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LIFESAVER

Living Impact on Fetal Evolution: Shelter – Analyze - Validate - Empower Regulations

Participant Organization Name: 1. EnginSoft S.p.A. 2. Seqvera Ltd. 3. Università Cattolica del Sacro Cuore 4. Elvesys S.A.S. 5. Evercyte GmbH 6. International Iberian Nanotechnology Laboratory 7. CELLINK AB 8. Pro-active sprl 9. National University Ireland Galway 10. Istituto Nazionale di Ricerca Metrologica 11. The Planet Calls 12. IDEA Consult b.v. 13. Malta Life Science Center Ltd. 14. Institute for Research and Innovation in Health	**Project Start date:** 01 Nov 2021 **Duration:** 48 months **Work Package:** WP 5 **Description of WP:** Safe Proof **Deliverable:** D 5.1 **Deliverable Title:** Demonstrated first operational version of the LIFESAVER microfluidic system with proper controls and interfaces **Author:** Elvesys (ELV)

DELIVERABLE REPORT

Deliverable	D 5.1	Description of deliverable: Demonstrated first operational version of the LIFESAVER microfluidic system with proper controls and interfaces	
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Lead beneficiary	Elvesys (ELV)
Contributing beneficiaries	none

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0.1	24/04/2023	Final draft	Elvesys (ELV)	ES, SEQ

Fluidic demonstrator

The LIFESAVER project concerns the building of a microfluidic *in vitro* placenta model to test the transport of compounds across the maternal-fetal barrier with the ultimate goal of assessing the toxicity risk of chemicals to the fetus.

This deliverable introduces the first working demonstrator of the full microfluidic flow control system, developed to host the *in vitro* placenta models and control all elements of fluid handling related to liquid perfusion through the model and testing of compounds (Fig. 1). The microfluidic system was developed by Elvesys with input from all project partners on the specific LIFESAVER needs. The fluidic demonstrator is driven by a pressure-driven flow controller for precise flow control through two circuits, i.e. corresponding to maternal and fetal channels. The two recirculating flow paths are directed by a series of valves. The setup enables injection of test compounds into the maternal circuit, and sample collection from both maternal and fetal circuits.

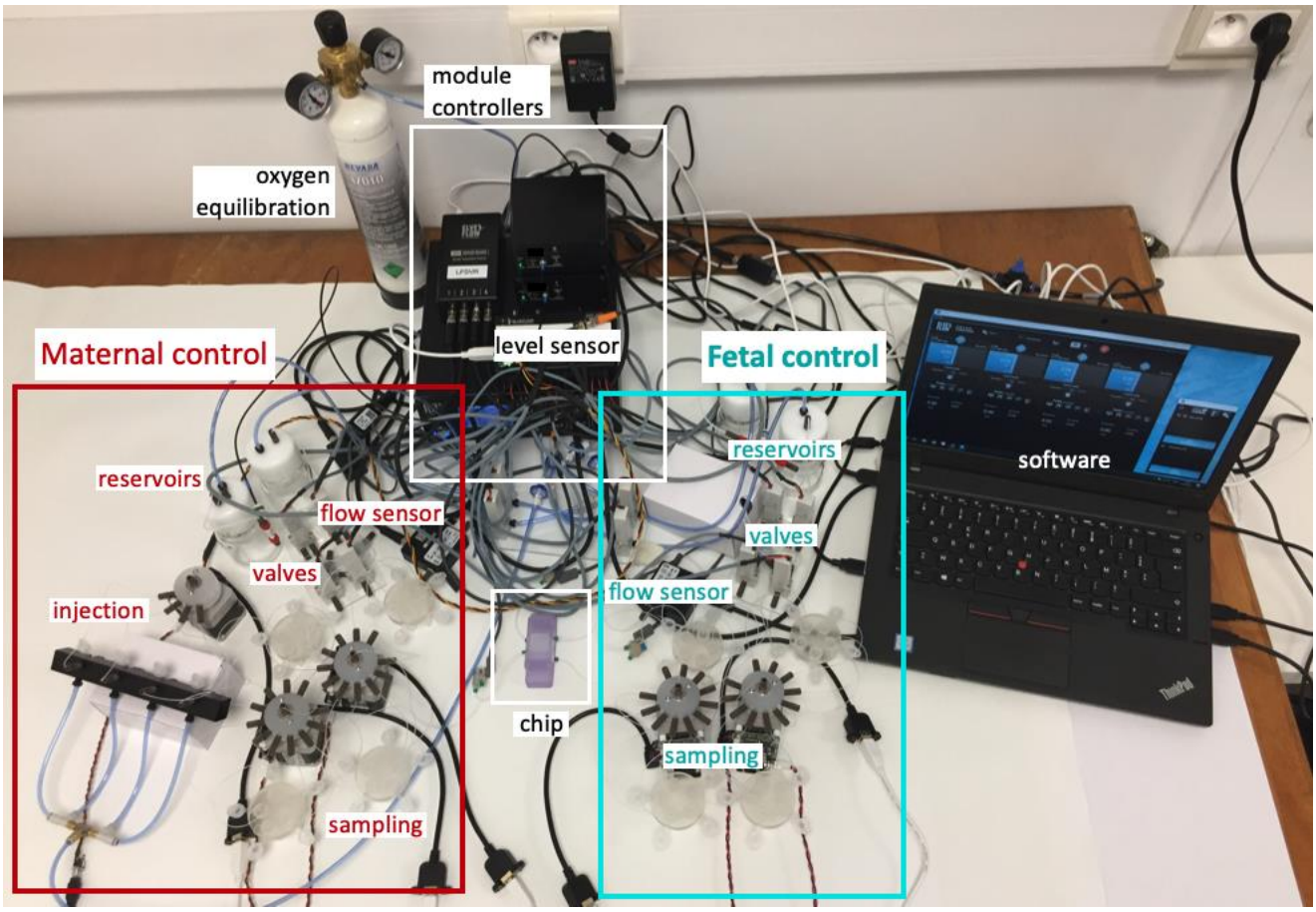

Fig. 1. LIFESAVER microfluidic perfusion system functional demonstrator.

The system is controlled by a pressure-driven flow controller (OB1 MK4, Elveflow) that pressurizes the air above the liquid in the reservoirs. The fluidic circuits feature flow profile control (e.g. flow rate feedback for steady or pulsatile flow profile control), continuous unidirectional recirculation through each channel of the microfluidic chip, monitoring and equilibration of dissolved oxygen concentration, and valves to inject chemicals and collect samples (Table 1).

Table 1. LIFESAVER first fluidic demonstrator functional features

Design requirements	Functional features
Flow control	Pressure driven flow controller enables simultaneous control of steady or pulsatile (e.g. 1.2 Hz) flow profiles in separate maternal and fetal channels with high precision. Flow sensor feedback enables precise flow rate control.
Liquid recirculation	Two individual fluidic loops for continuous, unidirectional perfusion through the chip (corresponding to maternal and fetal channels). Reservoir level sensors enable seamless and fail-safe recirculation.
Dissolved oxygen (DO) control	Sensors to monitor the dissolved oxygen concentration of medium in both channels. Equilibration of DO in fetal medium to below atmospheric level.
Injection of compounds	Sequential injection of compounds into maternal channel.
Sample collection	Collection of multiple samples from maternal and fetal channels.

The fluidic circuits employ reservoir level sensors to ensure fail-safe recirculation (Figs. 2, 3). The full fluidic system will be demonstrated to partners and European Commission officers at the LIFESAVER consortium review meeting in June, Braga, Portugal.

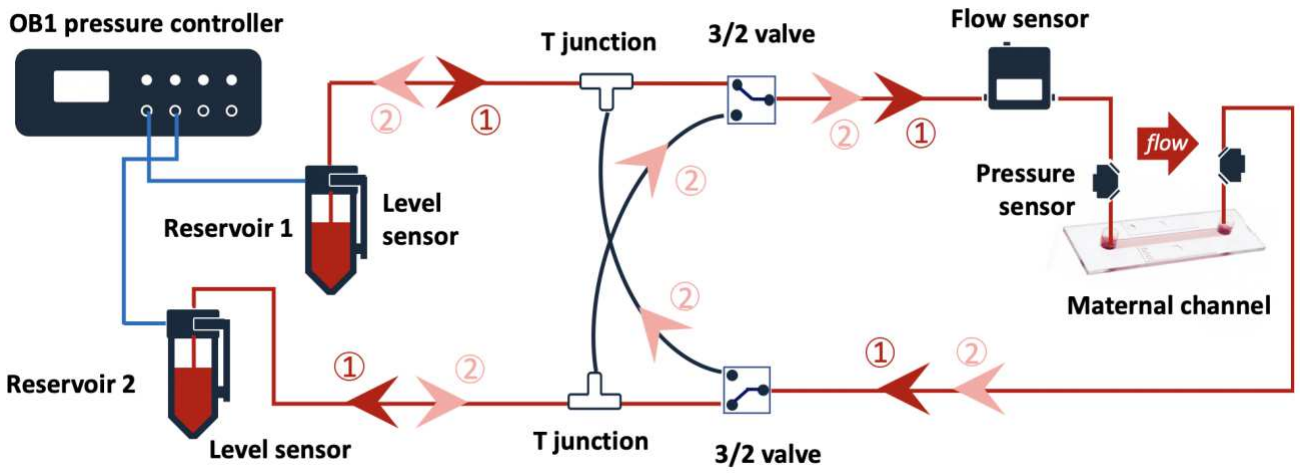

Fig. 2. Operational schematic of one fluidic circuit flowing through a microfluidic chip (e.g. maternal channel)*. The circuit features one liquid driven by an electronic pressure controller circulating unidirectionally through the microfluidic chip, two inline valves and a microfluidic flow sensor. The two possible flow circuit directions are shown by dark or light red arrows. Reservoir level sensors ensure automated, fail-safe recirculation.*

Fig. 3. Reservoir level sensors for fail-safe recirculation of liquid in each circuit. *Level sensors are adaptable to a range of tube sizes, from Eppendorf tubes to 15 mL and 50 mL Falcon tubes. User-friendly and intuitive software enables the user to get started in a few clicks and further automate the most complex and long-lasting experiments.*