

# Human Assisted Reproductive Technology



InterChurch Bioethics Council  
June 2019



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Front cover image adapted from <https://www.timesunion.com/news/article/What-s-covered-under-New-York-s-new-in-vitro-13732391.php>

## Introduction

Together with the rest of the world, Aotearoa New Zealand is living in an age of rapidly developing human assisted reproductive technologies (ART). These assisted reproductive technologies increasingly allow us the ability and choice of when and how to have children. Accordingly, these life-giving technologies raise a variety of ethical questions requiring societal and spiritual discernment.

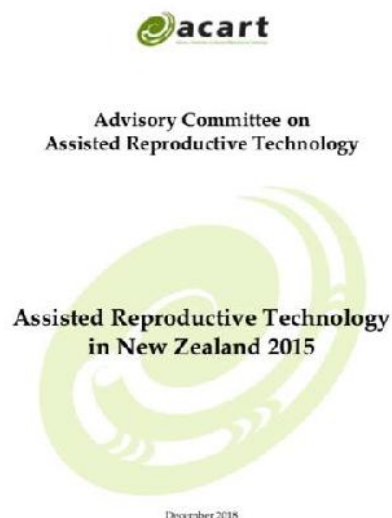
This article, collectively written by members of the InterChurch Bioethics Council (ICBC), aims to provide current background information on the science, ethics and Christian theology associated with reproductive technologies in the New Zealand context. We hope this information provides a useful resource and discussion platform for those wanting to explore through a faith lens what is currently emerging in ART. As Christians, we are called to have ears and voices both in discussions of the current bioethical issues arising from ART, and in identifying the unchanging principles of the Christian faith in these issues. This is the exploratory bridge that John Wyatt calls 'double-listening';<sup>1</sup> exploring the ethical questions surrounding each of these reproductive technologies while drawing upon biblical Christian principles in our best care for our communities and society.

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<sup>1</sup> John Wyatt. (2009). *Matters of Life and Death – Human dilemmas in the light of the Christian faith*. Nottingham England: Inter-Varsity Press. ISBN: 978-1-84474-367-4.

## Human assisted reproduction technologies: The current situation

Approximately 60,000 babies are born in New Zealand each year. As in other Western countries, more than 1 in 6 New Zealand couples seek fertility treatment to conceive. The most recent figures relating to Assisted Reproductive Technology in New Zealand were published in December 2018 and relate to the 2015 year. Of the 61,038 live births in NZ in 2015<sup>2</sup>, 1,438 (i.e. 2.1%) were the result of ART<sup>3</sup> (a figure consistent since 2012). There are also 400-500 registered foetal deaths each year,<sup>4</sup> and a natural miscarriage rate of 10-25% of confirmed pregnancies. This miscarriage rate is a conservative estimate since many miscarriages are thought to occur before a woman knows that she is pregnant, with about 80% of miscarriages occurring within the first three months of pregnancy.<sup>5</sup> Overall, the natural situation for human reproduction is that only around 30% of fertilised eggs (embryos) go on to produce a human individual.<sup>6</sup>



A number of factors appear to be contributing to the increasing consumer demand for assisted reproductive technologies including:

- women wanting to start a family at an older, less fertile age (21% of ART treatments in 2015 were undertaken by women aged 40 years or older),<sup>7</sup>
- same sex couples requiring help to have children, and
- increasing environmental factors that might lower our fertility. Such factors include, for example, the presence of chemicals in everyday products which disrupt our hormone systems by mimicking oestrogen (e.g. triclosan in some hygiene products, bisphenol-A in some plastics).<sup>8</sup>

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<sup>2</sup> Government statistics

[http://archive.stats.govt.nz/browse\\_for\\_stats/population/births/BirthsAndDeaths\\_HOTPYeDec15/Commentary.aspx](http://archive.stats.govt.nz/browse_for_stats/population/births/BirthsAndDeaths_HOTPYeDec15/Commentary.aspx)

<sup>3</sup> Assisted Reproductive Technology in New Zealand 2015. ACART report published December 2018.

<https://acart.health.govt.nz/assisted-reproductive-technology-new-zealand-2015>

<sup>4</sup> <http://www.health.govt.nz/publication/fetal-and-infant-deaths-2012>

<sup>5</sup> <https://www.southerncross.co.nz/group/medical-library/miscarriage-causes-risks-signs-symptoms>

<sup>6</sup> Gareth D. Jones. "Responses to the Human embryo and embryonic stem cells: scientific and theological assessments". Science and Christian Belief 17, no. 2 (2005): 119-222.

<sup>7</sup> See reference 3.

<sup>8</sup> 'Sperm count falling sharply in developed world, researchers say' Stuff NZ, July 2017.

<https://i.stuff.co.nz/national/health/95109893/sperm-count-falling-sharply-in-developed-world-researchers-say?rm=m>

Since the first successful in vitro fertilisation (IVF) baby was born in the United Kingdom in 1978, and in New Zealand in 1984, well over 6.5 million IVF babies have been born worldwide.<sup>9</sup> Fertility treatments have increasingly become part of our New Zealand society, with markets for fertility health care companies, such as Fertility Associates<sup>10</sup> and ReproMed<sup>11</sup>, growing rapidly. In New Zealand, a small amount of publicly funded fertility treatment is available for those eligible to have a funded specialist appointment (FSA), which makes an assessment of the couple's unlikelihood of becoming pregnant naturally. However, 2016 statistics showed that requests for FSAs for fertility issues had increased by up to 30% over 4 years, while national funding has grown by only 7%. This has resulted in increased waiting lists and decreased chances of obtaining treatment.<sup>12</sup>

A small number of children are available for adoption in New Zealand each year. Two hundred applications were granted in 2016-17.<sup>13</sup> The adoption process is overseen by Oranga Tamariki according to the 1955 Adoption Act, which stipulates adoption has no advertisement and no payment. The original 1955 Act has subsequently been updated to include same sex married couples, and de facto couples. Legal transfer of parenthood from a surrogate mother, who carries a baby after fertility treatments, to the intending couple or person can happen only by adoption.

The practice of whangai, or tamaiti whangai, is still practised within whānau today. According to Smith<sup>14</sup>, "Whangai was traditionally an important practice for strengthening whakapapa, and it was done to form important relationships. Tamaiti whangai were important people for whānau and hapu. This contrasts with the notion of adoption or fostering."<sup>15</sup> For Māori who are infertile, whangai provides a positive option for whānau.

## ART techniques: eggs, sperm and IVF specialisations

Before IVF technology was possible, the only options for infertile couples were sperm insemination from partner or donor which began being tested as early as the mid 1800's, and then between 1920-1940 treatment with the newly discovered



<sup>9</sup> <https://focusonreproduction.eu/2016/07/05/6-5-million-ivf-babies-since-louise-brown/>

<sup>10</sup> Fertility Associates [https://fertilityassociates3-px.rtrk.co.nz/?utm\\_source=ReachLocal&utm\\_medium=cpc&utm\\_campaign=search](https://fertilityassociates3-px.rtrk.co.nz/?utm_source=ReachLocal&utm_medium=cpc&utm_campaign=search)

<sup>11</sup> ReproMed <http://www.repromed.co.nz/>

<sup>12</sup> <http://www.stuff.co.nz/national/health/87523840/Funding-lagging-behind-as-demand-for-IVF-grows, 2016>

<sup>13</sup> <https://teara.govt.nz/en/adoption/page-5>

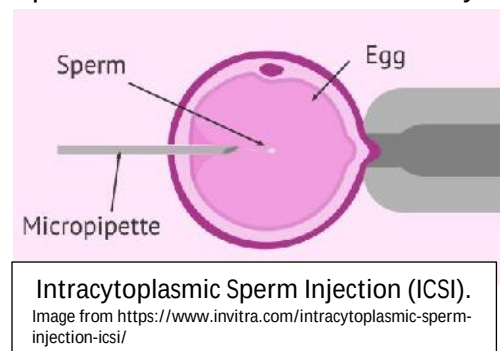
<sup>14</sup> Smith, C. (2012). "Tamaiti Whangai and Fertility," in *The Gift of Children: Māori an Infertility.* Eds, C. Smith and P. Reynolds. Huia Publishers, Wellington, NZ. pg. 143-202.

<sup>15</sup> Ibid. pg. 143.

hormones oestrogen, progesterone and testosterone to increase fertility in both women and men. Since the 1980s, IVF technologies have developed rapidly worldwide, with each new technique offering hope, and a more successful chance of a healthy baby, but also requiring new ethical consideration and regulation.

Hormone treatment for female superovulation allows the collection of up to 12-15 eggs at one time in preparation for IVF, but superovulation can hold medical risks for the intending mother, with potential unknown effects on her eggs. Research continues to design optimal laboratory conditions to incubate eggs and sperm before IVF, and for embryos after IVF. Now in New Zealand mostly a single embryo at a time is replaced for implantation compared to the tendency for multiple replacements previously. Of the 1,397 deliveries following ART cycles in 2015, 89.6% of embryo transfer cycles were single embryo transfer, 10.1% were double embryo transfer cycles, and 0.3% had three or more embryos transferred.<sup>16</sup> Single embryo replacement brings less risk to the foetus and no need for the foetal reduction procedures (where one or more foetuses are removed during gestation) that are carried out in some other countries where multiple pregnancies are more common.

Specialisations of IVF have been designed to overcome specific causes of medical infertility in a couple. In intracytoplasmic sperm injection (ICSI), for example, a single selected sperm is injected into an egg via IVF, then the resultant embryo is placed in the mother. A single sperm may be retrieved from the testis of an otherwise infertile intending father for use in ICSI. A new specialisation of ICSI using high magnification (IMSI) is also now available.



Another more recent IVF specialisation, mitochondrial transfer or donation, helps families where the mother carries an inherited disorder in the few genes of her egg (oocyte) mitochondria. Mitochondria occur in most cells to provide energy. Genetic mutations in mitochondria account for a highly diverse range of rare but severe metabolic, muscular and neural mitochondrial diseases. Around 4,000 children per year in the US are born with a type of mitochondrial disease.

To circumvent the inheritance of such disease-carrying mitochondrial DNA, the nuclear DNA of the intending mother is placed in a donated egg with healthy mitochondria but with its nucleus removed. IVF with the intending father's sperm is then carried out. An embryo resulting from mitochondrial transfer may be referred to as a '3 parent embryo' as it has the

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<sup>16</sup> Assisted Reproductive Technology in New Zealand 2015. ACART report published December 2018. <https://acart.health.govt.nz/assisted-reproductive-technology-new-zealand-2015>

nuclear DNA of its parents and mitochondrial DNA from a female donor.<sup>17,18</sup> Mitochondrial transfer was legalised in the UK in 2015. Mitochondrial donation is the first use of a technique that alters germline (sperm or egg) DNA, and therefore is inherited, altering the ongoing genetics for the family to include a small percentage of donor DNA. Mitochondrial donation has not yet been legalised in New Zealand.

## Selection of eggs for fertilisation and embryos for implantation selection.

New methods are always being sought for selecting the most promising egg(s) for IVF, and most promising embryo(s) for implantation. Age, and lifestyle factors such as diet, body mass/weight, exercise, smoking, and drugs are the biggest indicators currently of egg quality. Promising research on the cumulus cells surrounding the egg may soon provide genetic indicators of egg quality.

Since the late 1980's, Preimplantation Genetic Diagnosis or Screening (PGD, PGS) has been used to screen for a number of deleterious genetic (chromosomal) abnormalities in the cells of the recently created IVF embryo/s, to avoid using these embryos for pregnancy. Because PGD can also allow selection for gender and some positive personal attributes, strict regulation of PGD occurs in many countries, including New Zealand, to prevent exploitation and commodification of embryos.<sup>19</sup>

Selection of embryos specifically to provide a sibling with matched tissue suitable for a later transplant to a sibling in need (i.e. a saviour sibling) has been made possible using PGD.

Recently, next generation gene sequencing technologies have become able to sequence the entire genetic information of an embryonic cell rapidly and at comparatively low cost, and can potentially screen for any number of diseases and traits. These gene sequencing tests are now readily available privately to the general public. However, new generation sequencing also comes with the complication for geneticists of currently not knowing the full implication of the entire genetic sequence, including if and when some abnormal genetic sequences will be expressed and with what disease severity.<sup>20,21</sup>

While screening procedures may inform parents of genetic abnormalities present, this knowledge may also put an onus on parents to choose whether or not to have a child with

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<sup>17</sup> The dubious ethics of creating children with three genetic parents, Margaret Somerville. The Nathaniel Report, Issue 41, 2013.

<sup>18</sup> Mitochondrial Donation. ICBC resource article., 2015  
<http://www.interchurchbioethics.org.nz/index.php/resources/>

<sup>19</sup> Human Assisted Reproductive Technology Act 2004.  
<http://www.legislation.govt.nz/act/public/2004/0092/latest/whole.html>

<sup>20</sup> Embryo Screening and the Ethics of Human Genetic Engineering - Leslie A. Pray. 2008 Nature Education  
<http://www.nature.com/scitable/topicpage/embryo-screening-and-the-ethics-of-human-60561>

<sup>21</sup> Perinatal Bioethics – ICBC resource article, 2015.  
<http://www.interchurchbioethics.org.nz/index.php/resources/>

the predicted disability, with all the attendant pressures that accompany such a choice. There are considerable ethical issues around what genetic diseases should be screened for, and what to do with, and ownership of, the genetic information obtained by genetic sequencing. Gene sequences of unknown significance, and therefore unknown power of actual prediction of disability sometime during a lifetime, might cause dilemmas for both geneticists and parents, and require urgent discussion and guidelines for their use in guiding preimplantation choices.

Recently developed gene editing technology known as CRISPR allows DNA changes to be easily made in adult cells and in embryos. This has the potential to correct disease mutations to healthy sequences, and malfunctioning cells to be repaired for healthy functioning.<sup>22</sup> CRISPR treatment is not yet available in New Zealand, but the NZ Ministry of Health and supporting organisations are currently exploring the ethical issues surrounding the use of CRISPR in medicine, as well as in other biological fields. Some of these ethical questions include weighing up the benefits and harms of embryo editing that will be inherited by future generations; the ethical boundaries of which health issues to include for CRISPR treatment (e.g. cancer genes, other disease mutations, genes increasing cardiovascular risk and genes enhancing athletic performance); the equity issues of access for all groups of people to gene editing if legalised in NZ; and the valuing of individuals where gene editing has not been chosen.<sup>23</sup>

In July 2018, the UK bioethics Nuffield Council concluded it could be "morally permissible" to genetically engineer human embryos, thus the door was opened to a future change in the law that would enable parents to make use of DNA editing to "influence the genetic characteristics of their child".<sup>24</sup> This would primarily be to prevent a child from inheriting genetic diseases, but scientists notably did not rule out cosmetic use, such as altering DNA to increase height or change eye or hair colour.<sup>25</sup> However, recent reports of the birth of twins who were gene-edited at the embryo stage to be protected against HIV were condemned by scientists both in China and world-wide, as an example of positive eugenics, i.e. not treating existing disease but to enhance genetic make-up.<sup>26</sup> Instead, scientists and bioethicists including those in New Zealand, are calling for a more robust system of ethical governance in human gene-editing internationally.<sup>27</sup>

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<sup>22</sup> <https://video.nationalgeographic.com/video/magazine/160715-ngm-dna-revolution-animation>

<sup>23</sup> <https://royalsociety.org.nz/assets/Uploads/The-use-of-gene-editing-in-healthcare-discussion-paper.pdf> Dec 2017.

<sup>24</sup> <https://www.bbc.com/news/health-44849034>

<sup>25</sup> <https://i.stuff.co.nz/life-style/parenting/pregnancy/conception/105680875/are-designer-babies-more-fact-than-fiction>

<sup>26</sup> He Jiankui defends 'world's first gene-edited babies', <https://www.bbc.com/news/world-asia-china-46368731>

<sup>27</sup> Science News Jan 28, 2019 <https://www.sciencedaily.com/releases/2019/01/190128093213.htm>

## New relationships produced by ART

With the range of egg and sperm donor combinations potentially available, there comes a range of possible new parental relationships with up to 2 fathers (donor and intending) and 4 mothers (donor, intending, mitochondrial donor, and surrogate). With the storage of sperm, ovum and embryos via freezing (see below), there is also the possibility of one, or both parents, being deceased.

Only small numbers of surrogacy occur in NZ (0.5% of all ART cycles in 2012, and a similar 0.8% in 2015)<sup>28,29</sup>, but this is likely to increase as male couples increasingly request help to have families. While family relationships for children born using ART can be complex, children born into families who are blended from previous marriages or relationships may have similar complicated family networks, with both challenges and benefits.

In 2004, the NZ Human Assisted Reproductive Technology (HART) Act<sup>30</sup> was passed into legislation to regulate the use of the many steps and variations in ART primarily for the benefit of the children being born as a result, and for the many parent-child relationships possible through these technologies. The HART Act keeps foremost the best interests of children born through IVF in terms of i) their rights to identify their biological parents, and ii) maintaining non-commercial gamete (sperm and egg) and embryo transactions so that children do not become exploited or treated as a commodity.

The Advisory Committee for Assisted Reproductive Technology (ACART)<sup>31</sup> with its Ethics Committee (ECART) are commissioned by the Ministry of Health to investigate new emerging technologies, canvas NZ communities for cultural, spiritual and ethical views, and to recommend ART practice to the government for actioning (or not) in New Zealand fertility clinics, with the appropriate regulations. For example, the supply of gamete (eggs and sperm) and embryos, and their subsequent storage, is complicated. In New Zealand, there is not enough sperm to meet demand<sup>32</sup> and few donated eggs are available mainly due to donation being non-commercial and female hormone treatment being invasive for donors. Consequently, there is increasing popularity for reproductive treatment in other countries (ie. reproductive tourism). This leads to potential commercial exploitation of



<sup>28</sup> Assisted Reproductive Technology in New Zealand 2012 - ACART report published April 2016.

<http://acart.health.govt.nz/assisted-reproductive-technology-new-zealand-2012>

<sup>29</sup> Assisted Reproductive Technology in New Zealand 2015. ACART report published December 2018.

<https://acart.health.govt.nz/assisted-reproductive-technology-new-zealand-2015>

<sup>30</sup> Human Assisted Reproductive Technology Act 2004.

<http://www.legislation.govt.nz/act/public/2004/0092/latest/whole.html>

<sup>31</sup> ACART – Advisory Committee on Assisted Reproductive Technology, Ministry of Health.

<http://acart.health.govt.nz/about-us>

<sup>32</sup> 15.9.16 NZ Herald article 'NZ in grip of sperm drought, women pin hopes on foreign donors'.

[http://www.nzherald.co.nz/nz/news/article.cfm?c\\_id=1&objectid=11710932](http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11710932)

international donors and resultant children not always having access to information about their biological parents.

Human embryos until recently have been the main source of stem cells (the precursor cells for all other cell types), resulting in the destruction of the embryos used for stem cell collection. Human embryonic stem cells have been in increasing demand for research purposes on potential stem cell treatments and transfers to treat many human diseases. While embryo research is prohibited in New Zealand, our laboratory uses of human embryonic stem cell lines, which can be kept alive indefinitely (i.e. are immortal) for all sorts of cell biology research, is widespread.

Internationally, other laboratory-produced sources of human stem cells have been developed to provide cells able to grow into any number of specialised cells for treatment or transfer. For example, induced pluripotent stem cells (which can be turned into any other cell type) are produced by the chemical induction of already specialised cells, such as skin cells, to revert to their original stem cell state. Stem cells may also be produced by somatic cell nuclear transfer, where a specialised cell nucleus is used to replace the nucleus in an egg cell). Stem cell transfer treatments are offered in several countries, with sometimes questionable cell sources and medical regulation of the procedures.

As a result of increased technology, there are a number of ethical issues around the creation by IVF of embryos for research, including for producing embryonic stem cells, and research involving genetic manipulation of the embryo.

## Storage of gametes and embryos

In New Zealand, unused sperm, eggs and embryos are stored frozen at fertility clinics with good documentation, under the regulation of the 2004 HART Act. However, ethical questions arise as to what to do with unwanted gametes and embryos. Should embryos that are 'spare' because they are no longer needed for implantation be kept indefinitely (with decreasing chances of viability), be used in research, or be discarded?



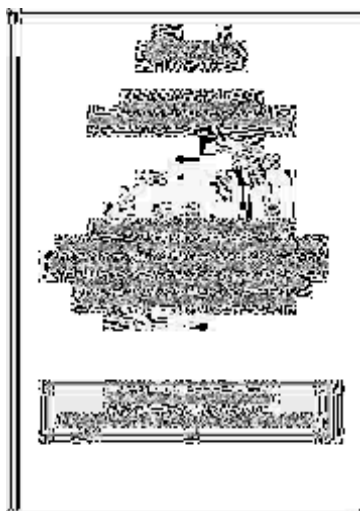
Storage of embryos and gametes by New Zealand fertility clinics is currently regulated at a maximum of 10 years unless extended by donors, and after this time fertility clinics will discard the tissue if contact with donors is unsuccessful. In contrast with the UK and USA, scientific research on embryos is not legal in NZ. ACART periodically canvases community and professional groups in order to gauge public views on ethical issues such as the use of 'spare' gametes and embryos, in order to advise the government for policymaking.

In an attempt to overcome infertility for women in their late 30's and early 40's, a recent trend in the US has seen young women encouraged to store their frozen eggs for parenting at a later, more convenient time in their life using IVF. This trend might be at risk of over-promising fertility with unknown health outcomes for the older mothers and their children, and an altered societal profile.<sup>33</sup> It also bypasses investigating alternatives such as adoption by starting on the IVF pathway at an early age for these young women.

Another branch of reproductive medicine, oncofertility, aims to help cancer patients of reproductive age by collecting and storing gametes before they begin any chemotherapy, which would harm their eggs or sperm, for later IVF and pregnancy.<sup>34</sup> In prepubescent girls, ovarian tissue is able to be frozen, and in some countries this tissue is able to be thawed and incubated in the fertility clinic so the immature eggs can develop and mature (in vitro maturation) before fertilisation using IVF. However, the processes for thawing and use of frozen ovarian issue for NZ patients are not yet available or legal.

The technique of in vitro maturation could possibly produce single, healthier eggs with more successful IVF results than with superovulated eggs, and therefore reduce the production of 'spare' embryos. However, the current demand for fertility treatment maintains the status quo for multiple, superovulated eggs being fertilised for each client, often with reduced chances of reimplantation for several of the subsequent embryos. Scientific progress for more successful IVF outcomes is intrinsically influenced by economics and utilitarian markets, maybe at the cost of bioethical considerations.

Posthumous reproduction is the technology now available for stored sperm and eggs, embryos and ovarian/testes tissues to be used a considerably long time after collection, with the possibility of being used after the person who gave the tissues has died. Additionally, techniques are now possible for retrieval of gametes or tissues soon after someone's death. Ethical discernment and new regulations are required for both these types of posthumous situations and their diverse possibilities. Requests for posthumous reproduction are increasing both worldwide and in NZ. For example, a NZ mother has applied to ECART twice, requesting surrogate use of sperm stored by her 15 year old son before his cancer treatment and subsequent death at 17, in order to produce a grandchild.<sup>35</sup>



<sup>33</sup> All Babies by IVF? – Still an Unproven Experiment. 2014. <http://www.interchurchbioethics.org.nz/resources>

<sup>34</sup> The Oncofertility Consortium. <http://oncofertility.northwestern.edu/news>

<sup>35</sup> <https://i.stuff.co.nz/national/health/105297367/talented-teen-filmmaker-cameron-duncan-died-of-cancer-at-17-15-years-later-he-could-become-a-father>

ACART is currently canvassing New Zealand societal views on who should be allowed to request posthumous use of tissues previously stored, and on the collection of reproductive tissue after death. Should there be limits of any use of stored ovum, sperm or embryos? What types of authorisation and regulation does New Zealand require? What are the reproductive rights of people (and their families) who are near death or not near death but incapable of consent?<sup>36</sup>

In all these diverse situations where ART is used to help people have children, there are many new relationships created that would not naturally occur without medical intervention. It is important that the relationships surrounding children born with ART help are healthy and nurturing for the child, and that all decisions around the use of ART have at their foremost priority the future wellbeing of resulting children.

## How can we go about answering the ethical questions in ART?

### Ethical frameworks

Ethical frameworks are useful when making decisions that are hard to make on either individual or societal levels.<sup>37</sup> Bioethics is an academic discipline that can be matched to real life situations, to help us to decide on societal core values across cultural, spiritual and philosophical beliefs.<sup>38</sup> This is particularly difficult to do at times, especially in the face of consumer demand.<sup>39</sup> Biotechnology gives us a chance to reinvent ourselves, and blends the natural and the artificial, or the created and the produced, but may cause unrealistic aims of control over birth/death/disability and consumeristic demands on practitioners.<sup>40</sup>

Needless to say, the questions of whether a technology is acceptable or unacceptable are very important. However, such questions are usually complicated to answer and are frequently subjective. Rather than the questions being answered, the use of technologies may be allowed while controlled by heavy regulation (as seen in the UK), rather than the use prevented by strong ethical boundaries.

The ethics framework by Beauchamp and Childress is commonly used in medical disciplines including ART, with the ethical aims of autonomy (having control over a choice), non-maleficence (actions causing no harm), beneficence (actions resulting in benefit), and justice (fairness for all involved). A key feature of the above ethical categories is that a person's

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<sup>36</sup> <https://acart.health.govt.nz/publications-and-resources/guidelines-and-advice-issued-ecart/guidelines-use-storage-and-disposal>

<sup>37</sup> Gerard Aynsley, *Potential and Actual Persons*. The Nathaniel Report Issue 36, 2012. Gerard Aynsley, *Does 'Ethics' get in the way?* The Nathaniel Report Issue 45, 2015

<sup>38</sup> John Wyatt. (2009). *Matters of Life and Death*.

<sup>39</sup> Maintaining a principled ethical approach in the face of a global fertility market, by the staff of the Nathaniel Centre. The Nathaniel Report Issue 41, 2013

<sup>40</sup> John Wyatt. (2009). *Matters of Life and Death*.

autonomy is nested within relationship (often familial) rather than being solely individual. These relations are further emphasised in many cultural and faith contexts, including Christian and Māori contexts, and are a large part of many wider discussions on the ethics of care.

ART has required people to ask critical questions about the creation of life, which also could include questioning what is considered life, and life as being the sacredness of creation. For Māori, ART has necessitated discussion around some of these key questions of creation, and how this relates to Tikanga Māori. Professor Hirini Mead dedicates a whole chapter in his book, *Tikanga Māori: Living by Māori values*, to these important contemporary discussions, and has designed a tikanga Māori framework of five tests, which when applied should provide a Māori viewpoint or position<sup>41</sup>. The first test in the tikanga Māori framework relates to tapu. For example, Moana Jackson asked a key question during the debate around the relevance and significance for Māori of genetic engineering and genetic modification, especially during the Royal Commission on Genetic Modification. His question was: “Always go back to the same question: Do you think our tupuna [ancestors] would have agreed to putting [human] genes in sheep?” This same question could be put another way, to ask: “Do you think our tupuna would have agreed to the creation of life utilising the method and processes of ART?” This question relates directly to a question on the sacredness of life and creation.

The tests identified by Professor Mead, “could be useful to families confronted by the dilemma of having to decide whether to participate in new technologies, new cures for medical problems, and new ways of doing things.” There are many tikanga and ethical frameworks that have been developed to assist people, communities and whānau in making decisions on new technologies. The most important thing here is that people, communities and whānau need to meaningfully engage in asking these questions of themselves, and also ask how any decisions that they make may impact on their whānau, hapu and iwi.

There is also a growing realisation that religion can inform bioethics, and often deepens the justification for ethical action by focusing on the “intention embedded in action”<sup>42</sup> rather than a justification based on the action or result alone. One such scheme is to focus on the overarching story of the Bible. The theme of Creation focuses on God’s love, humanity made in the image of God, and the relational nature of the world. Therefore, ethically how do we discern limits to human activity, focus on relationships not individuality, and understand personhood and human autonomy? The theme of Continuing Creation focuses on God’s continuing activity and therefore ethically, how we participate with God in the world. Importantly, in participating we also need to consider human character, virtues and wisdom from a biblical lens to ask what type of people are we called to be. Finally, New Creation

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<sup>41</sup> Mead, H.,K. (2003). *Tikanga Maori: Living by Maori Values*.” Huia Publishers, Wellington. Pg. 350.

<sup>42</sup> Baruch Brody, “Religion and Bioethics,” in *A Companion to Bioethics*, ed. Helga Kuhse and Peter Singer (Oxford: Blackwell Publishers, 1998), pp. 41-45. Also see Fraser Watts, “Approaches to Bioethics,” in *Christians and Bioethics*, ed. Fraser Watts (London: SPCK, 2000), pp. 2-3.

points us toward hope, so ethically how can our actions anticipate God's future, and how can we leave this place in a better shape for future generations.<sup>43</sup>

Christian ethics also points to and critiques deeper cultural structures and assumptions, rather than always delivering particular verdicts on sometimes very complex problems (termed 'wicked problems,' where there might appear to be no solution). A new approach by Michael Banner sets ethics in dialogue with anthropology, rather than moral philosophy.<sup>44</sup> Banner notes that creeds of the church point to Jesus' conception, birth, suffering, death and burial, all aspects of life that anthropology is also interested in.<sup>45</sup> Anthropology also recognizes that kinship patterns and attention to the suffering of Christ (for instance) have historical and geographical distributions and variations and development. Christianity dramatically disrupts normal kinship relationships in the first century and in our own society.<sup>46</sup> The New Testament emphasises spiritual over biological kinship and this is symbolized in the church by the (previous) priority of godparents over parents in baptism, the restructuring of kinship in monasticism and celibacy, and the universal kinship of the Lord's Supper.<sup>47</sup> Banner applies this to ART by suggesting that biblical patterns of kinship, if working as intended, should undercut the *partially* socially constructed "tragedy of childlessness" and the perceived only solution as a "child of one's own."<sup>48</sup> Christianity would not then necessarily adjudicate on either side of particular issues in ART (except to minimize commodification) but faith might fund and sustain communities capable of providing alternatives and other solutions to childlessness, such as work and life alternatives to parenting, and adoption of children.

Banner's ethics has much in common with a virtue theory approach. Rosalind Hursthouse (a virtue theorist but not a Christian), in an article on abortion, for instance, argues that many women find themselves in "vicious" circumstances, and that the ideals of virtue (which would side with continuing pregnancy) hardly apply under these conditions.<sup>49</sup> Banner and others like Stanley Hauerwas and Richard Hays have argued that within a Church community there might be alternative solutions to both the problems of childlessness and the problem of unwanted pregnancy. A woman might, for instance, be supported in bearing a child to term (given adequate community support and a higher Christian tolerance of self-sacrifice), and a childless couple might in some circumstances see adoption as an answer to their

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<sup>43</sup> Graham O'Brien, 2019. *Biblical Bioethics: Biblical Theology, Biblical Ethics, and Bioethics*.

<http://www.interchurchbioethics.org.nz/resources>

<sup>44</sup> Michael Banner, *Ethics of Everyday Life: Moral Theology, Social Anthropology and the Imagination of the Human* (Oxford: Oxford University Press, 2014).

<sup>45</sup> Banner, *Everyday Ethics*, p. 6.

<sup>46</sup> Banner, *Everyday Ethics*, p. 42

<sup>47</sup> Banner, *Everyday Ethics*, p. 38

<sup>48</sup> Banner, *Everyday Ethics*, p. 38

<sup>49</sup> Rosalind Hursthouse, "Virtue Theory and Abortion" in *Applying Ethics: A Text with Readings*, 5th Ed., edited by Jeffrey Olen and Vincent Barry (Belmont: Wadsworth, 1996), pp. 204-216.

childlessness.<sup>50</sup> In no case do these writers argue that all couples or pregnant women should always react in this way, only that the radical re-ordering of kinship patterns and re-orientation to suffering that Christianity affords, offers solutions less possible outside the church, thus destigmatising childlessness and deconstructing the socially constructed aspects that fuel the ART industry.

## Biblical Perspectives<sup>51</sup>

The Bible is an important source informing Christian ethic. It promotes justice for all to have equal access to medical help and for the right to life as God intends. Within the new context of bioethics, the challenge is to discern how to use Christian resources that can be considered “ancient”, as a voice in these areas of new knowledge and applications. In the context of biotechnology, Gareth Jones has identified four possible approaches to the use of the Bible: 1) as a complete guide; 2) as the major of many sources; 3) as the one of many sources; and 4) as irrelevant.<sup>52</sup> It is the second of these approaches that is being suggested here as the most helpful approach when faced with the new issues presented by bioethics.

Even though for Christian ethics the moral teachings of Jesus form a paradigm that provides scenarios for action, it is possible to discern the correct patterns of behaviour and extend the paradigm to new situations in order to use the Bible as the major source of many. In doing so, as Howard Marshall notes, Scripture is ‘freed up to offer signposts in areas not on the original map’<sup>53</sup> in which the paradigms are utilised in an analogous sense to that indicated in the Bible. Richard B Hays, describes this as providing ‘imaginative analogies’ that allow the biblical stories to speak into our historical context through a process of ‘metaphor making’, in which imaginative links can be inspired by the Holy Spirit, resulting in ‘imaginative correlations’.<sup>54</sup>

One example of using the Bible as an imaginative signpost might be the re-ordering of kinship described above.

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<sup>50</sup> Stanley Hauerwas, “Abortion Theologically Understood” in *Virtues & Practices in the Christian Tradition: Christian Ethics after MacIntyre*, ed. Nancey Murphy Brad J. Kallenberg & Mark Thiessen Nation (Harrisburg, PA: Trinity, 1997) pp. 221-238.

<sup>51</sup> This section and its references have been sourced from Graham O’Brien. See O’Brien, *Biblical Bioethics* p.3.

<sup>52</sup> D Gareth Jones, “Responses to the Human Embryo and Embryonic Stem Cells: Scientific and Theological Assessments,” *Science and Christian Belief* 17, no. 2 (2005): 213-17.

<sup>53</sup> I Howard Marshall, “New Occasions Teach New Duties? 2. The Use of the New Testament in Christian Ethics,” *Expository Times* 105 (1993): 135-36.

<sup>54</sup> Richard B Hays, *The Moral Vision of the New Testament: A Contemporary Introduction to New Testament Ethics* (San Francisco: HarperSanFrancisco, 1996), 298-306.

## Ethical Considerations- exploring the hard issues

Who is involved/related in ART?

Many people are potentially involved and impacted, and many relationships possible, in situations requiring the use of ART. There is a need to examine, therefore, which of these many people involved we are focussed on when using an ethical framework – is it the child, the embryo, the intending mother/father, the egg/sperm donor, the surrogate mother, the mitochondrial donor? What tools are in place, such as fertility clinic registers and ethical guidelines for communication between all the reproductive stakeholders in a given situation, to ensure that parent and child information is accessible and accurate in an ongoing way? Underlying these questions is the understanding that relationships are life-long and highly impacting in the lives of the people involved, especially for the children.

*Discussion question:*

*A key Christian ethical principle is in the care of the vulnerable. In the context of ART who do you see as “the vulnerable”, and what steps do you feel are necessary to protect them?*

When does a “person” begin?

This is a question that we can’t help asking, even if after our consideration it may be the wrong question to ask. Most people intrinsically value human life, but views differ about the importance given to it at specific stages of development. While it is tempting to draw a line in the sand for a start of personhood, in different circumstances different concerns have to be weighed during any decision-making. We have respect for human life as part of creation, but also from the stage of the fusion of egg and sperm cells, no stage of human development can happen without human input. Whether cells in a petri dish can develop without human assistance or not, and therefore may be regarded as more dispensable, is also relevant to other stages of embryo and infant development. ‘Independent’ life is a misnomer, as we all live in relationship and interdependency with others.

However, because ART involves the creation of human embryos through IVF, a key question for ART bioethics is “what is the moral status of the embryo?” The human embryo provides unique challenges to bioethics in the areas of human personhood, the boundaries of research, public acceptance, and the balance between beneficence (benefit) and non-maleficence (non-harm). The central religious questions have focused on the protection of the early embryo so that non-harm takes precedence over benefit (e.g. the current ban in NZ on embryo use in

research), a view supported by many Christian denominations. This is especially true since the human embryo is the “point of access”<sup>55</sup> for the genetic manipulation or enhancement of humans. The progression towards any form of genetic enhancement (for example using CRISPR gene editing) in which “genetic changes stand to set the biological boundaries within which human flourishing takes place,” could result in a radical break from the past that may separate future generations from their historical context as humans.<sup>56</sup>

The advent of IVF for the production of human embryonic stem cells also raises many ethical and spiritual issues especially related to the destruction of human embryos for therapeutic purposes.<sup>57</sup>

Key questions include:

- Does a person gain personhood when an egg and sperm first fuse, or a few days later when there are a certain number of embryonic cells, or at 7 weeks when the embryo has a heartbeat, or at 8 weeks when the foetus has all the major structures developed, or at 12 weeks when all physiological systems of the foetus are working, or around 40 weeks when the baby is born, or later when the baby is self-aware? Does an embryo have more worth than a group of tissues, what is the moral status of an embryo?<sup>58</sup> At what stage does a person start to have human value?<sup>59</sup>
- From the moment of fusion of egg with sperm, the embryo is genetically human – does the mode of conception make a difference to the status of being human?
- Do you think every embryo has a right to be born?
- Do ‘spare’ embryos have less worth and are therefore available for research and generation of stem cells?
- Who owns an embryo?

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<sup>55</sup> Ronald Cole-Turner, "Religion Meets Research," in *God and the Embryo: Religious Voices on Stem Cells and Cloning*, ed. Brent Waters and Ronald Cole-Turner (Washington D.C.: Georgetown University Press, 2003), p. 12.

<sup>56</sup> Celia E Deane-Drummond, *Genetics and Christian Ethics*, ed. Robin Gill, vol. 25, New Studies in Christian Ethics (Cambridge: Cambridge University Press, 2006), p. 147.

<sup>57</sup> Jones, "Responses to the Human Embryo," p. 201. Ted Peters, *Science, Theology and Ethics*, Ashgate Science and Religion Series (Aldershot: Ashgate Publishing Limited, 2002), pp. 177-80 and 84. Ethically there are seven basic policy options available for hES cell regulation, with counties supporting each of the options. See Cahleen Shrier and Paul Shrier, "Human Embryonic Stem Cell Research and Christian Community Ethics: An Old Testament Investigation," *Perspectives on Science and Christian Faith* 58, no. 1 (2006): pp. 39-40. Gareth Jones outlines four positions. See D Gareth Jones, "Why Should Cloning and Stem Cell Research Be of Interest to Theologians?," in *Stem Cell Research and Cloning: Contemporary Challenges to Our Humanity*, ed. D Gareth Jones and Mary Byrne, Interface (Hindmarsh: ATF Press, 2004), pp. 91-94.

<sup>58</sup> Richard Stith on the moral status of the human embryo and fetus. The Nathaniel Report Issue 34, 2011. Also, Graham O'Brien, "Christian Perspectives on the Human Embryo and its Moral Status". Submitted to *Stimulus: The New Zealand Journal of Christian Thought and Practice*.

<sup>59</sup> Brad Harrub (2002). *The Inherent Value of Human Life*, <http://www.apologeticspress.org/apcontent.aspx?category=7&article=159>

- Is having a child a human right, a God-given right? What does this say to those without children by choice, or due to untreated infertility or where fertility treatment has failed?

The answers to these questions depend much on our spiritual and cultural frameworks, ie. our worldview. Importantly, ethical decisions made for individual couples and their children will also impact more widely on communities and societies, shaping values for future generations, perhaps in ways that are irreversible. Individual choices contribute to who we are as a collective society.

The Bible recognises the mystery and majesty of the process of foetal development and articulates God's role in forming the unborn child. All the integrated parts that we understand scientifically as part of human molecular and reproductive biology are also part of a personal and intentional creation.

Conception is mentioned many times in the Bible as an important event both individually and as a community. Some specific Bible verses are worth noting as they often come up in discussing these points are:

- Psalm 139:13-16 (NIV) 'For you created my inmost being; you knit me together in my mother's womb. I praise you because I am fearfully and wonderfully made; your works are wonderful; I know that full well. My frame was not hidden from you when I was made in the secret place, when I was woven together in the depths of the earth. Your eyes saw my unformed body; all the days ordained for me were written in your book before one of them came to be.'
- Jeremiah 1:4-5 (NIV) 'The word of the Lord came to me, saying, "Before I formed you in the womb I knew you, before you were born I set you apart; I appointed you as a prophet to the nations".'
- Galatians 1:15 (NIV) 'But when God who set me apart from my mother's womb, and called me by his grace...'

When read in context, these verses see the writer looking back over their life and affirming that a person is known by God before birth, well before that person is able to know God, and that God's commitment is a continuum throughout foetal-child-adult-eternal life.<sup>60</sup> Our role as Christians is to look after and help restore humanity, but not to be creators of new creations ourselves. This includes the design, generation and commodification of people. Assisted reproductive technologies offer many benefits, yet also have the potential to be on the edge of this creation line, therefore requiring our best ethical care.

Overall, even though it is difficult to determine a precise biblical perspective, five biblical points about the beginning of human life lead to general principles rather than specific

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<sup>60</sup> O'Brien, *"Christian Perspectives on the Human Embryo and its Moral Status."*

mandates that are suggestive of a more conservative approach with regard to the human embryo:<sup>61</sup>

1. The human child is a deeply-to-be-desired creation and gift of God.
2. The Bible recognises the mystery and majesty of the process of foetal development and articulates God's role in forming the unborn child.
3. God has knowledge of those who will be born even before they are born.
4. The developing child in the womb was treated as worthy of some legal protection in Old Testament law.
5. The incarnation began with the miraculous conception of Jesus, and Mary's acceptance of her role, and not just his birth.

In terms of the moral status of the embryo, there are three main views to be considered:

- 1) The embryo is just a ball of cells and has no status in terms of personhood. It can therefore be used for any purpose. This tends to be the secular view - religious perspectives generally follow one of the two other perspectives.
- 2) From the point of conception, the embryo has the same full moral status and dignity as every other human person. This argument is based on the unique human genetic identity of the embryo and the intuition that all persons, including Jesus, start their existence as such an embryo.
- 3) That personhood, and therefore moral status, is a gradually emerging property of the embryo so that each stage of development represents quantitatively different properties culminating in 'personhood'. This view points to differing developmental stages as important and often takes a relational view of development that emphasises specific events such as cellular differentiation and implantation. This view adds some significant points to consider compared to the full moral status position. Firstly, that environment plays a significant role in determining the potential of the embryo – an embryo in a petri dish or stored frozen is in an environment that lacks the ability for development; whereas an embryo implanted in the womb is in an environment that supports further development and is necessary for growth into a person. This is especially relevant for IVF embryos, since the embryo in a petri dish can never become a person outside of the womb and so some would say, does not the same moral status as an embryo *in utero*. Second, there is a moral difference between the creation of an embryo for fertility and if unused, then using the embryo for research where some benefit can come from the embryo's destruction (after say 10 years in storage), and the creation of embryos specifically for research and stem-cell harvesting.

*Discussion question:*

*Which view of the moral status of the embryo do you find more convincing and why?*

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<sup>61</sup> Stassen and Gushee, *Kingdom Ethics*, p. 220.

## Participation with God

That humanity is made in the image of God is the central biblical principle worth defining.

*Genesis 1:27 (NIV)*

The Hebrew terms for 'image' (*selem*) and 'likeness' (*demut*) can be translated 'representation' and 'approximation' respectively. Here the image comprises the whole person: personality; self-determination; rational thought; the capacity for relationship. Within Ancient Near Eastern culture, the concept of image was associated with representing a god on Earth, so that in biblical terms, humanity functions as the installed image-bearers of God within creation to look after creation on behalf of God. This perspective represents a “functional view” where the image of God relates to the function that humanity performs.

Another perspective is the substantive view where the image of God consists of characteristics within human nature - physical, spiritual or psychological – such as wisdom, creativity, love and uprightness.

Finally, there is the relational view that emphasizes the human ability for 'authentic relationship' with God, with each other, and with creation. In a relational view all of humanity is made in the image of God, and as already noted, the human child is a precious creation and gift of God and is equally made in the image of God. All humans are loved and valued by God, belong to God and are equal, whether they are disabled, sick, burdened or healthy. All people have purpose in God's creation, whether they are parents or not.

Part of being made in the image of God is to look after the rest of creation and to love others as God loves us, equally and justly (John 15:12-17). We are God's representatives and called to bring wholeness and healing, to bring about God's vision to heal the world as indicated in Luke 10:29-37, where love defines the healing task in terms of the needs of the neighbour. Technology provides so many God-given benefits to our lives, and for those who cannot conceive, the use of IVF is certainly a blessing and the resulting child a “gift”.

*Discussion questions:*

*How can ART be seen as fulfilling the functional, substantive and relational views of being made in the image of God?*

*How does being made in the image of God shape our view of technology and the mandate to use it?*

## The worth of people with disability/impairment

The processes a society uses for screening pregnancies or selecting embryos for implantation reveals much about how we view children born (and adults) with disability, diseases or traits perceived as less acceptable. In New Zealand, women pregnant for the first time are offered blood tests at 10-14 weeks for blood group, rhesus factor, haemoglobin, harmful antibodies, rubella, hepatitis B, syphilis, HIV, diabetes, and Down syndrome. If Down syndrome, or another medical situation such as Turner syndrome, Trisomy 13 or Trisomy 18 is indicated, the blood test will be followed by an ultrasound scan or other diagnostic tests, for confirmation. The NZ Ministry of Health advertises that a woman's midwife or specialist doctor will give information and support for a woman to make the decision whether to have screening or not.<sup>62</sup> Currently, it appears that availability of such support services is not enough or consistent across New Zealand. Recently a documentary exploring the ethics surrounding the screening for Down syndrome investigated attitudes in Iceland, where 100% of pregnancies identified with Down syndrome end in termination.<sup>63</sup> What we decide about selecting embryos as acceptable or unacceptable, and what happens to unacceptable embryos, shapes society's current stance on our care for the disabled and vulnerable, and as such will impact on medical care for future foetal screening, delivery of premature babies, foetal disability and foetal dying, as well as societal treatment and care for people with disability. In this way disability and disease is both biological and social, with our attitudes also shaping suffering, and our future value and care for all people.<sup>64</sup>

*Discussion question:*

*How do we value someone with disability/impairment, given this could happen to any of us during our lifetime?*

## How far should we go with ART?

There is a strong biblical mandate to do good without doing harm (Romans 3:8), and that good ends require good means to get there.

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<sup>62</sup> Antenatal Down Syndrome Screening in New Zealand 2007

<https://www.health.govt.nz/system/files/documents/publications/antenatal-down-syndrome-screening-in-nz-2007-apr07.pdf>

<sup>63</sup> 'A world without Down syndrome'. BBC documentary 2016

<https://www.bing.com/videos/search?q=YouTube+sally+phillips+documentary+a+world+without+down+syndrome&view=detail&mid=336D2414A45FCF83E4E3336D2414A45FCF83E4E3&FORM=VIRE>

<sup>64</sup> Letter to Minister of Health from ICBC 26.07.11

<http://www.interchurchbioethics.org.nz/index.php/submissions-media/>

*Discussion questions:*

*What are the ethical issues already mentioned that are associated with IVF?*

*For you, how far is too far?*

*How far is too far for society?*

Because the embryo created by IVF is also the entry point for sex selection (choosing the gender), genetic manipulation and enhancement, then we have to be very careful about our ethical consideration of what procedures we allow and in deciding our moral boundaries for science and technology. A central question is “should we” rather than “could we,” so that a clear sense of personhood and sanctity of life is maintained. Also, there is a risk that the embryo becomes a commodity or a tool of research. Accordingly, for many the use of IVF to create embryos for research, or to produce stem cells, is morally wrong. As well as commodification, another justice issue is equity and distributive justice (e.g. equal access to treatments for all). Therefore, many would favour the use of the “Precautionary Principle” – to proceed with IVF for a limited number of situations, for example, for reproduction only.

There are other less black and white situations, such as the use of unused/spare IVF embryos. Those with a view of an embryo as having emerging personhood over time, might say that the spare IVF embryo is only a “potential person,” especially since it can never become a person outside of the womb. Accordingly, separating the embryo’s creation (for the purpose of a child), from its destruction or use in research (after say 10 years in storage) may be viewed as morally acceptable and beneficial for production of stem cells for medicine. This could be viewed differently from creating embryos only for destruction during research, treating embryos as a commodity. The sheer extent of natural miscarriages might make us think twice about the personhood of the foetus in early development. If we maintain that all persons have eternal significance, is it really the case that heaven is mainly peopled by those who were never born? Others would say, the embryo has full status as a human once it is created and so should only ever be used for reproductive purposes; indeed technologists might be seen to have this responsibility to ensure this use having helped to create the embryo.

Other issues arise with genetic screening: what genetic diseases should be screened and what supports are offered for decisions? If a full DNA profile is done, who owns that information and how is that used? How should data be collected about us (with associated issues of consent and privacy)? What happens to this data as it accumulates it becomes ‘big data’ that can be shared for many uses? What sort of analysis and decisions about use does the data undergo? Artificial intelligence, including algorithms to process our data, is a controversial and current topic with the big question ‘who decides what artificial intelligence can ask and

decide’?<sup>65</sup> Where do we draw the lines between artificial and human decisions, and the ethics around these decisions?

*Discussion questions:*

*How would you now respond to a family member or friend who comes to you to talk about using IVF to have a family?*

*What do you identify as the key issues to consider?*

## Conclusion

Even though IVF technology has been available now for 40 years, the continual and rapid expansion of new ART technologies produces new boundaries requiring both our ethical consideration, and our Christian awareness and pastoral response. There are emerging ethical and spiritual challenges in balancing the blessing of providing a sense of family completeness for many, and the irreversible and societal changes from technologies such as germline manipulation and posthumous reproduction, as well as the potential redefinition of what we mean and believe about being human.

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<sup>65</sup> Scientific American 25 Feb 2017. Helbing D et al: Will Democracy Survive Big Data and Artificial Intelligence? <https://www.scientificamerican.com/article/will-democracy-survive-big-data-and-artificial-intelligence/>

## Glossary

Adoption - legally taking another's child and bringing it up as one's own.

Assisted Reproductive Technologies (ART) - the use of technologies to assist human reproduction in the treatment of infertility.

Autonomy - the right or condition of self-government.

Bioethics - a field of study concerned with the ethics and philosophical implications of certain biological and medical procedures, technologies, and treatments.

Biotechnology - any technological application that uses biological systems, living organisms, or their derivatives, to make or modify products or processes for specific use.

Commodification - the transformation of goods, services, ideas and people into commodities or objects of trade.

Conception - the process of becoming pregnant involving fertilization of oocyte by sperm, or implantation in the uterine wall, or both fertilisation and implantation.

CRISPR gene editing – Gene/genome editing is a group of technologies that give scientists the ability to change an organism's DNA by adding, removing, or altering particular locations in the genome. Recently CRISPR-Cas9 (clustered regularly interspaced short palindromic repeats and CRISPR-associated protein 9) technology has allowed faster, cheaper, more accurate, and more efficient editing than previous methods.

Cumulus cells - cluster of cells (called cumulus cells) that surround the oocyte both in the ovarian follicle and after ovulation.

Embryo - An unborn offspring in the process of development, in particular a human offspring during the period from approximately the second to the eighth week after fertilization (after which it is usually termed a foetus).

Ethics - a field of intellectual inquiry and the branch of philosophy dealing with moral principles that involve systematizing, defending, and recommending behaviour or the conducting of an activity.

Foetus - an unborn human more than eight weeks after conception.

Gametes – reproductive germ cells i.e. egg (oocyte/ovum) and sperm that have half the number of chromosomes (DNA) compared to the other cells (somatic cells) in the body.

Genetic mutation - the permanent alteration of the nucleotide sequence of the genome of an organism, virus, or extrachromosomal DNA or other genetic elements, which can be beneficial or detrimental to the organism.

Genome – the complete set of genes or genetic material present in a cell or organism.

Germline - a series of germ cells each descended or developed from earlier cells in the series, regarded as continuing through successive generations of an organism.

Human embryonic stem cells (hESCs) - cells derived from human embryos or human foetal tissue that replicate themselves and are known to develop into cells from which all tissues and organs develop i.e. are pluripotent cells.

Induced pluripotent stem cell (iPS or iPSC) - a type of pluripotent stem cell that can be generated directly from adult cells by chemically reprogramming or inducing adult cells to return to being pluripotent stem cells (i.e. Being able to replicate into any cell type).

Intracytoplasmic sperm injection (ICSI) – an in vitro fertilisation procedure in which a single sperm cell is injected directly into the cytoplasm of an egg. T

In vitro fertilisation (IVF) - The uniting of egg and sperm outside the body (in the laboratory).

Mitochondria – organelles found in large numbers in most cells and involved in the processes of energy production. Mitochondria contain only a small part of the cell's DNA; the rest of the DNA is in the cell nucleus.

Mitochondrial transfer/donation - when mitochondrial DNA carry mutations which parents do not want passed to their children, a recent mitochondrial transfer process is possible where the mother's nuclear DNA is inserted into a donor egg containing healthy mitochondria but with nucleus removed and then fertilised with father's sperm.

Next generation gene sequencing – new high throughput process of determining the accurate order/sequence of DNA nucleotides along chromosomes and genomes.

Nuclear DNA – DNA contained within the nucleus of a cell.

Oncofertility - a subfield that bridges oncology and reproductive technology to explore and expand options for the reproductive future of cancer survivors.

Personhood - the status of being an individual person; a controversial topic and one of international debate, critically during the abolition of man slavery, in theology, in debates about abortion, and in foetal rights and/or reproductive rights and the beginning of human personhood.

Posthumous assisted reproduction - the process by which ART is used to establish pregnancy and produce genetic offspring after the death of the parent. This may include use of

gametes/embryos/reproductive tissues stored before death or gametes retrieved after death.

Preimplantation Genetic Diagnosis or Screening - the determination of chromosomal abnormalities in the embryo during the course of vitro fertilization, before it is transferred to the uterus to ensure that a baby does not possess a known genetic defect of either parent.

Prepubescent – prior to the age of puberty

Reproductive tourism – the practice of traveling to another country or jurisdiction for fertility treatment, due to legal prohibitions or regulation of the sought procedure in the home country, the non-availability of a procedure in the home country, as well as lower costs in the destination country.

Spare embryos – embryos produced during IVF treatments no longer with a future of implantation

Sperm insemination - introduction of sperm into a female's cervix or uterine cavity for the purpose of achieving a pregnancy

Stem cells - the precursors of all other cell types.

Superovulation - to produce more than the normal number of eggs at one time using a series of injected hormones, for the purpose of IVF or egg storage.

Surrogate - A woman who becomes pregnant, carries and delivers a child on behalf of another person or couple (intended parent(s)).

Tikanga - The customary system of Māori values and practices that have developed over time.

Tupuna – grandparent or ancestors

Viability - ability to survive or live successfully

Virtue theory - ethical theories which emphasize virtues of mind and character

Whakapapa - genealogy, ancestral history, descent.

Whānau - Family group. In the modern context, the term is sometimes used to include friends who may not have any kinship ties to other members.

Whangai/tamaiti whangai - Customary Māori practice where a child (tamaiti) is raised by someone other than their birth parents, usually a relative.

