Inconceivable: An Analysis of Assisted Reproductive Technology for the Church

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Abstract

Infertility pushes the boundaries of emotional and physical health, which is why many couples inside and outside the church turn to Assisted Reproductive Technology (ART) for a solution. Despite what has seemed like silence from the Church, some individuals have braved the biological confusion and ethical dilemmas to evaluate the technology. Three major ethical viewpoints have emerged that each prioritize something over medical technology, namely community, order, or human dignity. This paper serves to educate pastors and church leaders on the ever-changing biology of ART as well as give voice to Christians that have spoken out on this issue. At stake is the emotional and spiritual wellbeing of the infertile couple as well as the life of the embryo. In question is how an accurate theological view of health, medical technology, and infertility impact Christian involvement in ART.

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Introduction

Infertility reveals questions of faith and suffering, challenges marital intimacy, and tests church unity. Research shows about 10% of women ages 15-44 will face infertility, meaning it is present in churches, workplaces, and families.[1] These couples suffering in silence often turn to secular sources or self-guided research to answer their questions. Some of the most advanced options medicine offers are found in Assisted Reproductive Technology (ART), which includes the human handling of either sperm, eggs, or both in the process of procreation.[2] This technology is not without concerns. It is estimated that 1.4 million embryos sit in indefinite frozen storage due to ART procedures of both believer and non-believer alike.[3] As a result, there is an urgent call for the church family to serve the emotionally tender couple as they wade through the faith-challenging experience. There is an equally urgent call for church leaders to be well educated on this topic. As technology continues to invade every area of human life, it is important that the church process and respond to the often calloused and haphazard treatment of human life with a consistent biblical worldview. This paper is designed to serve as a resource for pastoral education, congregational equipping, and infertility counseling. After a careful theological examination of infertility, health, and medical technology there follows a detailed explanation of the biology underlying various ART procedures. To conclude, the reader can find a literary

[1] "Female Infertility: Office of Population Affairs", *U.S. Health and Human Services*, February 21, 2019, https://www.hhs.gov/opa/reproductive-health/fact-sheets/female-infertility/index.html.

[2] The Centers for Disease Control defines ART as the handling of both sperm and egg, thereby excluding IUI. However, for clarity and fullest discussion this paper also includes sperm handling alone under the banner of ART.

[3] Marilynn Marchione, "In Limbo: Leftover Embryos Challenge Clinics, Couples," *Medical Press: Obstetrics and Gynaecology*, January 17, 2019, https://medicalxpress.com/news/2019-01-limbo-leftover-embryos-clinics-couples.html.

review of Christian opinions on ethical issues surrounding ART that will serve to demonstrate church positions on the topic as well as present some of the strongest concerns with ART a couple should be diligent to understand before considering such procedures.

Theology

The Church and Infertility

For a couple experiencing infertility painful daily reminders and mixed feelings of shame, anger, and sorrow may permeate each waking moment. A crying baby in a stroller in the grocery store, a mother's post on Facebook about the hardships of motherhood, an elderly woman's well-meaning but brash comment about a ticking biological clock all seem to add to the emotional damage of infertility. "And if childlessness itself were not enough, the social castigation, even if unreal and imagined by the couple, often carries significant emotional trauma."[4] For those suffering deeply with infertility, the church should be a place of sanctuary where their heavy and broken hearts can find rest and encouragement. Too often they find pitied glances, prodding questions, empty attempts to pacify, or judgmental opinions readily offered. The family of Christ should pursue unity as couples search to understand their identities apart from their reproductive capacity or wrestle with God's character and active involvement in their lives. Perhaps this requires a more robust understanding and willingness to acknowledge pain, especially in a culture so determined to avoid it at all costs.

The Bible and Infertility

Scripture has a lot to say about infertility. Proverbs 30:15-16 states, "Three things are never satisfied; four never say, 'Enough!': Sheol; a barren womb; earth, which is never satisfied

[4] Matthew Arbo, *Walking through Infertility: Biblical, Theological, and Moral Counsel for Those Who Are Struggling* (Wheaton: Crossway, 2018), 19.

with water; and fire, which never says, 'Enough!'"[5] Furthermore, in other cases infertility can be seen as divine punishment (Gen. 20:18, Hos. 9:7, Hos. 11). The Bible also affirms the treasure of children as a gift from God (Ps. 127). Scripture shows God is near to the broken hearted (Ps. 34:18, 147:3), comforts those who mourn (Matt. 5:4), and offers safety to express hurt and grief (Ps. 13, 86, 142). Popular stories such as Sarah and Abraham (Gen. 15-21), Rachel and Leah (Gen. 28-30), Hannah (1 Sam. 1), and Elizabeth (Luke 1:5-25) demonstrate God's sovereignty as the Creator and Sustainer of life. They also teach about the deep pain of infertility and the passionate and desperate responses of a woman whose identity is tied to childbearing and motherhood. The desperate response of Abraham and Sarah in Genesis 16 when facing childlessness shows the possibility of even faithful men and women to make harmful choices. This couple should stand as an example of warning to current Christians facing ART as an option. Instead, infertile women cling to Sarah and other stories as hopeful promises God will also redeem their barrenness with a miraculous child. However, these stories should be viewed in light of other passages and common themes throughout the Bible. For example, Genesis themes of infertility are important because they threaten the fulfillment of the Abrahamic covenant with the nation of Israel. Therefore, God's miraculous involvement in infertility can be seen as a sign of His covenant faithfulness. Matthew Arbo explains, "The new covenant is unthreatened by infertility… The infertile are in this case the spiritually infertile… those who, irrespective of how many children they have, parent no spiritual children, point none to Christ, and rear no one to

[5] Unless otherwise noted, all Scripture quotations are taken from the Holman Christian Standard Bible® Copyright © 1999, 2000, 2002, 2003 by Holman Bible Publishers. Used by permission. Holman Christian Standard Bible®, Holman CSB®, and HCSB® are federally registered trademarks of Holman Bible Publishers.

maturity."[6] So while the church should mourn with the infertile and point them to Christ, it should not buckle under the emotional struggle at the compromise of Biblical truth.

When does life begin? ART procedures challenge views about where human life begins and the value and responsibility to protect it thereafter. There are historically two ways of answering the question: biologically or philosophically. Biologically, there are 10 commonly held opinions on where life begins, with the first 5 being found in Christian settings (see Table 1 in Appendix for explanations). Philosophically, an explanation about where life begins can center around the following argument.[7]

Premise 1: An adult person results from the continuous growth beginning at fertilization.

Premise 2: From fertilization to adulthood, there is no break in development.

Conclusion: Therefore, one is a human from the point of fertilization, onward.

Varying philosophical views of the beginning of life all originate in opposition to premise 2 by proposing notable "breaks" where life is more likely begin (See Table 2 in Appendix for further details). While Scripture does not settle the biological dispute of the stage life begins, it does clearly attribute personhood to embryos by describing them in the same way as a born human. Job 3:3 says "May the day I was born perish, and the night when they said, 'A boy is conceived.'" The latter half of this verse uses the word "boy" (Hebrew *geber*) which is used elsewhere to refer to an adult man (Ex. 10:11, Deut. 22:5). Therefore, the conceived is seen as equivalent to the adult. Similarly, the same word "baby" (Greek *brephos*) in Luke 1:41-44 is a

[6] Arbo, *Walking through Infertility*, 39.

[7] Scott B. Rae and D. Joy Riley, *Outside the Womb: Moral Guidance for Assisted Reproduction* (Chicago: Moody Publishers, 2011), 89.

child still in the womb while in Luke 2:16 it refers to newborn baby Jesus.[8] Finally, Psalm 51:5 shows David ascribing characteristics such as sin to himself as a child in the womb.

When both biological and philosophical views of where life begins are taken into account, the most biblical, logical, and historically supported is the view that it begins at the fusion of sperm and egg, hereafter referred to as fertilization. Typically, this is expressed by the Church as, "life begins at conception." However, much of modern science defines conception as implantation or ignores the word all-together.[9] For the Christian, despite a long and comfortable history with the word, perhaps the advice of Dr. Best is advisable, "Any terms that obscure the truth instead of increasing transparency should be avoided."[10]

The desires of our heart. Despite the biblical clarity that the infertile are seen by God and their pain is to be shared by believers, there is also clear teaching about the problem of ravenous desires. Although desires, even for children, are not inherently a bad thing, when they replace God as priority, it becomes sinful idolatry. Similarly, James says evil desires, which in the case of infertility could be self-fulfillment or pride, give birth to sin that eventually leads to death (James 1:14-15). So, while children are indeed a blessing from the Lord, they are not a right that a Christian can demand, or even expect from God. God alone gives gifts, in accordance with his good and perfect will, which for the believer does not guarantee health, wealth, or fertility.

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[8] Rae and Riley, *Outside the Womb*, 81.

[9] Donald Venes, *Taber's Cyclopedic Medical Dictionary*, 2017., "ReVITALize Gynecology Data Definitions," *ACOG*, accessed March 18, 2020, https://www.acog.org/practice-management/health-it-and-clinical-informatics/revitalize-gynecology-data-definitions.

[10] Megan Best, *Fearfully and Wonderfully Made: Ethics and the Beginning of Human Life* (Kingsford, N.S.W.: Matthias Media, 2012), 19.

A Theology of Health and Medical Technology

Sickness is a theologically profound occurrence for a few reasons. First, it reminds of the omnipotence of God relative to the weaknesses of man. Second, it reminds humans of their limits. Third, it is a reminder that the Christian is both body and spirit and that both should be valued and stewarded well. Finally, sickness points towards the eschaton and the fullness of redemption for the broken bodies and feeble minds.

> People should pursue health because their lives are given to them in stewardship by God (1 Cor. 6:12-20)…but we can find ways to serve others and glorify God, even as our bodily health deteriorates… Throughout history, Christians have entered regions of famine, pestilence, and war, viewing their bodily health as less important that witnessing for Christ. Many have given the ultimate sacrifice of their physical lives because there is more to life than temporal health, and there is more to health than temporal life. Decisions about health should be made with an eternal perspective.[11]

While medical technology is centered on breaking limits, avoiding suffering, and prolonging life, Christians serve a God who designed them with limits, promises suffering, and sees death as great gain (1 Pet. 2:24, Phil. 1:21). Christians should not only be wary of pursuing that which promises ease, comfort, and a fear of death, but should also be aware of the values medical technology promotes. Medical technology views the body as an instrument and health as a right all can freely assert and have access to. Christians should oppose this mechanistic and selfish view of reality in favor of a more biblical view of both health and medical technology.

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[11] David O'Mathuna, "The Goals of Medicine: The Case of Viagra," in *The Reproductive Revolution: A Christian Appraisal of Sexuality, Reproductive Technologies, and the Family*, ed. John F. Kilner, Paige C Cunningham, and W. David Hager (Grand Rapids: W.B. Eerdmans Pub. Co, 2000), 56.

Biology

Diagnosing Infertility

Infertility is the failure to conceive after one year of unprotected sex. Primary infertility is applied to a couple with no previous children while secondary infertility applies to couples who either are unable to conceive despite previous children or who are unable to carry a pregnancy to 20 weeks or more.[12]

Normal biology. At puberty male testes begin to produce 200-500 million sperm every 74 days.[13] Females are born with 1-2 million follicles (immature eggs) that diminish to 400,000 by puberty.[14] Every month hormones cause 1-2 eggs to mature, which are then released (ovulated) by the ovary into the fallopian tube where fertilization could occur (See Figure 1 in Appendix for diagram). During sex, ejaculated sperm are left in the female cervix and then travel through the uterus and fallopian tube to reach the mature egg, which can take anywhere from minutes to multiple days.[15] The fallopian tubes will then carry the embryo to the uterus where it buries into the endometrium (lining of the uterus) resulting in implantation and clinical pregnancy. Failure to fertilize the egg results in menstruation while failure of the embryo to attach to the endometrium results in miscarriage. It is believed, based on current data, that

[12] Best, *Fearfully and Wonderfully Made*, 264.

[13] Best, 264.

[14] Hugh Taylor, et al., *Speroff's Clinical Gynecologic Endocrinology and Infertility,* 9th ed. (Philadelphia: Williams and Wilkins, 2020), 976.

[15] S.S. Suarez and A. A. Pacey, "Sperm Transport in the Female Reproductive Tract," *Human Reproduction Update* 12, no. 1 (January 1, 2006): 23–37, https://doi.org/10.1093/humupd/dmi047.

anywhere from 25-70% of embryos fail to implant and therefore are miscarried, called "natural wastage" by embryologists.[16]

Causes of infertility. The cause of infertility is found in only 80% of cases, with factors being attributable to the male, female, or both[17] (See Figure 2 in Appendix for more detailed statistics). Known female and male infertility factors are often related to specific reproductive organs and their impaired functions (see Figure 1 in Appendix for a breakdown). Sometimes lifestyle factors such as stress and diet can be the contributing factor.

Ovary Stimulation and Gamete[18] Retrieval

A frequent first step in ART supplements hormones to encourage the development of multiple follicles in the ovary. Drugs that increase the levels of follicle stimulating hormone (FSH) are used.[19] These medications can cause side effects similar to those of menopause. Stimulation cycles typically produce between 8 and 15 eggs.[20] Gonadotropins are the strongest medication used for increased stimulation in older women or when more eggs are desired. The eggs are then collected from the ovary with a needle inserted through the wall of the vagina under ultrasound guidance.[21] This is a procedure where only minor sedation is required and few

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[16] Best, *Fearfully and Wonderfully Made*, 21.; N. S. Macklon, "Conception to Ongoing Pregnancy: The 'Black Box' of Early Pregnancy Loss," *Human Reproduction Update* 8, no. 4 (July 1, 2002): 333–43, https://doi.org/10.1093/humupd/8.4.333.

[17] "Assisted Reproductive Technology National Data," Center for Disease Control, accessed January 29, 2020, https://nccd.cdc.gov/drh_art/rdPage.aspx?rdReport=DRH_ART.ClinicInfo&rdRequestForward=True&ClinicId=9999&ShowNational=1.

[18] Gametes are the sex cells of men or women (sperm or eggs).

[19] There are three methods of FSH elevation: Targeting the Pituitary to increase natural FSH (ex. Clomiphene Citrate), or supplementing synthetic FSH either in full (ex. Bravelle, Follistim, Gonal-F) or with dual hormones (ex. Gonadotropins). "Infertility Medications," *American Pregnancy Association*, accessed March 18, 2020, https://americanpregnancy.org/getting-pregnant/infertility-medications/.

[20] "ART: Step-by-Step Guide," *Society of Assisted Repro Tech*, accessed March 18, 2020, https://www.sart.org/patients/a-patients-guide-to-assisted-reproductive-technology/general-information/art-step-by-step-guide/.

[21] Best, *Fearfully and Wonderfully Made*, 331.

complications are reported. Ovary stimulation is not always performed, especially if a patient cannot tolerate the medication, although the pregnancy success rates are around 3-4%.[22] Hyperstimulation is now a standard step in ART because it prevents the need for multiple rounds of expensive medication ($3,000-5,000).[23] Sperm needed for ART procedures is typically collected through masturbation.[24] However, other methods of sperm collection exist such as non-invasive home collection (with a condom) or invasive surgical procedures (MESA or TESA).[25] Once the eggs and sperm are ready a couple can proceed in one of two ways: either combining the eggs and sperm inside or outside the woman's body.

Internal Fertilization Techniques-

Internal fertilization involves the combination of gametes inside a woman's body either after partial or full human handling. Intrauterine insemination (IUI) injects handled sperm into the female uterus, which usually follows ovarian stimulation and uterine prepping. Fertilization occurs in the uterus followed shortly by implantation. Gamete intra-fallopian transfer (GIFT) involves insertion of both egg and sperm into the fallopian tube, using a catheter with a dividing barrier during laparoscopic surgery, where fertilization occurs in the fallopian tube. Both techniques can lead to multiple pregnancies (8-30% in IUI) since they involve large numbers of

[22] Jerome F. Strauss and Robert L. Barbieri, eds., *Yen & Jaffe's Reproductive Endocrinology: Physiology, Pathophysiology, and Clinical Management*, Eighth ed. (Philadelphia, PA: Elsevier, 2019).

[23] Jennifer Uffalussy, "The Cost of IVF: 4 Things I Learned While Battling Infertility," *Forbes*, February 6, 2014, https://www.forbes.com/sites/learnvest/2014/02/06/the-cost-of-ivf-4-things-i-learned-while-battling-infertility/#5bdf0e4924dd.

[24] Best, *Fearfully and Wonderfully Made*, 330.

[25] Microsurgical epididymal sperm aspiration (MESA), testicular sperm aspiration (TESA).

sperm injected in closer proximity to the egg than in normal reproduction and often follow ovarian stimulation.[26]

External Fertilization Techniques

External fertilization involves the combination of gametes in a petri dish with nutrient-rich solution that mimics the fallopian tube fluid. The oldest and most common method is in vitro fertilization (IVF) where fertilization occurs spontaneously as it would inside the human body. An alternative, commonly used for male factor infertility due to sperm problems is intracytoplasmic sperm injection (ICSI). This involves washing and choosing a single visibly healthy sperm and injecting it into an egg. This is also frequently used to aid sperm penetration of the hardened outer layer if the eggs were previously frozen.

Embryo staging. Not all the eggs retrieved will be mature and not all mature eggs will successfully fertilize. There is an average fertilization rate of 80%.[27] However, once fertilization has occurred, marked by the presence of two pronuclei (one each from sperm and egg), the embryos are then monitored closely in the laboratory. Embryology has set standards about the way a "viable" embryo should develop, which either includes the rate of growth or visible characteristics (morphology) a normally developing embryo should possess. Failure to keep the timeline or look right results in discard, although some clinics use these embryos for research or technique practice for their training staff. Systems of grading vary depending on the clinic but will ultimately determine whether the embryo is transferred, frozen, or discarded.[28]

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[26] "How Well IUI Works By Patient Type," FertilityIQ, accessed March 18, 2020, https://www.fertilityiq.com/iui-or-artificial-insemination/how-well-iui-works-by-patient-type#defining-iui-success.

[27] Best, *Fearfully and Wonderfully Made*, 339.

[28] Best, *Fearfully and Wonderfully Made*, 346.

Genetic Testing and Cryopreservation

For cells that reach the appropriate stage within 7-14 days many clinics offer embryonic genetic testing, especially if the couple has had recurrent miscarriages with an unknown cause.[29] This procedure, called preimplantation genetic diagnosis (PGD), involves the removal of 1-2 cells to test for chromosomal abnormalities. There is the small risk of damage to the embryo resulting in subsequent discard. PGD has been used for both sex and characteristic selections (such as eye color) recently. Embryos testing positive for undesirable disorders are usually discarded. While waiting for PGD results, all embryos must undergo cryopreservation (freezing to -196°C with liquid nitrogen) until the window for optimal implantation returns in the woman's reproductive cycle.[30] There is no deterioration over time once cryopreserved so embryos can be maintained indefinitely as long as regular storage fees are paid by the couple to the clinic which range from $350-1,000 per year.[31] Despite the indefinite longevity once frozen, only 50-90% of embryos will survive the freezing and thawing process.[32]

Embryo Transfer and Implantation

After initial embryo grading, or subsequent ranking following PGD, the "optimal" embryos are chosen for implantation. They are inserted into the uterus through the cervix with the use of a catheter. There are multiple types of transfer performed based on the history of the

[29] "What Goes on Behind Closed Doors of the IVF Laboratory", Carolina Conceptions Fertility Clinic Patient Handout.

[30] Daniel A. Potter and Jennifer S. Hanin, *What to Do When You Can't Get Pregnant: The Complete Guide to All the Options for Couples Facing Fertility Issues*, 2nd ed. (Boston, MA: Da Capo Press, 2013), 220.

[31] Ryan Riggs et al., "Does Storage Time Influence Postthaw Survival and Pregnancy Outcome? An Analysis of 11,768 Cryopreserved Human Embryos," *Fertility and Sterility* 93, no. 1 (January 2010): 109–15, https://doi.org/10.1016/j.fertnstert.2008.09.084.; "Embryo Storage Costs," *ReproTech*, accessed March 18, 2020, https://www.reprotech.com/embryo-storage-costs.html.

[32] Best, *Fearfully and Wonderfully Made*, 340.

embryo. For example, the embryo can either be fresh or cryopreserved. According to the latest statistics collected by the CDC, frozen embryo transfer was 12.3-18.7% more successful than fresh transfer, depending on maternal age.[33] Fresh embryos can be transferred after 24 hours, 3 days, or 5+ days. Zygote intra-fallopian transfer (ZIFT) is a process that transfers a 24-hour embryo (called a zygote) into the fallopian tube through laparoscopic surgery. This has a higher chance of ectopic pregnancy due to the transfer location and costs more than embryo transfer on day 3 or 5.[34] An embryo transferred on day 3 is the most common stage for transfer practiced nationally. There is a lower rate of implantation at this early stage so more embryos are typically transferred with the expectation not all will implant.[35] Embryos transferred at the blastocyst stage on day 5+ are believed to have the highest chance of implantation success. However, the quality of the embryo storage liquid available limits how many embryos a clinic can sustain to day 5. Therefore, waiting may result in the death of embryos that could have been used on day 3.[36]

As mentioned previously, it is estimated that anywhere between 25-70% of fertilized embryos that occur through natural intercourse will fail to implant in the endometrium. Despite the advances in science and technology, the reasons for this are largely unknown. In normal development, hormones control an embryo "hatching" from its outer layer and attaching to the endometrium, which also must be in the right stage. Assisted hatching (AH) and uterine prepping are common attempts to mimic this. The former involves either poking a hole in the zona pellucida or exposing it to chemicals to allow for the embryo to break out. Uterine prepping uses

[33] CDC, "Assisted Reproductive Technology National Data."

[34] Best, *Fearfully and Wonderfully Made*, 355.

[35] Rae and Riley, *Outside the Womb*, 140.

[36] Best, *Fearfully and Wonderfully Made*, 347.

more hormones to get the uterus ready for implantation. Despite those popular solutions, CDC data shows implantation success rates between 9.3-41.8% (fresh) and 30.7-49.6% (frozen), varying due to maternal age. Furthermore, among only those successful implantations, there is a 13.6-40.4% (fresh) and 16.7-23.7% (frozen) chance of fetal death before birth. That means a limited number of ART cycles actually result in pregnancy and even fewer result in live births.[37]

Embryo Extras and Multiples

As ART is designed to increase the statistical likelihood of successful pregnancy and birth rates, many of its steps are designed with the intent to create in abundance. As a result, there are currently many embryos frozen as "extras," no longer wanted due to success of previous IVF cycles, natural pregnancy, even death or divorce. If a couple no longer wishes to pay to keep the embryos frozen there are a few proposed solutions such as embryo discard, research, donation, or "mercy implantation." In most fertility clinics, failure to pay storage fees or respond to clinic contact usually results in discard only. However, couples can designate their remaining embryos for research or clinical technique development as they desire. A growing trend is that of embryo donation and subsequent "adoption." This is not identical to traditional adoption as embryos are often commodified, whereas traditional adoption is closely regulated so as not to view children as products that can be bought or sold.[38] The final option for embryo extras, viewed as "mercy implantation," involves the transfer of all remaining embryos without the use of uterine prepping medications. This final option is seen as giving the embryos some

[37] It should be noted that CDC statistics are collected through independent submissions by each fertility clinic and includes couples using ART that are not infertile or surrogates who are expected to also have optimal fertility. The inclusion of both of these groups impacts the outcome of statistic reports, although not by much.

[38] Arbo, *Walking through Infertility*, 90., Edward E. Wallach and John A. Robertson, "Ethical and Legal Issues in Human Embryo Donation," *Fertility and Sterility* 64, no. 5 (November 1995): 885–94, https://doi.org/10.1016/S0015-0282(16)57897-2.

option to implant, notably less than that of ART with uterine medications, while avoiding discard. The failure to implant is seen as equivalent to the natural "wastage" of pregnancy. It is often described as leaving the implantation up to "fate" or "God's sovereignty" (in Christian circles).[39]

Multiple pregnancy. A multiple pregnancy refers to more than one embryo successfully implanting and can cause maternal and fetal morbidity or mortality. There are many medical complications that can arise in multiple pregnancy cases such as maternal preeclampsia, hypertension, or hemorrhage as well as fetal restricted growth or umbilical cord prolapse.[40] As a result, there are now set standards for how many embryos can be transferred based on the stage of the embryo and the age of the mother (See Table 4 in Appendix).[41] When multiple pregnancies do occur, one frequently suggested solution is selective reduction. This is an abortive procedure that selects some of the developing children and removes them from the womb to produce a singleton pregnancy (one baby). Often selective reduction occurs in a sex-selective way.

The Christian Voice

Since the first successful IVF baby in 1978[42], many physicians, ethicists, philosophers, and theologians affiliated with Christianity have examined this issue. [43] These opinions can be

[39] Stephen Bell, and Brianne Bell, "In Vitro Fertilization is Pro-Life," in *Cultural Engagement: A Crash Course in Contemporary Issues*, ed. Joshua Chatraw, and Karen Swallow Prior (Grand Rapids: Zondervan, 2019), 134.

[40] Neville F. Hacker, Joseph C. Gambone, and Calvin J. Hobel, eds., *Hacker & Moore's Essentials of Obstetrics & Gynecology*, Sixth edition, Recommended Shelving Classification Obstetrics & Gynecology (Philadelphia, PA: Elsevier, 2016), 170–82.

[41] Rae and Riley, *Outside the Womb*, 130.

[42] 1978- In the United Kingdom. The first "test-tube" baby in the USA was in 1981 at Eastern Virginia Medical School.

[43] Rae and Riley, *Outside the Womb*, 30.

grouped into three categories: community, order, or human dignity, based on what is more valuable than medical technology. [44] Among the category that prioritizes order there are three subgroups who view either the order of nature, Genesis, or human flourishing as the ultimate focus. Some individuals who write on ART may fall in multiple categories based on multiple arguments they hold or present.[45] As with many things, each approach may value things at the cost of others. Regardless, it is important to evaluate how Christians have engaged with ART in the most recent years.

Community

The first ethical viewpoint, called the community approach, prioritizes love and compassion for couples struggling with infertility. Proponents of this idea recognize the overwhelming desire of couples to have a child and affirm both this desire and medical technology's ability to satisfy. Commonly affirmed biblical themes include God's fulfillment of the desires of one's heart (Ps. 37:4) and the blessing of children (Ps. 113:9, 127:3-5). One supporting author, Peter J. Paris, states, "How [IVF babies] came into the world is not as important as the context of love from which the invitation to life had been issued and into which they have been welcomed from the moment of birth onwards."[46] Many proponents of this community approach may not even see ART as a moral concern.

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[44] Adapted from Dennis Hollinger, "Sexual Ethics and Reproductive Technology," in *The Reproductive Revolution: A Christian Appraisal of Sexuality, Reproductive Technologies, and the Family*, ed. John F. Kilner, Paige C Cunningham, and W. David Hager (Grand Rapids: W.B. Eerdmans Pub. Co, 2000), 79.

[45] To be clear, the arguments against ART listed in this section are not the only ones these individuals may hold or have presented.

[46] Peter J. Paris, "Is it Moral to Make Test-tube Babies: A Response," in *The Befuddled Stork*, ed. Sally B. Geis, and Donald E. Messer (Nashville, TN: Abingdon Press, 2000), 55. It is important to note that Paris uses the same utilitarian premise both to extend the use of ART to homosexual couples and to justify selective reduction.

Normative Order

The normative order approach views technology either negatively or positively based on the way it impacts the given order of things. The view has 3 subgroups. While the first two stances are opposed to ART, the last viewpoint is more receptive to the use of this technology. It is important to note that all three subsets, though different in their scope of application and limits placed on ART, believe these technologies should only be utilized by heterosexual married couples. This serves to exclude homosexual couples and single women.

Natural law. The Catholic church is the most outspoken on a number of beginning of life issues such as contraception, abortion, and ART. Catholic ethics is based on natural law which says moral truths known by all humans through reason are whatever is most "natural." Therefore, the purpose or nature of marriage is child rearing and the purpose or nature of sex is procreation. Three documents of the Catholic church address this issue: *Humanae Vitae, Donum Vitae, and Dignitas Personae. Humanae Vitae* was originally written in response to contraception and explains that the ultimate and inseparable purposes of sex in marriage are both unitive and procreative.[47] Therefore, contraception is opposed because it prevents or limits the procreative while ART is opposed because it divorces the unitive (as fertilization occurs in a petri-dish and not inside the woman). The Catholic church continues this theology in the *Donum Vitae*, written specifically in response to ART. It affirms the value of the embryo at all stages of development and forbids the use of third parties in procreation such as surrogates or gamete donors. Catholics are opposed to IUI because masturbation for sperm collection is "unnatural."

[47] Paul VI, "Humanae Vitae: Encyclical Letter of The Supreme Pontiff Paul VI," July 25, 1968, http://www.vatican.va/content/paul-vi/en/encyclicals/documents/hf_p-vi_enc_25071968_humanae-vitae.html.

Genesis norm. Many Christians are opposed to ART because it separates sex and procreation while disagreeing with the Catholic natural law foundation. Instead the case is built on God's design of marriage and sexual intimacy for multiplying the family found in Genesis 1 and 2 and further to New Testament appeals to the Genesis norm as authoritative in settling disputes (Matt. 19:4, Rom. 1:18-32, 1 Cor. 11:8-9, 1 Tim. 2:11-15). This opinion is expressed by Evangelical writers in a Gospel Coalition article saying, "To view this interdependency as simply contingent, rather than normative, radically undermines the place of Genesis 1-2 in both theological anthropology and ethics."[48] However, one of the earliest proponents of this view was Oliver O'Donovan who said, "when procreation is divorced from its context in man-woman relationship, it becomes a project of marriage rather than its intrinsic good; the means to procreation become the instrumental means chosen by the will, rather than themselves being the good of marriage."[49] Ethicist Gilbert Meilaender explains the important distinction between making and procreating when he says,

> A child who is thus begotten, not made, embodies the union of his father and mother. They have not simply reproduced themselves, nor are they merely a cause of which the child is an effect. Rather, the power of their mutual love has given rise to another who, though different from them and equal in dignity to them, manifests in his person the love that unites them. Their love-giving has been life-giving; it is truly procreation.[50]

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[48] Matthew Anderson Lee and Andrew T. Walker, "Breaking Evangelicalism's Silence on IVF," *The Gospel Coalition*, April 25, 2019, https://www.thegospelcoalition.org/article/evangelicalisms-silence-ivf/.

[49] Oliver O'Donovan, *Begotten or Made?* (New York: Oxford University Press, 1984), 39.

[50] It is important to note while Meilaender's opposition to ART appears to demonstrate a strong value of the newborn, he also believes abortion in the case of rape is permissible, which seems to present an inconsistent biblical worldview. Gilbert Meilaender, *Bioethics: A Primer for Christians*, 3rd ed (Grand Rapids, Mich: William B. Eerdmans Publishing Company, 2013), 15.

Meilaender finds this a human glimpse of Trinitarian love. Other popular individuals who oppose ART for its separation of sex and procreation include Albert Mohler and Russel Moore.[51]

Restoring health and flourishing. The final view of normative order ART ethics is typically in favor of its use because it restores health and leads to human flourishing. This group places great value and emphasis on the use of medical technology to restore the broken effects of the fall such as infertility. The foundation for engagement with ART is Edenic freedoms to create and subdue. Proponents believe it is using the creativity given by God to investigate, and the dominion from God to participate in ART.[52] Therefore, it is seen as good to overcome the brokenness that infertility brings as a result of the fall. In this perspective, ART is seen as closely related if not identical to other medical treatments the church has never opposed. Christian ethicist Scott Rae argues, "Not only does medicine intervene; at times, it substitutes for a failing bodily function. For example, dialysis substitutes for diseased kidneys, ventilators substitute for diseased lungs, and pace-makers substitute for critical heart functions. In the same way, some reproductive technologies substitute for diseased fertility functions."[53] Furthermore, the biblical case is made that all the infertility accounts mentioned specifically in scripture all end with God blessing the couple with children (Gen. 11:30, 16:1, Gen. 21:1-7, Gen. 29:31, Judg. 13:2, 1 Sam. 1:2-18, and Luke 1:7). Therefore, theologian Wayne Grudem in his article in The Gospel Coalition concludes, "Given the force of these biblical passages, it is right to consider infertility

[51] Albert Mohler Jr., "Is it Moral to Make Test-tube Babies: A Response," in *The Befuddled Stork*, ed. Sally B. Geis, and Donald E. Messer (Nashville, TN: Abingdon Press, 2000), 57-66., Russell Moore, "Should Christians Adopt Embryos?" September 20, 2012, https://www.russellmoore.com/2012/09/20/should-christians-adopt-embryos/.

[52] Bell and Bell, "In Vitro Fertilization is Pro-Life," 134.

[53] Rae and Riley, *Outside the Womb*, 70.

as something that, in general, we should seek to overcome with the confidence that God is pleased with such efforts."[54]

Human Dignity

The final approach to ART ethics emphasizes the technological impact on human dignity and cultural values. Proponents point out how the technologies, designed to create life in excess are impacting the cultural understanding of life and health. For example, Meilaender challenges that ART has changed the view of both children and the body from that of a gift to that of utility and an instrument.[55] They believe it is contributing to a utilitarian ethic of society where the blessing of children justifies any means and any loss necessary. Writers such as Mohler and Physician Megan Best feel that cryopreservation strips embryos of human dignity by freezing them in a stage of indefinite suspension.[56]

Boundaries

Among individuals that are typically opposed, or at the least wary of ART, many place specific limits on moral Christian participation rather than condoning it outright. Below is a simplified list of a few of those boundaries.[57]

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[54] Wayne Grudem, "How IVF Can Be Morally Right," *The Gospel Coalition,* April 25, 2019, https://www.thegospelcoalition.org/article/ivf-morally-right/.

[55] Gilbert Meilaender, "A Child of One's Own: At What Price?" in *The Reproductive Revolution: A Christian Appraisal of Sexuality, Reproductive Technologies, and the Family*, ed. John F. Kilner, Paige C Cunningham, and W. David Hager (Grand Rapids: W.B. Eerdmans Pub. Co, 2000), 36-45.

[56] Mohler, "Is it Moral to Make Test-tube Babies: A Response." 57-66.; Best, *Fearfully and Wonderfully Made*, 341.

[57] Adapted from Arbo, *Walking through Infertility*, 93.; John MacArthur, *Right Thinking in a World Gone Wrong* (Eugene, Or: Harvest House Publishers, 2009), 94–96.; Daniel McConchie, "An Ethical Perspective on Reproductive Technologies," *The Center for Bioethics and Human Dignity,* July 17, 1999, https://cbhd.org/content/ethical-perspectives-reproductive-technologies.

1. Christian couples should not use surrogates or gamete donors.[58]
2. ART is not for homosexual couples, unmarried couples, or single women.
3. There is a limit to how many eggs can be fertilized.

   (Note: Arbo goes so far as to say only 1 egg should be fertilized at a time to avoid the use of cryopreservation.[59] Interestingly, the nation of Germany forbids the use of cryopreservation and only allows up to 3 eggs to be fertilized at a time.[60])
4. There is a limit to how many embryos can be transferred.

   (Note: MacArthur says 3 is the maximum that should ever be transmitted as that is the largest number reasonably sustainable to the mother's womb.[61])
5. Selective reduction is never morally permissible.
6. All embryos should be implanted, never discarded. (Note: Italian national law prevents the discard of embryos requiring all are implanted and in rare cases donated to other couples.[62])

More precise rules given by Daniel McConchie from The Center for Bioethics and Human Dignity include a limited use of stimulation medications for IUI that are known to lead to multiple pregnancies or "litters." Similarly, McConchie believes that no external fertilization procedure should be used if it has an implantation rate lower than that of natural implantation.[63]

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[58] An exception is made by many (but not Catholics) that surrogacy for embryo adoption is morally acceptable.

[59] Arbo, *Walking through Infertility*, 93.

[60] Best, *Fearfully and Wonderfully Made*, 342.

[61] MacArthur, *Right Thinking in a World Gone Wrong*, 95.

[62] Best, *Fearfully and Wonderfully Made*, 342.

[63] McConchie, "An Ethical Perspective on Reproductive Technologies."

Concerns in ART

Biology

While affirming the success and value of many medical advances in prolonging life and sustaining health, an honest critique of the biological dilemmas of ART is important. One should consider whether there is a moral difference between *prolonging* life (ex. kidney transplant) and *creating* life (ex. IVF).

Epigenetics. Every human cell has genes that are made of DNA. These genes determine how a person develops, looks, and functions. The way a gene functions can be changed by directly switching some parts of DNA (usually by inserting or removing pieces), or by modifying the genes (usually by attaching something on top). This latter action is known as epigenetics, or "above the genes", seeks to study how attachments are acquired and impact gene functions. There is recent scientific evidence that shows many steps of ART are causing either concerning or clearly harmful epigenetic changes. Those include imprinting disorders (Prader-Willi, Beckwith-Wiedemann, Angelman, and Silver-Russel syndromes) and even impaired implantation and placental growth.[64]

[64]April Batcheller et al., "Are There Subtle Genome-Wide Epigenetic Alterations in Normal Offspring Conceived by Assisted Reproductive Technologies?," *Fertility and Sterility* 96, no. 6 (December 2011): 1306–11, https://doi.org/10.1016/j.fertnstert.2011.09.037; Sisi Song et al., "DNA Methylation Differences between in Vitro- and in Vivo-Conceived Children Are Associated with ART Procedures Rather than Infertility," *Clinical Epigenetics* 7, no. 1 (December 2015): 41, https://doi.org/10.1186/s13148-015-0071-7; Suneeta Senapati et al., "Superovulation Alters the Expression of Endometrial Genes Critical to Tissue Remodeling and Placentation," *Journal of Assisted Reproduction and Genetics* 35, no. 10 (October 2018): 1799–1808, https://doi.org/10.1007/s10815-018-1244-z; Xuan Chen et al., "Effects of Superovulation, in Vitro Fertilization, and Oocyte in Vitro Maturation on Imprinted Gene Grb10 in Mouse Blastocysts," *Archives of Gynecology and Obstetrics* 298, no. 6 (December 2018): 1219–27, https://doi.org/10.1007/s00404-018-4905-3; Yves Menezo, Patrice Clément, and Brian Dale, "DNA Methylation Patterns in the Early Human Embryo and the Epigenetic/Imprinting Problems: A Plea for a More Careful Approach to Human Assisted Reproductive Technology (ART)," *International Journal of Molecular Sciences* 20, no. 6 (March 17, 2019): 1342, https://doi.org/10.3390/ijms20061342.

Ovarian hyperstimulation. As women get older, their follicles lose sensitivity to medication meaning higher doses of medication are required.[65] The use of large amounts of stimulation medication, particularly gonadotropins, can cause ovarian hyperstimulation syndrome (OHSS). This occurs in 3-20% of all ART cycles.[66] Similarly, research shows that gonadotropins can also prevent implantation for fresh embryos transfers.[67]

Embryo handling. Human involvement creates the potential for error. For example, a recent published article found links between the liquid storage solutions used for IVF and the multiple imprinting disorders listed above.[68] ICSI and assisted hatching are procedures that create a risk of embryonic damage due to clinician mistake.

Finally, cryopreservation tanks are other areas that could create a problem. Take for example the two fertility clinics whose tanks spontaneously malfunctioned in 2018 leading to 4,000+ eggs and embryos being destroyed.[69]

Multiples. A multiple pregnancy is a threat to the health of both the mother and all offspring involved both during and after pregnancy. Infants are typically born early and

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[65] Taylor, et al., *Speroff's*, 978.

[66] Mário Sousa et al., "Ovarian Hyperstimulation Syndrome: A Clinical Report on 4894 Consecutive ART Treatment Cycles," *Reproductive Biology and Endocrinology* 13 (June 23, 2015): 66, https://doi.org/10.1186/s12958-015-0067-3.

[67] Vanessa de Oliveira et al., "Uterine Aquaporin Expression Is Dynamically Regulated by Estradiol and Progesterone and Ovarian Stimulation Disrupts Embryo Implantation without Affecting Luminal Closure," *Molecular Human Reproduction*, January 16, 2020, gaaa007, https://doi.org/10.1093/molehr/gaaa007.; Senapati et al., "Superovulation Alters the Expression of Endometrial Genes Critical to Tissue Remodeling and Placentation," 1799-1808.

[68] Hiromitsu Hattori et al., "Association of Four Imprinting Disorders and ART," *Clinical Epigenetics* 11, no. 1 (December 2019): 21, https://doi.org/10.1186/s13148-019-0623-3.

[69] Bianca Bagnarelli, "Heartbreak, Anxiety, Lawsuits: The Egg-Freezing Disaster a Year Later," *NBC News*, March 4, 2019, https://www.nbcnews.com/news/all/heartbreak-anxiety-lawsuits-egg-freezing-disaster-year-later-n978891.

underweight, predisposing them to other problems later in life.[70] Recent research has shown connections between the development of hypertension, hyperlipidemia, obesity, and diabetes to low-birth weight and pre-term births.[71]

Eugenics. The systems used for embryo staging, selection, and transfer serve to rank developing humans based on either their "fitness" or personal preferences such as eye color or gender. This is known as eugenics, which was infamously pursued by Nazi Germany to establish an elite Aryan race during the Holocaust through sterilization or extermination. Grading standards in ART parallel eugenic decisions to choose only the "fit" and to eliminate all other embryos such as those with chromosomal or developmental abnormalities.

Morality

Idolatry and utility. The desire to have children can become so strong that a couple is willing to pursue children through ART at any cost. This can become idolatry, a disordering of the love of children over love of God and submission to His will. Matthew Arbo explains Christians should view children, infertility, and ART in light of biblical discipleship when he says, "God may use you to advance his mission *as he so chooses*. In giving your life over to him in discipleship, you acknowledge your total dependency and thus place yourself fully at his disposal."[72] He further concludes that opting for the risks and dilemmas of IVF is, "on the

[70] Aila Tiitinen, "Single Embryo Transfer: Why and How to Identify the Embryo with the Best Developmental Potential," *Best Practice & Research Clinical Endocrinology & Metabolism* 33, no. 1 (February 2019): 77–88, https://doi.org/10.1016/j.beem.2019.04.001.

[71] Kelli K. Ryckman et al., "Pregnancy Complications and the Risk of Metabolic Syndrome for the Offspring," *Current Cardiovascular Risk Reports* 7, no. 3 (June 2013): 217–23, https://doi.org/10.1007/s12170-013-0308-y.

[72] Arbo, *Walking through Infertility*, 40.

assumption that having a biological child is an end no means could upset, and needless to say, that is not the logic of discipleship but of utility."[73]

Intentions and Realities. A quick glimpse at the success rates of ART procedures call into question the intentions of a couple pursing them. 2016 CDC data reports 263,577 cycles and 76,930 babies born. That means 29.2% of embryos created were born, and consequently 70.8% died. "That is far from pro-life," notes Jessica Lahl, president of the Center for Bioethics and Culture.[74] In fact, ethicist Paul Ramsey goes so far as to say, "[IVF] constitutes unethical medical experimentation on possible future human beings (without their consent)."[75] Another concerning reality of ART is the number of embryos claimed "unviable" and discarded by the morphological staging techniques. As of 2019 there is still little evidence to indicate those morphological standards used are successful at predicting viability in implantation and birth.[76] Christians couples with an obligation to protect life should be aware that secular standards often declare embryos "unviable" while they are very much alive. Legally, clinic contracts may not give parents rights or freedoms to decide the outcome of embryos termed "unviable" by the clinic, which should be an alarming concern to Christians.

Unbiblical view of the future. The future is unknown to humans yet much of ART operates with an assumption that this reality is not true. As many Christian couples are prolonging starting families, often due to career pursuits, many find they are not able to have

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[73] Arbo, *Walking through Infertility*, 93.

[74] Jennifer Lahl, "The Case Against In Vitro Fertilization," in *Cultural Engagement: A Crash Course in Contemporary Issues*, ed. Joshua Chatraw, and Karen Swallow Prior (Grand Rapids: Zondervan, 2019), 138.

[75] P. Ramsey, "Shall We 'Reproduce'? I. The Medical Ethics of in Vitro Fertilization," *JAMA: The Journal of the American Medical Association* 220, no. 10 (June 5, 1972): 1346–50, https://doi.org/10.1001/jama.220.10.1346.

[76] Tiitinen, "Single Embryo Transfer," 77-88.

children and regret waiting so long. Despite their "5-year plans" they find their biological clocks work otherwise. Christians should be careful when making and asserting their plans for the future (James 4:13-15).

Purity. Sperm for ART procedures are traditionally obtained through masturbation in rooms filled with pornographic materials. Some opponents believe the pornographic images could create thoughts or sinful habits of lust. Other Christians view masturbation in itself to be a habit that is training the body towards immediate gratification and destroying self-denying natural intercourse.

Stewardship. Many infertile couples confess that it is nearly impossible to quit ART without a successful pregnancy. Authors Rae and Riley admit, "there is little doubt that by the time many couples seriously consider some of the more expensive reproductive options, they have become desperate to have a child. Getting pregnant can become an obsession for them."[77] This calls into question the wisdom of participating due the biblical command to be good stewards of money, bodies, and relationships. ART procedures cost an average of $12,000[78] which couples pay for through loans, mortgages, or other forms of indebtedness. Furthermore, women are usually all too willing to endure the physically taxing and emotionally draining procedures for a child. For this reason, the feminist movement has been quick to challenge ART because it traps women in cycles of emotional trauma and exposes them to procedures with low success rates, which they feel is medical experimentation.[79] Other opponents question whether

[77] Rae and Riley, *Outside the Womb*, 19–20.

[78] This does not include ovarian stimulation medication, cryopreservation storage fees, or PGD if applicable. Uffalussy, "The Cost of IVF."

[79] Helen B. Holmes, ed., *Issues in Reproductive Technology I: An Anthology* (New York: Garland Pub, 1992), 253–396.

ART is dishonoring the body meant to be a temple (1 Cor. 6:19-20) or limiting a couple's willingness to obey if God calls them to give, serve, or go on mission.

Relationships. One final challenge to Christian stewardship is the impact ART has on the marriage relationship. Not only does infertility increase human likeliness to place blame (typically on others), it also impacts the physical intimacy of the couple. During the use of IUI especially, sex can become a cold, calculated, and scheduled rather than a pleasurable or mutual self-giving love-act. This "baby-making" routine becomes so focused on the product (the child) that it is no longer about serving the spouse but about satisfying their desire for a child. Christians should consider the emotional and physical impacts of ART of the marital bond before proceeding with such technology.

Conclusion

One argument for the use of ART states that embryos do not deserve moral human value or protection because even Christians have routinely participated in their destruction through certain contraceptives or reproductive technology without significant objection from the church.[80] While Christians may disagree with the conclusion, the truthfulness of church silence should be a wake-up call. The apathy on this issue requires an education of the congregation on the theology of health, medical technology, and infertility. The church needs to be aware of the deep hurt of the infertile as well as their temptation for isolation or idolatry. While the procedures and statistics of ART are constantly changing, this paper sought to provide a biological foundation that allows for more informed Christians, especially when trying to sort through biased physician advice. Thirdly, while it is clear that Christians, and even evangelicals,

[80] Best, *Fearfully and Wonderfully Made*, 28.

fall on either side of the ART debate, many still opt for strict moral limitations. Are these limitations enough? At present, the epigenetic problems created by ART procedures seem to enlarge the scope of impact beyond just the here and now. It is no longer easy for the Christian to partake in ART without an acceptance of the unknown effects on future generations. Furthermore, it is important to consider whether cryopreservation and exposure to enhanced risks due to human involvement maintains a coherent biblical worldview that believes in the sanctity of life beginning at fertilization. While secular culture continues to use ART for embryo research, genetic engineering, and complicated family arrangements, should the church rethink its activity? Finally, what should be done of the unwanted children sitting in freezers whom are left at the disposal of the cultural whim to be used or abused as needed. When the mysteries of God in the womb become open to human manipulation, it is the responsibility of the church to be informed, discerning, and prayerfully active.

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Appendix 1: Illustrations

Table 1. Biological views for when life begins

Biological Stage	Description
Fusion (0 hours)	The combination of the egg and sperm cells (also called the beginning of fertilization)
Syngamy (20 hours)	The combination of the egg and sperm DNA (also called the end of fertilization)
Full Genetic Expression (8 cells)	When the new embryo begins making proteins on its own rather than through maternal regulation
Implantation (~7 days)	When the embryo attaches and buries into the endometrium (uterine lining)
Twinning (~14 days)	Loss of totipotency so there is no longer an option for the embryo to split into identical twins
Detection	Varies depending on the test method used (Normal pregnancy tests usually detect hCG produced by the placenta of the embryo)
Heartbeat (4 weeks)	Heart begins beating
Brain waves (45 days)	The earliest embryonic brain waves were detected via EEG on day 45 although the spinal cord is established on ~day 20 and the cerebral cortex on ~day 33.
Viability (~22-24 weeks)	The earliest a fetus can life outside the mother's womb (Varies depending on location)
Birth (~37-42 weeks)	Only after a child is born and detached from the umbilical cord is it alive

Sources: Categories and information from Megan Best, *Fearfully and Wonderfully Made: Ethics and the Beginning of Human Life* (Kingsford, N.S.W.: Matthias Media, 2012), 23–24., and G. H. Breborowicz, "Limits of Fetal Viability and Its Enhancement," *Early Pregnancy (Online)* 5, no. 1 (January 2001): 49–50.

Note: Responses to specific biological arguments: **1)** Syngamy- Fusion is when the specific combination of genetic material is first together in one cell. Similarly, gender and axis development are established here prior to syngamy. Best, *Fearfully and Wonderfully Mad*, 23–24. **2)** Twinning- Just because two humans can result, as opposed to just one, does not deny personhood and value prior to that point **3)** Implantation- this is an "environment" argument similar to viability or birth. Someone's environment should not cause them to gain or lose inherent value. For further explanations see Scott B. Rae and D. Joy Riley, *Outside the Womb: Moral Guidance for Assisted Reproduction* (Chicago: Moody Publishers, 2011), 77–102; Best, *Fearfully and Wonderfully Made*, 15–80.

Table 2. Philosophical views for when life begins

Point of Personhood	Explanation
Fertilization	Union of sperm and egg
Implantation	An environment necessary for development
Twinning (~14 days)	Twinning no longer possible
Consciousness (~33 days)	Commonly this is attributed to cerebral cortex development and is thought to be parallel to the use of brain death to declare end of human life
Appearance of Humanness (~8-10 weeks)	As visible during an ultrasound, the fetus has developed facial features, fingers and toes, and even gender can be determined
Sentience (~8-13 weeks)	The capacity to feel pain
Quickening (~17-20 weeks)	The first time the mother feels fetal movements
Viability (~22-24 weeks)	Establishes the possibility of the embryo to live independent from the mother
Birth (~37-42 weeks)	True independence is achieved once the child takes a breath and is detached from the umbilical cord
Self-awareness	Once the child is aware that they exist and can form "self-constructs"
Functionality	Personhood is attributed to those who can perform certain functions such as reasoning, communication, or self-motivated activities

Sources: Mark W Foreman, *Christianity & Bioethics: Confronting Clinical Issues* (Eugene, Oregon: Wipf & Stock Publishers, 2011), 92–94., Megan Best, *Fearfully and Wonderfully Made: Ethics and the Beginning of Human Life* (Kingsford, N.S.W.: Matthias Media, 2012), 34-35.

Table 3. Infertility specific ART procedures

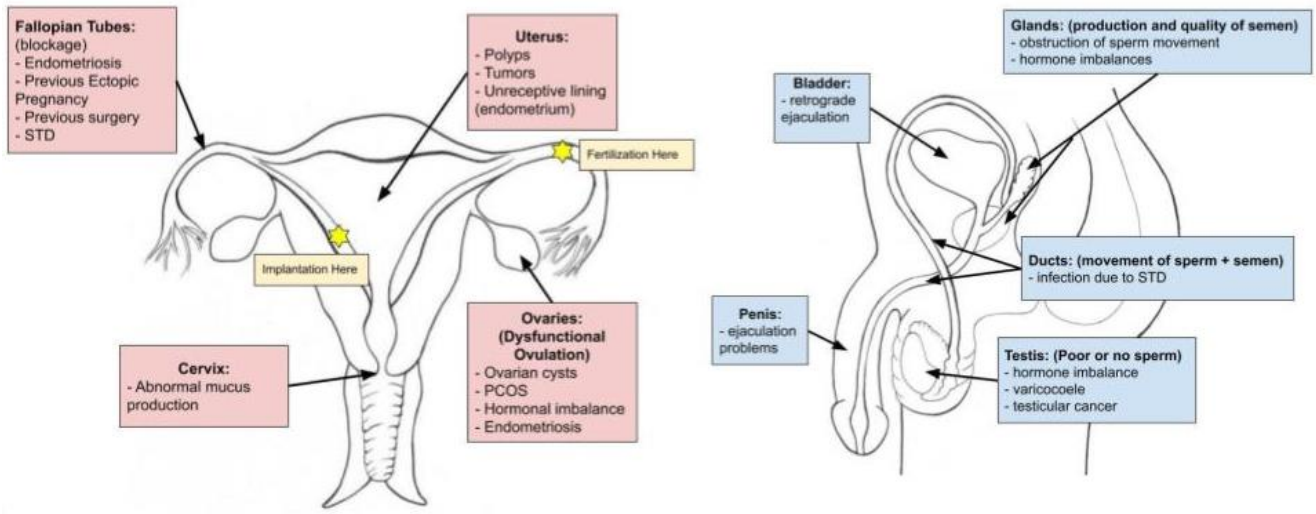
Infertility Factor	ART procedure used
Sperm quality	ICSI
Semen quality	IVF, GIFT, ZIFT
Ovulatory problems	Ovarian Stimulation (can be used with IUI or IVF)
Tubal obstruction	IVF
Endometriosis	IVF

Table 4. Embryo transfer rates

Age of Woman	Number and Stage of Embryo
Under 35 years	No more than 2 (any stage)
35-37 years	No more than three (3-day) OR 2 (blastocyst)
38-40	3-4 (3-day) OR 2-3 (blastocyst)
40-42 years	No more than 5 (3-day) OR 3 (blastocyst)

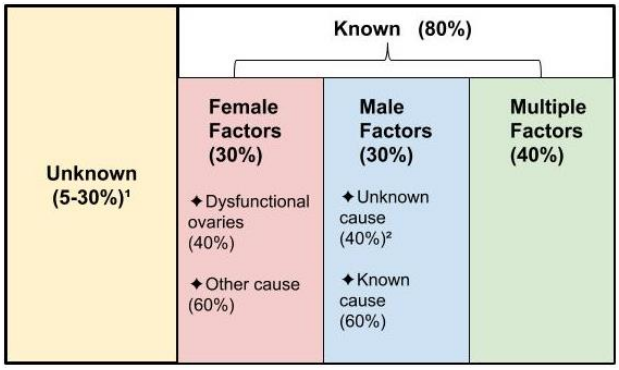
Source: Adapted from Scott B. Rae and D. Joy Riley, *Outside the Womb: Moral Guidance for Assisted Reproduction* (Chicago: Moody Publishers, 2011), 140.

Figure 1. Female and male anatomy and infertility.



Source: "Anatomy Diagrams: Sex Info Online," accessed February 20, 2020, https://sexinfo.soc.ucsb.edu/article/anatomy-diagrams. Adapted with permission.

Figure 2. Infertility statistics breakdown



Source: Data adapted from B Megan Best, *Fearfully and Wonderfully Made: Ethics and the Beginning of Human Life* (Kingsford, N.S.W.: Matthias Media, 2012), 34-35.

1-Percentage varies due to the difference in medical definitions of "unknown cause."

2-Around 2/3rd of couples in this category will conceive naturally within three years if they keep trying.