Beyond science fiction: artificial wombs and real progress of fertility treatments

Central Thesis: While the creation of a fully functional artificial womb for human gestation remains science fiction, significant and real progress is being made in adjacent fields of fertility treatment and reproductive technology.

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1. The Catalyst: Fake News

- **Event:** A false report claimed a Chinese firm planned to create the world's first pregnancy robot with an artificial womb.
- **Reaction:** Major news outlets circulated the story.
- **Author's Insight:** The story was widely believed because it fit a narrative of omnipotent AI making science fiction concepts seem possible.

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2. The Current State of Artificial Womb Research

- **Status:** The concept remains largely in the **realm of science fiction**; we are nowhere near an artificial womb that can fully gestate a human.
- **Historical Research Examples:**
    - **Hung-Ching Liu (Cornell University):**
        - Engineered endometrial tissue to grow in an artificial uterus.
        - Successfully implanted and grew a mouse embryo.
        - Created an artificial womb using a scaffolding and a woman's cultured cells, where fertilized IVF embryos implanted for 14 days (the legal limit for lab-grown human embryos).
    - **Global Experiments:**
        - **Japan:** Grew goat foetuses in a prototype womb.
        - **New South Wales:** Tested an artificial womb designed to birth live sharks.

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3. Real-World Progress: Uterine Transplants

- **Milestone:** The first successful baby born from a womb transplant was in **Sweden in 2014**.
- **Scale:**

    - Approximately **135 womb transplants** have been performed in over a dozen countries (including the U.S., China, France, Germany, **India**, and Turkey).
    - Approximately **65 babies** have been born from transplanted wombs.
- **Notable Example:** Galaxy Care Hospital in India has successfully performed uterine transplants and delivered babies from them.

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4. Current Application: nurturing Preterm Babies

- **Technology:** "Bio bags" that mimic the amniotic sac.
- **Function:**
    - Preterm babies float in a liquid that mimics amniotic fluid.
    - An **artificial placenta** connected to the umbilical cord provides oxygen and nutrients.
- **Purpose:** This technology is currently used as an advanced incubator to improve survival rates for very premature infants, not for full gestation.

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5. Related Frontier Research

- **Gamete Production:** Experiments are underway to try to produce **eggs and sperm from stem cells**.

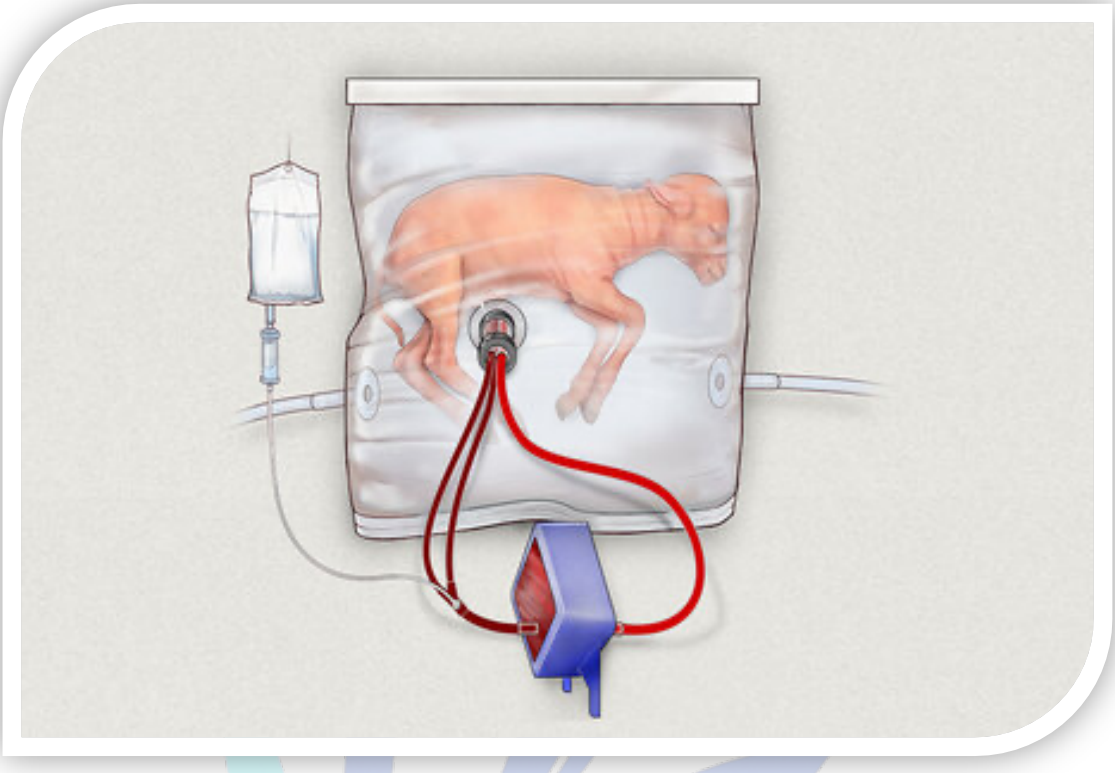
Conclusion

The article distinguishes between sensationalized fake news and the tangible, albeit incremental, scientific progress being made in reproductive medicine, highlighting uterine transplants as a present-day reality and artificial womb technology as a future possibility currently limited to aiding preterm infants.

What are Bio Bags?

A **bio bag** is the common name for an **artificial womb system** currently in development, designed to support extreme premature infants. It is not for creating life from conception, but for acting as a bridge to replicate the protective environment of a natural womb for babies born too soon.

The most famous prototype is the **EXTEND system** (EXTra-uterine Environment for Neonatal Development), but other research institutions are developing similar technology.



How Do They Work?

The system is designed to continue the gestation process that was interrupted by premature birth. Here's how its key components function, as described in the article:

1. **The Bag Itself:** This is a sealed, sterile, fluid-filled container made of biocompatible material. It replaces the traditional incubator.
2. **Amniotic Fluid Substitute:** The baby floats in a warm, sterile liquid that mimics the natural amniotic fluid. This protects the baby's skin, prevents heat loss, and allows for movement.
3. **Artificial Placenta (The Core Technology):**
    - A key innovation is the **pumpless oxygenator circuit**.
    - Catheters are connected to the baby's **umbilical cord** (specifically the umbilical blood vessels).
    - The baby's own heart pumps blood through the umbilical cord into the system outside the bag.
    - This external system acts as an **artificial placenta**: it removes carbon dioxide and adds oxygen directly into the blood before it is returned to the baby.
    - This eliminates the need for mechanical ventilators, which can damage the underdeveloped lungs of a preemie.

Purpose and Benefits

The primary goal is to radically improve outcomes for **micro-preemies** (babies born at 22-28 weeks of gestation).

- **Protects Underdeveloped Organs:** By providing oxygen through the umbilical cord, it avoids ventilator-induced lung injury.
- **Reduces Infection Risk:** The sealed, fluid-filled environment is sterile, reducing exposure to pathogens compared to a traditional NICU incubator.
- **Mimics the Natural Womb:** The system provides physical cushioning, allows for fetal movement, and is designed to support critical developmental processes that usually happen in the third trimester.

Current Status and Future

- **Not Science Fiction, But Not Widely Available:** This is **real technology** currently in the experimental stage. It has been successfully tested on **fetal lambs** (and later, fetal pigs), which showed normal development inside the system.
- **Human Trials:** Research is ongoing, and clinical trials for human infants are being planned and are a subject of significant ethical discussion.
- **Distinction from Full Artificial Wombs:** It is crucial to understand that this is **not** an artificial womb that can gestate a fetus from conception to term (like in science fiction). It is a **neonatal intensive care technology** intended for a specific window of time (a few weeks) to support a baby already conceived and born prematurely.

In summary, a **bio bag** is a groundbreaking medical device that represents the **real and current progress** in artificial womb technology, focused on saving the lives of the most vulnerable newborns rather than replacing natural pregnancy.