On The Use Of Digital Twin Technology Arielle For The Development Of New Generation Perinatal Life Support Systems

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ON THE USE OF DIGITAL TWIN TECHNOLOGY *ARIELLE* FOR THE DEVELOPMENT OF NEW GENERATION PERINATAL LIFE SUPPORT SYSTEMS

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Introduction

Perinatal Life Support (PLS) consortium is developing an artificial womb (PLS system) to **increase chance of survival of extremely preterm infants** (<28 weeks of gestational age). To develop such a complex medical device, knowledge from multidisciplinary fields must integrate into one single system. Mathematical models are used to support this integration by composing a digital twin of the system, named *Arielle*, to allow computer simulations of the device. *Arielle* is connected with a manikin to support clinical implementation. For this purpose, a new model named *Arielle* is proposed as digital twin of the *PLS system*. This study presents possible applications of Arielle.

Methods

- Literature search
- Interviews with clinicians and medical engineers

Artificial womb
PLS system

Digital twin
Arielle
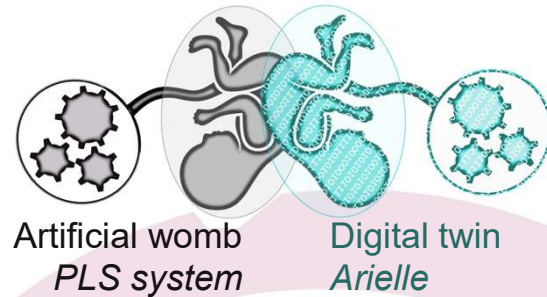
Results

First the purposes of *Arielle* are defined and a concept of *Arielle* and manikin is developed to test and analyze these purposes:

Gaining knowledge

Arielle should be able to help gaining the necessary knowledge to create an optimal environment for fetal development.

Mechanical components

Arielle should simulate the properties and interactions of components of the PLS system to optimize their desired effect on the status of the fetus.

Monitoring

Arielle should be able to monitor and interpret vital signals of the fetus once integrated in the *PLS system*.

Decision support

Arielle should allow patient specific decision support to inform the user to optimize settings of the *PLS system* and support interventions.

Discussion

To support the development of the *PLS system*, *Arielle* should be able to simulate the fetal physiology and the *PLS system* to gain knowledge of the fetal physiology and optimize components. When the PLS system is implemented, *Arielle* should be able to interpret vital signals and as a patient specific decision support. Future work focuses on the development and evaluation of Arielle with respect to the defined goals.

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