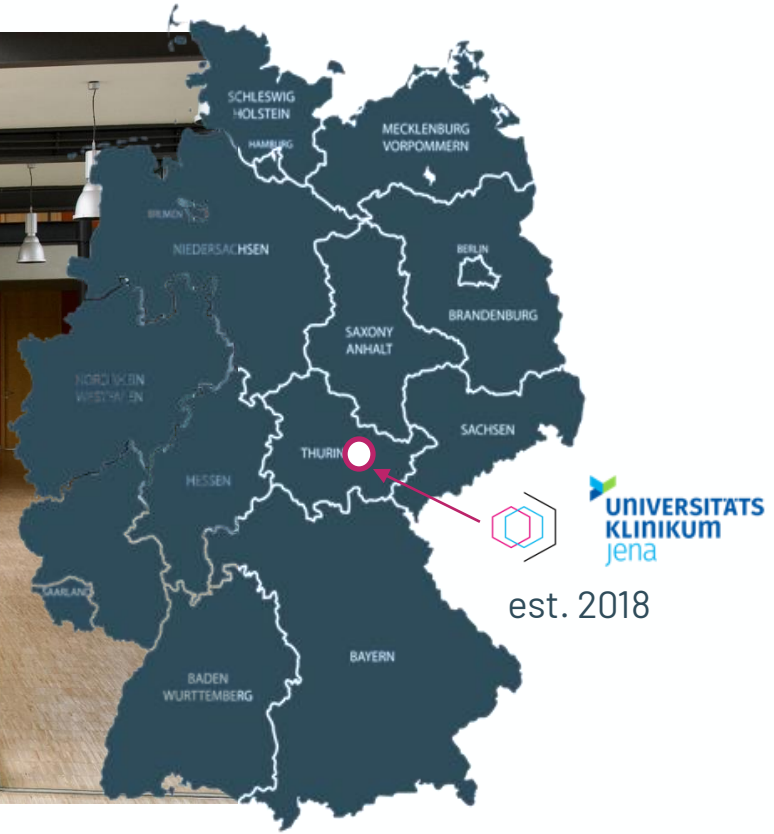
DYNAMIC42

Dynamic42 Organ-on-chip

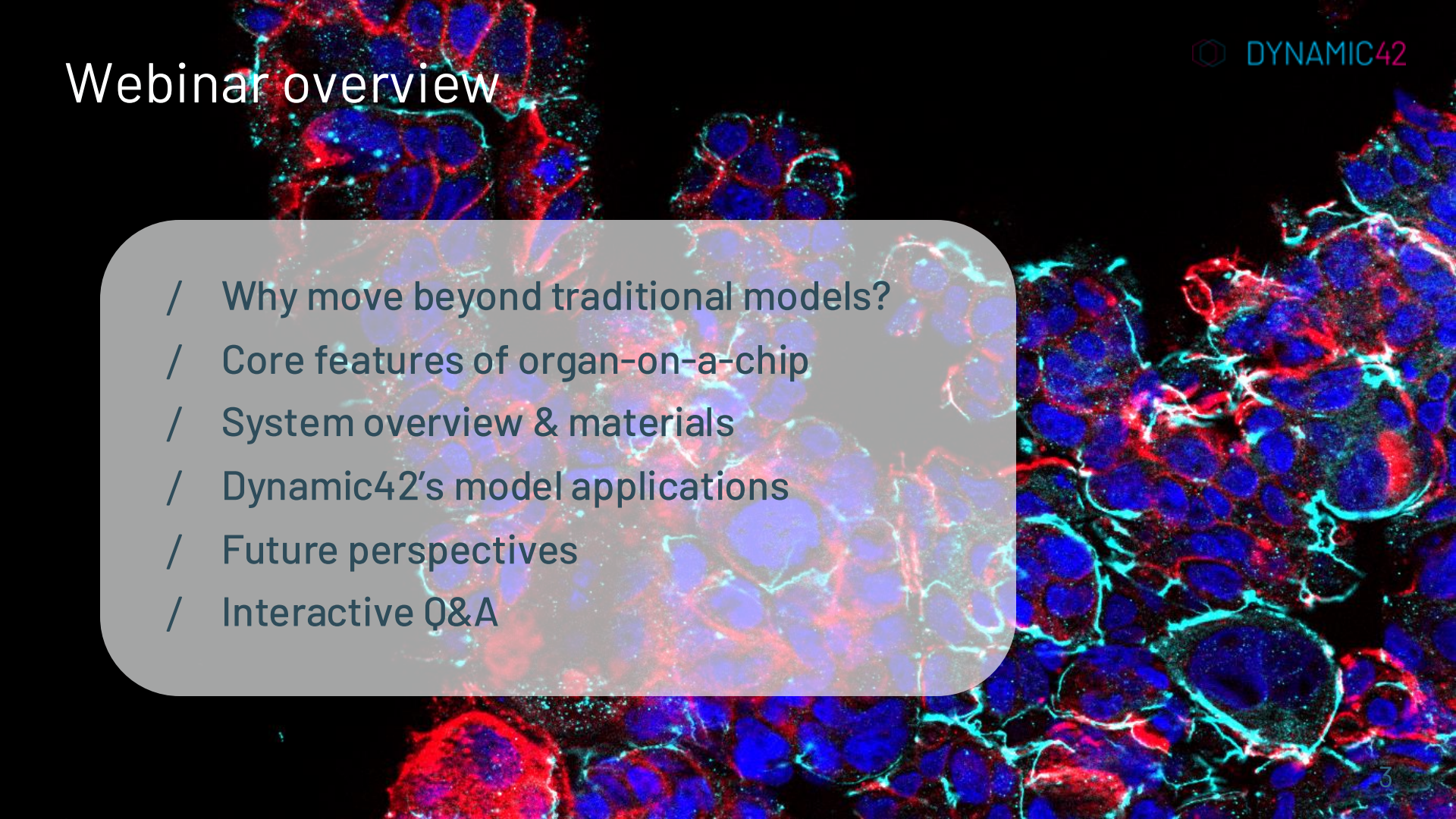
- Your Introduction to the Future of Biomedical Research

Dynamic42 GmbH – About us



est. 2018

Webinar overview



- Why move beyond traditional models?
- Core features of organ-on-a-chip
- System overview & materials
- Dynamic42's model applications
- Future perspectives
- Interactive Q&A

In Vitro Evolution

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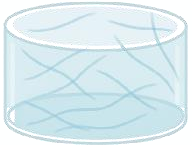
Complexity

2D Monoculture

First animal cell cultures[1-2]
Flat, simple, foundational.

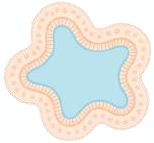
Air–Liquid Interface (ALI)

Differentiated epithelial cultures on permeable membranes[3]



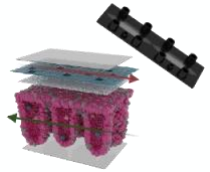
3D Collagen / ECM Cultures

Early tissue-like models importance of ECM shown[4-6]



Organoids

Stem-cell derived mini-organs[7]



Organ-on-a-Chip

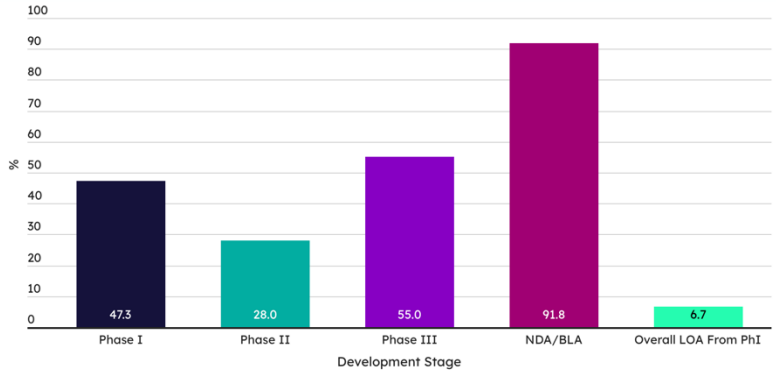
Microfluidic systems mimicking organ-level physiology[8]

1900s | Mid-1980s | 1970s–1980s | 2009 | 2010

[1] Harrison, *Proceedings of the Society for Experimental Biology and Medicine*, 1907;
[2] Carrel & Burrows, *Journal of Experimental Medicine*, 1911;
[3] Whitcutt et al., *In Vitro Cellular & Developmental Biology*, 1988;
[4] Elsdale & Bard, *Journal of Cell Biology*, 1972;
[5] Bissell et al., *Journal of Theoretical Biology*, 1982;
[6] Barcellos-Hoff et al., *Development*, 1989;
[7] Sato et al., *Nature*, 2009;
[8] Huh et al., *Science*, 2010.

Why Better Preclinical Models are Needed

- **Only~6–7%** of drugs entering Phase I get approved
- Phase I screens for safety (toxicity).
- Phase II = biggest hurdle (28% success)
- Failures here = efficacy not translating from preclinical



Source: Biomedtracker, Citeline, February 2024

https://insights.citeline.com/IV154612/Why-Are-Clinical-Development-Success-Rates-Falling/

Biology

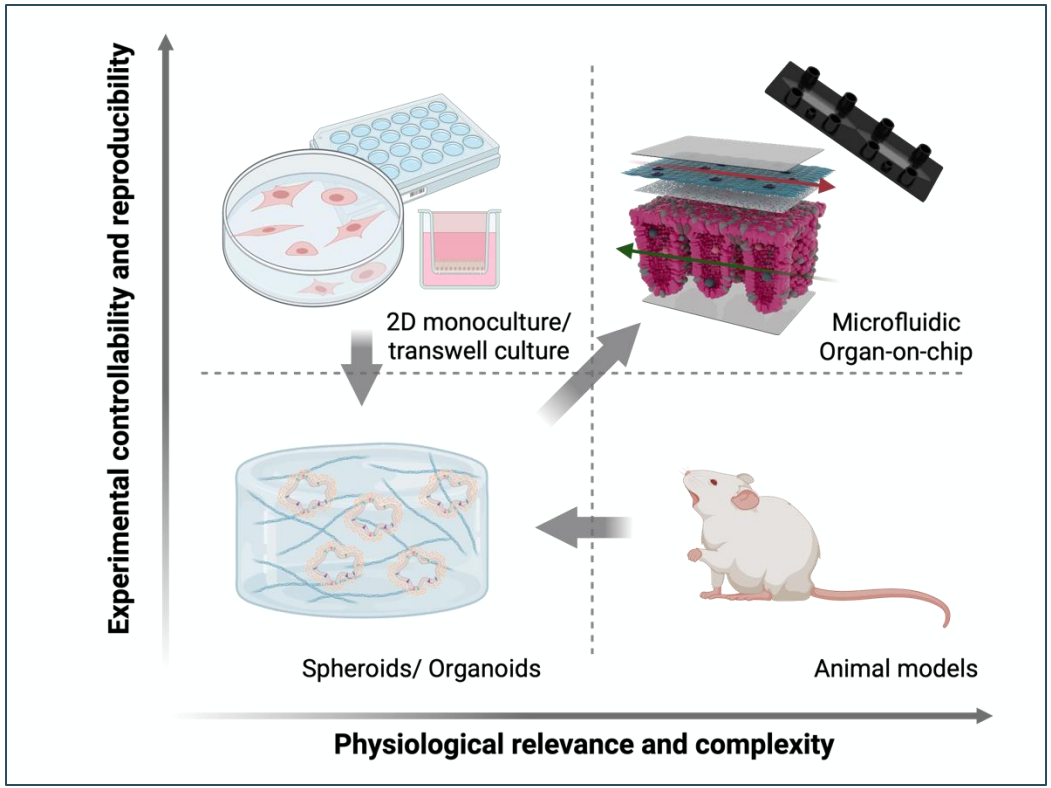
FDA NEWS RELEASE

FDA Announces Plan to Phase Out Animal Testing Requirement for Monoclonal Antibodies and Other Drugs

For Immediate Release: April 10, 2025

- FDA's current regulatory framework permits and encourages the use of new alternative methods to animal testing
- "In the near term, the current state of the science related to alternative methods may provide tools that complement traditional methods and, in some cases, possibly eliminate specific tests"

Better Models for Better Science



More complexity → more human relevance → greater predictivity. Use the simplest model that answers the question.

Why Organ-on-Chip Stands Out

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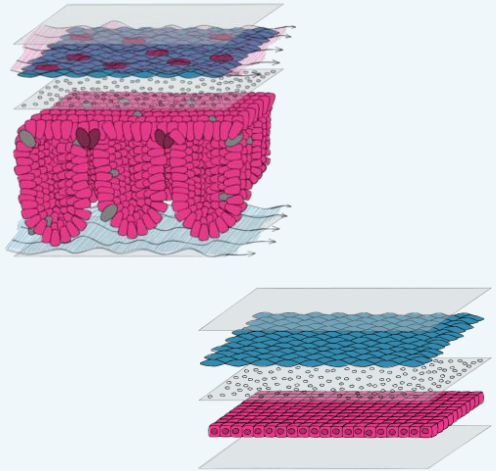
	2D Cell culture	Spheroids	Organoids	Animal models	Organ-on-Chip
Human relevance of data	⊖	⊖	✓	✗	✓
3D organs/tissues	✗	✓	✓	✓	✓
Cellular diversity	✗	⊖	✓	✓	✓
Immune component	✗	✗	✗	✓	✓
Molecular gradients	✗	✗	✗	⊖	✓
Microbiome/ pathogens	✗	✗	✗	✓	✓
(Blood) flow/ perfusion	✗	✗	✗	✓	✓
Max. culture time	~4 weeks	~4 weeks	~4 weeks	months	2-4 weeks
Throughput	high	high	medium to high	low	low to medium
Time to result	fast	fast	medium	slow	medium
Cost	low	medium	medium	high	medium
Effort of model set up	low	low	medium	high	medium

Simulating human organ biology

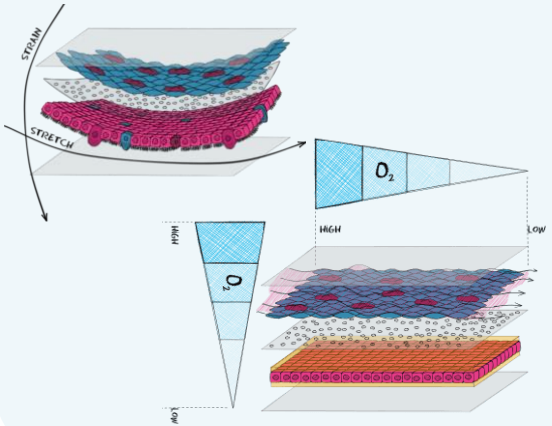
Structure & Communication

- 3D architecture
- Cell–cell signaling



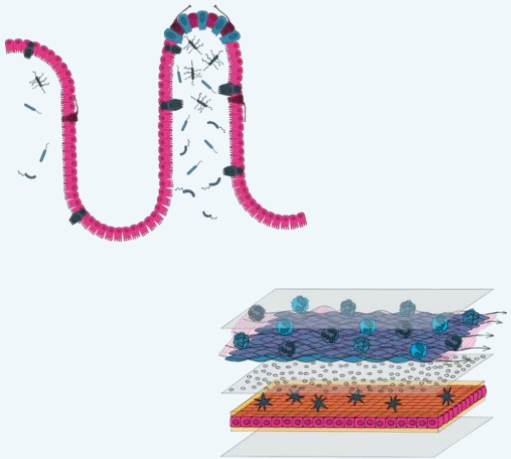
Dynamic Cues

- Biomechanical stimulation
- Vascularization
- Gradients



Biological Context

- Immunity
- Infection modeling



Organ-on-Chip Anatomy

Biochip – The basis of the model

- Biocompatible
- Low-adsorbing chip material
- User-friendly handling
- Plug-and-play assembly
- Great price to performance ratio
- Microscopic slide format
- Compatibility with live imaging

Biochip – the basis of the model

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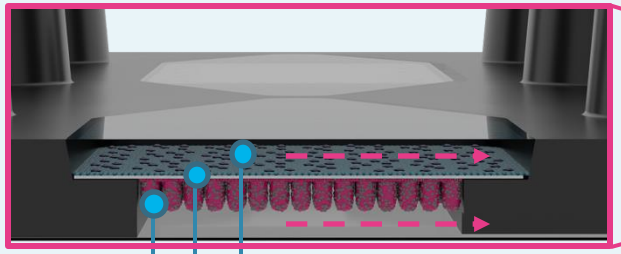
Cell culture chamber

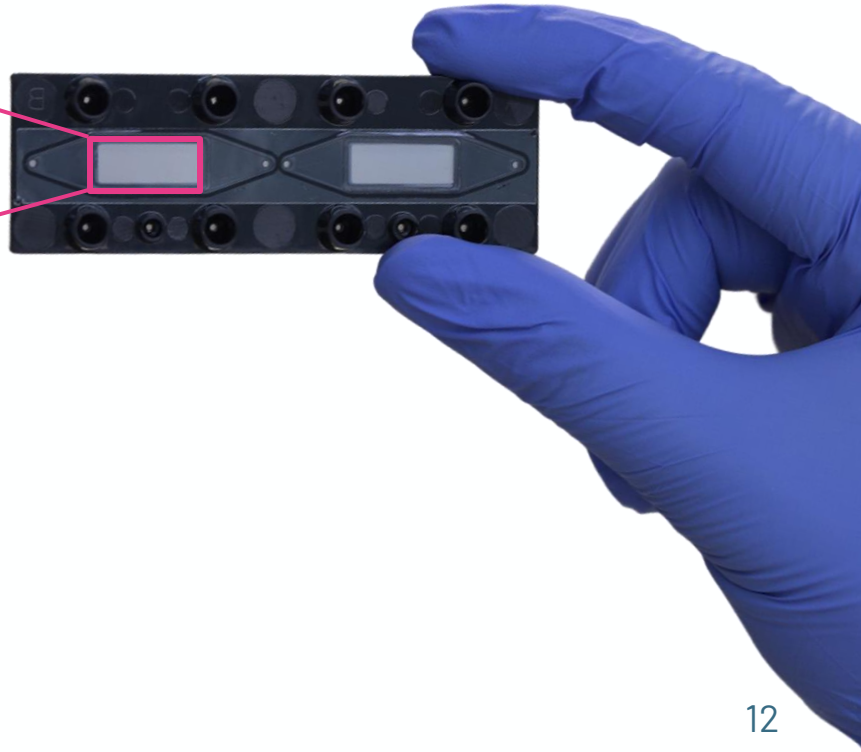


Top channel

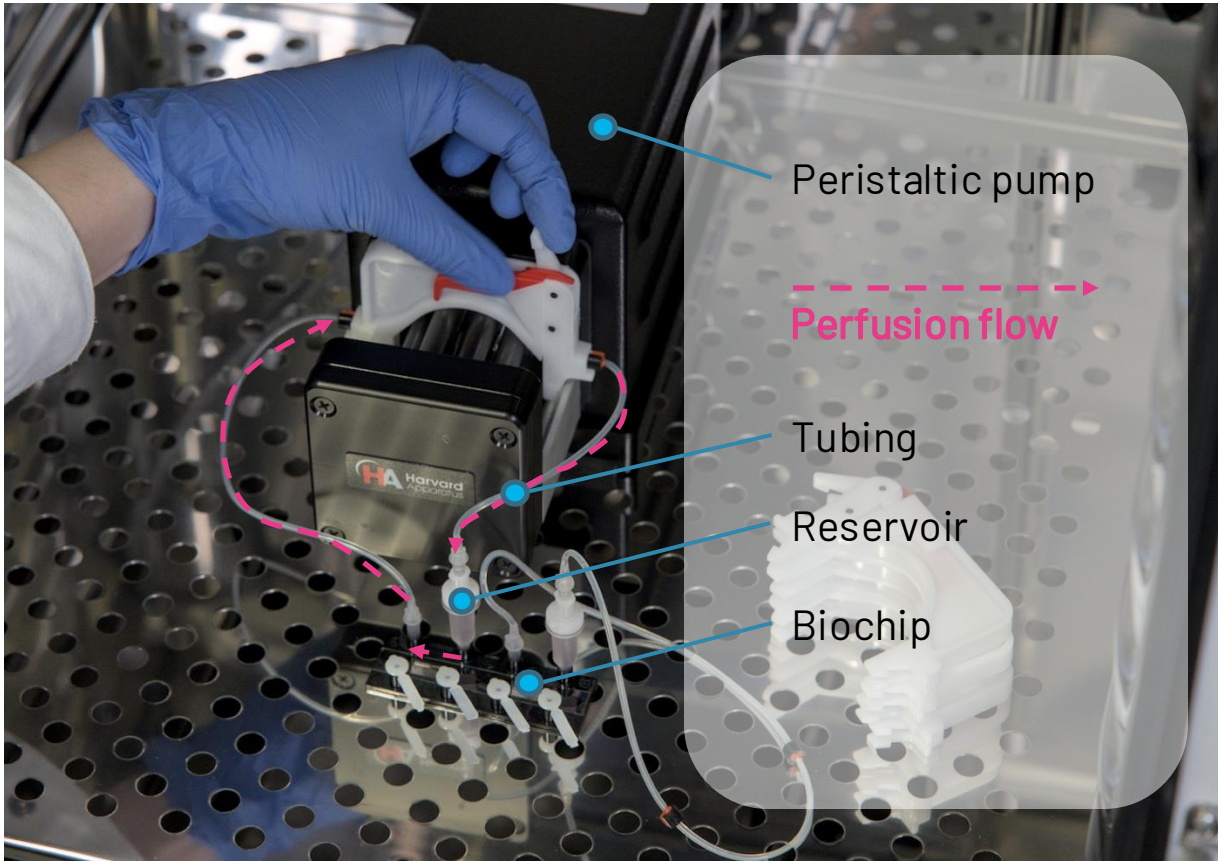
Porous membrane

Bottom channel

Perfusion flow



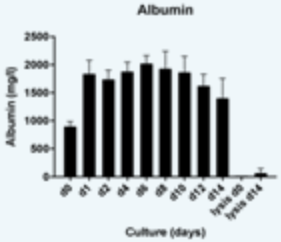
Perfusion set-up of an organ model



- Simulates blood flow
- Continuous nutrient & oxygen supply
- Independent channel perfusion

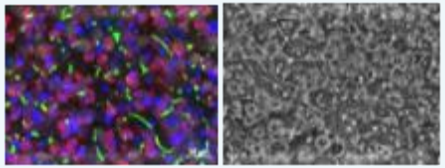
Assay Options

Supernatant sampling



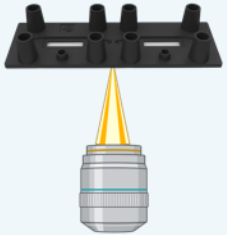
Clinical parameters: LDH, ALT, AST
Cytokine profiling
Compound turnover
Barrier function
Viability/Cytotoxicity

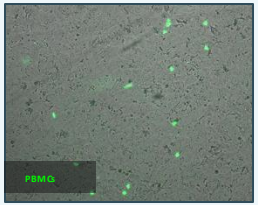
Tissue recovery



Immunofluorescence analysis
Flow cytometry analysis
Viability assays
RNA sampling / PCR
Western Blot

Live cell imaging

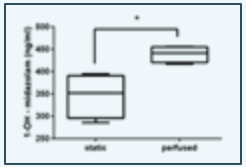




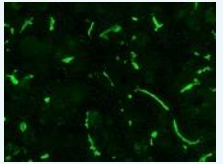
Immune cell perfusion

Glutathione depletion
ROS formation
Mitochondrial activity
Immune cell perfusion

Enzyme activity



CYP3A4 activity
(midazolam turnover)

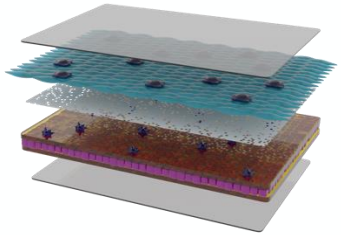


Presence of relevant transporters

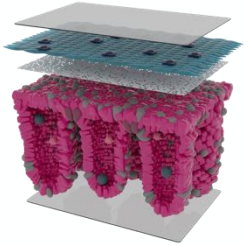
Transporter function
Enzyme activity

Dynamic42 – Established organ models

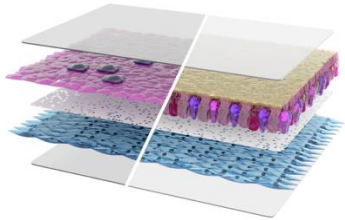
Liver



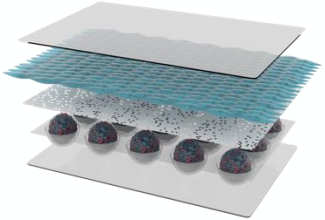
Intestine



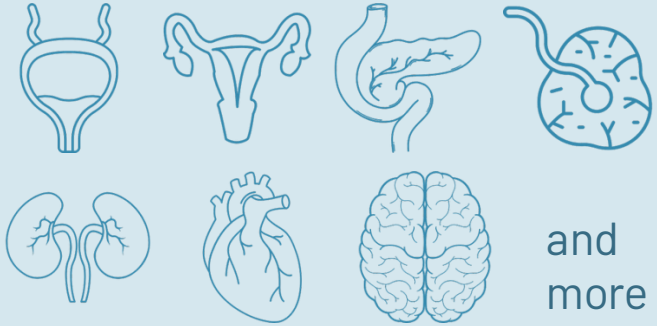
Lung
(Bronchus, Alveolus)



Cancer



Supports custom organ model development.



and more

\+ **Vasculature only**

DynamicOrgan® Product Line

DynamicOrgan® System

Peristaltic pump
+ Developer Kits

2-Channel Kit
2-Channel Kit – sparse
3-Channel Kit
Spheroid Kit

Coming soon!

DynamicOrgan® TME Kit
DynamicOrgan® TEER System
DynamicOrgan® O_2 System

Standardized biochip features

- Microscope-slide size
- Luer connectors
- Interconnectable chambers
- Independent perfusion

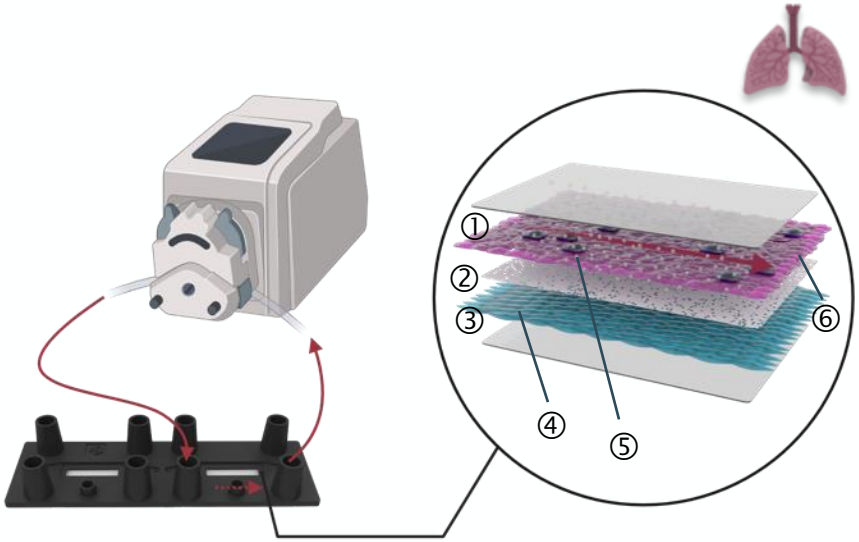
DEKRA certified
Quality Management
ISO 9001
www.dekra-seal.com

Biocompatible material:
no PDMS, minimal
adsorption, medical grade

Real-world applications

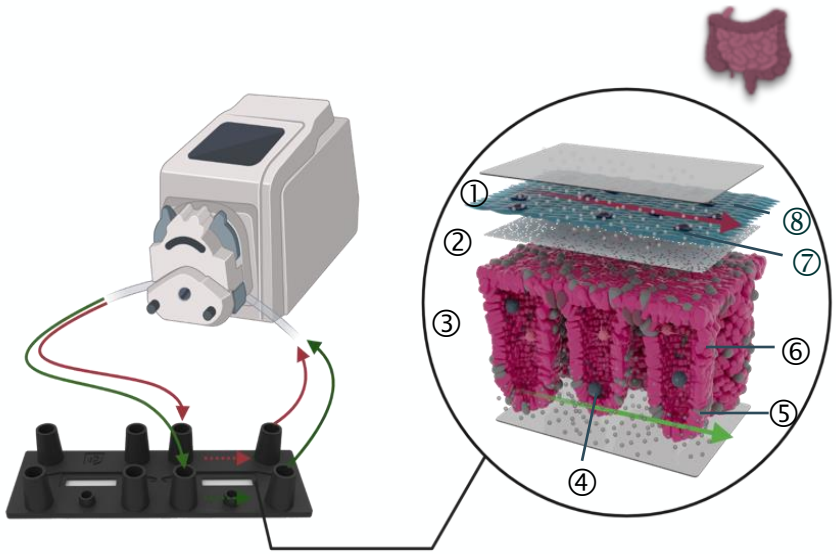
Application I:
Modeling microbial infection in intestine and lung systems

Dynamic42 Lung-on-Chip



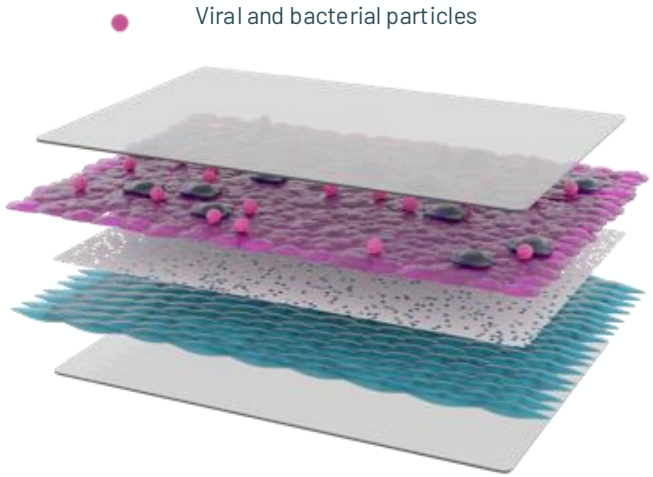
① Alveolar chamber
② Porous membrane
③ Vascular chamber
④ Pulmonary endothelial cells
⑤ Macrophages
⑥ Pulmonary epithelial cells

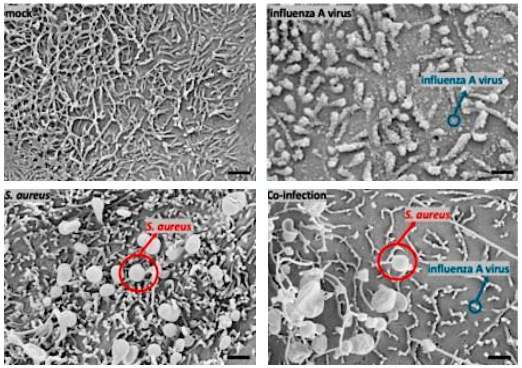
Gut-on-Chip

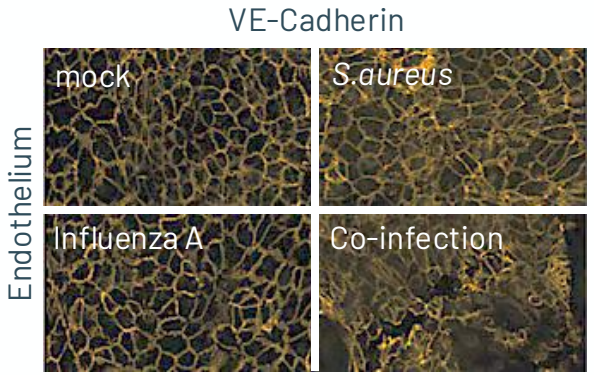


① Vascular compartment
② Porous membrane
③ Intestinal compartment
④ Tissue-resident immune cells
⑤ Goblet cells
⑥ Enterocytes
⑦ Macrophages
⑧ Endothelial cells

Modelling bacterial and viral co-infection

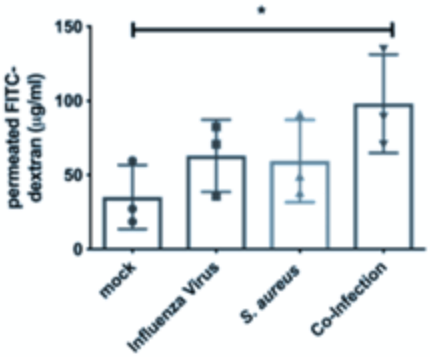






Infection schedule after 7 days at ALI mode:

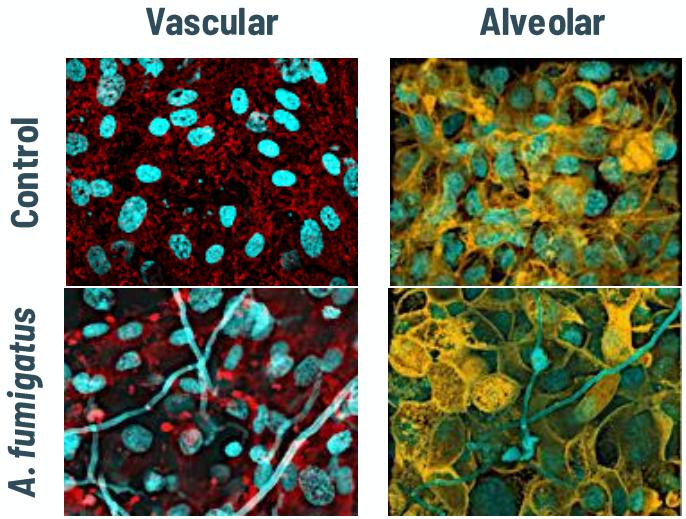
- 30 min Influenza A virus infection (MOI 1)
- 90 min *Staphylococcus aureus* infection (MOI 1)
- Total incubation time 2.5 h or 6.5 h

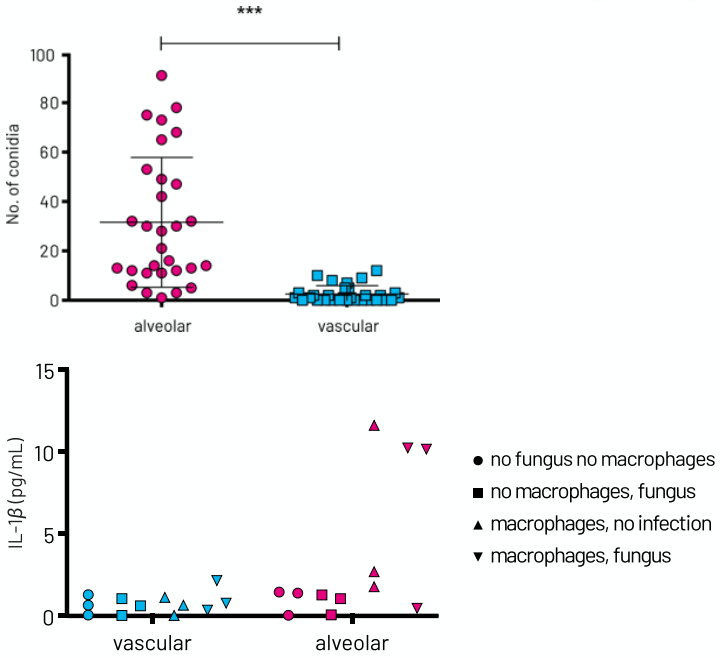


- Co-infection, but not single infection, of *S. aureus* and influenza A is ditrimental to the cellular barrier of the lung model

Deinhardt-Emmer et al., Biofabrication, 2020
Schicke et al., Microorganisms, 2020

Modelling fungal airway infection





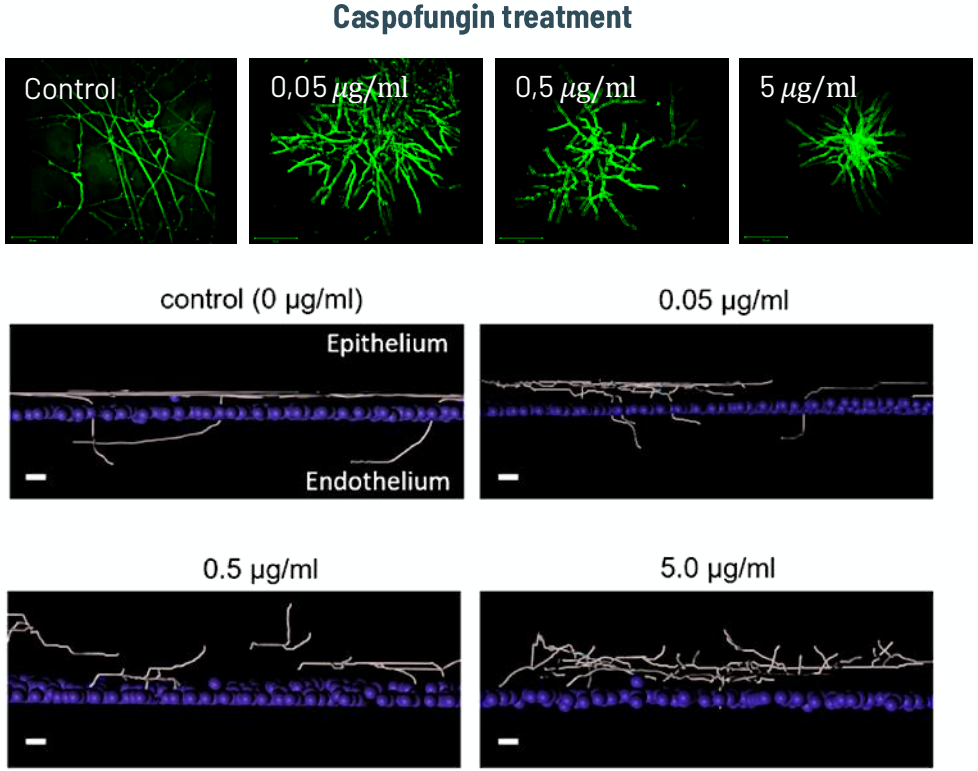
Dr. Mai Hoang

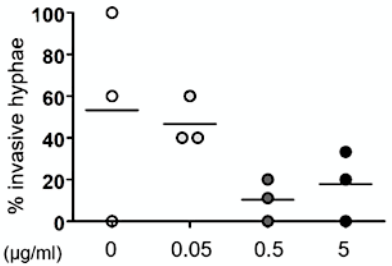
/ The model recapitulates crucial stages of *Aspergillus fumigatus* infection (attachment, hyphal germination, translocation)

/ Integrated macrophages are the main drivers of pro-inflammatory cytokine release upon fungal infection

Hoang et al., Biomaterials, 2022

Application of antifungal drug treatment





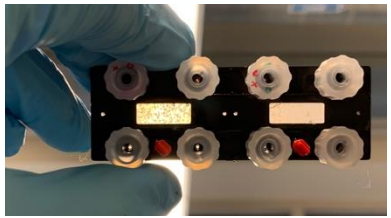
Dr. Mai Hoang

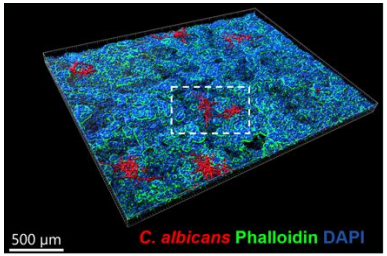
- Vascular administration of caspofungin reduces hyphal growth
- The model allows for testing of antifungal drug compounds in a human-relevant microenvironment

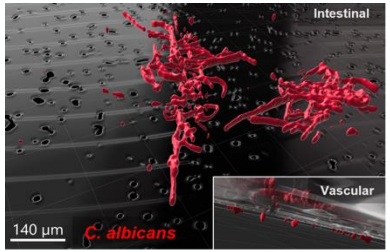
Purple spots: membrane pores
Grey lines: hyphae

Hoang et al., Biomaterials, 2022

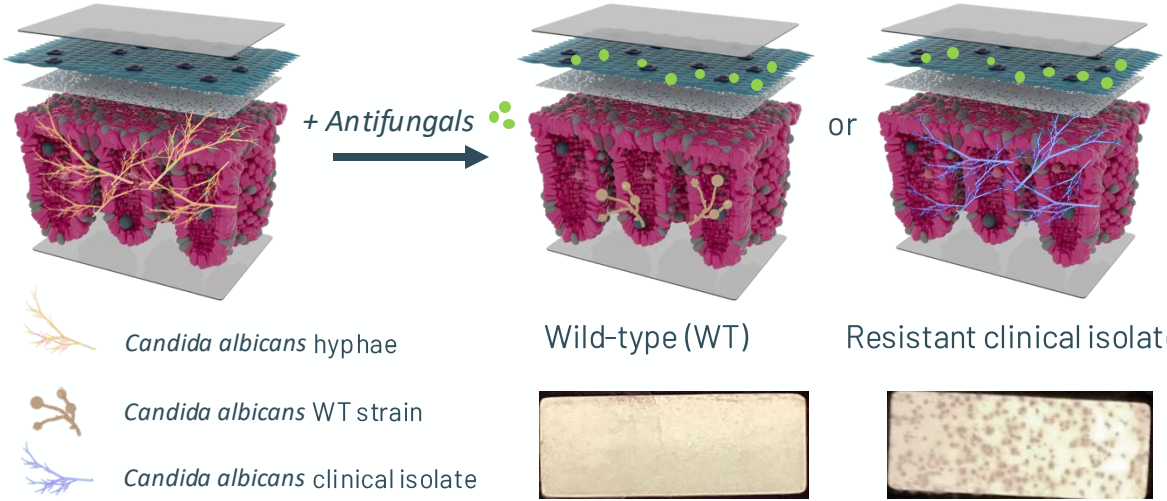
Modeling intestinal fungal infection

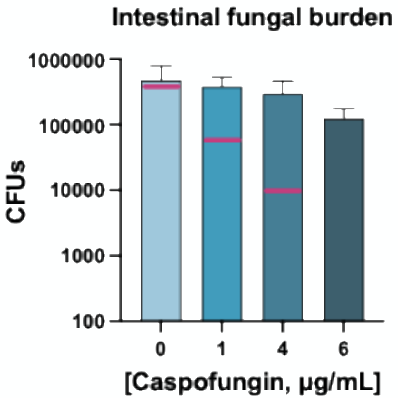






Tim Kaden

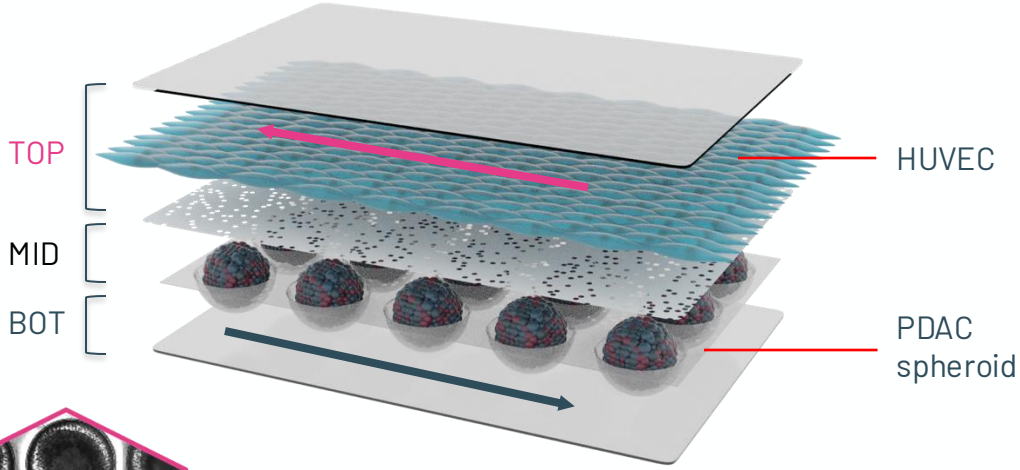


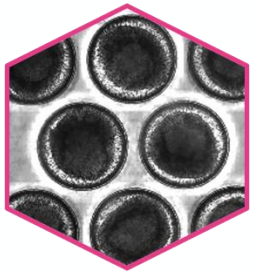


Kaden, Alonso-Roman, Akbarimoghaddam et al., Biomaterials, 2024

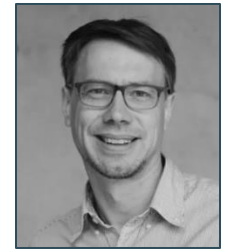
Application II:
Cancer-on-chip for immuno-oncoloy and drug testing

Dynamic42 PDAC-on-Chip

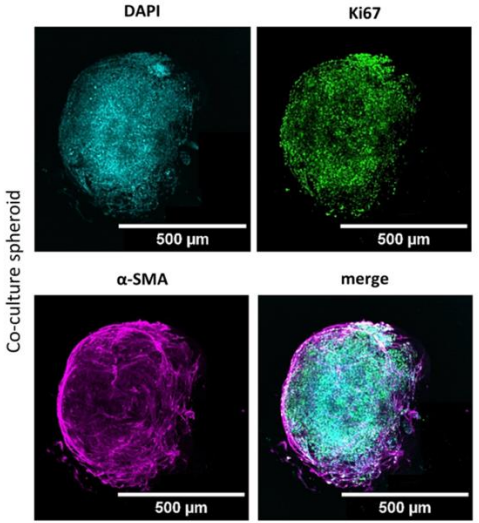




Spheroids in microcavities

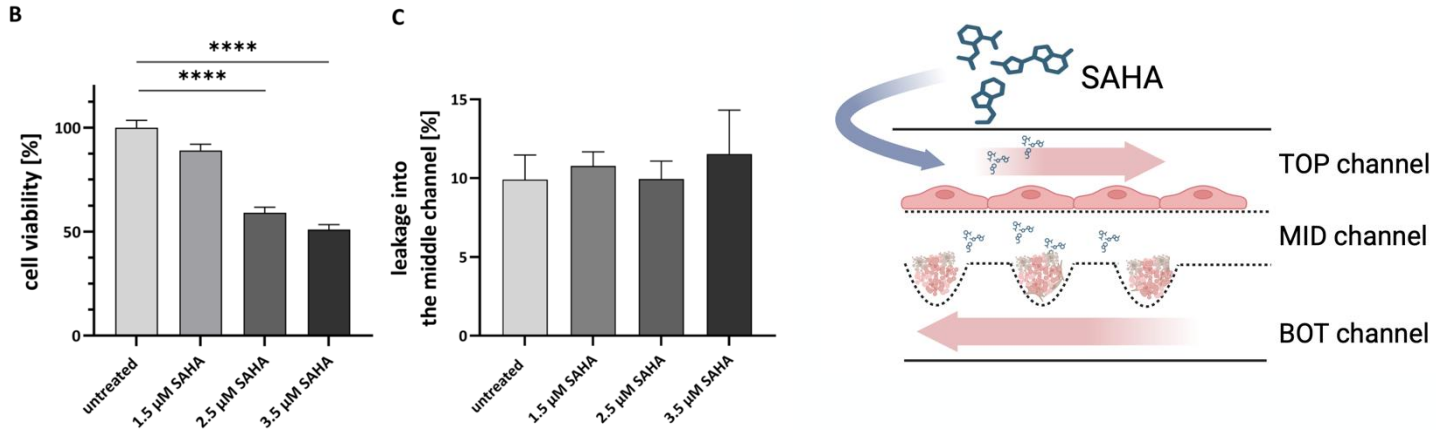


Dr. Tom Sommermann



Deipenbrock et al., Lab on a Chip, 2025

Tumor-on-chip for antitumor drug testing

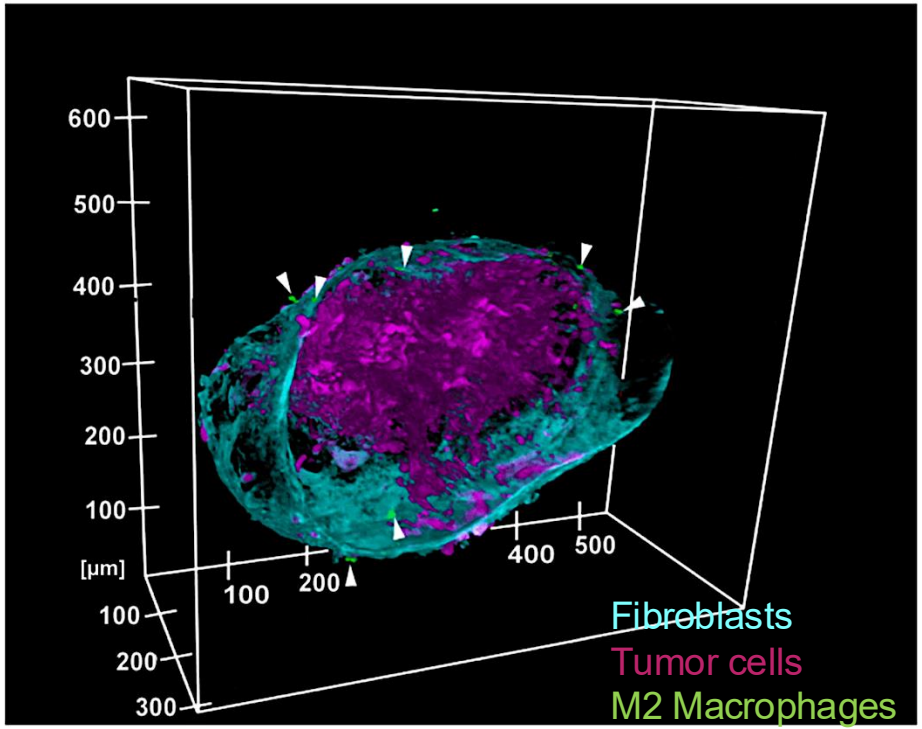


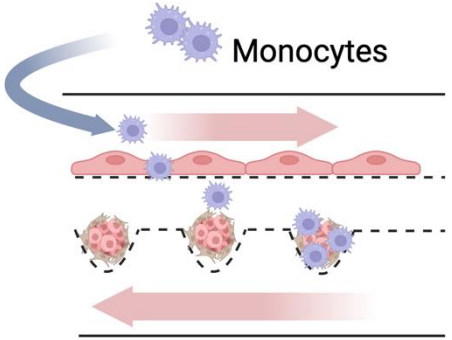
Dr. Tom Sommermann

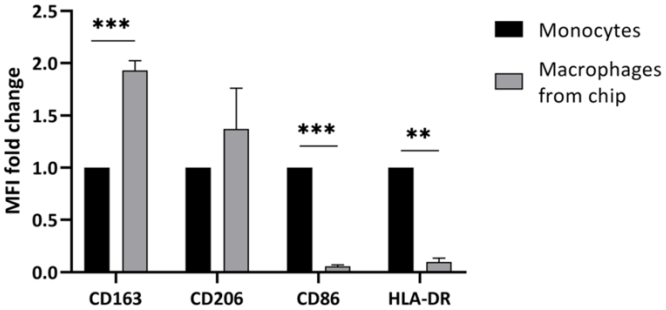
- SAHA administration for 72 h in the vascular channel decreases tumor spheroid viability in a concentration-dependent manner
- No impairment of the vasculature during SAHA treatment

Deipenbrock et al., Lab on a Chip, 2025

Tumor-on-chip for immuno-oncology







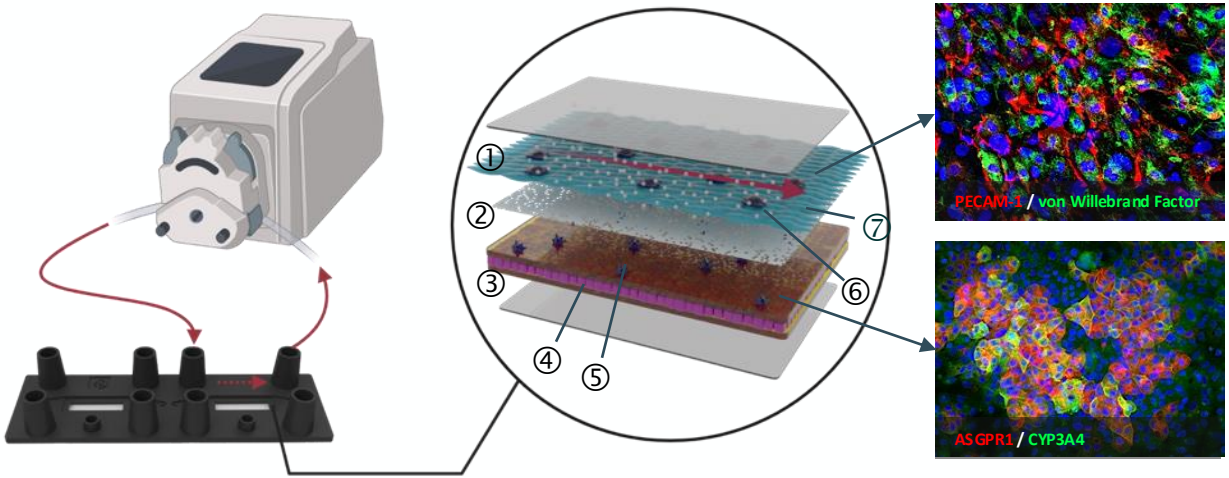
Dr. Tom Sommermann

Deipenbrock et al., Lab on a Chip, 2025

Application III: Investigation of drug-induced liver toxicity

Dynamic42 Liver-on-Chip

DYNAMIC42



① Vascular compartment

② Porous membrane

③ Hepatic compartment

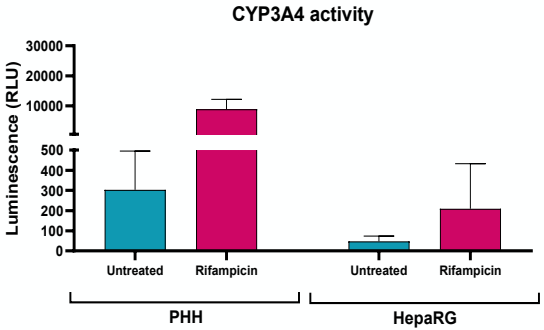
④ Hepatocytes

⑤ Optional: Hepatic stellate cells

⑥ Macrophages

⑦ Liver sinusoidal endothelial cells

Dr. Knut Rennert

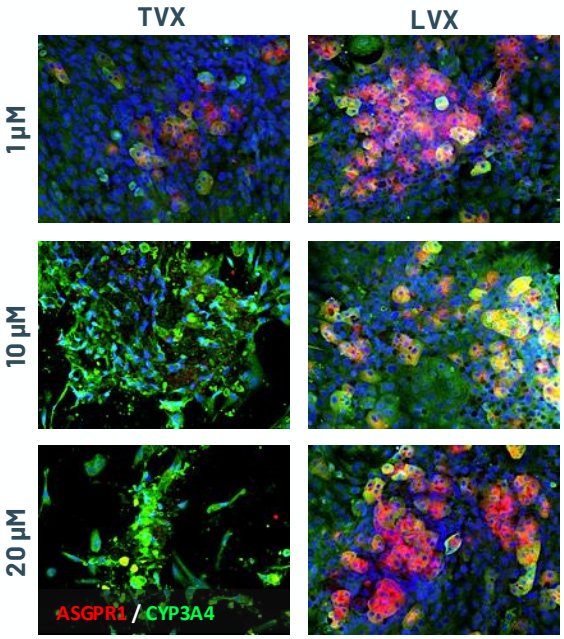


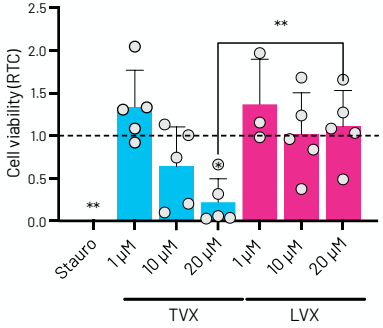
Rennert et al., Biomaterials, 2015

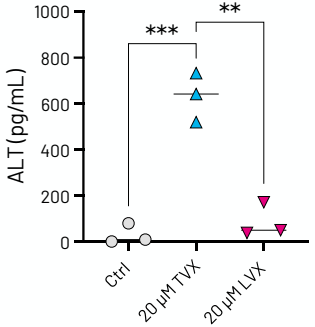
Evaluation of drug-induced liver injury (DILI)

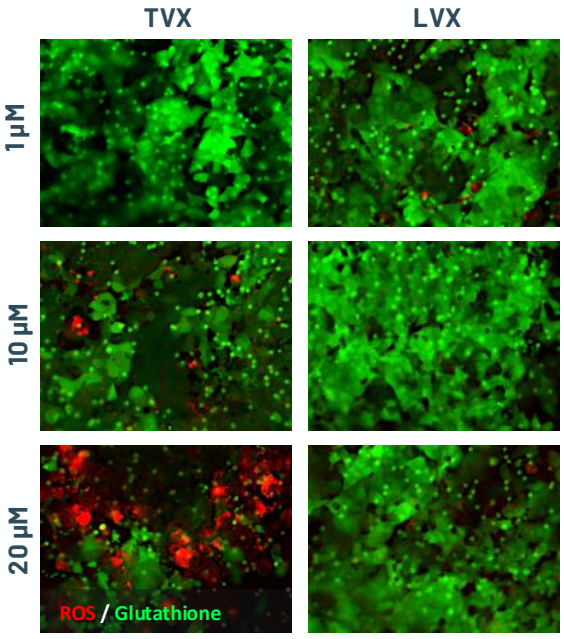
- Trovafloxacin (TVX), a broad-spectrum fluoroquinolone was withdrawn from market after causing unexpected side effects of severe hepatotoxicity, which was not detected during preclinical testing
- The D42 liver model enables the investigation of vascular and hepatocellular toxicity of various drug compounds

Tim Kaden







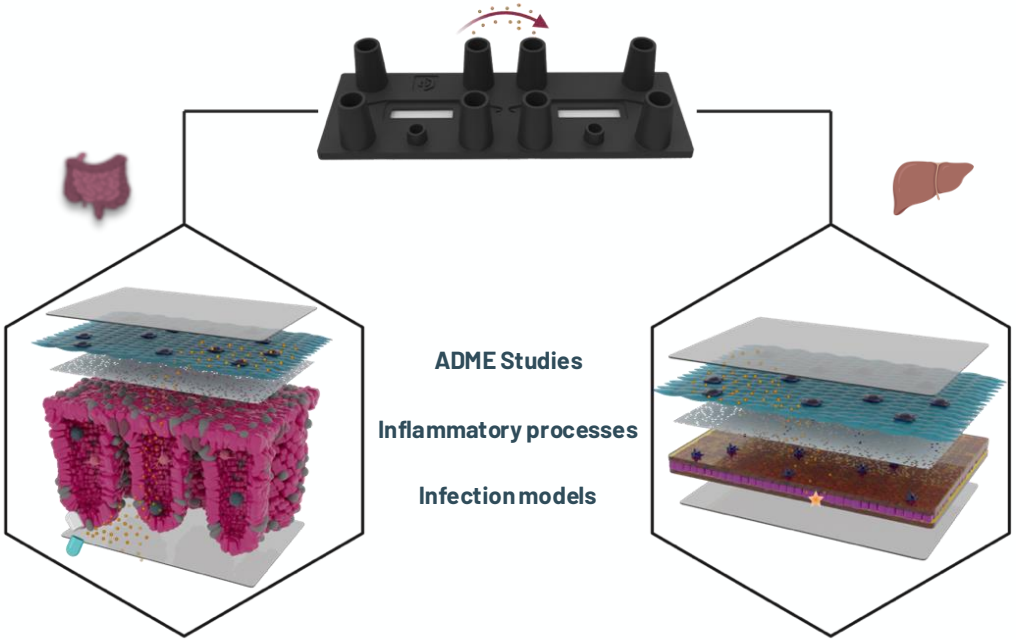


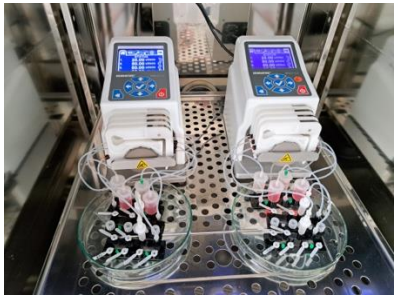
Kaden et al., Nature Scientific Reports, 2023

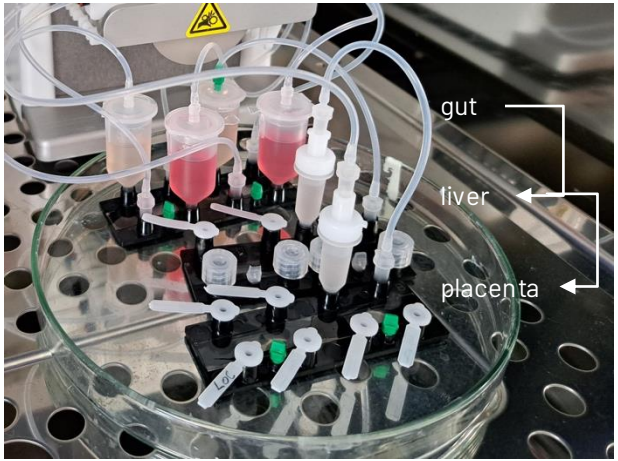
Outlook and future considerations

Multi-organ models

e.g. gut-liver, gut-liver-placenta, lung-liver



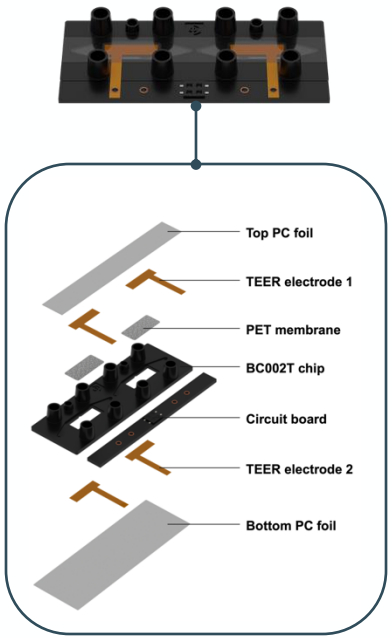


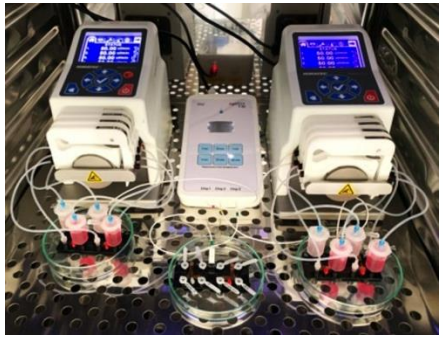


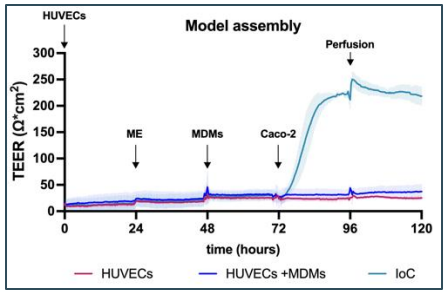
Graf et al., Frontiers in Pharmacology, 2025

Sensor integration and real-time measurement

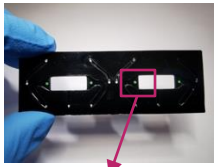
TEER electrodes for measurement of barrier integrity

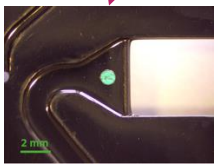


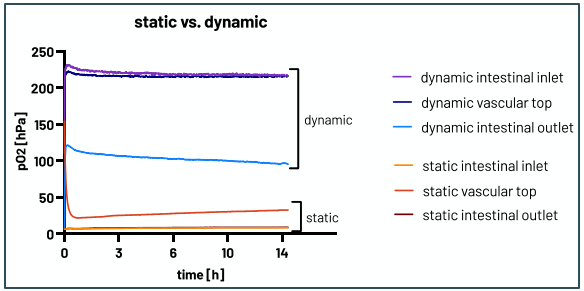




Sensors for oxygen monitoring





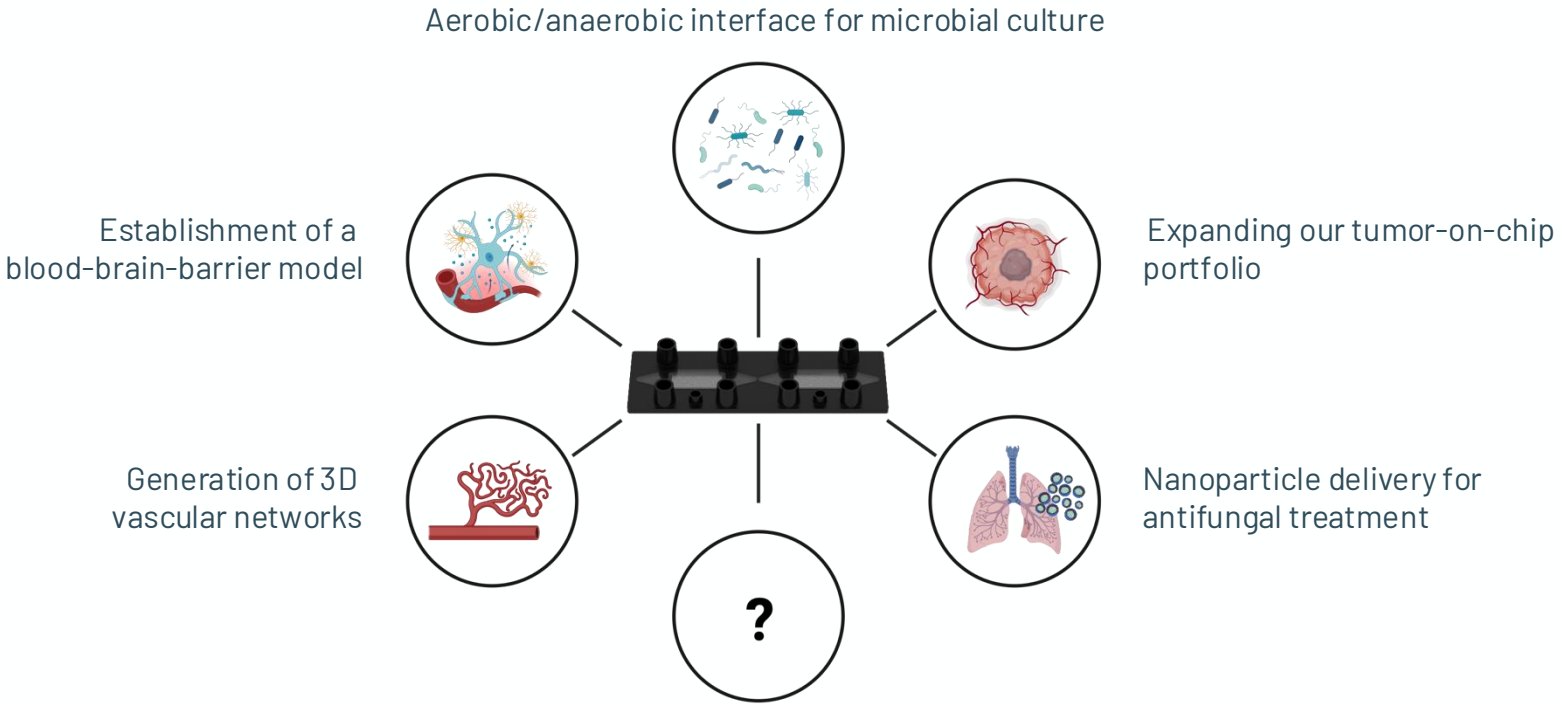


Tim Kaden

Sophie Besser

Kaden et al., BioRxiv, 2025

Ongoing projects and developments at Dynamic42



Your model or application?

How can you benefit from Dynamic42 models?

- Complex disease and infection models
- Immunocompetent organ models
- Human relevant data for advanced preclinical research
- Vascularization and biomechanical stimulation through flow
- Models are customizable and scalable in biological complexity
- Fewer animal studies - less paperwork, quicker results

Our organ models enable human-relevant research for meaningful clinical insights and outcomes, while reducing animal use!

DYNAMIC42

Thank you for your attention!

Dynamic42 website

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Scientific references

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Illustrations were created with BioRender.com