

Fraunhofer IWS

RadioPK Multi-Organ Chip

Human organ models in one circulation for radiopharmaceutical testing

Radiopharmaceuticals have to be tested before approval – so far almost exclusively in animal studies. Our multi-organ chip connects human cell models of tumor, liver and kidney in a closed circulation. This makes it possible to follow the biodistribution of a radiopharmaceutical in vitro, organ by organ and without animals. The technology is patent pending and has been validated with the reference tracer [^{18}F]FDG.

The challenge

Before clinical use, new radiopharmaceuticals must be characterized for their biodistribution: How strongly do they accumulate in the tumor, how are they metabolized in the liver, how are they excreted by the kidney? The standard method is the animal study – laborious, slow, ethically controversial and only partly transferable to humans.

Animal studies need long lead times and approvals, are costly and face growing social and regulatory pressure (3R). Available organ-on-chip systems are expensive, complex to operate and usually model only one organ – for radiopharmaceuticals, only uptake tests on single organs exist so far.

Our solution

Human cell models of tumor, liver and kidney sit in separate chambers of one chip. A microchannel circuit connects them and distributes the perfusion to the organs in physiologically derived proportions – like the bloodstream in the body.

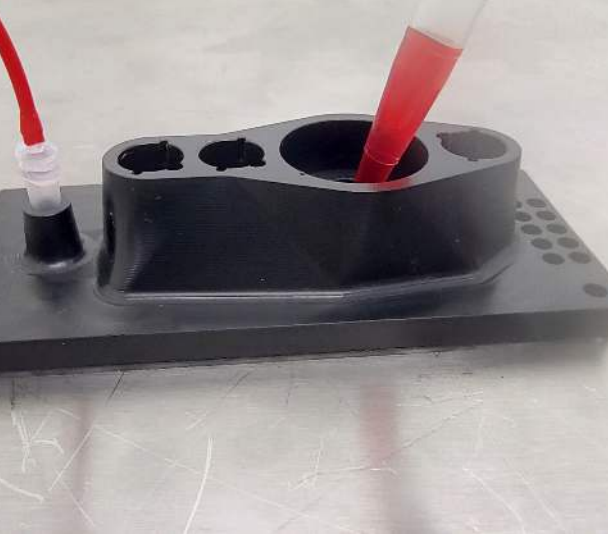
1. Pipette cell culture medium into the chip and insert the organ models
2. Connect the chip to the control unit and run it in the incubator
3. Add the radiopharmaceutical and measure its distribution, e.g. by phosphor imaging

The measured flow distribution deviates from the design value by **less than 1 percentage point** in all compartments. After 60 minutes of perfusion, [^{18}F]FDG has accumulated specifically at the organ models.

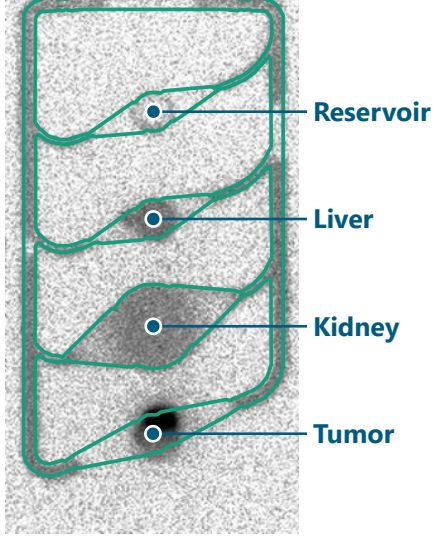
Contact

Dr. Florian Schmieder
Group Manager
Biosystems Engineering and Digitalization
Phone +49 351 83391-3520
florian.schmieder@iws.fraunhofer.de

Fraunhofer IWS
Winterbergstraße 28
01277 Dresden
www.iws.fraunhofer.de







Advantages

- Biodistribution testing without animal studies
- Human cell models instead of animal models
- Tumor, liver and kidney in one circulation
- Single-use chip: no cleaning, no carry-over of radioactive residues
- Compatible with phosphor imaging and microscopy, SBS format
- Modular: chambers for your own cell models and organoids

Applications

- Preclinical biodistribution of new radiotracers
- ADMET and toxicity screening
- Organoids and organ interaction

Technical data

- Compartments: tumor, liver, kidney and "rest of body" reservoir
- Material: thermoplastic, black, transparent bottom foil
- Dimensions: 82.5 × 36 mm, three chips in SBS format
- Culture time: ≥ 3 days, target 14 days
- Operation in a standard incubator, 35–39 °C
- Sterile packed, research use only
- Patent applications DE 10 2023 210 990 and DE 10 2023 209 605

Left
Insert the organ models, fill and connect the chip – with standard laboratory tools.

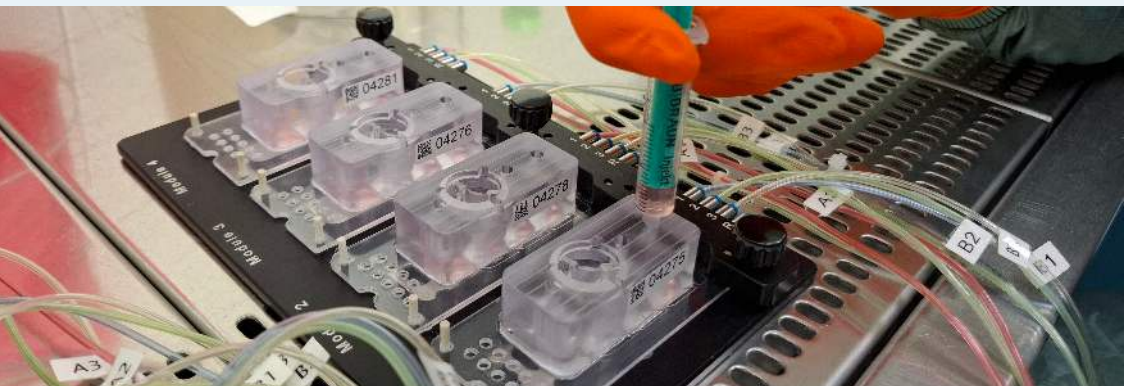
Center
Built for everyday lab work: sterile packed, individually labeled, ready for the bench.

Right
Phosphor imaging after 60 min of perfusion: [^{18}F]FDG accumulates at tumor, liver and kidney (previous chip model, channel layout overlaid).

Validated with [^{18}F]FDG – together with HZDR

Static uptake assay | ~0.25 MBq per well | 1 h | 37 °C

Organ model	Cell model	Uptake (pmol/mg)
Tumor	A431 spheroids	**106.1 ± 5.7**
Kidney	RPTEC-TERT1	**44.3 ± 3.8**
Liver	HepG2 spheroids	**32.2 ± 4.8**



Test with us

Are you developing or testing radiopharmaceuticals? Test your tracer together with us on the multi-organ chip.
s.fhg.de/radiopk

Supported by the Fraunhofer High Performance Center Smart Production and Materials.

LEISTUNGSZENTRUM SMART Production Materials

Images: © Fraunhofer IWS / Hedvika Maxová. Phosphor imaging: Fraunhofer IWS / HZDR. Data: Petzold et al., Curr. Dir. Biomed. Eng. 12 (2026) 391–394, doi:10.1515/cdbme-2026-0199.