin, 2022). These aim at controlling the abuses in bioethical researches in the post-World War II period to the Modern Times (Shabana, 2019 p112). Muslims cannot isolate themselves from the bioethical issues of modernity. IBE have the responsibility to bridge the Muslims from traditional Islamic teachings with the bioethical concepts and practices of the secular world, the present world they live in. Islamic Thought is the foundation, core and pillar for forming, framing and developing IBE. It is the basis to understand Sickness, Disease and Treatment and guide all therapeutic decisions.

Chronic Organ failures are increasingly more prevalent globally. Organ Transplantation (OT) becomes the accepted treatment. The demand for human organs for Allotransplantation (AT) creates enormous bioethical problems. Xenotransplantation (XT) is the transplant of tissues or organs from one species to another species. XT and especially Porcine Xenotransplantation (PXT) is the attempt to solve Human Organ Shortages and their associated bioethical problems.

This Research details the background of PXT and explores the knowledge gap of how Muslims should see XT and PXT from the Islamic Perspectives; the importance, role and development of PXT in the Muslim world from now and into the future.

#### Research Questions

1. How is Islamic Thought related to IBE?
2. What is the contribution of Islamic Thought on Health, Sickness and Treatment?
3. How should Islamic Thought influence the Decisions on AT, XT and PXT?

4. What are the significance of PXT for Muslims?
5. What are the crucial bioethical issues involved in PXT?
6. What are the relieves available to reverse Prohibitions in PXT and how are they applied?
7. How should Muslims posit in PXT, now and in the future?

## RESEARCH METHODS

The Methodology is a qualitative and where appropriate, quantitative, analysis and review of English publications using Google, PubMed and Scopus. The first step is a systematic search using the following sets of keywords (Dzukroni, 2022; Kazemi et al., 2022):

- a) Islamic Thought and Islamic Bioethics.
- b) Islamic Thought and Health.
- c) Islamic Thought, Sickness and Treatment.
- d) Islamic Thought and Organ Failures.
- e) Islamic Thought, Islamic Bioethics and OT.
- f) XT, PXT and Islamic Bioethics.

The second step is selection, analysis and review of f key articles on

- a) Health, Sickness and Treatment.
- b) Organ Failures and Treatment of Organ Failures from Islamic Perspectives.
- c) Permissibility and current status of Permissibility for PXT.

## RESEARCH RESULT

### Health, Sickness and Disease:

People tend to forget what health is until they are sick. Islam attaches much significance to Health. Health does not come by naturally but is considered as a divine gift and blessing from the Creator, Allah. This is the preferred state in this world and The Hereafter in Paradise (*jannah*) (Mishkat al-Masabih 2489, Sunan Ibn Majah 4141, Sahih al-Bukhari 6412, Riyad as-Salihin 1892). The healthy state serves as the platform for serving Allah and fulfilling all the other purposes of creation. Actively maintaining good health is Man's obligations. 'The *telos* of medicine is health (*ṣiḥḥa*), and the *telos* of health in turn is the good life (*ḥayāt ṭayyiba*) lived in private and in public with perpetual mindfulness (*taqwā*) and remembrance (*dhikr*) of the Creator' (Setia, 2022 p90).

In contrast to the state of health are the periods of Sicknesses. For most people and most Sicknesses or Diseases, the periods of Sickness or Non-Healthy state are short. With the change

in the pattern of diseases globally, chronic and non-communicable diseases are increasingly prevalent. Patients with these diseases can have good quality of life or with little or minimal suffering after receiving appropriate treatments.

Everything is created with a purpose or purposes. Sickness has a much deeper and profound meaning for Muslims. If health is a divine blessing, Sickness is a divine blessing in disguise. Sickness can be construed as purposefully created, permitted or willed by Allah for the person and the family (Ali et al., 2023 p166). The Sickness could be a test of patience and faith. Falling sick may be the chance for Man to repent his sins to avoid punishments in The Hereafter (Ragab, 2022 p53). Forgiveness from Allah brings recovery and return of health.

If the belief that this Sickness is willed by Allah and Allah will heal and cure, it may be sinful to use human-sourced treatments.<sup>1</sup> A heightened spirituality with a total surrender to Allah may be sufficient. Nevertheless, Allah's will could be construed differently. It might be the intention of Allah to demand the person to take treatment that bring back his health and abilities to fulfil his purposes of creation.

### Sickness, Spirituality and Treatment

It is natural for people to seek remedies and treatment when sick. Spiritually, this is the driving force for Man to unravel the human microcosm, understand how the body operates and appreciate the mystery, beauty, complexity and perfection of Allah's creation. If people have not been sick, they may not understand the values of health. Sickness causes discomforts, sufferings and hardships that may affect the worship and his obligations to Allah in addition, Allah will not waste the treatments derived from Man's efforts and creativity, that are given by Him, to be unused. Thus, lawful treatment with possible cure should be taken, as said in the Prophet's PBUH hadith.<sup>2</sup>

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<sup>1</sup> Quran Ash-Shu'ara 26:80

وَإِذَا مَرَضْتُ فَبِهِوَءِ يَشْفِينِ ٨٠

And He "alone" heals me when I am sick.

<sup>2</sup> Narrated Abu al-Darda, Sunan Abi Dawud 3874

حَدَّثَنَا مُحَمَّدُ بْنُ عَبْدِ الْوَاسِطِيِّ، حَدَّثَنَا يَزِيدُ بْنُ هَارُونَ، أَخْبَرَنَا إِسْمَاعِيلُ بْنُ عَيَّاشٍ، عَنْ ثَعْلَبَةَ بْنِ مُسْلِمٍ، عَنْ أَبِي عِمْرَانَ الْأَنْصَارِيِّ، عَنْ أُمِّ النَّزْدَاءِ، عَنْ أَبِي النَّزْدَاءِ، قَالَ قَالَ رَسُولُ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ " إِنَّ اللَّهَ أَنْزَلَ الدَّاءَ وَالذَّوَاءَ وَجَعَلَ لِكُلِّ دَاءٍ دَوَاءً فَتَدَاوُوا وَلَا تَدَاوُوا بِحَرَامٍ "

The advances in biomedical sciences and treatments in the Modern Times are the main causes for the improved quality of life and longevity of Mankind, Muslims and non-Muslims alike. However, the desire for treatment is not absolute. Broadly, five juristic views have been put forward with regards to Treatment of Sickness. These are based on individual school's theological interpretation of the cause, connection and significance of Sickness in faith, divinity and destiny; and assessment of the real-world data on the certainty of cure from the offered treatment (adapted from Shabana, 2019 p114-115).

Treatments are;

- a) Recommended: adopted by most *shāfi'ī* and some *ḥanbalī*, based on the Prophet's hadith on seeking of cure for disease both of which are sent down by Allah. Receiving treatment does not contradict faith and belief in Allah.
- b) Obligated: adopted by some *ḥanafī* and *ḥanbalī*. It is sinful if an effective treatment is not taken since the person's life may be endangered.
- c) Permissible: adopted by most *ḥanafī*, the *malikī* and some *ḥanbalī*. This relies on the acceptance that all healings come from Allah.
- d) Avoidance preferred: adopted by most *ḥanbalī* and some *shāfi'ī*. Treatment can be sought but avoidance is preferred since the treatment itself may infringe on Allah's power in healing.
- e) Impermissible: mostly adopted by mystics. Allah's power is sufficient for all healings. All treatments contradict faith and belief in Allah's power. Treatments are also prohibited if they use prohibited ingredients or materials. However, reversal of such Prohibitions is possible through the application of Transformation (*istihalah*), Dire Necessity (*ḍarūrah*) or Public Interest (*maṣlahāh*) (Wong & Faris, 2023).

Legally, seeking cure is considered as part of *tawakkul* (reliance on Allah) especially when there is no explicit prohibition. Recovering from the Sickness after active treatment brings back health, which is the desired state to serve Allah at full capacity (Ragab, 2022 p53).

Finally, effective treatments for previously untreatable Sicknesses or Diseases are increasingly available. For example, Plague or other serious infections killed lots of people in the

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The Prophet PBUH said: 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.

past but now kills much less after appropriate treatments. Similarly, in organ failures. Allotransplantation (AT), that is not known in the past, has improved the quality of life and survivals for patients with organ failures. If Porcine Xenotransplantation (PXT) is successful, it may replace AT as the preferred treatment in the future.

The Prophet had said ‘Old Age’ has no ‘cure’ or ‘remedy’ (Jami` at-Tirmidhi 2038). The field of ‘Rejuvenate or Regenerative Medicine’ is being given much more attention recently. This may provide relief to the natural process of ageing in the future. In simple terms, if the treatment or healing is effective, the person’s health is restored. He continues with his duties to worship and serve Allah. If the treatment or healing does not work, the person may die and he continues in another form in The Hereafter.

### Nature and Origin

Allah created Man, other living creatures on earth and the Cosmo. The primary purposes of creation are for Man to serve and worship Allah, and enjoyment of this life and The Hereafter (al-Baqarah 2:29, al-Jathiyah 45:13). Man, being created as the image of Allah, the Almighty (the Relative Human Form), does not have all the functionality and attributes of Allah (the Divine Form) (Bakar, 2022 p71). This Relative Human Form, is God-like and is only a reflection of the divine attributes. Man has his uniqueness from the human seeds from creation and the ‘differentiated soul’, and is endowed with abilities, creativity and power over other living creatures. However, he also has the physical and psychic imperfection, and subsequent proneness to malfunction of his body systems, be it in the Primordial Reflection or Actuality Stage. The latter may be the cause of his susceptibility to sicknesses.

Moreover, the notion of Sickness is different in Islam. According to Bakar, the *preparedness* to receive the ‘undifferentiated Spirit’ and the ‘transformation of human seeds embedded in the *filtra* (primordial state)’ determine what the person ought to be or has to have (Bakar, 2022 p71-72). In congenital or hereditary diseases, the unique genetic makeups of the person pre-determine the inevitable appearance of these Sicknesses or Diseases. Their existence could also as purposeful and metaphysical as the other acquired Sicknesses or Diseases, and not a reflection of evil (Rouzati, 2018) or sin (Dr. Zakir Naik. (2023): *Is genetic disease a punishment from Allah?* <https://www.youtube.com/watch?v=TwMmliTv060>).

Organ failures are like all other Sicknesses that occur in Man and are increasing globally that burden Muslim and non-Muslim countries (Dzukroni, 2022). Some of them are congenital or hereditary and others, that are most common, are developed or acquired after birth. In addition, some organ failures are environmental or combination of genetic proneness and environmental (Ghareeb, 2011 p86-87). Their occurrence or existence are likewise theological, mystical or metaphysical. Finally, Man has also his personal obligations to preserve his health to prevent vital organ failures. For example, poorly controlled or inadequately treated diabetes mellitus has much higher risk of chronic kidney failure requiring kidney transplant.

### Organ Failures, Replacement Therapy and AT:

The foundation principles of medicine include seeking for cure of disease and saving of lives (Chamsi-Pasha & Albar, 2019 p5). These conform with what is expected from the sunnah that Allah will send down cure for every disease. <sup>2</sup> Since the last century, transplantation sciences and medicine revolutionize the treatments of patients with vital chronic organ failures or related deadly diseases. However, not all organ failures are treatable or require OT.

The treatments of vital organ failures evolve with time. There are two levels of treatments:

- a) pharmacological or biomechanical therapy.
- b) organ replacement.

For vital organ failures, the first stage of therapy is usually necessary to stabilize the patients or improve the physiological function, albeit temporarily. It is envisaged that patients with organ failures will receive some form of treatments to relieve his symptoms or prolong his life for whatever period. The decision-making process would involve his personal experience and wisdom, and need to be compliant with the *Shari'ah* (Rahman et al., 2021). Missing this opportunity of treatment means death on the spot or in the very near future, or prolonged impairments and complications. Many biomechanical devices have been invented. However, none of them can replace the full physiological functions of these affected organs in the long term.

Patients with acute vital organ failures e.g. kidney, liver, heart or lung may recover after pharmacological therapy without or with biomechanical support systems and will not require OT. The next stage will be an assessment and the decision to undergo OT for irreversible vital organ failure. AT for specific vital organ failures, e.g. kidney, heart and liver, are developed and accepted as the preferred treatment options. However, the growing demand exceeds the supply of human

organs resulting in an enormous demand-supply gap. Bioethical issues and illegal or immoral activities then appear.

Since OT or the like are not mentioned in the Qur'an, the acceptance of OT remains open and the debate is still on-going despite after years of published fatwas, deliberations, decrees etc. (J. A. Ali, 2021; Padela et al., 2022). Ali (2020) analysed fatwas and results of researches on OT from 1925, and proposed seven 'conflicting' OT options for AT that are equally acceptable from Islamic Perspectives (M. Ali & Maravia, 2020). Muslims are free to choose any of these options without being sinful, both as donors and recipients. The seven acceptable options are:

- a) Organ Reception and Donation are both Forbidden;
- b) Organ Reception and Donation are both Permissible;
- c) Organ Retrieval after Brain Death are Not Allowed;
- d) Irreversible Loss of) Higher Brain Functioning and Organ Retrieval are Permissible;
- e) Donation is Only Allowed from Living Donors;
- f) Donation is Only Allowed from Cadaver Donors;
- g) Suspended Judgment is Allowed.

Thus, by this stage, the Muslim patient with vital organ failure has three options, all of which are acceptable in Islam:

- a) no AT.
- b) receive human organ from deceased donor.
- c) receive human organ from live donor for non-vital organs.

Moreover, there are certain limitations in transplantable human organs for Muslims:

- a) non-transplantable from deceased or living donors: organs carrying genetic information infringe on progeny, e.g. gonads. Uterus is not permitted (A. I. Padela & Auda, 2020 p4).
- b) non-transplantable from living donors: vital organs or organs with aesthetic importance (Sachedina, 2009 p187-188; Dayan et al., 2021 p514-515).

### **XT and PXT:**

Most importantly, there are subsets of patients with chronic organ failures who are excluded from AT or AT is not available due to Human Organ Shortages or psychosocial factors (Parker & Chin, 2020). XT especially PXT are developed to meet such needs. For Muslims, PXT may not be permissible since Pork and, arguably, all porcine derived products are prohibited.



### **PXT: Medical or Experimental Researches:**

The practice of medicine nowadays is far more complicated than the contemporary period. Modern day medicine or treatments, like AT and PXT, are not 'one-shot settles all' therapy. To prove that a certain treatment or intervention is effective, various phases of clinical trials and biostatistical analysis are required.

For Muslims, IBE are involved in these studies to make sure these are compliant with *Shari'ah*. Both knowledgeable researchers and patients with respective diseases are needed. Being experimental studies, the benefits and risks of these treatments or interventions may not be certain. However, without the participation of the researchers and patients, these results can never be known or confirmed. Denying the participation in Experimental studies may halt the advances in treatments that may benefit Mankind and could be against the wills of innovation and creativity given by Allah. Therefore, Muslims should avail themselves in these Experimental researches either out of altruism and benevolence or *maṣlahāh*.

OT, including AT, XT and PXT, has to prove their effectiveness of 'curing' organ failures through the 'standard' proportionality and risk-benefits analysis for different treatment options e.g. immunosuppression or immunomodulation protocols. AT is well established but data on PXT are scanty and insufficient. Experimental, Pre-clinical and Clinical PXT Studies are needed to obtain the data on benefits and risks.

### **PXT: Human Organ Shortages and Public Interest:**

AT uses human organs procured from the living or decedent person. Vital organs can only be obtained from deceased person. For those jurists who object the use of human organs in OT or controversies in Muslim to non-Muslim donation and receipts (Dayan et al., 2021 p516-517), PXG offers the best alternative. Sheikh Ibn al-'Uthaymīn (d. 2001), the former Chief Mufti of Saudi Arabia, remarked that, with the exception of pork, all other porcine derived products are permissible if the patients need them (M. Ali et al., 2023 p172).

IBE leave open the discussion on whether the donor is dying or unstable life (still alive), or dead (Rashid, 2023 p11-12). Jurists who allow donation from live donors with consents will accept procurement when brain death is confirmed or DCDD established per protocol (A. I. Padela & Duivenbode, 2018 p6-7; Butt, 2019 p99-101). Those jurists, who only accept cadaveric organs as permissible, will allow procurement only after death is confirmed. Despite this generally accepted

definition of brain death among Islamic traditions, some jurists still refuse to accept brain death as death in Islam. Procuring organs from brain death person, who may not have died, is the equivalent of killing a life person with violation of the Islamic Moral Code.

Other scholars emphasize that Islamic judicial principles should not be compromised simply because of societal or utilitarian need. Brain death, that has a utilitarian objective solely for procurement of human organs in AT, should not be permitted (Rady & Verheijde, 2014 p4-5). If PXGs can substitute allografts, there is no need to procure human organs during the end-of-life period. All these bioethical issues and distresses for family members (Khan, 2021 p16-18) will be solved.

In fact, Muslims have much more public interests at stake from successful PXT. Many of the bioethical problems or illegal activity arisen from Human Organ Shortages e.g. forced organ harvesting and human organ trafficking are much more prevalent in Muslim countries or disadvantaged Muslims e.g. in refugee camps (Domínguez-Gil et al., 2017; Gonzalez et al., 2020; A. I. Padela & Auda, 2020; Interpol, 2021; Ambagtsheer, 2021; A. Khan et al., 2022). Thus, Muslims would be obliged to participate in Experimental PXT as researchers and recipients of PXG through *maṣlahāh*.

### **PXG: Preferred Donor Organ:**

There are natural and acquired factors that support the pig as the most favored animal in XT. These include their high reproduction and breeding efficiency, familiar husbandry, and ease of genetic editing which is essential to overcome the medical obstacles in PXT etc. (Aristizabal et al., 2017 p65).

For Muslims, Pigs are one of the non-*halāl* animals. This prohibition has been extended to all Porcine derived products (Azri et al., 2017 p114) but some jurists restrict the prohibition to pork only (Ali et al., 2023 p170, 172). Arguably, the prohibition of consumption of pork may be metaphysical rather than what have been proposed (Qotadah & Syarifah, 2022 p98; Dzukroni, 2022 p74). These reasons to support the prohibition are not unique for pigs.

The infection and metabolic risks from pork are real. However, zoonosis, the transmission of infection from animals to human, are not uncommon and may originate from both *halāl* animals and non-*halāl* animals. The ingestion of the permissible beef and mutton carries similar magnitude of risks of zoonosis as compared to Pork. These red meats have other health risk e.g. cancer of

the colon and mad cow disease. The donor pigs in PXT programs are different from ordinary pigs for consumption as pork. These wild or genetically manipulated pigs (GMPs) are strict isolated in biosecured facilities with regular infection surveillance and only infection free pigs are used in PXT (Montgomery et al., 2022 Supplementary Appendix; Porrett et al., 2022, Supplementary Information).

If all living creatures are created with purpose(s) and for the benefits of Man, how could the prohibited pigs benefit Man. Man and other earthy creatures do not need the pork or the pigs to survive because there are readily available substitutes. Purposeless pigs can be easily removed by Allah. However, they are not. Allowing them to exist and perpetuate could be another form of unrevealed knowledge.

### **PXT: Permissibility and Relieves:**

Most jurists underestimate the complexity of PXT. Simple blanket statements of permission or prohibition may not be inappropriate (Butt, 2019 p33-34; Nurmansyah et al., 2023). Personal, cultural and social effects for PXT should also be considered (Kazemi et al., 2022). In addition to juristic expertise, modern day deliberations need to incorporate biostatistics and epidemiological data to assess the 'real' benefits of PXT. The latter is one of the major determinants on the Permissibility of PXT (Ali et al., 2023 p173). Most PXT deliberations or decisions are applicable to personal level. Public Interests are seldom relied upon and discussions are usually on the negative impacts e.g. xenozoonosis in bystanders or Community at Large (Hurst & Cooper, 2024 p2-3).

The jurists and scholars are divided on the permissibility of PXT:

- a) All PXT is prohibited because PXGs are Porcine and prohibited in entirety.
- b) PXT is prohibited under *Shari'ah* principles but the prohibition could be reversed by invoking Dire Necessity. The pre-conditions for Dire Necessity have to be satisfied: established or certain benefits, no other lawful alternative is available etc. (Wong & Faris, 2023).
- c) All PXT is permissible because of Public Interests. The minority Jurists permits use of Porcine derived products other than Pork (Hammad, 2004 quoted in Azri et al., 2017 p115).

Theological objections to PXT should take into consideration that the Qur'an provides relief (Dire Necessity, *darūrah*) to consumption of Pork in the same passage (Al-Baqarah 2:173). The over-riding Public Interest and suitability of PXG over Human Organs for Muslims should negate

such objections. However, as of now, PXT should not be permissible invoking Dire Necessity or Public Interest because benefits are not definite nor highly probable. However, the current replacement therapy for chronic kidney failure is much inferior to any OT (Dzukroni, 2022; Ali et al., 2023 p168).

Experimental PXT is only available in a few centres in USA. South Korea has its own XT research centres (Cho et al., 2019; Kwon et al., 2020). Japan has recently started its GMP program (Genetic Engineering and Biotechnology News, 13 February 2024). China has an enormous demand for allografts and may start XT soon (Tu et al., 2024).

Most Muslims with chronic organ failures do not have access to XT or PXT centres in their home countries. Any permissions that are granted are only applicable for Muslims who have access to any of these PXT treatment centres. At this present moment, PXT can only be permissible by invoking *maṣlahah* and out of the patient's altruism or benevolence for benefits of future patients with organ failures. The latter is highly praised by Allah.

Qur'an Al-Baqarah 2:195

وَأَنْفِقُوا فِي سَبِيلِ اللَّهِ وَلَا تُلْقُوا بِأَيْدِيكُمْ إِلَى التَّهْلُكَةِ وَأَحْسِنُوا إِنَّ اللَّهَ يُحِبُّ الْمُحْسِنِينَ ١٩٥

*“Spend in the cause of Allah and do not let your own hands throw you into destruction 'by withholding'. And do good, for Allah certainly loves the good-doers.”*

Once successful PXT is confirmed, Dire Necessity or Public Interest can be invoked to establish Permissibility.

### **PXT: Acceptability:**

In PXT, communication is very important. Most people and healthcare providers including medical doctors may not have sufficient knowledge and experience in PXT (Tu et al., 2024). Moral acceptance and approval of PXT by Muslims are still debatable (Andrade et al., 2024). Experimental and Clinical PXT need patients to participate in these programs. The success of PXT programs will depend on the technical expertise of the respective specialists and communications with the patient, family and community at large. A small study in Turkey involved 18 patients with kidney failure receiving hemodialysis. Almost all patients have not heard of xenotransplantation (Akboğa & Hobek, 2023 p4). Yet, 88.8% accepts receiving transplant from *halāl* animal and 66.4%, from non-*halāl* animals. These reflect the need for transfer of information to the patient and desperation of these patients on waiting list for kidney AT.

Thus, despite lots of media attention recently, we cannot assume data and information can flow adequately and efficiently to the appropriate patients and healthcare providers. Efficient explanations and communications of Islamic Thought, IBE and jurists' deliberations on PXT can facilitate patients to decide whether he or she should participate in or accept Experimental or Clinical PXT.

## DISCUSSION

Islamic Thought is central to IBE and contributes to the required theological, philosophical, legal and mystical bases. The Islamic Thought covers almost every aspect of Man as a living being: from creation, knowledge acquisition, handling of health, sicknesses and treatments. Health, Non-Health, Sickness constitute the whole life time of Man. The theologically and philosophical concepts on Health and Sickness, especially on the Islamic Worldview and the origin of diseases, determine why and how Man should decide what should do or should have been done during these periods to fulfil the purposes of his creation. These pin his choices in seeking treatment.

IBE in the modern world have evolved from the Islamic Medical Ethics in the contemporary period and become the indispensable parts of current medical practices. They govern mostly the conducts of the healthcare providers, treatment and technologies. However, the responsibilities of the recipients and the community at large are much less attended to. IBE may not satisfy day-to-day needs of ordinary Muslims because they are derived from and strongly linked to the Islamic texts that. A separate Muslim Bioethics, that are more understandable and deal with more practical issues with less dependence on textual references, has been proposed (Padela, 2023).

For an ordinary person, life begins as a being at birth and ends at death. In between is the period of existence as a person. Science puts life earlier, at the time of fertilization or conception. In Islam, Man exists as a being at the time of ensoulment (120 days from conception) (Rashid, 2022 p18-19) and ends when the soul leaves the body (Padela et al., 2011 p61-70; Miller, 2016 p397; Rashid, 2023 p5). Since the soul is the determinant and metaphysical, the time when life begins and ends is also metaphysical. From the beginning to the end of life is the life of a person, constituted by the enjoyments, the sufferings or hardships and ageing. In Islam, every moment of life is valuable (Daar & Al Khitamy, 2001 p61). Bioethical issues involving Sickness and Treatments arise during this whole period of his existence, from before conception to after death.

The general consensus is to seek and receive lawful treatment for Sickness where effective treatments are available especially for saving life, or where public interest or public health demands the treatment. Treatment can be refused if the treatment is unlikely to be effective, or harms exceed benefits. In between these two options, the patient may elect to undergo, refuse or defer treatments. Prohibited treatments can be permissible if Transformation, Dire Necessity or Public Interest is invoked. Moreover, the legal permissibility as advised or decreed may be rejected or refused by the patient. The final decision whether to receive any treatment is still personal and an ethical decision rather than a legal obligation (Islam, 2021 p3) except when legislations or public interests mandate for compulsory treatment.

For every new biotechnology, bioethical issues usually appear simultaneously. Islamic Thought and IBE are involved in providing the governance, guidance, acceptability and permissibility of the respective biotechnology and the mode(s) of treatments. The field of XT and PXT has expanded very rapidly following an ever-growing Human Organ Shortages in AT. Man is the only earthy creature who is able to acquire and develop the system of knowledge and interventions to solve the sufferings and hardships arisen from Sicknesses and Diseases. Islam permits and encourages researches that originate from the endowed gifts of intellect (*'aql*) and creativity to Man (Rajab & Irfan, 2022 p22-30).

PXT researches provide a fine dissection of the immunologic process of XG rejection, physiological properties of different porcine proteins and interplay of different regulatory porcine proteins in human physiology and immunology systems. These are not known before this era of XT. GMs at multiple points of PXT are used to overcome rejection, enhance physiological compatibility, minimize xenozoonosis, and ameliorate post PXT syndromes. Moreover, Liver PXG as of now may be too complicated for clinical PXT using a conventional approach with GMP and immunosuppression or immunomodulation. Blastocyst Complementation and GMP may be the better alternative in the future.

Almost all publications on PXT are on Prohibitions and Permissibility with little information or emphasis on the process of PXT. The neglected issue is communication with patients at Point of Care which is one of the most determinants for patients to accept PXT. The impacts of Islamic Thought on IBE may be well-perceived by many scholars, jurists and healthcare providers. However, the patients may not be aware of or not been timely updated on treatment options, Islamic Thought and IBE related decrees or decisions (Daar & Al Khitam, 2001).

The presumption that an individual can search, find and understand all biomedical and bioethical issue adequately may be erroneous. For some of these issues, even an ordinary doctor may not be able to understand or may be familiar with their applications. This will be definitely more problematic for those patients who are under-privileged and less educated or have less access to information. Therefore, contrary to what has been proposed (A. I. Padela, 2022 p304), it is unrealistic to expect the patients to have the full set of skills to handle all aspects that are involved in these biomedical or bioethical issues. Without much assistance, they may not be able to make decisions on the biotechnology or treatment options despite being ‘informed’. Furthermore, the published or available data that are available to the patients may not be relevant or appropriate to his situation. These data could be affected by the subjects being studied and the institutions doing these studies. These variations could cause tremendous differences in the risks and benefits of treatment or procedures and are difficult to be understood by the patients. Thus, the medical doctor or healthcare provider, who has a good knowledge in theology, philosophy and laws, has the responsibility of ensuring this process of IBE communication is well undertaken and effective.

Patients with chronic organ failures that require OT are increasing rapidly in Muslim countries. These include the often-neglected demand from patients with Type 1 Diabetes Mellitus (pancreatic  $\beta$  cell failure) (Abuyassin & Laher, 2016; Robert et al., 2018). XT had been performed in the Islamic Contemporary Period but had stopped since (M. A. Albar & Chamsi-Pasha, 2015 p210). With the support from jurists, scholars and philosophers, Muslim researchers and policymakers should not just sit and wait for others (non-Muslims) to develop the PXT to address these needs of the Muslims. They should see establishing PXT as an opportunity and challenge for the benefits of Muslims, community at large and non-Muslims. With the relieves of Dire Necessity and Public Interest, Muslim should be permitted to participate in PXT to ensure that it is going to be successful and change the whole field of OT in the future.

## CONCLUSION

Islamic Thought is central to IBE and contributes the required theological, philosophical, legal and mystical bases. Islamic Thought covers almost every aspect of Man as a living being: from creation, knowledge acquisition, handling of health and sicknesses or diseases, treatments or remedies. IBE in the modern world are the indispensable part of the conduct of medical practices and have evolved from the Islamic Medical Ethics in the contemporary period. They govern mostly

the conducts of the healthcare providers, treatment and technologies. The responsibilities of the recipients and the community at large are much less attended to.

Organ failures are one of the many diseases that affect Man. Their theological origin is like any of the other diseases. OT for vital organ failures is an important advance in modern day therapeutics. This provides a fundamental change to the pessimistic outlook for these patients, from demise to a renewed hope for their lives. AT is the accepted and preferred mode of treatment. However, the human organ supply gap results in multiple bioethical, legal and inequitable problems. PXT stands out as the most promising alternative to AT for solving the Human Organ Shortages and their associated problems (Wong & Faris, 2024).

Muslims with irreversible vital organ failure have a 'restricted' autonomy of deciding on how to treat their problem (Chamsi-Pasha & Albar, 2013). From the Islamic Perspectives, there are two important determinants: the availability of the treatment and the certainty of benefits from the treatment (Akhmad & Rosita, 2012). These Muslim patients are expected to receive 'standard' replacement therapy and most will accept AT if this is available. If AT is not accessible, PXT may be considered.

Islamic Thought on PXT provides the basis for support for medical or experimental researches, invoking Public Interests to solve the bioethical and legal problems from Human Organ Shortages, choosing PXG as the preferred donor organ and, most importantly, for permitting PXT. Muslim Countries have the obligation of promoting and ensuring the success of PXT to abrogate the exploitation of and illegal activities involving those under-privileged Muslims (A. I. Padela & Auda, 2020 p3).

As of now, all of these are mostly positive for PXT. However, benefits from PXT are not firmly established and have not satisfied the mandatory pre-condition to invoke Dire Necessity or Public Interest. However, Muslim researchers and patients with organ failure can and should be permitted to participate in Experimental PXT studies out of Public Interest and personal benevolence on benefit of Mankind. Once PXT benefit is confirmed, Dire Necessity or Public Interest can be invoked and will negate all prohibitions of the Porcine Xenografts.

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