Submodule Organ-on-Chip

Interreg Co-funded by the European Union
North-West Europe
STEP4NAMs

Module No.		Lecture Title	Content / Educational Objective	Potential Expert Lecturer
1. Introduction to OoC			• Definitions • History of OoC • The Journey of an OoC • Design considerations for different tissue types • Application scenarios	Prof. Dr. Peter Loskill, University of Tübingen, 3R-Center Tübingen
2. Development of OoC Models				
	2.1	Microfabrication	• Exploring material choice, types of polymers, and their application limitations and parameters to consider, such as biocompatibility, bioinert materials, risk of compound absorption, leaching, etc. • The fabrication methods and why choose one over another • The importance of considering endpoint analysis, such as imaging, effluent collection, tissue retrieval, etc., while choosing fabrication approach and design	Ass. Prof. Dr. Thomas Winkler, KTH Stockholm
	2.2	Fluid Dynamics	• Understanding diffusive and convective transport for different molecular sizes. • What is laminar flow, and why is it required? • What is shear stress, and how do we decide whether it is required or needs to be avoided? • How do fluid dynamics define the design parameters? • Design considerations such as reducing dead volume	Dr. Mathias Busek, University of Tübingen
	2.3	Vascularization	• Understanding the importance of vasculature in OoC models – transport/barrier processes, inflammatory pathways, cell signalling • Different types of endothelial cells and vessels – blood vs lymphoid; specialised endothelium (fenestrated, BBB, micro- vs. large vessels) • Co-culture strategies and endothelial barrier integration • The barrier function and drug delivery to the tissue	Dr. Hanna Vuorenpää, 3R-Center Tübingen
	2.4	Sensor Integration, TEER measurements	• Why do we need sensors in OoC systems, and their relevance to the various tissue models, • The importance of real-time monitoring. • The importance of sensor configuration and placement strategies in the OoC devices, • The challenges of signal acquisition and noise	Prof. Dr. Torsten Mayr, TU Graz
	2.5	Readouts	• The type of analysis methods employed for OoC • Effluent analysis: ELISAs, Colorimetric assays, Multiplex cytokine assays • Gene expression: targeted vs non-targeted • Imaging methods – real time monitoring vs fixed samples; non-invasive spectroscopy	Dr. Julia Marzi, University of Tübingen, NMI
	2.6	Biomaterials	• Definition and types of biomaterials • Intro to the extra cellular matrix including (tissue-specific) physical properties • Deep dive into Hydrogels • Application of biomaterials in OoC devices	Prof. Dr. Kevin Healy, University of California, Berkeley

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	2.7	(Stem)Cells	• Basic introduction to cell biology • The cell sources (Primary cells, immortalized cell lines and stem cells) • Limitations and advantages of different cell types	Dr. Julia Rogal, University of Tübingen
	2.8	Increasing Complexity	• Challenges and potentials of integrating immune cells • Challenges and potentials of innervation • Which multi-organ approach exist? • What are limitations and challenges of multi-organ approaches	Dr. Madalena Cipriano, University of Tübingen
	2.9	In Silico Modelling	• How simulations work and what is the goal of simulating an in vitro process? What is a digital twin? • Advantages of employing in silico modelling when i) designing a new organ model (OoC) and ii) for experimental design • How in silico modelling can make an organism out of individual tissue-chips • Using digital twins' translatability towards clinical research	Dr. Christian Maass, MPSlabs
3. Regulatory Requirements			• Which type of regulatory frameworks exist • Where does organ-on-chip technology stand in the regulatory environment? • The implementation of standardization (ISO) and current regulations for OoC devices • Risk assessments for OoC research • Good in vitro method practices	Dr. Monica Piergiovanni, EURL ECVAM JRC
4. Industrial Applications & Case Studies				
	4.1	Pharmaceutical Applications	• Where are applications for OoCs in pharmaceutical R&D? Which gaps can they address • What are success stories of OoC integration? • Challenges of adopting OoCs and future opportunities	Dr. Remi Villenave, Roche
	4.2	Food Safety	• What is food safety assessment and which regulatory frameworks existing • Where are applications for OoCs in food safety assessment? Which gaps can they address • What is the current state of adopting OoCs for food safety assessment? Challenges of adopting OoCs and future opportunities	Dr. Sofia Batista Leite, EFSA
	4.3	Personalized Medicine	• What is personalised vs precision medicine? • How can OoC contribute to personalised/precision medicine? Which gaps can they address • What are success stories of OoC applications? • Challenges of adopting OoCs and future opportunities	Prof. Dr. Heidi Haikala, Tampere University