LIFESAVER
Living Impact on Fetal Evolution

Human placenta reproduced in a laboratory

The LIFESAVER project prototype has been birthed

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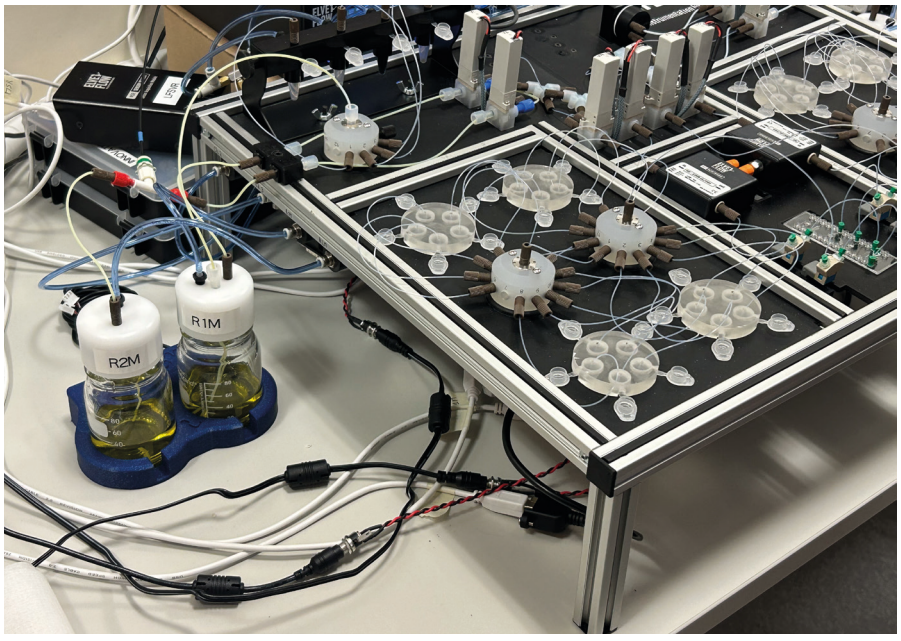
Pollution by microplastics, chemicals and antibiotics is one of the major environmental problems of the last ten years and inevitably affects human health, including of the unborn.

To date, little is known about what happens to a pregnant woman or her foetus when they are exposed to such pollutants or when the mother-to-be takes a medicine, specifically how much of these chemicals reach the foetus.

The fundamental role of the placenta is to protect the foetus and to allow vital substances, such as nutrients and oxygen, to pass from mother to child. Unfortunately, it is well-known that, along with substances vital to the foetus, other potentially harmful substances are also passed on. The proof of this is the fact that microplastics have been found in the placenta.



Since testing on pregnant women is justifiably prohibited to protect the health of the mothers and of their unborn children, and testing on animals is meaningless because their placentas have a different structure and behave differently, there is no existing knowledge or technology that can predict the transmission of chemicals from the mother to her baby in the womb.

The EU's LIFESAVER project, coordinated by EnginSoft, is developing a laboratory system to forecast the penetration of various chemicals through the placenta. The first prototype was presented in Braga in Portugal at the International Iberian Nanotechnology Laboratory in June 2023. This system, unique in the world, replicates both the mother's blood circulation and

the foetus's blood circulation through two microfluidic circuits.

A membrane, housed on a chip and representing the placenta, lies between the two circuits. The high-tech system is equipped with various nano-biosensors capable of detecting concentrations of harmful substances such as antibiotics, antivirals, hormones, or microplastics in the two circuits as well as their transfer from one circuit to the other.

Top European experts from the best in class European universities, research institutes and companies have been involved in creating this prototype. It was the transdisciplinary nature of the expertise – in microfluidic systems, 3D organ printing, cell cultures, nano-biosensors, and digital twins – that made it possible to realize such a complex system.

The main challenge of the project is to ensure the system biofidelity, i.e. to replicate, as closer as possible, the placenta's behaviour during the first three months of pregnancy, which are the riskiest for foetal development.

The placenta is the most complex organ in the human body and the most difficult to study due to the enormous transformation it undergoes day by day during pregnancy. While some literature exists on the placenta at term, nothing or little is known about the placenta during the first three months, both due to the ethical issues concerning voluntary abortion and to the fact that the placenta is completely destroyed and unusable for scientific research in the event of a miscarriage.

Therefore, the only way to create a model of the placenta's behaviour is to reproduce it virtually, through a bio digital twin.

The digital model, or digital twin, consists of a series of fluid-dynamic models that emulate the blood flows in and across the placenta; machine learning algorithms make it possible to correlate these flows with the health of both the maternal and foetal cells.

However there is still a long way to go from this initial prototype to achieving a stable, reliable and easily reproducible system: the researchers have two more years of work ahead of them to fine-tune the system, validate its functionality, and create the protocols for its use.

At present, every package insert for any medication states "Do not take during pregnancy", or "Take under strict medical supervision during pregnancy".

The Lifesaver projects wants to overcome this and will culminate in a system to certify which medicines are safe and which are not during pregnancy. The LIFESAVER vision is for every pregnant woman to have a proper living environment with minimal risks to the fetus, and to be safeguarded with scientifically justified regulations of potentially harmful chemical and medicinal products. This will lead to a healthier quality of life for the mothers and for their babies.

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