

## Submodule Organ-on-Chip

Module No.	Lecture Title	Content / Educational Objective	Expert Lecturer	
1.	<b>Introduction to OoC</b>	<ul style="list-style-type: none"> <li>• Definitions</li> <li>• History of OoC</li> <li>• The Journey of an OoC</li> <li>• Design considerations for different tissue types</li> <li>• Application scenarios</li> </ul>	Prof. Dr. Peter Loskill, 3R-Center Tübingen	
2.	<b>Development of OoC Models</b>			
	2.1	Microfabrication	<ul style="list-style-type: none"> <li>• 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.</li> <li>• The fabrication methods and why choose one over another</li> <li>• The importance of considering endpoint analysis, such as imaging, effluent collection, tissue retrieval, etc., while choosing fabrication approach and design</li> </ul>	Ass. Prof. Dr. Thomas Winkler, KTH Stockholm
	2.2	Fluid Dynamics	<ul style="list-style-type: none"> <li>• Understanding diffusive and convective transport for different molecular sizes</li> <li>• What is laminar flow, and why is it required?</li> <li>• What is shear stress, and how do we decide whether it is required or needs to be avoided?</li> <li>• How do fluid dynamics define the design parameters?</li> <li>• Design considerations such as reducing dead volume</li> </ul>	Dr. Mathias Busek, University of Tübingen
	2.3	Vascularization	<ul style="list-style-type: none"> <li>• Understanding the importance of vasculature in OoC models – transport/barrier processes, inflammatory pathways, cell signalling</li> <li>• Different types of endothelial cells and vessels – blood vs lymphoid; specialised endothelium (fenestrated, BBB, micro- vs. large vessels)</li> <li>• Co-culture strategies and endothelial barrier integration</li> <li>• The barrier function and drug delivery to the tissue</li> </ul>	Dr. Hanna Vuorenpää, 3R-Center Tübingen
	2.4	Sensor Integration, TEER measurements	<ul style="list-style-type: none"> <li>• Why do we need sensors in OoC systems, and their relevance to the various tissue models</li> <li>• The importance of real-time monitoring</li> <li>• The importance of sensor configuration and placement strategies in the OoC devices</li> <li>• The challenges of signal acquisition and noise</li> </ul>	Prof. Dr. Torsten Mayr, TU Graz

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	2.5	Readouts	<ul style="list-style-type: none"> <li>The type of analysis methods employed for OoC</li> <li>Effluent analysis: ELISAs, Colorimetric assays, Multiplex cytokine assays</li> <li>Gene expression: targeted vs non-targeted</li> <li>Imaging methods - real time monitoring vs fixed samples; non-invasive spectroscopy</li> </ul>	Dr. Julia Marzi, University of Tübingen/ NMI
	2.6	Biomaterials	<ul style="list-style-type: none"> <li>Definition and types of biomaterials</li> <li>Intro to the extra cellular matrix including (tissue-specific) physical properties</li> <li>Deep dive into Hydrogels</li> <li>Application of biomaterials in OoC devices</li> </ul>	Prof. Dr. Kevin Healy, UC Berkeley
	2.7	(Stem)Cells	<ul style="list-style-type: none"> <li>Basic introduction to cell biology</li> <li>The cell sources (Primary cells, immortalized cell lines and stem cells)</li> <li>Limitations and advantages of different cell types</li> </ul>	Dr. Julia Rogal, University of Tübingen
	2.8	Increasing Complexity	<ul style="list-style-type: none"> <li>Challenges and potentials of integrating immune cells</li> <li>Challenges and potentials of innervation</li> <li>Which multi-organ approach exist?</li> <li>What are limitations and challenges of multi-organ approaches</li> </ul>	Dr. Madalena Cipriano, University of Tübingen
	2.9	In Silico Modelling	<ul style="list-style-type: none"> <li>How simulations work and what is the goal of simulating an in vitro process? What is a digital twin?</li> <li>Advantages of employing in silico modelling when i) designing a new organ model (OoC) and ii) for experimental design</li> <li>How in silico modelling can make an organism out of individual tissue-chips</li> <li>Using digital twins translatability towards clinical research</li> </ul>	Dr. Christian Maass, Aesculap
<b>3.</b>	<b>Regulatory Requirements</b>		<ul style="list-style-type: none"> <li>Which type of regulatory frameworks exist</li> <li>Where does organ-on-chip technology stand in the regulatory environment?</li> <li>The implementation of standardization (ISO) and current regulations for OoC devices</li> <li>Risk assessments for OoC research</li> <li>Good in vitro method practices</li> </ul>	Dr. Monica Piergiovanni, EURL ECVAM JRC

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<b>4. Industrial Applications &amp; Case Studies</b>				
	4.1	Pharmaceutical Applications	<ul style="list-style-type: none"> <li>Where are applications for OoCs in pharmaceutical R&amp;D? Which gaps can they address</li> <li>What are success stories of OoC integration?</li> <li>Challenges of adopting OoCs and future opportunities</li> </ul>	Dr. Adrian Roth,
	4.2	Food Safety	<ul style="list-style-type: none"> <li>What is food safety assessment and which regulatory frameworks exist?</li> <li>Where are applications for OoCs in food safety assessment? Which gaps can they address</li> <li>What is the current state of adopting OoCs for food safety assessment? Challenges of adopting OoCs and future opportunities</li> </ul>	Dr. Sofia Batista Leite, EFSA
	4.3	Regulatory Toxicology	<ul style="list-style-type: none"> <li>Overview of regulatory toxicology and the legal frameworks</li> <li>"History" of NAMs for regulatory tox</li> <li>Where are applications for OoCs in regulatory toxicology? Which gaps can they address?</li> <li>What are success stories of OoC integration?</li> </ul>	Prof. Dr. Thomas Hartung, CAAT
	4.4	Personalized Medicine	<ul style="list-style-type: none"> <li>What is personalised vs precision medicine?</li> <li>How can OoC contribute to personalised/precision medicine? Which gaps can they address</li> <li>What are success stories of OoC applications?</li> <li>Challenges of adopting OoCs and future opportunities</li> </ul>	Prof. Dr. Heidi Haikala, Tampere University