

Ectolife

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ABSTRACT:

This paper looks into how artificial intelligence systems can support medical science and help humanity in protecting the environment and encouraging human development. First, AI could be used to create better ways to grow embryos in labs. By using AI to look at data from past successful embryo experiments, scientists might find new methods for making pregnancies happen outside the body more quickly. This would give them more control over the time it takes for a baby to develop without harming the embryo or affecting the baby's health when it is born. The paper also imagines how artificial wombs, AI systems, and medical technology could help lower environmental impact in the future. An artificial womb would let a fetus grow outside the mother's body, avoiding the risks and problems that come with pregnancy and childbirth. It could also offer a cleaner, safer environment free from pollution, which can lead to birth defects or health issues later in life. Plus, AI could help doctors monitor a baby's growth from a distance and collect important data for each case. This information can help doctors make better decisions about care for mothers who are carrying twins or those with high-risk pregnancies due to conditions like diabetes or high blood pressure. Also, medical technology will help protect the environment by reducing preterm births and other pregnancy complications that often need extra resources, such as medications that can be harmful to ecosystems if not disposed of properly. By using these technologies together, we can build a healthier future where humans live in balance with nature and enjoy its benefits without causing more harm. This article discusses the future of Artificial Intelligence in Artificial Womb Technology. It explores how AI might influence the development of artificial womb technology and how it could be used in the near future.^[1]

Keywords: Concept of Ectolife, Artificial Womb Technology, Working of Artificial Womb, Importance, Advantage and Disadvantage.

I. INTRODUCTION:

The concept of development of embryos outside the human body is not new, from Mahabharata the world-famous epic says Rishi Vyasa helped Gandhari queen of Dhritarashtra to produce a hundred of babies at once with the help of the pots and produces strong and powerful children's from the history itself the ectolife concept was implemented. Ectolife is all about improving reproductive technology. To provide a safe, nurturing and infection-free environment for the development of embryos outside the human body. According to Hashem, every person should have access to safe and reliable options when it comes to starting a family. Ectolife prioritizes the wellbeing of both parents and babies. The goal of the process is to offer an alternative option for those who don't want to undergo natural pregnancy, and at each stage of the process is carefully monitored for a successful pregnancy. The artificial womb could provide a solution for those unable to conceive and can also avoid high-risk pregnancies and premature birth. Countries with low populations can take this as a solution.^[2]

Artificial womb technology more accurately Artificial Amnion and Placenta Technology (AAPT) is highly anticipated for its ability to help pregnant people experiencing dangerous pregnancies_ and as a superior alternative to neonatal intensive care for entities born prematurely.^[3] The technology is intended to facilitate the continued gestation of human entities after premature delivery from a pregnant person's uterus. While initially intended for clinical purposes to aid those that experience clinical difficulty during pregnancy, in the future, the technology might also have broader uses some that might further equality between the sexes in reproduction.^[4]

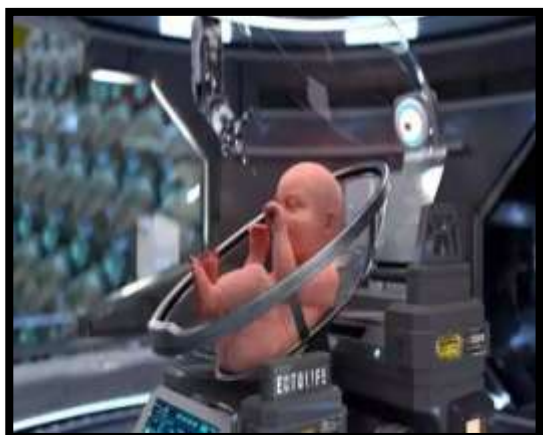


Figure 1: concept of ectolife

About Artificial Womb Technology:

According to the World Health Organization, about 15 million babies are born too early each year, and around 1 million of them don't survive because of related problems. To help lower the number of deaths among newborns, people have developed a technology called the artificial womb, or artificial uterus. This is a machine that allows a baby to grow outside the mother's body, which is normally where a baby develops. An artificial uterus can be used in different ways. It can help couples, whether male or female, in growing a baby. It might also be an option for people who cannot carry a baby naturally, allowing the baby to develop earlier than usual. In this way, it acts like a special kind of baby incubator that can do more than just keep a baby warm. It can also be used to start the baby's development early. Plus, it could make it possible to perform certain surgeries on a baby while it's still very young, instead of waiting until the baby is fully grown. An artificial uterus can also play a role in saving endangered animals and even bringing back species that are no longer around. For example, it might help with the sand tiger shark, which is very rare. Some species that are already extinct might only be able to be brought back through an artificial womb because they are too different from the animals they are related to.^[5]

In 2016, scientists released two studies showing that human embryos can develop for thirteen days in an environment outside the womb. Then, in 2017, researchers at the Children's Hospital of Philadelphia published a study demonstrating they were able to grow premature lamb fetuses for four weeks using a special life support system outside the womb. There is a rule called the 14-day rule that limits how long human embryos can be kept in artificial wombs, and this

rule is now part of the law in twelve countries. In 2021, The Washington Post reported that the International Society for Stem Cell Research changed the 14-day rule, allowing longer studies with embryos in the lab. However, the article also said that human embryos cannot be implanted into a real uterus.^[6]



Figure 2: artificial womb technology

Working Of Artificial Womb:

The artificial womb uses low-resistance hollow-fiber oxygenator technology. This system has a streamlined, pumpless design with small priming volumes and a large surface area. It works using the pressure difference and the natural flow of blood from the heart. The oxygenator used is the Maquet Quadrox-ID Paediatric Oxygenator, which has a priming volume under 80 mL and very little resistance. Blood is moved from the arteries to the oxygenator and back through short lengths of tubing. All internal surfaces, including the tubing and cannulas, are coated with anti-thrombogenic compounds to prevent blood clots and ensure the system is safe for the baby.

The growth chamber mimics the natural environment of the mother's uterus, keeping the right temperature, humidity, and providing necessary oxygen and nutrients to the developing fetus.

A steady flow of oxygen-rich blood is supplied from a separate container until the baby is born. Amniotic fluid, which normally surrounds the baby in the womb, is also present in the artificial womb, offering vital nutrients for the baby's growth. The growth chamber has advanced AI-powered sensors that monitor the baby's vital signs.

In early tests, the artificial womb successfully supported preterm lamb fetuses for

four weeks, creating an environment similar to the uterus.

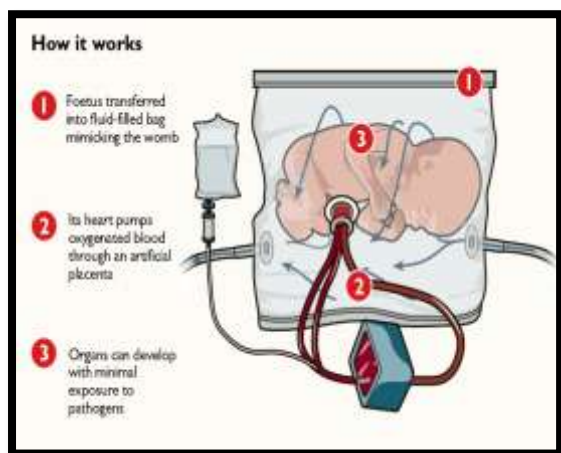


Figure 3: working of artificial womb

These lambs, born at 24 weeks, showed development similar to human preterm infants. All the lambs survived, which made headlines worldwide. The system developed by the Philadelphia team includes a pumpless oxygenator system enclosed in a circuit that mimics the amniotic fluid environment and is connected to the lamb fetus through an umbilical cord interface. Premature lambs can live for up to four weeks, which is similar to extremely premature human babies. The system maintains the baby's blood flow, proper oxygen levels, and steady heart function. Lambs that receive the right nutrition show healthy growth, lung development, and brain growth.

Why Artificial Womb technology important in future Aspects:

Artificial womb technology (AWT) is important for the future primarily because it promises to significantly improve survival rates and long-term health outcomes for extremely premature infants by providing a protective environment that mimics the natural womb. Beyond neonatology, this technology could offer new reproductive options for infertile individuals and same-sex couples, and potentially redefine societal perceptions of pregnancy and parenthood.^[7]

1. Medical and Scientific Importance

- **Improved outcomes for premature babies:** The immediate application of AWT is as an alternative to conventional neonatal intensive care units (NICU) for infants born at the cusp of viability (22-24 weeks gestation). By continuing development in a fluid-filled,

womb-like system, AWT aims to prevent common complications associated with prematurity and mechanical ventilation, such as chronic lung disease and brain hemorrhage.^[8]

- **A bridge to maturity:** The technology can provide a crucial few extra weeks for underdeveloped organs, especially the lungs, to mature before the infant is exposed to air breathing, making the transition to independent life safer.
- **Enhanced fetal research and therapy:** AWT could facilitate new methods for treating congenital defects and administering gene therapies at an early developmental stage within a controlled environment, potentially before they cause lasting damage. It allows for enhanced, real-time monitoring of fetal development, which is currently limited in natural pregnancy.
- **Reduced maternal health risks:** For high-risk pregnancies where the mother's health is in danger, AWT could allow for the fetus to be safely removed and gestated externally, potentially saving both the parent and the child.

2. Societal and Ethical Importance

- **Expanded reproductive choices:** AWT offers a new pathway to parenthood for a wide range of individuals who currently face barriers, including those with uterine infertility, women who have had a hysterectomy, and potentially single males or same-sex male couples via surrogacy after IVF.
- **Challenging the definition of "motherhood" and "parenthood":** The technology forces society to reconsider traditional definitions of pregnancy, birth, and legal parentage, which may lead to more inclusive and diverse family structures.^[9]
- **Public health benefits:** Widespread use of AWT could potentially lead to reduced global maternal mortality rates by removing the physical risks of labor and delivery for some, and may even help address population decline in certain countries.

Ultimately, while the technology is still in early development and raises significant ethical and legal questions that require careful deliberation, its potential to save lives and expand human choice makes it an important area of future focus.^[10]

Advantages Of Ectolife:

1. Medical & Health Advantages:

- **Alternative for Infertile Couples:** EctoLife would allow couples with fertility problems, or women who have had their uterus removed, to conceive and have biological children.
- **Improved Fetal Monitoring:** The artificial pods would have AI-powered sensors to continuously monitor the baby's vital signs (heartbeat, temperature, oxygen saturation, etc.) and physical development, allowing for early detection and potential correction of health issues.
- **Infection-Free Environment:** Babies would develop in a sterile environment within the growth pods, protected from potential external infections.
- **Support for Premature Babies:** The core technology the concept is based on is being researched to help extremely premature infants continue gestation in a womb-like environment, improving survival rates and reducing complications.^[11]

2. Convenience & Societal Advantages

- **Convenience and Control:** Parents could monitor their baby's development remotely via a smartphone app, which would provide real-time data and high-resolution live views.
- **Flexible Parenthood:** The technology could allow for parenthood without the need for a leave of absence for pregnancy, offering an alternative to surrogacy or adoption.
- **Population Decline Solutions:** The facility model is presented as a potential solution for countries experiencing severe population decline by providing an alternative method of reproduction.
- **Home Use Option:** Smaller, at-home growth pods supported by long-lasting batteries are suggested for parents who prefer a more intimate experience away from a large facility.^[12]

3. Genetic Enhancement Advantages

- **Genetic Disease Prevention:** Using gene-editing tools like CRISPR-Cas9, parents could potentially fix inherited genetic diseases in the embryo.
- **Customization Options:** An "Elite Package" in the concept would allow parents to customize their baby's traits, such as eye color, hair color, height, intelligence, and strength.

- **Enhanced Bonding:** Features like a haptic suit would allow parents to feel their baby's kicks, and internal speakers would let them play music or sing to their baby, promoting pre-birth bonding.^[13]

Disadvantages Of Ectolife:

1. Ethical and social disadvantages

- **Genetic inequality:** If only the wealthy can afford genetic enhancements, it could lead to a greater social divide between the genetically "enhanced" and the disadvantaged.
- **"Designer babies" and eugenics:** Screening embryos for non-medical reasons raises concerns about a new form of eugenics.
- **Devaluation of pregnancy:** It could devalue pregnancy and the risks women undertake, although some also see it as a way to liberate women from these burdens.^[14]

2. Psychological and relational disadvantages

- **Weakened mother-child bond:** The natural bond between a mother and child could be significantly weakened.
- **Parental guilt and alienation:** Parents may feel guilty, powerless, and detached, feeling like they have to ask permission to interact with their child, similar to feelings reported by parents of premature infants in NICU, says National Institutes of Health
- **Parental stress:** The feeling of being "on duty" for the entire gestation period could lead to significant stress.

3. Health and safety disadvantages

- **Unintended consequences:** Long-term health risks from genetic modifications are unknown.
- **Ecological imbalance:** Introducing EctoLife or its materials to existing ecosystems could lead to ecological imbalance
- **Technical failure:** The technology is complex, and there is a risk of system failure and infection for the fetus^[15]

II. CONCLUSION:

Artificial womb technology, enhanced by artificial intelligence, offers a groundbreaking advancement in reproductive science. It enables safe fetal development outside the human body, reducing risks from premature births and high-risk pregnancies while improving monitoring and outcomes. This innovation could also support environmental sustainability by minimizing medical waste. However, it raises ethical and social

concerns regarding genetic modification, parental bonding, and equality. With responsible use and regulation, AI-integrated artificial wombs can transform healthcare and redefine human reproduction, creating safer and more inclusive possibilities for future generations.

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