



Uterus Transplantation as a Model for Decision Making: Islamic Perspectives

Kee Lam Wong^{1*}, Waleed Fekry Faris²

¹ International Institute of Islamic Thoughts and Civilization, International Islamic University Malaysia (IIUM)

² Department of Mechanical Engineering, Kulliyyah of Engineering, International Islamic University Malaysia (IIUM)

*Corresponding author: wongkl7352507@gmail.com

Abstract. Decision Making is an essential part of our daily living for private and public matters. These range from trivial to life-and-death situations. Man is endowed with the capacity and ability to make decisions on all earthy activities. Throughout this process, Islam demands that rationality and crucial analysis are applied before, during and after the event. In Sickneses, intermittent or continuous decisions are often required. Apparently, the decisions are personal. However, as a patient, the recommendation or advice from the Healthcare Providers are almost mandatory for most. This is offered at the Point-of-Care. For Muslims, all advices and treatments must be lawful. Nevertheless, there could be bioethical controversies that need to be revealed and analyzed. Healthcare Providers and the patients are exposed to lots of information that may be conflicting, deceiving or irrelevant. Relying on such information may result in erroneous decisions. Healthcare Providers and Patients are in need of a common platform to direct and discuss about the most optimal options. The authors propose an Algorithmic Model, that incorporates *maqāṣid shari'ah*, to simplify Decision Making at the Point-of-Care. This consists of determination of the primary medical condition(s) or issue(s), identification of key bioethical issue(s), information gathering and filtering, identification of permissibility and/or prohibitions, availability and limitation of relieves to reverse prohibitions, inputs from patient and other stakeholders leading to the recommended option. Uterus Transplantation has been advocated as treatment for Absolute Uterus Factor Infertility that is not uncommon in Muslim Countries. Through the discussion and analysis of its causes, importance of progeny, availability, permissibility and ethical considerations of various treatment options from the Islamic perspectives, this Algorithmic Model can be successfully applied at the Point-of-Care and assists patients and Healthcare Providers to make the lawful decision.

Keywords: Decision Making; Islamic Bioethics; Absolute Uterus Factor Infertility; Uterus Transplantation; Porcine Xenotransplantation.

1. INTRODUCTION

We need to make decisions all the time. These decisions may have trivial or significant ramifications for ourselves, the people around us or the Community at Large. Islam requires that all these decisions must conform with the Qur'an, hadith, sunnah and the *Shari'ah* laws; and not inflicting harms to ourselves and other people (Rahman et al., 2021 p43). Decisions have to be made with full functional mental and intellectual capacity, are rational and well-judged. Moreover, assistance from appropriate and relevant authorities are acceptable.

Decision Making (DM) at Point-of-Care is an important process in the conduct of providing healthcare to patients with the respective health needs. The Healthcare Providers (HCPs) have the responsibility of helping patients to make the 'correct' decisions especially

for new and complicated technologies or treatment options. Research on Islamic Decision Making at the Point-of-Care is scarce, lacks uniformity and at times, conflicting. From the Islamic Perspectives, *maqāṣid shari'ah*, the hierarchical higher objectives of *Shari'ah*, have used in lots of bioethical deliberations and decisions. At the Point-of-Care, the HCPs may not have sufficient experience or expertise to provide an up-to-date recommendation for making the most optimal decision on various bioethical issues. Furthermore, these decisions may involve more than just the person. Faith and Religion, the family and the Muslim Community at Large are also major determinants. HCPs have to understand the technical and bioethical issues of the existing and new technology or treatment, their effectiveness or certainty of benefits, the needs and acceptability of their patients as entrenched in *maqāṣid shari'ah*. If the preferred option is permissible, there is no biomedical controversy. In contrast, if the preferred option is prohibited, the ground(s) for the prohibition must be adequately analyzed. Any alternative(s) or relieve(s) from the prohibition has/have to be identified. This whole process can be complicated and confusing to both the HCPs and the patient. There are no models or guidelines that can be followed or applied for all bioethical issues. An Algorithmic Model can serve as an efficient interface to facilitate DM for HCPs and patients such that the correct and lawful decisions on any biomedical issues, biotechnology or treatments can be determined.

Infertility is a common problem in Muslim and non-Muslim communities, affecting 10-15% of couples (Albar & Chamsi-Pasha, 2015 p173; Sallée et al., 2022 p1). Infertile women have to face social, psychological, societal expectations of motherhood or femineity. Traditional Assisted Reproductive Therapy (ART) has provided successful pregnancies in many of these patients but not for patients with Absolute Uterine Factor Infertility (AUI). The latter can be considered as a form of non-vital organ failure and untreatable by conventional means. *In Vitro Fertilization* (IVF) or embryo donation with Surrogacy, and adoption have been advised for these patients with AUI. However, these may not solve completely those psychological or social impacts of infertility on the affected women or families. Like other major organ allotransplantation (AT), Allogenic Uterus Transplantation (UT) has recently been advocated as the alternative in treatment of these patients. Globally, more than 80 UT and more than 40 live births have been reported in 2023 (Brännström et al., 2023 p523). These successful pregnancies after UT have positive impacts on the value of Femineity, Motherhood or Parenthood, Gestation and Progeny (Kooli, 2019 p2). Thus, UT is considered as a panacea in the future and the solution for AUI or other related conditions.

If UT is established as a standard treatment for AUI, the demand for UT will increase globally. Like all other ATs, a supply-demand gap will appear. Human Organ Shortages and

their consequential bioethical problems and illegal or immoral activities will occur. Xenotransplantation (XT) especially Porcine Xenotransplantation (PXT) may solve these shortages. Unlike other solid organ PXT, the neat Porcine Uterus is not appropriate as a PXG. Therefore, the conventional PXT approach is not applicable. Blastocyst Complementation (BC) could be the possible alternative. The advantages and permissibility of BC in PXT from Islamic Perspectives is explained.

The permissibility of ART and UT in the Muslim world varies tremendously: from total acceptance to total rejection (Alvi & Rizwan, 2023). This, UT becomes another form of transplant tourism where Muslims with AUFI will travel from her home country that prohibits UT to another country that permits UT. PXT and UT is even more controversial. Therefore, UT is associated with numerous bioethical issues that need to be considered before the HCP and the patient can choose UT as the treatment for her AUFI. At the Point-of-Care, a practical and simple-to-use Algorithmic Model is desperately needed to assist and ensure a proper information flow, logical discussion, lawful, uniform and consistent decisions for most if not all bioethical issues. The article demonstrates how this Algorithmic Model can be suitably applied to help DM for Muslim HCP and patients at the Point-of-Care.

2. LITERATURE REVIEW

Sickness, Treatment and Decision Making

The traditional ethical basis for DM is the Principlists' ethical principles: autonomy, beneficence, non-maleficence and justice. There is almost no difference for IBE and Principlists' ethics in non-maleficence and justice. The biggest difference is in autonomy and less with beneficence (Plöckinger & Auga, 2022; Wong & Faris, 2023). Islamic autonomy involves a balance of three rights and their ramifications in the present world and The Hereafter: personal, divine and collective (Shabana, 2023). In IBE, Muslims have only limited capacity in making treatment decisions because they have only custodial rights of his body and need to be conform with Allah's requirements as stipulated in the Qur'an, hadith and sunnah (Rathor et al., 2011).

Most people will accept Sicknesses as natural phenomena. For Muslims, Sickness carries religious meanings and implications. They are part and parcel of creation, willed by the Creator, Allah, and unrelated to Allah's wrath, evil spirits or the like (M. A. Albar & Chamsi-Pasha, 2015 p214). Sickness provides the opportunity to reflect, repent and enhance religiosity. Cure from treatments is promised and sent down from Allah.¹ Man has the obligation to maintain

¹ Narrated Abu al-Darda, Sunan Abi Dawud 3874

his body in good condition and receive treatment to restore his health (Khaleefah, 2022 p4-5). Except for a small minority that believes solely on healing by Spirituality, Muslims will accept modern-day lawful treatments.

The decision for choosing a specific treatment is the combination of Allah's will and Man's effort of seeking these treatments. There are two determinants to decide on receiving treatment: i) the certainty of the outcome if the Sickness is not treated; ii) the effectiveness (benefits) and the side effects (harms) of the treatment(s). Both of them require objective analysis of available scientific data. Muslims have to receive effective treatments but can elect to refuse ineffective treatments or when the harms of the treatment exceed the benefit (Akhmad & Rosita, 2012 p9 and Table 1; Rashid, 2023). When the benefits from treatment is uncertain or doubtful, Muslims have the options of receiving, rejecting or delaying the treatment. For unlawful but effective treatments, reversal of the prohibition can be obtained through Transformation (*istihalah*), Dire Necessity (*ḍarūrah*), Public Interest (*maṣlahāh*) (Wong & Faris, 2023). Since no clinical scenario is completely identical, HCPs have to use his experience and interpretation of available information to offer the best option. Finally, at the Point-of-Care, the patient may elect to make decision on his own and not accepting any permissibility or advice granted by Islamic legal authorities and HCPs. However, these forms of decisions vary enormously among different institutions and countries. The absence of consistent models or guidelines, even within the 'Western Bioethics' domains, creates uncertainties and difficulties in DMs.

Infertility, AUFI and UT

Infertility is a common global problem (Sallée et al., 2022) and is a form of organ failure. In AUFI, it is uterus failure. The treatment of organ failure follows the general schemes: pharmacological, biological and supportive therapy, or where appropriate, organ replacement. For Infertility, the biological therapy includes IVF and other forms of ART.

This has been argued that having children is a right of a woman and life enhancing with better quality of life (Aberdeen, 2022 p994-995). Being sterile or childless, the woman could be stigmatized and suffered from undue psychosocial pressure (Kooli, 2019). AUFI accounts

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

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.

for 2.1 – 16.7% of female infertility, of which about 3% is due to Mayer-Rokitansky-Küster-Hauser syndrome (MRKH) (de Ziegler et al., 2019 p19-21) or 0.02% female live births (Sallée et al., 2022 p3-5). Patients with AUFI, like all other patients with Infertility, should be offered treatments that are available to achieve a successful delivery of a baby of her choice. With improved experience, UTs are performed for MRKH and other causes of AUFI (Table 1).

UT for AUFI has six stages: ‘technical success, menstruation, embryo implantation, pregnancy, delivery, graft removal, and long-term follow-up’ (the US Uterus Transplant Consortium, quoted in Richards et al., 2021 p2255). The ultimate target for UT is a successful delivery of a live baby. Since the Fallopian tubes are not transplanted with the uterus, natural fertilization is not possible. Successful IVF is a pre-requisite and mandatory before UT. The Recipient must be a good candidate for pregnancy, operations, immunosuppression, hormonal stimulation, ova harvesting and IVF, Embryo Transfer and post-delivery motherhood (Table 2) (Richards et al., 2021 p2252-2253; Brännström et al., 2023 p528). Being a relatively new biotechnology, UT has substantial and debatable bioethical issues with impacts on the four domains of ‘Western Bioethics’ in autonomy, beneficence, non-maleficence and justice (Ali & Amer, 2024). There are much less discussions from the Islamic Perspectives (Alghrani, 2013).

3. RESEARCH METHODS

The Research Methodology is a subjective, qualitative and where appropriate, quantitative, search, analysis and review of English publications by keywords using the Search Engines of Google, PubMed and Scopus (Dzukroni, 2022; Kazemi et al., 2022). The Algorithmic Model will also use this Methodology when building up the Biomedical Repertoire for all the relevant clinical issues (Chan & Eppich, 2019; Moran, 2021).

The first step is a systematic search using the following sets of keywords:

- a) Islam and Health.
- b) Islam, Sickness and Treatment.
- c) Islam, Healthcare and DM.
- d) Islamic Bioethics (IBE) and OT.
- e) IBE and ART.
- f) Infertility, Gestation and Motherhood.
- g) IBE, Infertility and UT.
- h) Xenotransplantation and UT.

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

- a) DM in Health, Sickness and Treatment.

- b) Infertility, Family and Progeny, and UT from Islamic Perspectives.
- c) Permissibility of UT.
- d) Xenotransplantation for UT.

The third step is to develop the Algorithmic Model and the fourth step is applying the Algorithmic Model for DM in AUFI.

4. RESULTS

Principles of DM

From the Islamic Perspectives, DM involves six steps:

- 1) A Biomedical or Biotechnological Issue.
- 2) Impacts on the person and associated Bioethical Concerns.
- 3) Intention and Purposes of any Intervention(s).
- 4) Available Intervention(s).
- 5) IBE and Applicability of the Intervention(s):
 - a) An Objective and Subjective Risks-Benefits Analysis of No Intervention against available Interventions.
 - b) Permissibility-Prohibition-Relieves.
- 6) The Final Decision and Execution.

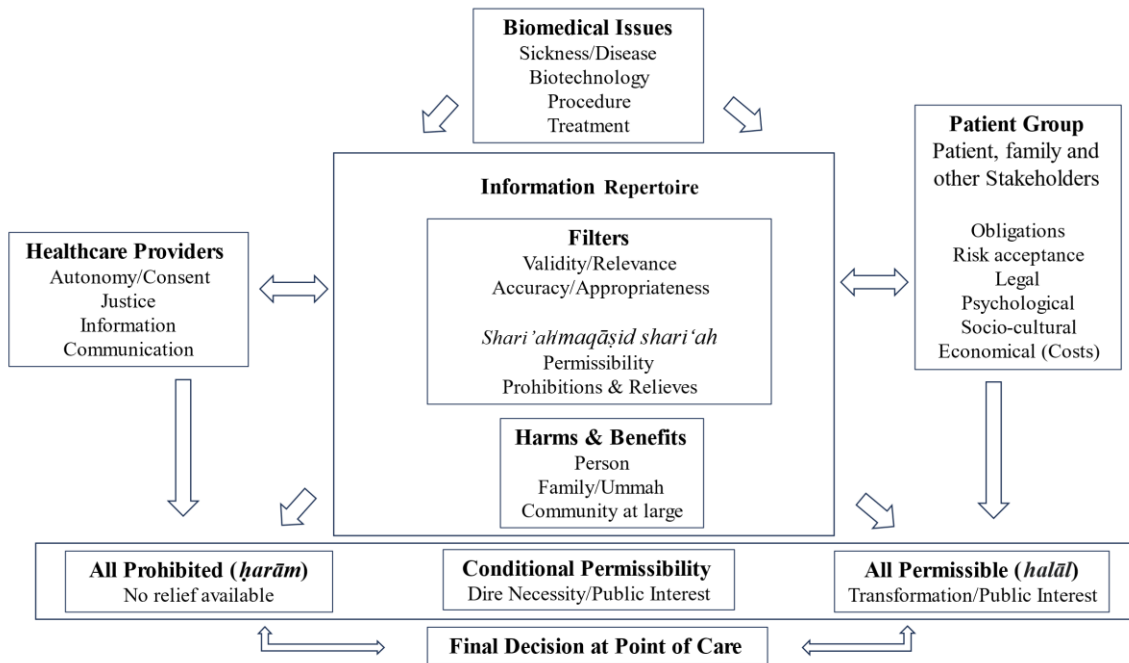
At the Point-of-Care, there are two groups of decision makers: i) HCPs; ii) the Patient Group with the patient, his family and other stakeholders. The process of DM has increasingly shifted from the traditional patriarchal decision by HCPs to patient-centred care and Shared DM (Al-Bahri et al., 2019 p352- 353). This is an extension of respects for patient's autonomy and has been legislated in some countries (Gulbrandsen et al., 2014; Shabana, 2023). Incorporating the patients and family in the DM improves the well-being of the patients, compliance with the treatment and achieves better outcomes (Legare et al., 2020 p291-292). Nevertheless, this shift is not absolute. Most biomedical decisions are some forms of Shared Decision Making between HCPs and the Patient Group. The family inputs are especially important when the sickness and its ramifications affect the well-being or benefits of the family, and at the end-of-life when the patient cannot make decisions on his own (Malek et al., 2021; Carola et al., 2023; Rashid, 2023).

This communication of information is a two-way interactive process between the HCP and the patient. The sources of information are multiple. In most situations, the information is mostly coming from the HCP with varying inputs from the patients and other people around him (Legare et al., 2020 p284). The relative importance of these inputs may vary with the clinical situations, countries, cultures and civilization. The personal experience, preference,

acceptance or tolerability of risks may also differ among patients with similar severity of the same disease. Within this context, the cognitive capacity and socio-emotional reactions of the patient to the Sickness and treatment options must be taken into consideration (Catic, 2023 p78). Moreover, the HCPs and authorities are occasionally entrusted to maximize the benefits to the patients (Gulbrandsen et al., 2014; Parker & Chin, 2020 p408; Waddell et al., 2021 p2).

Furthermore, not all information is adequate (Soqia et al., 2023), relevant and ‘correct’. This Information Repertoire has to be filtered to ensure that the information is appropriate to the patient (Figure 1). This filtering process is likely to be dominated by the HCPs. The relative strength of participation by the Patient Group in DM is influenced by religion, cultures, civilization and the urgency of the medical condition (Catic, 2023). For Muslims, the Sickness, its afflictions, treatment plans, provision of treatments by HCPs and comforts from treatments are all Allah’s plans. Religiosity and advice from Islamic authorities e.g. Imam are important in their DM (Ragsdale et al., 2018).

Figure 1. Algorithmic Model for Decision Making at Point-of-Care



For example, for UT in treatment of AUFI, it is envisaged that consent for treatment is mandatory for her spouse, directed donor (family member or relatives) and possibly other family or extended family members. Similarly, donating uterus for UT may be a family decision as in the traditional *wali* (guardianship) or *mahram* system (Khaleefah, 2022 p4-5; Weber, 2023 p56).

For the ‘Western’ Bioethics, there are no explicit categorical prohibitions. Any treatments that violate the ethical principles are deemed unethical and impermissible with no

relieves. In IBE, the Qur'an, hadith and sunnah provide the textual basis and the *Shari'ah* the laws for Permissibility (*halāl*) or Prohibition (*harām*) of all acts or things. Three common relief mechanisms are available to revoke such Prohibitions: Transformation, Dire Necessity and Public Interest. Each of these have specific requirements for application (Wong & Faris, 2024a). Thus, the final DM is expected to be coming from an interactive information sharing, a mix of objectivity and subjectivity, and after a proper analysis of benefits-harms and Permissibility-Prohibition-Relieves.

DM and the Algorithmic Model

Basing on the DM steps, an Algorithmic Model entrenching six determinant points is developed:

- 1) The Biomedical Issue: Sickness, Biotechnology, Procedure or Treatment. An issue is recognized that require advice and DM at the Point-of-Care.
- 2) HCP: doctors, paramedical personnel, policy makers. The HCP is providing the advice and/or treatment for the Recipient. This can be a single medical doctor or a group of HCPs. Even for patient-centred care, the HCP maintains a higher hierarchical position for DM because they are the primary or preferred source of information, the communicators and executors.
- 3) Patient Group: patient, family and other stakeholders. The Primary Recipient is a single patient. If the issue involves the family, a group of patients with similar sickness or the Community at Large, the family, whole group or the Community are the stakeholders. He/they is/are the person(s) who is/are affected by the Biomedical Issue that influences his/their obligation, impacts on risks of his/their lives and various aspects of his/their livelihood e.g. legal, psychological, socio-cultural, economical etc.
- 4) Information Repertoire: This is the centre piece in this Algorithmic Model and the basis of all Decisions. Information that can be gathered is put into the Information Repertoire. The most important process is Filtering. In this age of information overflow, lots of information may be superfluous or erroneous. HCPs, who have proper training, qualification and experience, obviously have an advantage to process and filter the Information Repertoire. These should cover established treatments, Experimental and Clinical Researches. They are also responsible to obtain informed consent from the patient and provide up-to-date legal information. In addition, they have to incorporate inputs from the Patient Group to make sure that the information communicated is valid, relevant, appropriate and acceptable by the

Patient or the Patient Group. The evaluation of the Biomedical Issue occurs at this interface. This begins with the intention or purpose of any biotechnology, procedure or treatment in the context of the Sickness. The whole process must be analysed from the source to completion. All Bioethical Concerns are identified and prioritized. For each sub-step, benefits-harms to the Patient Group and Permissibility-Prohibition-Relieves are determined.

- 5) Outcome after Permissibility-Prohibition-Relieves Analysis: After the full processing, options available for the Biomedical Issue are decided:
 - a) All Prohibited with no relief available.
 - b) Conditionally Permissible: Prohibited by itself but permissible after application of Dire Necessity or Public Interest.
 - c) All Permissible: either by itself or through application of Transformation or Public Interest.
- 6) Final Decision at Point-of-Care: This is the final step in the DM process. With full inputs from HCPs and Patient Group, adequate information sharing and communication, consensus building, a Final Decision is made. This is executed.

Infertility, AUFI and The Ethics of UT

The crucial step in the DM process is to understand and familiarize with the Sickness or Disease and identify the associated Bioethical Issues. The Bioethics of UT have two components: ART and OT for the patient. These are extended further to the Recipient's partner, family and the child.

Risks to Recipients and live donors

Since the Uterus is a non-vital organ, UT has only a small risk to the Recipient because the uterus can be removed if the transplanted uterus is non-functional or rejected, or if the Recipient cannot tolerate the immunosuppressive drugs. For live uterus donors, the donation has significant risks. For those donors who are pre-menopausal, ovarian stimulation needs to be given to prepare the uterus for UT. The procurement of the uterus carries operative risks e.g. ureteric damage and infection. With improved techniques, these operative risks to both the live donor and Recipients are decreased substantially (Brännström et al., 2023 p532).

Reproductive Autonomy and procreative liberty

The main crux of UT is the right of woman to overcome any uterine obstacle to gestate. This incorporates the notion of procreative liberty where an individual can self-determine all reproductive decisions and should be given access to treatments without any obstruction.

Gestational Parenthood

The primary objective of UT is to let the Recipient bear a child within her body and successfully born a child from her body. Surrogacy or adoption will not provide this gestational experience. The ethical issue is what is the value of a child to a woman and Gestational Parenthood. This is Recipient specific with wide variation across religion, cultures, civilization, societies and families.

Coercion of donor and Informed Consent

To date, a substantial source of uterus for UT comes from relatives or family members. Unlike other vital organs, uterus is not a required organ if the donor is peri-menopausal or has completed her family. However, there is a possibility that the donor within the family may be pressurized to donate her ‘unused’ uterus to help other family member.

Allocation of Healthcare Resources and Uterus

It has been argued that UT is not therapeutic (Aberdeen, 2022 p990, 994) and is debatable whether UT for AUFI should be given priority over more urgent or life-saving treatments to other patients. AUFI is undoubtedly a disease and an organ failure. UT is a form of OT to replace a non-vital organ. Since it is one of the treatments that can be given to patients with AUFI, i.e. it is therapeutic. If UT is successful, the demand for uteri will rapidly exceed the supply. A waiting list and a demand for an equitable distribution for non-directed UT will arise.

Extended indications

At present, UT are performed in genetically XX Recipients. Eventually, the indication may extend to non-XX Individuals e.g. transgenic XY or Complete Androgenic Insensitivity Syndrome. A separate set of ethical considerations and re-defining social parenthood will be required.

Application of the Algorithmic Model: AUFI and UT

In the Middle East, North Africa and Turkey (MENAT) region, it is estimated that more than 100,000 women of reproductive age have AUFI (Akouri et al., 2017 p164). The first two UTs were performed in Saudi Arabia and Turkey respectively. UT has increased since and has evolved from Experimental Research to Clinical Application. As reported in 2023, 71 UT are performed globally with 54 using uterus from life donors. Live birth rate is about 35% (Fageeh & Lucchini, 2007; Brännström et al., 2023). Many Muslims with Infertility in different countries are interested to participate in UT. However, there are still substantial bioethical debates in this procedure. Therefore, this is chosen to illustrate how the Algorithmic Model can be successfully applied at the Point-of-Care (Table 3).

The Biomedical Issue

A Muslim patient with AUFI is seeking advice for UT.

Impacts and associated Bioethical Concerns:

Infertility and the desire to have children is universal for both Muslims and non-Muslims. Infertility can be a test of faith and religiosity as in Ibrahim and Sara (The *Qur'an Adh-Dhariyat* 51: 28–30) and Zakaria (The *Quran Al-Anbya* 21: 89–90).² In Muslim communities, Infertile couples face social, cultural and societal pressure to have their own offsprings (Abu-Rabia, 2013 p55; Khan & Konje, 2019 p6; Kooli, 2019 p2). Therefore, seeking treatment for infertility is encouraged and appropriate (Kooli, 2019 p3).

For Muslims, family and parenthood have high regards (Akouri et al., 2017 p167). The family is the basic unit from which Muslim communities and nations are developed. Parenthood and kinship build the families. To maintain progeny and procreation, both man and woman have the obligation to get marry and have legitimate children of their own. The latter are promised and desired gifts from Allah (The *Qur'an An-Nahl* 16:72, *Al-Furqan* 25:74) (Abu-Rabia, 2013 p54; Albar & Chamsi-Pasha, 2015 p173-174; Padela et al., 2020 p21-22).

An unequivocal lineage consists of genetic, gestational and social parenthood. All children have to be born from natural conception with a known parental lineage to preserve the lineage, progeny and family structure; and out of a lawful marital relationship (The *Qur'an Al-Furqan* 25:54).³ Moreover, Islam defines parenthood quite uniquely. Though genetic lineage should be the prime determinant of parenthood, the legal mother is the mother who gestates (The *Qur'an Al-Mujadila* 28:2) (Khan & Konje, 2019 p6). The father is the one who is legally married to the legal mother at the time of pregnancy (Shabana, 2015 p109). Therefore, to safeguard an unequivocal descent from the intended parents, Sunnis prohibit third party involvements in parenting. These include donation of ovum, sperms or embryos. A 'rented uterus' in a separate woman as in Surrogacy is not permitted. On the other hand, the Shi'ites in Iran permit the use of third-party sperms, ova, embryos and Surrogacy (Albar & Chamsi-Pasha, 2015 p176-178; Shabana, 2015; Alvi & Rizwan, 2023 p64-66). Furthermore, the wet-nursing mother is given the *tahrim* status that confers certain rights, obligations and prohibitions (Alvi & Rizwan, 2023 p77-78).

² <http://quran.com/>

³ The *Qur'an Al-Furqan* 25:54

وَهُوَ الَّذِي خَلَقَ مِنَ الْمَاءِ بَشَرًا فَجَعَلَهُ نَسَبًا وَصِهْرًا ۗ وَكَانَ رَبُّكَ قَدِيرًا ۝٤

And He is the One Who creates human beings from a 'humble' liquid, then establishes for them bonds of kinship and marriage. For your Lord is Most Capable.

Though permitting ART generally, Islam rejects ART without medical justifications and those that may affect parental lineage and legitimate marriage. Uniformity in permitting ART is easier said than be done. The respective culture, ethnic and religious differences, social demographics etc. vary among Muslim countries. For some countries, legislations are made to cater for the needs at the time (Kooli, 2019 p11-13). Thus, the location of the Muslim patient may then affect her choice of ART. For example, some Muslims patients with AUFI travel from her home country where UT is prohibited to another country to receive UT where UT is permitted.

AUFI and Intention and Purposes of Intervention(s)

The Intention of Interventions in AUFI is to have a child in the Family to maintain the lineage and progeny.

AUFI and Available Interventions:

For Muslim patients with AUFI, there are five options: polygamy, adoption, IVF and Surrogacy, IVF and third-party Surrogacy, and UT. In contemporary times, infertility or sterility of married couple resorted to polygamy or marrying another woman. Obviously, this cannot solve the problem of male fertility. Nowadays, polygamy is not encouraged. Adoption is not allowed legally and not accepted socially (Atighetchi, 2007 p135-139). IVF can be allowed with the following conditions: i) existing marital relationship is lawful and valid; ii) the sperm is from the husband and the ovum, from the wife; iii) the procedure is undertaken by a competent team; iv) Surrogacy is not present; v) the number of fertilized eggs or zygotes transferred is appropriate and not excessive (Atighetchi, 2007 p142-159; Albar & Chamsi-Pasha, 2015 p175). For AUFI, Surrogacy and IVF will be needed. However, Surrogacy is not universally accepted: being prohibited in Sunni's Tradition and some Shi'ites scholars but permissible by Iranian Shi'ites (Alghrani, 2013, p628-629; Albar & Chamsi-Pasha, 2015 p178; Alvi & Rizwan, 2023 p64-65).

UT has distinctive advantages over Surrogacy. The conceived mother does not need to depend on a third party for Gestation, bear the costs of Surrogacy and the uncertainty of the surrogate on fulfilling her promised obligations. On the pregnancy itself, she has the liberty of enjoying the Gestation and complete influence over the baby on nutrition and psyche etc. In addition, she is the only mother for the child for legal, social, genetic and Gestational motherhood, and the full 'wet nursing' and nurturing thereafter (Fageeh & Lucchini, 2007; Alghrani, 2013 p623-625).

AUFI and UT: Islamic Perspectives

MENAT is the first region that had conducted UT. However, most of the successful pregnancies occur in ‘Western’ countries probably because UT is not uniformly accepted by Muslim countries. In a recent review of UT in 2021, thirty-one children were born after UT with only one child from Lebanon (Richards et al., 2021).

Significance of Womb (Uterus) in Islam:

The womb is a sacred organ in Islam and may be metaphysical. It defines motherhood and is where the baby is nurtured and born from. The womb is mentioned in the Qur’an repeatedly. The heart is the only other major internal organ that is often referred to in the Qur’an (*Al-An’am* 6:110, *Hud* 11:120, *Al-Baqarah* 2:7, *Ash-Shu’ara* 26:89)⁴ (Raza, 2022).

The womb is the location of dedication and multiplication of mankind (The Qur’an *Ali ‘Imran* 3:35, *An-Nisa* 4:1, *Ash Shuraa* 42:11, *Ar-Ra’d* 13:8). The womb is where: i) embryo and life begin (The Qur’an *Az Zumar* 39:6); ii) hearing, sight and intellect develop (The Qur’an *An Nahl* 16:78); iii) shaping and perfecting of the form take place (The Qur’an *Ali ‘Imran* 3:6, *At-Taghabun* 64:3, *Ghafir* 40:64). The Qur’an has not indicated explicitly whether the womb must be the woman’s own for these functions. Since a transplanted UT belongs to the Recipient (Aramesh, 2023 p183-184), it could be the same organ that can be dedicated to Allah.

AUFI and UT: Risks-Benefits analysis

The success of UT has improved substantially since its inception. Risks are real and well-known for both live donors and Recipients (Brännström et al., 2023). With advances in operative technologies and management of post-UT complications, these risks are reduced to acceptable levels. Furthermore, an increasing number of successful deliveries are recorded. More UT centres are established globally indicating UTs are well-accepted by both the clinicians and patients.

AUFI and UT: Permissibility-Prohibitions-Relieves

From the Islamic Perspectives, only lawful procedures or treatments are permissible. All new technologies or treatments have to be compliant with the *Shari’ah*. If any of these are prohibited, relieves from the prohibition must be obtained before they can be used by Muslims.

⁴ [The Quickest Way To The Quran](https://quickestwaytoquran.blogspot.com/2013/07/human-body-parts-mentioned-in-quran.html)

<https://quickestwaytoquran.blogspot.com/2013/07/human-body-parts-mentioned-in-quran.html>

(accessed on 7 May 2024).

These relieves include Transformation, Dire Necessity and Public Interest if the required pre-conditions are satisfied (Wong & Faris, 2023).

Most jurists' deliberations and decisions are based on the effects or outcome of the technology or treatment on the Recipient with much less emphasis on the Source and the full Process. In fact, the full chain of events should be analyzed. The certainty of effectiveness must be established by a qualitative and quantitative analysis of the benefits and harms. For every step, what is/are Permitted (*halāl*) and what is/are Prohibited (*harām*) is/are determined. If there is Prohibition, availability and applicability of relieves has to be decided.

For Muslims, the body and all the organs or tissues within are owned by Allah. Muslims do not have the full autonomy of making decisions on the use of their body or organs. Donations of organs alive or after death have to conform with *Shari'ah* and *maqāsid shari'ah*. Similar to most bioethical deliberations on OT, there are three groups of jurists' opinion on UT:

- a) All prohibited: The firm objection of all forms of AT bases on the dignity of the human body that cannot be violated. All forms of mutilations to the body, including organ donation from live or dead donors, are prohibited. The second objection is on the confusion of Gestational motherhood. The donor of the uterus, instead of the Recipient, may earn the claim of motherhood to the child born (Alvi & Rizwan, 2023 p74) affecting the lineage and progeny. However, the soul-less transplanted organ aligns with the soul of the Recipient, becomes a part of the Recipient and no longer belongs to the donor (Aramesh, 2023). The pregnancy in the transplanted uterus, the delivery and nurturing thereafter belongs to the Recipient and not the donor, i.e. the Recipient retains the gestational and 'wet-nursing' motherhood. In contrast to the Egyptian Sheikh Abdel Rahman Al-Adawey's opinion, the influences on the foetus are coming from the 'mother' carrying the foetus (the Recipient) and not from the transplanted uterus itself (Alghrani, 2013 p630). Gametes, gonads and Fallopian tubes are not transplantable. Despite not having any gametes, the third objection for UT rejects the uterus to be transplantable because it is one of the organs involved in acts of sexual reproduction (Shabana, 2015 p106; Padela & Auda, 2020 p5). This is different from the recommendations of the Islamic Organization for Medical Sciences in 1989 and the International Islamic Fiqh Academy resolution in 1990 where transplant of these sexual organs is permissible after invoking Necessity (Alghrani, 2013 p630; Matthews, 2021 p8).
- b) Conditionally Permissible: In Islam, effective treatment for Infertility e.g. ART is permitted. A successful UT is a form of ART. Dire Necessity is usually invoked

for preservation or saving of life. Since the uterus is not a vital organ, this relief cannot be invoked for UT on life saving. However, Progeny is one of the five necessities *maqāṣid shari'ah* (Shabana, 2015 p104-105). Thus, UT can invoke Dire Necessity on this cause. Furthermore, given that Surrogacy and adoption are prohibited in Islam, UT is the only alternative available for AEFI and should be permissible provided harms to the donor and recipients are minimal and acceptable or tolerable. The risks of harms in current UT from live donors and Recipients are real, albeit at a low level. Live donors have procurement operative complications and possible psychological trauma (Brännström et al., 2023 p533-534). The Recipient and her partner have to satisfy the requirements, medically and psychologically, for the UT treatment program (Table 2) (Brännström et al., 2023). With technological advances like robotic surgery, these operative risks should be low and more acceptable. Similarly, with improved agents for immunosuppression and early interventions in complications from immunosuppression before and during pregnancy, risks to Recipients and baby *in utero* are much lowered.

- c) All Permissible: Transformation is not applicable as a relief for any Prohibition in UT. The main support for this Permissibility is Public Interest. UT by itself is insufficient to invoke Public Interest at the personal level. However, UT has developed from Experimental Research to Clinical Studies in many countries. The first UT was performed in 2000 in Saudi Arabia with permission from Islamic Jurisprudence Council and after obtaining a detailed informed consent for both donor and Recipient (Fageeh & Lucchini, 2007). Dire Necessity can't be invoked because Risks-Benefits data are unavailable. Similarly, when a new UT Centre is established, local Risks-Benefits data for that UT centre will not be available. Knowledgeable Muslim HCPs and patients with AEFI have to participate in such UT programs. Besides her own personal interests, Permissibility can be allowed for Muslim patients to join these programs out of altruism and for the interests of future patients (Public Interest) (Wong & Faris, 2023). The latter is highly praised and rewarded (Al-Baqarah 2:195).⁵

⁵ 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.

AUFI and UT: the future:

In the context of a successful UT, the HCP must also advise the patient or the patient group what are the available alternatives in the future. In addition, if UT is accepted as a standard treatment for AUFI, more and more women will demand the treatment. The indications for UT may be broadened (Aberdeen, 2022 p995-996; Brännström et al., 2023 p537). Human Uterus Shortages and the consequent biomedical problems and illegal or immoral activities like uteri trafficking may occur (Aberdeen, 2022 p991, 996; Wong & Faris, 2024b). To solve these, there are two alternatives: Uterine Bioengineering or Porcine Xenotransplantation (PXT).

Uterine Bioengineering:

Solid human organs have not been grown *ex vivo*. Uterine Bioengineering, e.g. scaffolding and uterine stem cells are the emerging alternative (Brännström et al., 2023 p539). The foeto-placental interface is complex (Iske et al., 2020). During a normal pregnancy, there is corresponding changes in the decidual circulation. It is debatable whether such substantial changes in macro- and micro-environment can be simulated in these bioengineered uteri. All-in-all, Uterine Bioengineering is still in the early stage. Clinical trials probably will not materialize in the immediate future.

Uterus-PXT:

PXT using conventional approach with Porcine Uterus is not appropriate because the Porcine Uterus is bicornuate and anatomically different from Human Uterus. BC is the only promising approach in Uterus-PXT (Founta & Papanayotou, 2022 p114-116). BC creates a personalized Human-Porcine chimera with a transplantable chimeric organ that possesses both human and porcine genotype. Pluripotent stem cells (PSC) or induced PSC (iPSC) from the Recipient are injected into the extracted blastocyst from a Genetically Manipulated Pig with the organ-specific critical gene(s) being knock-outed. The PSC or iPSC complement the ‘emptied developmental niche’ (organ) genes in the host embryo that grows and forms the target organ. The BC chimeric organ has the same structural and physiological properties like a human organ. The Recipient’s immune system ‘sees’ the chimeric organ as self which is not rejected. Thus, post-transplant immunosuppression is avoided. After a successful BC Uterus-PXT, the chimeric uterus is a personalized human uterus. Since the Recipient does not need any immunosuppressive drugs subsequent to the transplant, she can keep the chimeric uterus as long as she likes.

The essential requirement for Permissibility of BC is a humanized target organ (uterus). The Recipient’s PSC or iPSC must contain the required genes for a normal human uterus. In

patients with Non-Genetic AUFI, the PSC or iPSC should satisfy this requirement. However, in Genetic AUFI like MRKH, their genes in forming a human uterus are defective and their native PSC or iPSC cannot be used (Herlin et al., 2020). The set of uterine organogenesis genes (causative candidate genes) are isolated and inserted into the PSC or iPSC to replace the abnormal genes in the particular patient. Then the GM-PSC or GM-iPSC cells are used in the subsequent BC.

At this stage, BC is still experimental and no human organs, including uterus, have been grown successfully (Freedman, 2018 p45). Substantial problems need to be solved before BC can be used in PXT (Freedman, 2018 p44-46; Founta & Papanayotou, 2022 p116-117): a) Low efficiency of human chimera formation from interspecies Xenobarrier; b) Difficulty in identification of organ specific critical DNA sequence; c) Difficulty of producing viable and maturing embryo; d) ‘Residual’ porcine cells in the chimeric organs that require Genetic Modification to minimize rejection and xenozoonoses.

From Islamic Perspectives, there are other objections:

- i) Pork is prohibited in Islam and all Porcine products or organs may be prohibited as well. Since Progeny is one of the five necessities *maqāṣid shari‘ah*, Dire Necessity can be invoked for Uterus-PXT if benefits are confirmed and certain (Ismail & Maifiah, 2023 p42-44; Shabana, 2015 p104-105).
- ii) Inserting any piece of human genetic information into the pig’s genome will contradict the purpose and dignity of human creation. The purity status of chimeric organ is also debatable, e.g. on lawful procurement or slaughtering, and permissible extent of porcine contribution to the chimeric organ. The residual porcine cells may be impermissible (*harām*) and will require Dire Necessity to make the organ permissible. These may also be construed as dilution. Permissibility after application of Transformation is possible (Wong & Faris, 2023). Moreover, the chimeric Uterus with the porcine cells may be construed to be integrated fully with the Recipient’s soul, become clean and pure and permissible (Aramesh, 2023 p183).
- iii) humanized phenotypic (external) appearance of the host: this refutes the intention of creation of human, identity, personhood and dignity of human body (A. I. Padela, 2019 p122-124).
- iv) Unintended migration of neurons to the brain may develop human-like cognitive function and personhood. This can cause severe infringement on Islamic believes of human creation.

- v) Unintended migration of gametes to gonads is not problematic as the migrated gametes are formed from the PSCs or iPSCs that bear the same genetic composition of the Recipient.

Final Decision and Execution:

UT is probably the only preferred option to achieve a successful pregnancy for a Muslim patient with AUF. Obviously, she can elect not to receive UT because UT is not permissible and wait for natural pregnancy from Spirituality. Similar to the *fatawa* on solid OT, the Muslim patient can accept UT as permissible and receive the Uterus from a live or deceased donor (Ali & Maravia, 2020). She needs to be enrolled in a UT program with UT lawfully performed in an established UT centre.

5. DISCUSSION

HCPs and the Patient Group are inter-dependent. The changing over to patient-centred care or Shared Decisions does not replace HCPs at the Point-of-Care. HCPs serve multiple functions:

- a) Information Provider.
- b) Director of Flow of Information.
- c) Information Filterer.
- d) Decision Maker or Facilitator.
- e) Executor of Final Decision.

Given such duties, HCPs have to develop the Information Repertoire and be responsible to handle such information to make sure that the information is relevant to the Biomedical Issue under consideration.

To start with, HCPs have to include inputs from varying sources and Patient Group to cover different areas for 'usual' patients. To cater for Muslim patients, jurists' deliberations and decisions are incorporated. Complicated Systematic Review Methodology, e.g. PRISMA (Page et al., 2021), may not be appropriate especially for the lay person. Therefore, a systematic search using common search engines with the appropriate keywords (Chan & Eppich, 2019) is preferred to obtain the most up-to-date information related to the Biomedical Issue to build up the Information Repertoire:

- a) background information for the Biomedical Issue e.g. nature and cause of the Sickness.
- b) Interventions available and their Risks-Benefits and Limitations. These interventions include established or accepted treatments, Experimental Research and Clinical Trials or Studies.

c) Bioethical Issues or Controversies and their possible solutions.

Most DM at Point-of-Care are done haphazardly without a consistent protocol. Most HCPs just use his own experience, including his own personal religious exposures, to solve any queries or controversies. At times of Bioethical debates, they may elect to get assistance from publications, media or seniors (A. Obeidat & Komesaroff, 2019; A. S. Obeidat & Komesaroff, 2021). However, it will be problematic if the HCP works in isolation or without appropriate bioethical supports and guidelines. The development of an Algorithmic Model will help to guide the thought process, ensure an efficient interactive platform, streamline DM and improve consistency. This Algorithmic Model must be simple to develop, executable and be used easily by both HCP and patients.

The authors analyse and dissect the DM process into six steps to build up an Algorithmic Model. To test out this model, Infertility, AUFI and UT is used. It can be seen that it is possible and feasible to conduct separation of this interface into three sub-platforms: the HCPs, the Patient Group and the Central Part, Information Repertoire (Figure 1). The model details the background information for Sickness and Treatments, Infertility and Causes and Impacts, AUFI cause and available interventions. At various points, Inputs from the Patient Group are incorporated and Bioethical Issues are identified. Most importantly for DM, Risks-Benefits and Permissibility-Prohibition-Relieves are analysed, determined and communicated to arrive at the preferred option which is UT for AUFI. UT is initially an Experimental Research and now becomes an accepted treatment. The future of this treatment modality, e.g. Uterus bioengineering and Uterus-PXT, is also discussed. The use of BC in Uterus-PXT is explained in details bringing up-to-date information on the development of PXT which is communicated to the patient. The Final Decision is then made after all lawful options including no UT are offered.

The Algorithmic Model is probably applicable and adaptable to many if not all Biomedical Issues, minor or complicated. This process of dissection of DM can be executed easily and consistently maintaining uniformity. It is a good base for developing and applying Islamic Thought, IBE and educational programs for HCPs and Patient Group. Eventually, a Biomedical Repertoire for biomedical scenarios can be built and accessible to all HCPs and Patient Group to facilitate DM at Point-of-Care. Healthcare Policy Makers can seize this as an opportunity and challenge to enable rational and lawful DM at all levels of healthcare.

6. CONCLUSIONS AND SUGGESTIONS

DM at Point-of-Care is a mandatory process for modern-day management of patients. There are varying models or practice guidelines to assist DM at the clinical levels. In the

context of traditionalism-modernity, 'Western' Bioethics and IBE, abundance of information from Internet and social media, DM can be difficult, fragmented, conflicting and possibly inconsistent. Without a simple and mutually understandable platform or model, it is often difficult for HCPs to advise the patients to make the optimal decision. The Information Repertoire is the most important element in this model. HCPs and Patient Group are responsible to build up this Shared Repertoire. Padela has proposed that the patient should be primarily responsible to acquire and analyse such information. Assistance from respective experts are obtained when required. This view is probably debatable especially for some complicated Bioethical Issues that even ordinary doctors or HCPs may not be familiar. These may also be more difficult for under-privileged patients who are less educated or have poor access to information. Thus, the HCPs should be trained and prepared to be the predominant source of information and to have the ability to guide DM. To achieve the ultimate goal of an optimal DM at Point-of-Care, this Algorithmic Model will help HCPs and Patient Group to develop the necessity interface where information is collected, shared, filtered and communicated.

Infertility and AUFI are not uncommon in Muslim countries. This is selected to show how this Algorithmic Model can be applied. Progeny and a completed family with children have unique importance in Islam. Infertility may be stigmatized in Muslim family and Community. Muslims with AUFI may have substantial socio-psychological pressure in getting a child from their marriage. However, they have only very limited options to have the child. Adoption and Surrogacy are prohibited. UT may be the only or preferred option available. The Bioethical Issues at each step of DM from the Algorithmic Model are shown. The reasoning and the legal arguments are detailed leading to the three possible lawful options for Muslims: a) All Prohibited; b) Prohibited with Conditional Permissibility; c) All Permissible. The Final Decision is left with the Patient or the Patient Group since any of the options are acceptable and lawful. This Algorithmic Model with open access can be developed further, and incorporate more and more Biomedical Issues. Eventually, HCPs and Patients can access this Biomedical Repertoire with ease and be able to have efficient DM at the Point-of-Care.

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