

Artificial Womb

الرحم الاصطناعية

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Received: 21/08/2025

Accepted: 08/01/2026

Published: 20./01/2026

Abstract: Artificial wombs are advanced incubators that allow fetal development outside the human body, replicating the natural uterine environment by supplying oxygen and nutrients. While no human embryo has yet been carried to full term in such a device, experiments with sheep have shown partial success. This research explores the potential of artificial wombs to address infertility in women without a uterus and to provide an alternative to surrogacy, potentially reducing related ethical, religious, and legal disputes. The study plans to examine the technology's current capabilities, its medical applications, and the societal implications of its adoption **Keywords** Reproduction ;Artificial Womb ;Embryos ;Artificial reproduction

ملخص: الأرحام الاصطناعية هي حاضنات متقدمة تتيح تطور الجنين خارج جسم الإنسان، مع محاكاة البيئة الطبيعية للرحم من خلال تزويده بالأكسجين والعناصر الغذائية. وعلى الرغم من أنه لم يتم حمل أي جنين بشري حتى تمام اكتمال الحمل في مثل هذا الجهاز، إلا أن التجارب على الأغنام أظهرت نجاحاً جزئياً، يستكشف هذا البحث إمكانية استخدام الأرحام الاصطناعية لمعالجة العقم لدى النساء اللواتي لا يملكن رحمًا، وتوفير بديل عن الأم البديلة، بما قد يسهم في تقليل الخلافات الأخلاقية والدينية والقانونية المرتبطة بذلك. ويخطط البحث لدراسة القدرات الحالية لهذه التقنية، وتطبيقاتها الطبية، والآثار المجتمعية المترتبة على تبنيها، ما هي الأبعاد القانونية والأخلاقية والشرعية لفكرة جهاز الرحم الاصطناعي؟ وكيف عالج الفقه الإسلامي المسألة؟

كلمات مفتاحية: الإنجاب ; رحم صناعي ; أجنة ; إنجاب صناعي.

I- Introduction:

The concept of artificial wombs has increasingly come to be regarded as a settled, perhaps even inevitable, feature of the twenty-first century, largely due to the rapid and extraordinary pace of technological advancement. While human experimentation remains prohibited in this era, the remarkable progress made in developing fully formed animal embryos within artificial wombs has reignited intense debate and speculation about the prospect of extending these experiments to humans. Researchers' ambitions in this field appear boundless.

In 2019, Chinese scientists achieved a striking breakthrough by developing a fully equipped artificial womb, which was successfully fertilized with a monkey ovum, progressing to the point of organ formation without the involvement of a living body. It is not far-fetched to imagine, in the near future, the emergence of a fully developed human fetus brought into existence under the care of a specialized robot designed for this very purpose.

These early efforts are gradually addressing technical disruptions and shortcomings, step by step, in hopes of eventually achieving a viable and fully successful creation of a human being outside the bounds of natural wombs. This paper seeks to engage with the current conceptualization—still very much in the experimental phase—through the central question: What are the legal, ethical, and religious implications of artificial womb technology? And how has Islamic jurisprudence approached this issue?

To answer this problematic question, the paper is structured around an introduction, two main sections, and a conclusion. The first section explores the concept, origin, and development of artificial wombs, while the second addresses the legal, ethical, and religious challenges posed by this emerging artificial womb.

This will be addressed in the following:

Section One: The Concept, Emergence, and Development of the Artificial Womb

The development of artificial wombs began with animal embryos, starting from mice and progressing to fetal lambs incubated in plastic containers and sacs. Scientists are rapidly advancing in these experiments on animals, aiming to eventually benefit humans and safeguard the continuity of the human species on Earth. The artificial womb might seem like something out of science fiction—embryos suspended in transparent, fluid-filled bags, their nourishing blood circulating through a network of tubes connected to machines, computers, and control systems.

However, this is not a dreamy, speculative vision of an unknown future. Why? Because research into artificial wombs has already emerged and evolved as an innovative technique designed primarily to reduce the risk of death among premature infants. In what follows, we will explore the definition of the artificial womb, its significance, the stages of its development, and the major challenges it currently faces.

Subsection One: Definition of the Artificial Womb

The artificial or synthetic womb is, in simple terms, a specially designed and engineered device that allows for gestation to occur outside the human body. In this process, the embryo or fetus grows externally, housed in an artificial environment that can sustain development until birth. Functionally, the artificial womb is a simulation of the natural womb, often taking the form of a bioengineered plastic sac filled with a fluid analogous to amniotic fluid that surrounds the fetus in the uterus. This sac is connected via tubes to an artificial umbilical cord, through which oxygen and vital nutrients are delivered. One of the key aspects of artificial womb science is maintaining the fetus at a stable temperature equivalent to that of the natural womb environment.¹

In 2019, Dutch scientists reported that within a few years, artificial wombs would likely be developed to the point of saving the lives of premature infants. As specialists in neonatal medicine well know, births occurring before 37 weeks are a leading cause of mortality among newborns. However, despite the potential medical promise, the concept of artificial wombs has sparked considerable ethical debate and raised a number of complex questions.

Essentially, an artificial womb is a device that allows for pregnancy to occur outside the biological body, enabling the external growth and development of embryos that would otherwise be carried within a living organism until birth. As a novel approach and alternative method, the artificial womb carries numerous applications, benefits, and advantages. It may be used to assist individuals or couples—regardless of gender—in safely developing and protecting a fetus. The possibility of transferring an embryo from a natural womb to an artificial one may the viability threshold of the fetus from early gestation and enhance survival prospects.

In that sense, the artificial womb can be seen as a highly advanced incubator for neonates, capable of extended functions beyond postnatal care. It could even facilitate the initiation of gestation itself. Moreover, it may allow for early fetal surgeries—procedures that currently must be postponed until after delivery—offering significant medical benefits.*

In 2016, researchers published two studies on the development of human embryos for up to 13 days in an artificial womb environment. Currently, the widely observed “14-day rule” prohibits keeping human embryos in artificial gestational

²*Al-Raḥim al-Ṣināʿī* [Artificial Womb], <https://www.marefa.org/> Accessed 09/02/2023, at 22:19

systems for more than 14 days. This ethical guideline has been codified into law in over 12 countries.

In 2017, embryology researchers at the Children's Hospital of Philadelphia published a study showing that they had successfully sustained premature lamb fetuses for four weeks in a life-support system outside the natural womb.

Artificial wombs are sometimes referred to as "ex utero environments" or "external wombs," as they are designed to supply the fetus with nutrients and oxygen while also allowing for the removal of waste and toxic substances. The broader concept of an artificial womb—or what is often termed an "artificial womb system"—includes an interface that replicates the functions of the placenta, along with a reservoir surrounding the fetus that mimics the amniotic sac, and a mechanism to simulate the umbilical cord.[†]

Another term used for the artificial womb is "biobag," a device that may facilitate carrying and nurturing the fetus outside the human body. Some describe it as an unconventional neonatal incubator; however, scientists emphasize the functional distinction between a full artificial womb and devices like poultry incubators.

The primary goal of the artificial womb is to support the external development and proper formation of the fetus outside the mother's body. This involves a sealed, bioengineered bag equipped with an umbilical port and oxygenation tubes, simulating the intrauterine environment. The bag remains sterile and isolated from external contamination to minimize the risk of infection.[‡]

Subsection Two: The Emergence of Artificial Wombs and Their Operating Principle

First: The Emergence and Development of the Artificial Womb

Since its first appearance, the artificial womb has undergone various stages of development, which will be outlined below:

1. The Development of Artificial Wombs in the 20th Century

The design of the artificial womb first appeared as a patented invention in 1955 by Emanuel Greenberg. The initial prototype included a container in which the fetus was placed, floating in a fluid mimicking amniotic fluid, with a device connected to the umbilical cord, blood pumps, artificial kidneys, and a water heater.

Building on this achievement, Cooper Williams was granted a U.S. patent in 1993 for a new system that supports a suspended infant's life via the placenta and umbilical cord. The system included upper and lower chambers separated by a dome-like structure. The lower chamber held a physiological solution where the infant floated, while the upper chamber contained oxygen and nutrients that interacted with the placenta positioned at the top.

[†]<https://www.marefa.org/Ibid>.

[‡]Du'ā' Ramzī, *Bayna ittihām bi-muḥāwalat al-khalq wa-takhawwufāt min ikhtilāf al-ansāb... Arḥām iṣṭinā 'iyya tuthīr al-kathīr min al-tasā'ulāt* <https://www.arageek.com/artificial-uterus> Accessed 7/9/2023 at 23:20

In 1987, researcher Kuwabara and his team at Juntendo University in Tokyo conducted a groundbreaking experiment to sustain a goat fetus in an artificial womb for an extended period—one of the first scientific attempts in this area. They used 14 goat fetuses immersed in a fluid resembling amniotic fluid and connected to an external oxygen supply. Blood was extracted from the umbilical arteries and reinfused via the umbilical vein.

They developed a technique known as *Extra Uterine Fetal Incubation* (EUI), which successfully supported goat fetuses at 17 weeks for a period of three weeks in an artificial environment. EUI consisted of a rectangular, transparent plastic box filled with body-temperature fluid and connected to vital function devices, including a dialysis machine that filtered waste through the umbilical cord.

2. The Development of Artificial Wombs in the 21st Century

In 2017, researchers from the Fetal Research Center in Philadelphia, USA, introduced a new technology involving a suspended "biobag" made from polyethylene and filled with synthetic amniotic fluid. It was tested on premature lambs that are biologically comparable to 24-week-old human fetuses. Outside the biobag, a gas-exchange machine maintained oxygenated, nutrient-rich blood. The umbilical cord of the lamb fetus was connected to this machine, which oxygenated the blood and returned it through a second tube, mimicking placental function.

The study, which lasted four weeks, aimed to preserve stable conditions for fetuses between 23 and 28 weeks of gestation, which is the critical threshold for preterm birth. During this time, the fetuses showed development of the brain and lungs, exhibited movement, swallowed, and opened their eyes. However, the research team still faced technical challenges in umbilical cord connectivity and in generating suitable surrounding fluids. Efforts are ongoing to refine the system for potential application with human fetuses.

In 2018, researchers at the University of Michigan assessed whether continued fetal brain and lung development could proceed normally within artificial wombs using manufactured placentas. By diverting blood from the jugular vein and reinfusing it via the umbilical vein for seven days, they confirmed the natural development of these organs without injuries related to respiratory machines.

At Dutch Design Week in 2018, a conceptual model of an artificial womb for preterm infants was proposed in collaboration between Eindhoven University of Technology and Maxima Medical Center. This *Perinatal Life Support System* (PLS) project officially launched in October 2019, aimed at recreating natural conditions for newborns transitioning from the womb. Through the umbilical cord, oxygen and nutrients would be delivered, increasing survival chances.

The team intends to deliver a fully functional prototype for use in maternity wards within five years. Their system targets the critical period of gestation from 24 to 28 weeks, during which 61% of infants die at 24 weeks, and 43% at 25 weeks,

according to global statistics. Even survivors from this period often suffer from brain damage, respiratory disorders, and risks of blindness.[§]

On June 29, 2023, Spanish researchers in Barcelona^{**} launched an artificial womb project for premature newborns. After successful animal trials keeping fetuses alive for 12 days, their model recreated a protective environment using a transparent, biocompatible container where fetal organs—lungs, intestines, and brain—could continue developing.

This womb is connected to a circulating amniotic fluid system, shielding the fetus from external stimuli while allowing access for ultrasound monitoring. Infants born before six months face high risks of death or disability. According to WHO data, about 900,000 such infants died globally in 2019.

Dr. Eduard Gratacós, head of the project at BCNatal Research Center—a joint effort by two Barcelona hospitals and La Caixa Foundation—stated: "We aim to develop a system where the fetus stays outside the mother's body but remains in fetal conditions: breathing and feeding via the umbilical cord, immersed in a fluid at a constant temperature." The team successfully maintained lamb fetuses for 12 days and plans to conduct pig trials before seeking approval for human trials within a few years. Gratacós emphasized: "This highly complex project involves many medical disciplines and engineering fields. It is an extremely sensitive endeavor—an attempt to deceive nature -according to him- and make this possible."

Among the few similar projects worldwide, researchers at the Children's Hospital of Philadelphia had previously succeeded in keeping animal fetuses alive for 28 days.

Second: The Artificial Womb, the Fetus, and it Necessitates

1. Fetus Needs

Millions of years of evolutionary development have made mammalian gestation an extraordinarily complex system. The fetus is intimately connected to the mother through the placenta, where it develops within the uterine lining. Through the placenta, oxygen, nutrients, and a range of hormones are transferred from the mother to the fetus—stimulating and maintaining pregnancy throughout the fetal development process. At the same time, carbon dioxide and other waste products are returned by the fetus to the mother's bloodstream. The mother's body temperature also plays a crucial role in fetal growth. An artificial womb must be able to replicate this entire process with equivalent efficiency.

2. Conditions Necessitating the Artificial Womb

Each year, around 15 million babies are born prematurely—before 37 weeks of gestation—and over one million of them die from complications, according to statistics from the World Health Organization. Premature birth remains the leading

[§]Mahmoud Shazly, *Al-Raḥim Al-Ṣinā'ī*, Mawqī' Al-Fahras Al-Ṭibbī, MédicalFahras, <https://medical.faharas.net/artificial-uterus/> Accessed 2/9/2023 at 21:44

^{**}<https://www.marefa.org/> Accessed 7/9/2023 at 22:01.

cause of infant mortality worldwide and the second leading cause of death—after pneumonia—among children under five years old. Researchers hope that artificial wombs will improve survival rates for extremely premature infants by allowing them to continue developing as if they were still in utero.

In a natural womb, the fetal heart pumps deoxygenated blood to the placenta through the umbilical cord, where it is oxygenated by the mother's blood. The oxygen-rich blood then returns to the fetus via the same cord. When a baby is born too early, its underdeveloped and stiff lungs cannot yet absorb oxygen from the air—a key issue that the artificial womb aims to solve. Thanks to this technology, premature babies—who might have once been left to face a likely death—can now go home with their mothers within two to three weeks. For example, only about 20% of babies born at 23 weeks survive, often with severe complications. By 25 weeks, the survival rate increases to nearly 80%.^{††}

3. Advantages of Artificial Wombs

Despite the many doubts and controversies—especially those tied to ethical, religious, and existential concerns—artificial wombs present several undeniable benefits for humanity. Key among these are:

a. Deeper Understanding of Embryonic Development:

Whether in humans or animals, there is still much unknown about how the body forms and develops. Artificial wombs, especially when equipped with advanced monitoring technologies, allow scientists to observe the second-by-second evolution of fetal growth, potentially unlocking deeper insights into the origins of life and paving the way for breakthroughs in disease prevention and treatment.

b. Supporting Fetal Development:

This is perhaps the most immediate and compelling benefit. In cases of premature delivery—due to maternal health issues, accidents, or other causes—the fetus often does not survive, leaving parents devastated. Placing premature newborns into an artificial womb allows them to complete their development more effectively than in traditional incubators, avoiding contentious debates around human creation or cloning.

c. Correcting Congenital Defects:

Currently, during natural pregnancy, congenital defects can only be detected within very narrow limits, and even then, they are usually untreatable in utero. The options are typically limited to either abortion or delivering a child who will require complex and often tragic medical interventions. Transferring premature infants to an artificial womb could allow for precise fetal surgeries based on predictive assessments, especially as artificial womb technologies continue to advance in coming years.

⁴Mahmoud Shazly, *Ibid.*

d. Offering a Solution to Infertility:

For couples diagnosed with fertility issues, current alternatives include adoption or surrogacy. However, if an artificial womb can be fertilized using the mother's egg and the father's sperm, and the embryo can grow safely outside the body, it may offer new hope to many who have long struggled with infertility.^{††}

Section Two: The Legal, Ethical, and Religious Challenges of Artificial Wombs

Perhaps the least understood and most delicate stage of pregnancy is the roughly ten-day period following fertilization, during which the developing egg implants itself into the uterus and begins to grow. Researchers are now experimenting with maintaining uterine cells outside the body—an effort that could, in the future, allow these cells to be supported within an artificial womb, offering a potential site for embryo implantation. For this to be viable, however, uterine tissue must be supplied with blood—a condition that has not yet been achieved. Scientists believe that resolving this challenge would represent a significant breakthrough in the development of artificial womb technology.

At present, there is little hope for sustaining fetuses younger than 23 weeks. Researchers argue that this developmental stage presents a significant barrier for artificial womb technology. The system relies on inserting a tube into the umbilical cord and generating pressure to circulate blood through it. Naturally, smaller fetuses require narrower tubes, which increases resistance and poses a serious problem—the more immature the fetus, the less capable it is of withstanding this heightened resistance.

However, researchers do not necessarily view this limitation as a failure. Their goal is not to develop a system that supports the fetus growth from conception to birth entirely outside the human body. Crucially, they are not attempting to challenge the current medical and legal thresholds of fetal viability. Rather, their focus is on the critical stage between 23 and 24 weeks—an age at which infants face severe challenges in adapting to life outside the womb.

Subsection One: Future Directions for Artificial Wombs

Other researchers are pursuing a different path in the development of artificial wombs, focusing on the earliest stages of embryonic development—specifically the phase when organs first begin to form. Importantly, no human embryos have been involved in these studies so far. The experiments have instead been conducted on mouse embryos. In March 2021, researchers announced that they had successfully grown mouse embryos outside the womb for approximately one-third of the pregnancy period.

On the other hand, some researchers argue that the challenges of achieving complete development of the fetus from conception to full gestation are far greater than

^{††}Du'ā' Ramzī, *Bayna ittihām bi-muḥāwalat al-khalq wa takhawwufāt min ikhtilāf al-ansāb... Arḥām iṣṭinā 'iyya tuthīr al-kathīr min al-tasā'ulāt* <https://www.arageek.com/artificial-uterus> Accessed 8/9/2023 at 08:33

simply assisting a fetus that has already reached an advanced stage of development. They stress that this endeavor would require extensive resources and vast amounts of data before artificial womb technology can be used clinically on human embryos within the coming decade.

Subsection Two: Ethical Concerns Raised by Artificial Wombs

Even if scientists eventually discover a way to enable full gestation in an artificial womb, a key question remains: should we pursue this? Advocates of the concept hope it could offer an alternative to biological pregnancy, benefiting people without wombs or addressing some of the inequalities associated with motherhood. However, some researchers warn that artificial wombs may not be accessible to those who need them most.

It is well known that preterm birth can be linked to stress during pregnancy, and that economically disadvantaged people often lack access to expensive treatments like artificial wombs. There is a need to ensure that marginalized and low-income groups can benefit from such technologies. At the same time, concerns arise that societies could become selective about who is deemed fit to carry a pregnancy.^{ss}

While this technology could do amazing things, we must approach it in a way that narrows existing gaps rather than widens them—especially regarding inequality among different groups of women. These concerns will not vanish simply because a new reproductive technology becomes available. Though artificial wombs may one day save the lives of premature infants, they are not a cure-all for the broader inequalities surrounding childbirth and parenting. Achieving reproductive equity will require more than costly technologies—it will also demand investment in public health education programs.***

Subsection Three: Legal and Religious Issues of Artificial Wombs

The development of artificial wombs and ectogenesis raises bioethical and legal considerations, with significant implications for reproductive rights and abortion debates.

Artificial wombs may expand the gestational age at which fetuses can survive, prompting questions about the role viability plays in abortion law. Under the “separation theory,” for example, abortion rights include only the right to remove the fetus, not necessarily to end its life. If transferring the fetus from a woman’s womb to an artificial womb becomes possible, then ending a pregnancy in this way could provide an alternative to fetal termination.

There are also theoretical concerns that children who grow in artificial wombs may lack “some of the fundamental bonds with their mothers that other children enjoy.” In April 2017, scientists created an artificial womb hoping that one day the device would be used to save premature babies. The device was tested only on lamb

⁶Mahmoud Shazli, al-Raḥīm al-Ṣināʿī, Mawqīʿ al-Faḥras al-Ṭibbī, *MédicalFahras*.

<https://medical.faharas.net/artificial-uterus/> Accessed 2/9/2023

⁷ Ibid.

fetuses. A study involving eight animals found that the device appeared effective in enabling extremely premature fetuses to grow normally for about a month.

Dr. Alan Flake, a fetal surgeon at the Children's Hospital of Philadelphia who led the study published in *Nature Communications*, said: "We've made great strides in replicating the conditions of the womb in our model." Flake added, "The fetuses grew normally, their lungs developed normally, and their brains developed normally. They developed in all measurable ways." The group hopes to test the device on extremely premature human babies within three to five years. "What we've tried to do is develop a system that mimics the environment of the womb as closely as possible. It's essentially an artificial womb."

The experiment was conducted on a 107-day-old lamb fetus, equivalent to a human fetus of 23–25 weeks pregnancy—about 60% into a full-term pregnancy—placed inside the artificial womb. The device is kept in a dark, warm chamber where researchers can play the mother's heartbeat and monitor the fetus via ultrasound. Previous research has shown that lamb fetuses are a good model for human fetal development.

The artificial womb device consists of a transparent plastic bag filled with synthetic amniotic fluid. An external system connects to the umbilical cord to function like a placenta, delivering nutrients and oxygen to the blood and removing carbon dioxide. Flake said: "The whole idea is to support normal development—to replicate everything the mother does in every possible way to support fetal growth and maturation."

Other researchers praised the breakthrough, saying it could help thousands of premature infants born each year—if human trials prove successful. Dr. Jay Greenspan, a neonatologist at Thomas Jefferson University, described the device as a "technological miracle" and "a major step forward in trying to do something we've been aiming at for many years." Dr. Thomas Shaffer, a professor of physiology and pediatrics at Temple University, added that the device could also help scientists learn more about normal fetal development. "I think it's a major accomplishment," he said.

Flake concluded, "If you can use this device simply as a bridge for the fetus, it could significantly improve outcomes for extremely premature infants. That would be a big deal."

1. Gender and LGBTQ+ Equality

In her seminal 1970 book *The Dialectic of Sex*, feminist thinker Shulamith Firestone argued that biological reproductive roles are the root of gender inequality. She specifically identified pregnancy and childbirth as central to this imbalance, suggesting that artificial wombs could ultimately liberate "women from the tyranny of their reproductive biology." Similarly, in her *Guardian* column titled *How Artificial Wombs Will Change the Way We Think About Sex, Family and Equality*, Arati Prasad contends that such technologies "may give men [...] a foundational tool to have a child without a woman, should they choose to do so. It will force us to question ideas about

sex and parenthood." Furthermore, she argues artificial wombs could benefit same-sex couples: "It could eliminate the traditional mother-father divide; a womb outside the body serves women, trans women, and same-sex couples equally, without bias."

2. Religious Considerations and Ethical Questions

Does the possibility of a fetus developing fully in an artificial womb suggest that humans are creating life? The concept of an artificial womb centers on sustaining a lab-fertilized embryo in conditions that replicate a natural womb. However, it does not entail the act of ensouling the fetus or creating the fertilized egg itself.

Another religious concern involves the fear of lineage confusion—mix-ups between sperm or egg donors could result in violations of ancestry lines. There is also apprehension that sperm could be used to fertilize an egg not belonging to a man's wife, turning the practice from a humanitarian need into a form of commercial exploitation.

Artificial wombs also raise concerns about gender selection, or the termination of pregnancies without physical risk to the mother. Some might choose to abort a fetus after determining its sex, while others—perhaps in the midst of a dispute—could choose to terminate a pregnancy regardless of gestational age, simply because the fetus is developing in a visible, external bag.^{†††} These scenarios introduce behaviors toward fetal life that were previously unimaginable.

3. Prospective Legal Challenges

Currently, legal frameworks addressing artificial wombs are minimal, likely due to the novelty of the technology and the lack of human trials. Still, it is expected to raise significant legal questions, similar to those that emerged around surrogacy. Each country will bear the responsibility of developing legislation suited to the spread of artificial womb cases and its own cultural context—especially when disputes arise between parents, for instance after separation. Global organizations and international political blocs may need to step in to outline broad policies and safeguards, including agreements preventing exploitation—whether by authoritarian regimes or criminal groups—of such technologies for unethical ends such as child trafficking, organ trade, military uses, or genetic manipulation resembling dystopian science fiction scenarios.

4. Biological Considerations

It is well known that a child receives far more from their parents than just genetic material. Emotional bonding with the mother, or even hearing the father's voice, shapes aspects of personality. Thus, growing a fetus apart from both parents raises questions about the depth of attachment or connection that may be possible. While postnatal care and social interaction are undeniably critical for a child's development, this does not negate the importance of a natural gestational environment, especially for early emotional and neurological foundations.

⁸Du'ā' Ramzī, bayna ittihām bi-muḥāwalat al-khalq wa takhawwufāt min ikhtilāf al-ansāb... Arḥām iṣṭinā'īyya tuthīr al-kathīr min al-tasā'ulāt. <https://www.arageek.com/artificial-uterus> Accessed 7/9/2023

5. Social Fears Around the Device

Could men have children without marriage? Could women do the same? Could even healthy married women choose artificial wombs to preserve their physical appearance or avoid the burdens of pregnancy, childbirth, and breastfeeding? Such questions are increasingly legitimate amid a broader push for total gender equality—often detached from natural biological differences. Despite the appeal of artificial wombs in terms of medical care and fetal health monitoring, regulations will likely be necessary to restrict their use to ethical and humane contexts. Without such safeguards, we risk normalizing practices where women relinquish their biological role in gestation, or where children are created without families—leaving them vulnerable to abuse, illegal trade, or inhumane experimentation simply due to the absence of a natural parent to care for them⁹

6. Islamic Jurisprudence and Artificial Wombs

Islamic jurisprudence has outlined specific criteria and conditions that must be met for the permissibility of artificial wombs. As previously stated, an artificial womb is essentially a plastic bag made from specialized materials, integrated with uterine tissue sourced from a living organism, and filled with a synthetic fluid that mimics amniotic fluid. Based on this understanding, scholars assert that the artificial womb must meet defined general conditions to ensure it benefits humanity. These prerequisites serve to ethically and legally ground the use of such a groundbreaking technology within a framework of responsibility and respect for human dignity. These prerequisites could be summed up in the following:

- a.** The artificial womb must be subject to licensed medical supervision by the state and must serve no interest other than the welfare of patients in need of this technology—whether infertile couples or premature infants requiring an artificial womb to complete their development.
- b.** The fetus placed in the artificial womb must result from a legitimate marriage; the womb should not be used to carry embryos derived from anonymous sperm or egg banks, to avoid creating individuals without familial lineage—thereby preventing potential misuse in armed conflicts or threats to global or national peace.
- c.** Both the mother and father should be granted the right to follow up on the fetus during its development in the artificial womb, in a manner that guarantees emotional interaction. This is crucial to ensure the fetus forms emotional bonds with its parents during the gestational period, fostering healthy psychological development.
- d.** The artificial womb must not be used to conduct experiments on human embryos. It should only be used after its effectiveness has been scientifically and clinically confirmed according to recognized standards.

- d.** Its use should be medically necessary and not replace natural conception altogether. This preserves the fetus's right to proper emotional and psychological development before birth.

If these conditions are met, the use of artificial wombs, in principle, may be deemed permissible and acceptable. A detailed discussion of the legal or religious justifications, however, falls beyond the scope of this section.

Conclusion

Scientific advancement has reached remarkable levels thanks to mechanization and the rapid development of technology and life sciences. Following the success of in vitro fertilization (IVF), the path has become increasingly feasible for nurturing and developing embryos outside the womb through artificial means that simulate the natural maternal environment—by supplying nutrition and eliminating waste in a manner closely resembling the biological womb. This unconventional method of fetal development has triggered numerous questions and complex issues related to its psychological, familial, societal, ethical, legal, and religious implications for both the family and society.

This brief paper aims to shed light on these multifaceted aspects and outline the general frameworks and various perspectives associated with the topic. The study ultimately reached several conclusions, the most significant of which are:

1. Ongoing research is actively working toward presenting a comprehensive and viable alternative to the natural womb. This matter must be taken seriously and addressed from all relevant legal and religious perspectives in order to establish clear frameworks and regulations, prevent unforeseen consequences, guide the technology toward ethical and beneficial uses, and propose solutions to emerging problems while safeguarding human dignity and preventing unethical outcomes.
2. There is a critical need to engage with the challenges of artificial reproduction, genetic modification, and the unnecessary manipulation of human forms produced through these advanced technologies, particularly with respect to potential abuses driven by human selfishness.
3. Artificial wombs indeed offer a promising solution for many infertility issues and reduce the risks associated with premature birth, especially during the critical 24th and 25th weeks of gestation. However, there are significant ethical concerns over potential misuse by certain regimes or groups that may exploit the technology in ways that violate moral and religious principles and undermine human dignity.

In light of these findings, several topic-related proposals and recommendations may be outlined as follow:

1. Organizing scientific forums and conferences focused on artificial wombs is highly recommended due to the seriousness of the topic and its wide-ranging legal, ethical, religious, and social implications.

2. While the technology offers notable advantages—such as eliminating the need for surrogacy, addressing infertility for both men and women, and reducing medical risks during fetal surgery—it is recommended to support and develop this technology with strict ethical oversight and regulation to prevent misuse.
3. International regulatory frameworks should be established and overseen by global organizations to prevent women from opting out of pregnancy for reasons of aesthetics or convenience. This is crucial for preserving the natural bond between mother and child and avoiding abnormal developmental conditions for embryos, except in medically necessary cases. Unethical uses of the technology by states or private actors must also be strictly prohibited.
4. Specific ethical and legal conditions under which the use of artificial wombs may be considered acceptable should be articulated in the following:
 - a. Artificial wombs must be subject to state-licensed medical supervision and serve only the interests of patients genuinely in need.
 - b. The fetus placed in the artificial womb must result from a lawful (i.e., religiously sanctioned) marriage.
 - c. Fathers must be granted the right to follow up on the fetus during its development in the artificial womb to ensure effective bonding and involvement.
 - d. The technology must not be used unless it has undergone significant and validated laboratory experimentation.
 - e. Artificial wombs are not to replace natural reproduction except when medically or ethically necessary.
 - f. The use of tissues from halal animals that have been slaughtered according to religious law is permitted.
 - g. The use of tissues from prohibited animals such as pigs is only allowed in cases of necessity, and only when no permissible (pure) alternative is available.
 - h. Artificial wombs using tissues derived from the wife's womb are permissible only when the marital bond is still valid; their use is prohibited if the woman is no longer the legal wife of the fetus's father.
 - i. It is permissible to place premature babies in artificial wombs until their development is complete.
 - j. It is also permissible to use artificial wombs to carry embryos resulting from artificial insemination throughout the pregnancy period.
 - k. Terminating the fetus after ensoulment (i.e., after 120 days) is prohibited unless a valid medical justification is determined by experts; fetal deformity is not in itself a valid justification post-ensoulment.

5. Terminating a fetus before ensoulment is permissible if medical specialists deem the reasons acceptable and justifiable.

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