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Research Article

Islamic Bioethics, Porcine Therapeutics and Porcine Xenotransplantation: Islamic Perspectives

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Abstract. Medical personnel (Healthcare Providers, HCPs) have the moral and ethical obligations of fulfilling the health needs of the patients and must be attentive to the patients' cultural and religious needs. In Hong Kong, we have a small but significant Muslim population but very few Muslim HCPs. More often than not, we simply neglect or forget about the needs for our Muslim patients. The main cause is our lack of knowledge about Islamic Bioethics (IBE) especially on what treatments and procedures are permitted or prohibited. This article provides a detailed analysis to enable HCPs to understand and make decisions on permitted treatments for Muslim patients. This is extremely important for non-Muslim HCPs who have only mediocre or no knowledge in Islam. This study is a comprehensive review on the application of IBE, from their development since the contemporary period to Modern Times, the contributions of Islamic laws and the frames of belief in Sickness and

Treatment. A special emphasis is provided for the mechanisms of relieves in reversing Prohibition. Pork is prohibited in Islam. The authors choose Porcine Therapeutics and Porcine Xenotransplantation (PXT) as the model to illustrate how Prohibition is determined in medical therapeutics and how the Prohibition can be reversed such that appropriate treatments can be offered and accepted. This model has the potential of application to all forms of therapeutics and may facilitate the interactions and decision making among HCPs and Muslim Patients. The principles of *Shari'ah* and *maqāṣid shari'ah*, the basis of IBE in relation to sickness and treatment, and their applications to general biomedical issues, Porcine Therapeutics and PXT are explained in details. The prohibitions on the latter two areas can be reversed by invoking Transformation (*istihalah*), Dire Necessity (*ḍarūrah*), or Public Interest (*maṣlahāh*). The current permissibility in Xenotransplantation (XT) is considered to be premature and Dire Necessity (*ḍarūrah*) cannot be invoked because benefits from XT and PXT have not been established. Public Interest (*maṣlahāh*) can be invoked to allow for Experimental Research and Clinical Studies in PXT.

Keywords: Islamic Bioethics, porcine therapeutics, porcine xenotransplantation, *Shari'ah*, *maqāṣid shari'ah*, Transformation (*istihalah*), Dire Necessity (*ḍarūrah*), Public Interest (*maṣlahāh*)

INTRODUCTION

We, as medical practitioner and HCPs, seldom pay much attention to the religious background of our patients. In fact, we should. However, are we equipped with the skills and knowledge to deal with the impacts of religion and faith on their medical care? There are about 300,000 Muslims living in Hong Kong, of which fifty thousand are Chinese, thirty thousand are Pakistani, 150,000 are Indonesian and the rest are coming from other countries including Middle East Countries.[1] There are two mainstream in Islam: Sunni (majority in Hong Kong) (Ho, 2013 p20) and Shi'ites. Jurist and legal schools are responsible to decide on bioethical issues. Within the Sunni's, there are four major Sunni's legal schools (*ḥanafī*, *mālikī*, *shāfiʿī*, *ḥanbalī*) and within Shīʿites, three legal schools (*ja'farī*, *zaydī*, *ismā'ilī*). Both traditions have very much similar deliberations or judgements on bioethical issues (Daar & Al Khitamy, 2001 p61).

How much do we know about Islam, Islamic Bioethics (IBE) and their attitudes towards health, diseases and treatment? Both the Sunni and Shi'ites tradition have very much similar deliberations on most bioethical issues. The general principles on Islamic Bioethics (IBE), attitudes towards health, diseases and treatment are mostly similar among Islamic legal schools. However, juristic deliberations still vary among these legal schools, geographical locations, cultural differences and adherence to the recommendations.

The concept of Sickness and receiving of Treatment are different for Muslims. Not all Treatments are needed, acceptable or permitted (M. A. Albar & Chamsi-Pasha, 2015; Ismail & Setiawan, 2022). There are three common mechanisms to reverse Prohibitions for medical therapeutics: Transformation (*istihalah*), Dire Necessity (*ḍarūrah*), Public Interest (*maṣlahāh*). All of these require specific conditions that

[1] Hong Kong: The Facts; Religions and Custom. Home and Youth Affairs Bureau, July 2022 http://www.hyab.gov.hk

need to be satisfied before they can be applied (al-Mutairi, 1997; Sachedina, 2009; Safian, 2010; A. I. Padela et al., 2014).

Publications on these biomedical issues are written for readers who are Muslims and at times, they may even be too complicated for Muslim HCPs. In addition, there is a lack of publications that are directed to non-Muslim HCPs. This article specifically aims for HCPs who have no or little knowledge in Islam and for Muslim HCPs or patients who are not familiar with the principles guiding juristic deliberations on biomedical issues. It is divided into two parts. The first part briefs the general Islamic principles on *Shari'ah* (laws and obligations), *maqāṣid shari'ah* (the higher objectives of *Shari'ah*), Islamic Medical Jurisprudence (IMJ), Islamic Bioethics (IBE), and relieves from obligations or prohibitions. Variations among different legal schools are added where appropriate.

The Qur'an prohibits the eating of pork for Muslims. Arguably, all Porcine products, tissues and organs are prohibited as well. The second part uses Porcine Therapeutics and Porcine Xenotransplantation (PXT) as the model to explain prohibition and relieves from prohibition. The permissibility of PXT remains controversial and debatable. This article will enable Muslim and non-Muslim HCPs to understand the relevant bioethical issues related to PXT that may be extrapolated for decisions in similar prohibitory therapeutics and treatments.

RESEARCH METHOD

The Research Methodology is a qualitative and where appropriate, quantitative, stepwise analysis and review of English publications from contemporary to Modern Times.

The first step is a Systematic Literature Review on each of the following areas:

a) Islamic jurisprudence.
b) IBE.
c) Islamic Thought and IBE.
d) Relieves in Prohibitions: Transformation (*istihalah*), Dire Necessity (*ḍarūrah*), Public Interest (*maṣlahāh*).
e) Scientific basis and medical obstacles of Xenotransplantation (XT) and PXT.
f) Advances, Achievements and Unresolved Obstacles in PXT.
g) Participation of Muslim healthcare providers and patients in Experimental Research and Clinical Trials.

The second step is the identification of issues of interests and impacts of each of these areas on:

a) Sickness and Treatment.
b) Prohibitions and Relieves.
c) Permissibility in General Medical Therapeutics.
d) Permissibility for Porcine Therapeutics.
e) The reasons for allowing PXT and current status of permissibility for PXT.

For each specific issue, the development, key concepts, arguments, debatable and controversial issues, and pitfalls are identified and analysed. Solutions or remedies are suggested.

FINDINGS

Shari'ah and *maqāṣid shari'ah*

According to Islam, Man is created by the Creator, Allah. The purposes of human creation are to serve Allah, be the vicegerent of earthly matters, prosper and enjoy his existence in the present secular world and The Hereafter. Man is given the power of discretion and abilities to make decisions for his and worldly matters. The concept and system of benefits or interests (*maṣlahāh*) are gradually established since the time of the Prophet Mohammad, Peace be Upon Him (PBUH), and the Companions.

Shari'ah is the set of Islamic laws and obligations that covers all aspects of human life, public interests and all humanities (Albar & Chamsi-Pasha, 2015). The objectives of the *Shari'ah* extend from the welfare and benefits of the person to the Muslim community (*ummah*) and Community at Large (*maṣlahāh*). These objectives are classified into three categories: i) the essentials or necessities (*daruriyat*) that include the necessity *maqāṣid shari'ah*: faith (*al- dīn*), life (*al-nafs*), dignity or progeny (*al-'ird*), intellect or mind (*al-'aql*) and property or wealth (*al-māl*); ii) the needed or complementaries (*hajiyat*); iii) recommended or embellishment (*tahsiniyat*) (Raysuni, 2013; Al-Bar & Chamsi-Pasha, 2015; Hussin, 2017). Developed from *Shar'ah* is *maqāṣid shari'ah*, which are the higher objectives, purposes and principles of *Shari'ah*. These correspond to the above-mentioned essentials (necessities) in the same hierarchical order. For each issue considered by *Shari'ah*, there are five possible deliberations and decisions: Required (*wājib*), Recommended (*mandūb*), Permitted but Morally Indifferent (*mubāḥ*), Discouraged or Abominable (*makrūh*), and Forbidden or Prohibited (*ḥarām*)(Ebrahim, 2008).

Islamic Medical Jurisprudence (IMJ) and IBE

Medical Jurisprudence (MJ) is the application of medical knowledge to questions of law affecting life and property, including ascertaining and certifying the causes of death, proper medical practices etc. In actual practice, MJ is much broader than this definition. It extends to 'the application of medical sciences to legal problems' and covers a wide range of medical issues within the healthcare sector (Ebrahim, 2008; Fadel, 2022).

IMJ is an extension from Islamic Jurisprudence (IJ) to the medical and healthcare field. Its base is IJ, *al-fiqh* and *uṣūl al-fiqh*. The Qur'an is the source of Islamic laws and lays down the obligations for the life of Muslims and how to live as a being in this mundane world (*dunyā*). IMJ is the basis of IBE and handles the legal implications and dealings that flow from IBE.

Afridi gave a detailed explanation and comparison of *al-fiqh*, *Shari'ah* and *maqāṣid shari'ah* (Chapter 8, pp 171 – 193 and Chapter 9, pp 194 – 218) (Razak, 2017). In essence, *al-fiqh* is a deep understanding and knowledge of legal rights and obligations in Islam. It is a complement to Shari'ah. *al-fiqh* covers worship (*ibadah*), personal law (*ahwal al-shakhsiyyah*), transaction (*mu'amalat*), evidence and witness (*murafa'at*), crimes and punishments (*janayat*) and international laws (*siyar*). *uṣūl al-fiqh* is developed from *al-fiqh* and deals with the principles and methodology of derived Islamic laws and rulings. Thus, IMJ has four components: Qur'an, hadith and

sunnah (from the Prophet PBUH); *fiqh* and *usul fiqh*; *Shari'ah* and *maqāṣid shari'ah*; consensus (*ijmā*), analogical reasoning (*qiyās*), juristic reasoning (*ijtihād*) and other IJ legislations.

On the administration of judgements or deliberations, there is no Islamic global or central governing legal system, or ordained clergy (El Fadl, 2017 p11). Islamic scholars and jurists are given the responsibility of making decisions on religious practices and deliberations for IBE. Conferences are held and decrees or fatawa[2] are issued (Daar & Al Khitamy, 2001 p61). However, each country or jurisdiction can establish their own system of experts, expertise and deliberations. Legal precedent is also absent. Judgements or jurists' deliberations will not be binding on subsequent deliberations. Each juristic decision, including IBE decision, is actionable only for that particular issue at the time and is at most persuasive through analogy (*qiyās*) in other situations.

Moreover, Muslims facing similar circumstances may expect very much similar judgements and recommendations. Finally, legal pluralism is well tolerated. That means more than one deliberation can be decided for the same or very much similar issue. These are all compliant with *Shari'ah* laws and not sinful. In countries where laws and statues over-ride *Shari'ah* laws, compliance with laws of land is mandatory.

IBE, Sickness and Treatment

IBE and 'Western" Bioethics, there are four domains in the 'Western' Principlist Bioethicists (Principlism): autonomy, beneficence, non-maleficence and justice. IBE endorse non-maleficence and justice but differ in autonomy and beneficence (Chamsi-Pasha & Albar, 2013; Plöckinger & Auga, 2022 p15; Chamsi-Pasha et al., 2022; Rasool et al., 2023). Of these, autonomy has the biggest difference and, in IBE, avoiding harm (non-maleficence) presides over benefit (beneficence).

Autonomy means self-determination by the individual. Its application for Muslims is distinctly different from non-Muslims. From the 'Western' perspectives, it is the liberty of a person as the person to make his or her own decisions. Among different cultures, the contribution of family or care-givers towards these decisions can vary. For Muslims, complete or total autonomy is non-existent. Created and nurtured by Allah, man has conceded his right of decisions of himself to Allah. Allah is the ultimate owner of his body and soul. He has the obligation to take good care of his body and life, and make 'correct' actions for all dealings concerning his health and remedies or treatments. These considerations extend from himself to his family, ummah and Community at Large (Khaleefah, 2022 p4-5).

Muslim families may also follow the traditional *wali* (guardianship) or *mahram* system where the decision process itself is a joint process involving the individual member(s) and the whole (extended) families (Weber, 2023 p56).

Sickness and Treatmen, Men, being created by Allah to be vicegerent of the world, are given rights and powers over all other earthy creatures. Life, Sickness or Disease, and death are natural periods from creation, not only of Man but of all living

[2] *fatwā*, in Arabic, is a legal ruling issued by Islamic jurist(s); *fatawa*, is the plural for *fatwa*.

organisms. Saving of life is accepted as part of humanity in both Islamic and non-Islamic (Western) bioethics and Communities at Large.

However, the Islamic concept of life and preservation of life is different. All moments of lives, good or bad, are valuable in Islam. Saving of lives, be it personal or others, are highly rewarded by Allah (Qur'an al-Mulk 67:2, al-Ma'idah 5:32) and is an obligation (Daar & Al Khitamy, 2001 p61). Since Allah is the giver and taker of life, Man has no right to give live or take live away from himself (suicide) or other people's life (euthanasia or murder). Sicknesses or Diseases in Man are natural phenomena that are unrelated to demons, stars, evil spirit, wrath of Allah or any other celestial creatures (M. A. Albar & Chamsi-Pasha, 2015 p214).

However, Sickness or Disease may carry much deeper meanings for Muslims. It may be the time to reflect and repent, to test the strength of faith, to get the chance of unravelling the mystery of the body and microcosm etc.

Allah is the ultimate source of healing (Quran Ash-Shu'ara 26:80, al-Isra 17:82; Narrated Abu al-Darda, Sunan Abi Dawud 3874). In contrast to the highly honoured saving of life in Islam, seeking treatment for diseases to preserve or saving one's life is different. Seeking treatment could be considered as *tawakkul* (Allah's appreciation) which is relying on Allah for a permitted treatment or remedy (Ismail & Setiawan, 2022). This treatment must conform with *Shari'ah* laws, Islamic principles and teachings.

The effectiveness of treatment or outcomes after treatment is the major determinants for Muslims to seek treatment or remedy (Wong & Faris, 2023 Table 1 p372). Seeking treatment or remedy for diseases or illness can be divided into five groups: mandatory, encouraged and preferred, optional, abstinence preferred and prohibited. It is mandatory to seek treatment if life or major organ damage are at stake and effectiveness of treatment is certain, or if the illness is contagious and harmful to others (Butt, 2019 p22-25; International Fiqh Academy-Organization of Islamic Conference 1992, quoted in A. I. Padela et al., 2021 p10).

This is in line with the hierarchy of saving and preservation of life in *maqāṣid shari'ah*. Treatment can be refused if benefits from treatment is not proven or uncertain or if the side effects are more than the anticipated benefits. Some treatments are prohibited if the mode of treatment or the therapeutics are prohibited e.g. sorcery, wine or products from unlawful animals. Other than these three groups, the patients are given the liberty of deciding whether he or she is going to receive or delay any treatments.

Prohibition and Relieves

Shari'ah is the foundation for all Muslims. The *Shari'ah* laws determine the obligations, permissible acts and prohibitions. However, the intention of *Shari'ah* is not penalizing. When the performance of certain obligations or permissible acts may result in harms or injuries, relieves are provided: hunger (starvation) and unlawful food, worship and sickness, compulsion and faith, dignity of body and Public Interest etc. (al-Mutairi, 1997 p81-91, p115-117; Sachedina, 2009 p175-180; Safian, 2010 p31-42; A. I. Padela et al., 2014 p59-66).

IBE deal with issues pertaining to inventions, innovations, researches and treatments especially those at the forefronts. Specifically, the deliberations and decisions mainly deal with Permissibility e.g. genetic editing, allocation of scarce resources or withdrawal of life sustaining equipment etc. (Isa, 2021; Padela et al., 2021) and these must be compliant with the *Shari'ah* laws. There are three common mechanisms that allow Muslims to deviate from the *Shari'ah* laws: Transformation (*istihalah*), Dire Necessity (*ḍarūrah*) and Public Interest (*maṣlahāh*).

These three mechanisms are not mutually exclusive and can be complementary to one another. To avoid abuses and maintain relevance, pre-conditions are set for each that must be satisfied before such relief can be executed. Transformation and Public Interest have much less pre-conditions and there is no requirement to search for lawful alternatives.

Transformation, Transformation is often used as the relief in prohibited therapeutic products, for example, gelatin in vaccines and capsules, and trypsin in vaccines (A. I. Padela et al., 2014 p59-66; Nordin & Musa, 2015 p36-39). The Prohibited or unlawful products or materials must undergo transformation in full with fundamental changes in their physical, chemical or biochemical, genetic properties; external identifiable (phenotypic) appearance or intended use. The classical example is permitting vinegar that is generated from the prohibited wine. Prohibited ingredients that are of tiny amount, after extreme dilution or unavoidable and minute contaminations are accepted as a form of transformation and permissible (Azri et al., 2017 p118-119; Rosman et al., 2020 p1037-1045; Ismail & Setiawan, 2022 p31-35). Once transformation is applied, prohibition is removed. The product or appliance can be used lawfully.

Dire Necessity, Dire Necessity is the principal mechanism to reverse prohibition in most IBE issues (Samdani, 2019; Ebrahim & Padela, 2021). Dire Necessity is not the simple necessity or necessity in the literal sense. The primary basis of Dire Necessity is the saving or preservation of one or more of the necessity *maqāṣid shari'ah*. The classical example for Dire Necessity is the permission of eating the prohibited pork at time of hunger or starvation (Qur'an Al Baqarah 2:173).[3] However, the Qur'an does not lay down the requirements for Dire Necessity in one location. Pre-conditions for invoking Dire Necessity are gradually established.

For Dire Necessity to be applicable, the Medical Condition must be serious, causing significant harm to the person which is immediate, certain and proportional (Candlish, 2007); the Prohibited Treatment is effective and executable, not causing harm to other people or community, not having conflict with other necessity *maqāṣid shari'ah*, target based for the shortest possible period; and no other lawful alternative is available at the time (Wong & Faris, 2023; p379-380). However, the search and how exhaustive the search of lawful alternatives has not been clearly specified and could be specific to the situation. Since the availability of new biotechnology and lawful

[3] Qur'an Al Baqarah 2:173

إِنَّمَا حَرَّمَ عَلَيْكُمُ ٱلْمَيْتَةَ وَٱلدَّمَ وَلَحْمَ ٱلْخِنزِيرِ وَمَآ أُهِلَّ بِهِۦ لِغَيْرِ ٱللَّهِۖ فَمَنِ ٱضْطُرَّ غَيْرَ بَاغٍ وَلَا عَادٍ فَلَآ إِثْمَ عَلَيْهِۚ إِنَّ ٱللَّهَ غَفُورٌ رَّحِيمٌ ١٧٣

He has only forbidden you ˹to eat˺ carrion, blood, swine, and what is slaughtered in the name of any other than Allah. But if someone is compelled by necessity—neither driven by desire nor exceeding immediate need—they will not be sinful. Surely Allah is All-Forgiving, Most Merciful.

alternatives can vary with time and location, deliberations using Dire Necessity are dynamic, time and location specific.

Public Interest, Public Interest is the pursuit of public interests (the goods and welfare) for the person, the Muslim community and the Community at Large (Sajoo, 2014 p60-62). When there is a conflict among these three groups, the interests of the Community at Large over-ride the personal and Muslim community's interests. In the context of permissibility, the application of Public Interest can be adjunctive or complementary to Dire Necessity. Nevertheless, a cautious and restricted approach is recommended when Public Interest is invoked to make sure that the permissibility is compliant with the *Shari'ah* laws and not creating a separate legal system (El Fadl, 2017 p15; Isa, 2021 p350-351).

Permissibility in Porcine Therapeutics and PXT

halāl and *ḥarām* are two distinct and unique concepts in Islam. Both are applicable to everything in the life of Muslims. *halāl* is/are permissible, allowable and lawful in Islam whereas *ḥarām* is/are prohibited, unallowable, unlawful and punishable. For animal flesh or animal derivable products to be *halāl*, the animal must be an *halāl* animal and slaughtered 'lawfully' according to specific Islamic rules. [4]

Porcine Therapeutics, The Qur'an prohibits the consumption of pork as food. The majority of jurists prohibit porcine derived products or appliances (ḥarām) as well (Qotadah & Syarifah, 2022). A minority legal school (Zahiri) restricts the prohibition to eating of pork only. However, Porcine derived biomedical products have been used as treatments for years.

The first principle for permissibility for all Therapeutics is to determine whether the therapeutic is *ḥarām* or *halāl*.[3] This involves two determinants: i) the active and adjunctive ingredients of the therapeutic; ii) the process of production. For example, the bovine heart valve itself is *halāl*. However, if the ox or cattle is not lawfully slaughtered according to Islamic rules, the harvested bovine pericardial constructed heart valve will be ḥarām and not permissible. Thus, Unlawful Therapeutics include both the unlawful active and/or adjunctive ingredients and those that are produced after unlawful slaughtering or processing.

Unlawful Therapeutics that satisfy Transformation requirements are permissible (Azri et al., 2017 p118).

Unlawful Therapeutics can be classified into four groups:

a) those, that satisfy Transformation requirements, are permissible (Azri et al., 2017 p118).
b) those, that will not preserve or save one or more of the *maqāṣid shari'ah* e.g. live, should be avoided or prohibited.
c) those, that will preserve or save one or more of the *maqāṣid shari'ah* e.g. life, can invoke Dire Necessity and permitted.
d) those, that will have benefits to the Community at Large, can invoke Public Interest and permitted.

[4] Department of Halal Certification EU, https://halalcertification.ie/

Despite being prohibited, Pork itself is a form of permissible 'life-saving treatment' for hunger or starvation after application of Dire Necessity. [4]

For Porcine derived products, appliances or treatments, there are three groups of jurists' opinions:

a) All Prohibited.
b) Prohibited but may be permitted if Transformation or Dire Necessity can be invoked.
c) All Permissible because of Public Interest where benefits exceed harms. A minority legal school (Zhiri) only prohibits the eating of pork and permits the use of all porcine derived products (Azri et al., 2017 p115).

Examples of deliberations that permit use of Porcine therapeutic products:

a) Transformation is applied for gelatin in vaccines and capsules, and trypsin in vaccines.
b) Dire Necessity is invoked for Porcine heart valves for valvular replacements, Clexane for post-partum women and Porcine surgical products. Since bovine or synthetic (lawful) valvular materials are increasingly available, Porcine heart valves may no longer be able to invoke Dire Necessity (S. N. S. binti M. Ali & Gunardi, 2021; O. Ali et al., 2022).
c) Public Interest is invoked for influenza vaccines with porcine ingredients that are used as mass protection against influenza.

In simple terms, Muslim patients should know or be informed about the ingredients of all therapeutics before they are used. Easterbrook reported his study of porcine or bovine surgical products and concluded that patients with different religions should be duly informed about the source of animal-derived surgical products (Easterbrook & Maddern, 2008 p369). However, even in this study, the information on the source is not available in many of the products. More often than not, the manner of slaughtering is impossible to obtain. This is the area where *halāl* certification for therapeutics can help to confirm permissibility for Muslims. In the situation in Hong Kong or in countries where Muslims are a very small minority, it is not envisaged that there could be any *halāl* certification on biomedical products or the procurement of medical supplies will take into consideration of ḥarām requirements.

As a remedy, the working rule on these therapeutics is the Principle of Original Permissibility: all things are Permissible unless being proven to be prohibited [5] (Kamali, 2021). That is, in the absence of proofs of being prohibited, the therapeutics with unsure prohibitions can be used. However, there are Islamic rulings that Muslims should avoid consumables with doubtful ḥarām ingredients. Malaysian fatwa had been issued that a Muslim should not eat, drink or use any product (food, medicine or others) when he has doubts that they may contain pork or porcine derived products (Azri et al., 2017 p112-113, p123).

[5] Sayyid Fadhil Milani, Thirty Principles Of Islamic Jurisprudence, Chapter 2: https://www.al-islam.org/thirty-principles-islamic-jurisprudence-sayyid-fadhil-milani/chapter-2-principle-permissibility

In summary, therapeutic products that have:

i) known or doubtful ḥarām ingredients are prohibited. These may be Permissible if Transformation or Dire Necessity can be applied.
ii) no information, unknown or unsure ḥarām ingredients are Permissible.

On the other hand, Muslims know about the prohibition of pork but they may not be familiar with permissibility of Porcine Therapeutics after application of Dire Necessity or Transformation, or the deliberations of the Islamic authorities. The HCPs would have the responsibility of providing such information to assist patients to make decisions on treatments with the Porcine Therapeutics (Bokek-Cohen et al., 2023 p7-8).

PXT, From the Islamic Perspectives, the evaluation of the Permissibility of a new biotechnology or treatment starts with the intention or the purpose. What is/are the biomedical issue(s) or disease(s) that it attempts to solve. There are four determinants in most issues: The Source, The Process, The Recipients and The Community at Large. Most deliberations tend to under-address The Process and concentrate mainly on The Source and The Recipients, and where appropriate, The Community at Large.

The second step is a thorough assessment of the biotechnology or treatment. This involves:

a) understanding the whole process from source to completion and application.
b) qualitative and quantitative analysis on benefits and harms.
c) identifying what is/are *halāl* and what is/are *ḥarām*.
d) deciding whether relieves are available if the biotechnology or treatment is *ḥarām*.

PXT: Intention and Purposes, Allotransplantation (AT) with human organ as source is the accepted and preferred treatment for (major) organ failures including Muslims (A. Ali et al., 2020; Islam, 2021). However, the growing demand for AT exceeds the supply of human organs and creates an enormous demand-supply gap globally. Human Organ Shortages result in lots of moral, bioethical and legal problems (Table 1). XT and especially PXT is the attempt to solve this Human Organ Shortages and their consequent problems. If PXT is successful, the whole area of AT will be revamped. Uncountable number of patients with organ failures may be benefited.

Organ AT uses human organs whereas Organ XT uses animal sourced organs. Successful XT has to overcome the following medical obstacles: anatomical and structural incompatibility; severe immunological rejection from Xenobarrier; physiological incompatibility from non-human sourced proteins; cross species infections (xenozoonosis); increased cancer risk from animal sourced retrovirus and other carcinogenic viruses. The latter may be even higher if the more intensive post-XT immunosuppression is used.

Among the source animals, pigs offer the highest chance of unlimited supply because of their breeding capacity, large litter size, short reproductive cycles, familiar domestication and husbandry (Aristizabal et al., 2017, p65). Pigs also have the desired

anatomical and physiological compatibility. Most important of all is their ability and efficiency of accepting Genetic Manipulations (GMs) that are required to overcome the major obstacles in XT: minimizing rejection with enhanced graft survival, improve physiological compatibility, lower or abrogate Porcine Endogenous Retrovirus (PERV) infection and eliminate post-PXT syndromes. In Blastocyst Complementation (BC), GM is needed to create the required development niche and the rejection from contaminated Porcine cells in the chimeric graft. These are not easily available for other animals, including those *halāl* animals.

PXT: The Process, Besides the technical aspect of the PXT, the whole preparatory PXT process aims for achieving successful Porcine Xenograft (PXG) survival with full or almost full (acceptable) physiological functions of the transplanted organ. Both the Source Pig and the Recipients have to be prepared such that these medical obstacles can be minimized or overcome.

There are two approaches: a) Conventional Approach: using GM pigs (GMP) and immunosuppression/immunomodulation, and b) BC and Human-Porcine Chimera. It is not the intention of this paper to explain the details of these two approaches. The Conventional Approach with GM pigs for Islets, kidneys and, heart is promising (Carrier et al., 2022; Garry et al., 2022; Griffith et al., 2022; Porrett et al., 2022). BC is still experimental and has not been used in human recipients (Freedman, 2018 p44-46; Loike & Kadish, 2018 p1; Founta & Papanayotou, 2022 p116-117).

The Source Pig, The source pigs are raised in stringent biosafety isolation facilities. The most used technology is the Clustered regularly interspaced short palindromic repeats associated with protein 9 (CRISPR/Cas9). Multiple GMs on the Porcine genome for Knock-Out (KO) or Transgenesis (TG) are performed for minimization of rejection, maintenance of physiological functions, decrease post-PXT syndromes and reduction or elimination of PERV (Niemann & Petersen, 2016 p364-366; Aristizabal et al., 2017 p67 Table 2; A. Ali et al., 2024 p19.5 Table 1; Sykes, 2022 p136). For BC, an additional GM for development niche is needed for the Source Pig. The manipulated embryos are grown in gilt pigs. Zoonosis minimization procedures, e.g. operative delivery, early colostrum weaning, regular Porcine microbe screening etc., are conducted. Xenozoonosis-free GM pigs (GMP) are then selected for organ procurements.

The PXG, Additional procedure on the PXG may be required before PXT:

a) Immunomodulation with Porcine Thymus (Thymokidney) for Kidney PXT to decrease rejection (Montgomery et al., 2022 p1891).
b) *Ex-vivo* perfusion for kidney and heart PXT to improve PXG function (Pierson III et al., 2020 p1393, p1396; Montgomery et al., 2022 p1891).
c) Micro-encapsulation for Islet PXT to increase engraftment and decrease attrition from rejection (Coe et al., 2020).

The Recipient, The process will include the operative procedures, isolation and post-operative care in designated centres, post-PXT immunosuppression and infection surveillance.

PXT: Benefits and Harms

Recipients, Successful PXT will relieve the suffering of the recipient with organ failure, especially to those who are rejected for AT. The risk of relapse of the primary disease causing the organ failure can be lowered and repeated PXT for failed PXG can be more easily available. Furthermore, previous unattempted OT can be undertaken e.g. small bowel.

For Muslims, not all organs are considered transplantable. These include gonads that carry genetic information. Uterus is also not yet permitted (A. I. Padela & Auda, 2020 p4).

Community at Large, Successful PXT will decrease the healthcare burdens from organ failures, avoid injustices from allocation of organs, stop criminal and unethical organ procurement activities, mitigate procurement stresses of the family at end-of-life care. Furthermore, there are further advantages for Muslims (Table 1).

The harms to the Community at Large are mainly the risks of spreading xenozoonoses from the PXT recipients. The recent data on PXT and PERV do not suggest that there is a risk of spread of PERV from the recipient to the community (Denner, 2021). With good infection control at the animal husbandry facilities and proper selection of infection-free source pigs, the harms to the Community should be very low or negligible.

PXT: Relieves and Permissibility

The current opinion on Permissibility of XT:

a) Organs from *halāl* animals that are lawfully slaughtered are permitted.

b) Organs from *ḥarām* animals can be used lawfully if this provides cure that are definitive or highly probable and no other lawful alternative is available (Atighetchi, 2007 p182; Omar & Muda, 2017 p371; Dayan & Ali, 2020; M. Ali et al., 2023 p172; Aramesh, 2023).

However, XT using *halāl* animals is a false hope. Firstly, during the procurement process, the donor *halāl* animal has to be kept alive and cannot be slaughtered (lawfully). This is like the use of severed limb from an alive animal for transplant. The procured organ becomes a carrion, that is impure and *ḥarām*, and prohibited for XT just like organs from *ḥarām* animal (pig) (Zailani et al., 2022 p4; M. Ali et al., 2023 p169-170). Secondly, GMs are required to overcome most of the medical obstacles in Organ XT. Most of these GMs are only available for pigs and not for other *halāl* animals like sheep and cattle. Without GMs, Organ XT using organs from *halāl* animals has practically no chance of success. This Permissibility for organs from *halāl* animals is not executable.

Furthermore, this above opinion on Permissibility of PXT is probably premature and over-simplified. The following is a careful analysis to determine how Permissibility of PXT can be attained.

The Source Pig: Permissible

In the hierarchical order of creation, Man presides over all other earthy creatures (Qur'an Al-Isra 17:70). However, Man has the obligations to respect all kinds of animals. In the context of PXT, the Source Pigs must be given due attention to their lives and welfare. The procurement process and subsequent disposal must observe the required rules and regulations safeguarding the rights of these pigs (Supplementary Appendix in Montgomery et al., 2022; Supplementary Information in Porrett et al., 2022).

The opinions on whether the organs procured from the Source Pig after GM are *ḥarām*, are divided. As discussed, this varies from Total Prohibition and Conditional Permissibility to Total Permission.

The relief of Transformation is not applicable because the Porcine organs remain Porcine even after multiple GMs. For the experimental BC, the Chimeric Organs also contain substantial 'contaminated' Porcine cells, including the vascular endothelium and, before the procurement, the Chimeric Organ is perfused with Porcine blood that contains the Porcine blood cells. However, Dire Necessity and Public Interest can be invoked to satisfy the Conditional Permissibility.

The Process: Permissible

The details of the process should be obtained if possible. All materials and ingredients used throughout The Process should be determined whether they may contain *ḥarām* products. For example, the favoured CRISPR/Cas9 system does not involve any (Islamic) unlawful materials. Those that are not known, they can be permitted using the Principle of Original Permissibility (*vide* supra Section 6.1).

In practice, these materials are needed for the required procedures. Even if *ḥarām*, they may be permissible under Dire Necessity or Public Interest when the Permissibility of the entire PXT is satisfied (M. M. Nordin & Musa, 2015 p114-116; Azri et al., 2017 p117; Musa & Nordin, 2022 p36-38) (*vide supra* Section 6.1).

The Recipient and Community at Large: Permissible

Like all therapeutics, the PXT operation itself, the material used in the operation and the post-PXT therapeutics should also be included in the determination of Permissibility. The risk of xenozoonoses to the Community at Large is minimized by appropriate infection screening and control at biosecured facilities, appropriate PERV GMs, selection of infection-free Source Pigs, designated centres for PXT operations and post-PXT monitoring.

PXT: Overall Permissibility

Permissibility of PXT is divided into
a) All Prohibited.
b) Conditionally Permissible.
c) All Permissible.

The Jurists who prohibit PXT make this decision because the transplanted organ is Porcine. PXT is prohibited for all causes or whatever benefits. A transplanted

impure organ into a Muslim will make the believer unclean in all his services to Allah which is unacceptable.

On Conditional Permissibility, the Permissibility on the Source Pig, The Process and the Recipient is all based on the relief from Dire Necessity (Qotadah & Syarifah, 2022 p100). The major determinant for Dire Necessity is established or certain benefit to the recipient. As of now, Porcine Islet PXT has the best results (Shahab et al., 2022 p2-3). Despite having recent promising results, definite benefits from Organ PXT have not been established (Carrier et al., 2022 p6-7; Griffith et al., 2022; Montgomery et al., 2022 p1892). Therefore, Dire Necessity cannot be invoked. Conditional Permissibility cannot be granted.

For All Permissible, there are two views. Firstly, the enormous Public Interest to reverse Human Organ Shortages and solution to those derived problems are the determinants allowing PXT. The additional advantages from Islamic Perspectives are also contributory to invoke Public Interest (Table 1). Secondly, the minority jurists from the Zahiri School only prohibit eating of pork and permit using pigs or pig derived products for other purposes. Sheikh Ibn al-ʿUthaymīn (d. 2001), the former Chief Mufti of Saudi Arabia, also concurred that all porcine derived products, other than pork, are permissible if the patients need them (M. Ali et al., 2023 p172). However, Public Interest on Permissibility, benefits from PXT must be established and certain, and more than any possible harms.

In summary, at this stage of PXT, both Dire Necessity and Public Interest cannot be invoked to permit Organ PXT for Muslims because there are no confirmed benefits for patients with organ failures. Benefits from Islet PXT seem to be more certain and Islet PXT may be granted permission from Dire Necessity or Public Interest in the not-too-distant future.

Finally, Islam allows Experimental Researches to comply with the purposes of innovation and creativity. Participation in Experimental Studies or Clinical Trials can advance the understanding of Sicknesses and Diseases, and bring benefits to those with such afflictions. Muslim Researchers can join or conduct Experimental PXT. Altruism, benevolence and good-doers are highly rewarded in Islam (Qur'an Al-Hashr 59:9).

Despite having unknown benefits to themselves, Muslim patients with organ failures can participate in Experimental PXT out of their own benevolence, altruism and Public Interest for the future benefits of patients with organ failures. By the time the benefits from PXT are established, Dire Necessity or Public Interest can be invoked to allow Permission for Muslim patients with organ failures.

DISCUSSIONS

Shari'ah and *maqāṣid shari'ah* are central to IBE and the foundation for all IBE deliberations and decisions. Most of the latter are on permissibility. Among the necessity *maqāṣid shari'ah*, the most commonly involved is preservation or saving of life. For the relief from Prohibition, Dire Necessity is most commonly used. However, not all HCPs may know about the concept of Necessity but they may not be well versed in how the pre-conditions of Dire Necessity are developed and applied at the practice level or to specific biomedical issue like organ transplants (Ahmed et al.,

2018). In the absence of formal IME teaching, they often turn to their Seniors or self derived resources to ascertain what they think is relevant and appropriate (Abdulrazeq et al., 2019).

Health, Sickness or Disease and the search for cures or remedies have much more profound meaning and implications for Muslims. Spirituality and religiosity are often involved. Advances in medicine and therapeutics undoubtedly have improved the treatment outcome of people with various diseases, especially for those that may not be treatable in the past. However, not all treatments are necessary or permissible in Islam. Treatments with established or confirmed benefits or Public Interest are deemed necessary whereas treatment with no or uncertain benefits can be refused. In general, most Muslims accept modern day treatment with lawful (permitted or *halāl*) therapeutics. Only a small minority of Muslims will rely solely on spiritual healing. The technical issue is how to avoid unlawful (prohibited or *ḥarām*) products. The latter include alcohol, intoxicants, narcotics, Porcine or Porcine derived therapeutic products etc. [4] Finally, the decision on treatment by the respective patient can vary with his or her adherence to faith and religiosity (Bokek-Cohen et al., 2023 p2) or tolerance of risks from the treatment.

Porcine derived therapeutics or appliances have been used for a long time. Except for a minority jurist's opinion, the explicit prohibition of consumption of pork as food has been extended to prohibition of all porcine related products. However, relieves from Transformation, Dire Necessity or Public Interest are available in selected circumstances as described. On the practice side, religion and therapeutics are usually not discussed at all at the Point of Care. Furthermore, it is extremely difficult for an ordinary medical doctor to know whether the ingredients of the medications or the process of manufacturing the biomedical appliances could involve any Porcine components. This study provides the basis to obtain permissibility in medical therpaeutics. *halāl* certification or an Islamic Healthcare advocate who knows or is familiar with these products will help the HCP to decide on the appropriate therapeutics.

For a new or novel technology or treatment like PXT, it is even more important that HCPs and Muslim patients to have the required knowledge to participate or undertake the treatment (Akboğa & Hobek, 2023). These should cover in details for every step from the source, the process and mode or manner of application on the patient and should not be a simple blanket approval. At each point of the process or procedure, permissibility or prohibition are to be determined. If prohibition is present, any available relief should be decided before the treatment or procedure can be offered. This model of PXT is carefully dissected to illustrate how these principles are applied. At this point in time, benefits from PXT are not confirmed. Thus, the required pre-conditions for previously decided deliberations on permitting PXT using Dire Necessity are not satisfied. However, experimental PXT, with due informed consent, can be permitted through Public Interest. The latter is very important for the early phases of trying out any new technology or treatment because these are not expected to have data on confirmed benefits at the time.

CONCLUSION

Unless expressively requested, faith and religion are not major determinants when we ae treating our patients in Hong Kong. In our ordinary day-to-day practice, we may encounter patients who are Muslims. To fulfil our duties, HCPs have to know and understand how to satisfy their health needs without infringing their faith and religion (Paris et al., 2018). Specifically, we need to know what therapeutics are prohibited and what therapeutics are permitted in Islam. Since there are very few Muslim HCPs in Hong Kong, most HCPs in Hong Kong are non-Muslims who will not be expected to have sufficient knowledge in Islam to give proper advice on medical therapeutics to our Muslim patients. This article provides all the required background principles and information on the concepts of Sickness and Treatment from Islamic Perspectives, how permissibility is determined and how prohibited therapeutics can be used with no restrictions through Transformation, Dire Necessity or Public Interest when the required conditions are satisfied. These are important to HCP in Hong Kong and all other countries where Muslims are an extreme minority or for Muslim HCPs who are working in isolation with remote access to resources in IBE.

Pork is not permitted to be consumed as food in Islam. Porcine therapeutics and PXT are chosen as the model to explain how these can be permitted for Muslim patients without contradicting the Islamic Laws and Bioethics. Each deliberation or decision is situation specific. The reasoning and application of this model can be extrapolated to any other therapeutics or procedures to facilitate making decision for treatment in Muslim patients. HCPs can use these two models step-by-step to determine the permissibility of different therapeutics, new technologies or treatment programs to advise Muslim patients to make lawful decisions.

Finally, Muslim patients may not understand or know about the latest deliberations or decisions (Daar & Al Khitamy, 2001 p62; Bokek-Cohen et al., 2023 p7). He may not have the required skills or knowledge to interpret the complicated biostatistics etc. in making the choice of treatments. Despite being advocated (A. I. Padela, 2022 p304), relying on his own initiatives to make decisions may not be appropriate. In other words, both the HCPs and the patients must know or understand the latest biotechnology or treatment to make the informed decision (Bokek-Cohen et al., 2023 p8).

The authors suggest that there should be an interface or platform that they can interact or communicate efficiently to facilitate making the ‘correct’ or appropriate decisions. An Islamic Healthcare Advocate who possesses such knowledge and skills may help to bridge the gap and facilitate decisions at such interface. This is especially important in a society, like Hong Kong, where Muslim is a small minority.

Table 1 Problems arisen from Human Organ Shortages for Allotransplantation (AT)

Problems	Examples
Medical	a) long waiting lists. b) patients dying or become unsuitable for AT while waiting for AT. c) exclusion of patients with milder but significant diseases. d) healthcare cost and burdens to families and Community at Large.
Ethical	a) some exclusion criteria, e.g. age, for AT may be injustice. b) limited availability for patients who need repeated AT. c) controversies in procurement of human organs at end-of-life e.g. definition and acceptance of brain death or donation after circulatory determination of death (DCDD).
Legal	a) human organ trading and trafficking. b) transplantation commercialism and transplantation tourism. c) forced human organ harvesting that involves duress, exploitation on Muslim and non-Muslim people from developing countries, under-privileged or under-protected sub-populations etc.
Specific to Muslims	a) human organ procurements from living or deceased donors. b) the small (health) risks of living donor after organ donation. c) the debates on Muslim to non-Muslim organ donation and receipt of organ(s). d) the stress of family at end-of-life care and organ procurements. e) financial compensation or initiatives for organ donors.

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