Ready-to-use Organ-on-a-Chip (OoC) *in vitro* models

Bacterial dynamics

No man is an island – single isolate research should be combined with its community.

In vivo and *in vitro* to explain causality

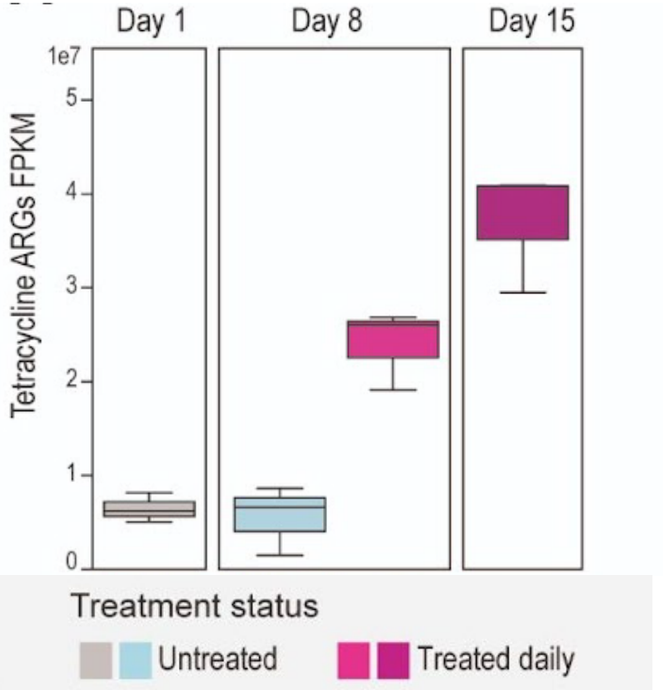
In Vivo models for microbiomes, cockroaches:

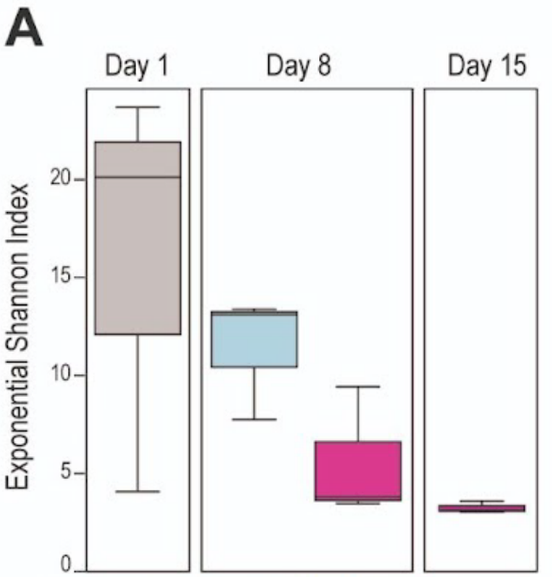
Cockroach microbiomes
(*Pycnoscelus surinamensis*)

Treated and untreated populations – various frequency and concentrations of antibiotics.

Increased Tet resistant with treatment.

Diversity changes same way.





Bogri et al 2024

In vivo in cows: *Escherichia coli* dynamics in ruminants

artificial inoculation of *E. coli* mix in calves

TV2 (NJ – 10 calves)

TV2.2 (GWAS – 9 calves)

With FLI: Chris Berens & Christian Menge
INRAE: Panos Sapountzis

In vivo is VERY expensive
Facility
Ethical approvals
.
.
.

artificial inoculation *E.coli* mix

ctrl vs ceftiofur

ctrl vs ceftiofur

3w

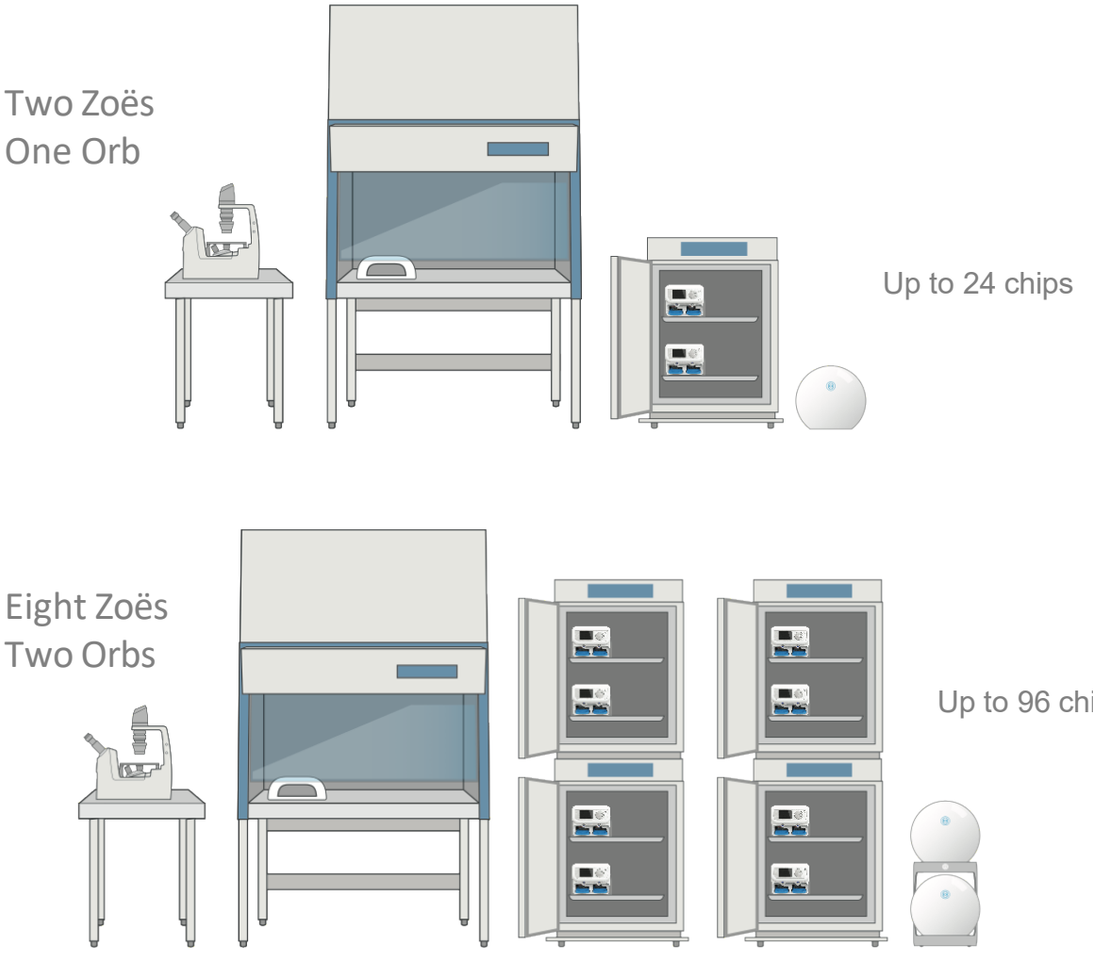
5w

2 types of *E.coli* cocktails - different colonization properties (GWAS *vs* NJ)

Microbiome changes

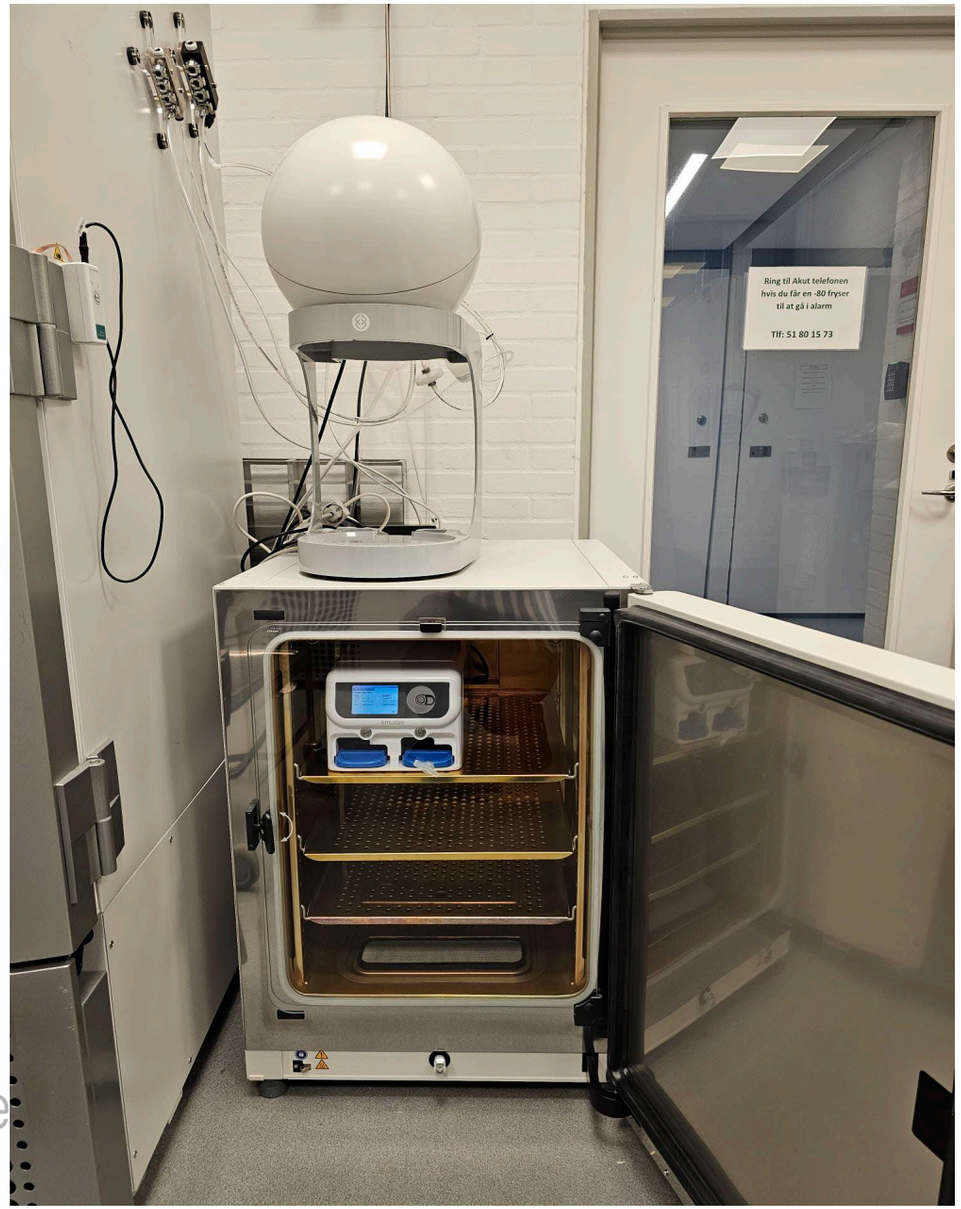
In Vitro: OoC Emulation System

- One ORB can power up to 4 ZOËs.
- One ZOË can support up to 12 chips.

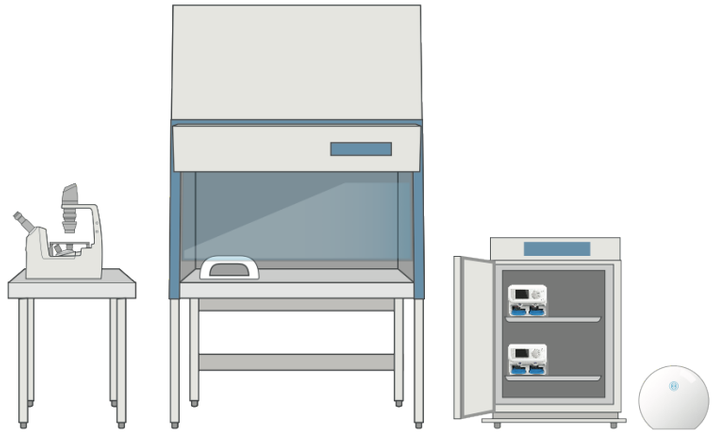


emulate

OoC Emulation System

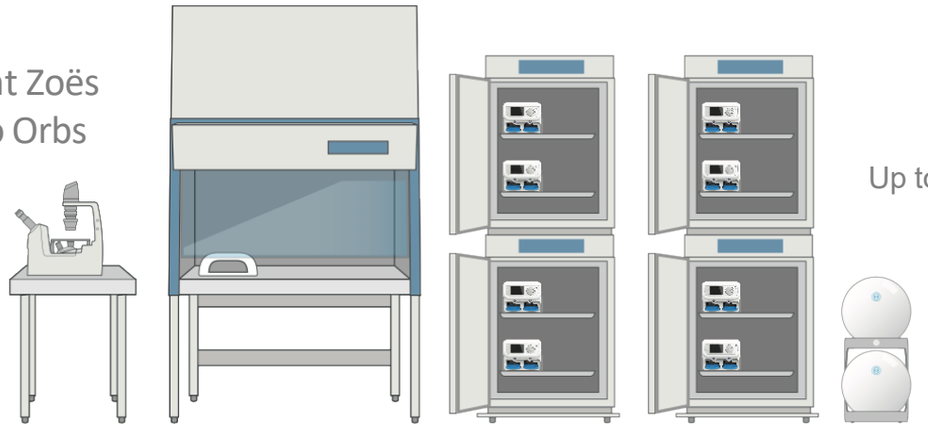


Two Zoës
One Orb



Up to 24 chips

Eight Zoës
Two Orbs



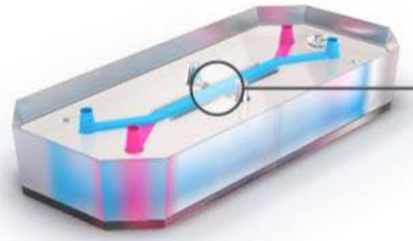
Up to 96 chips

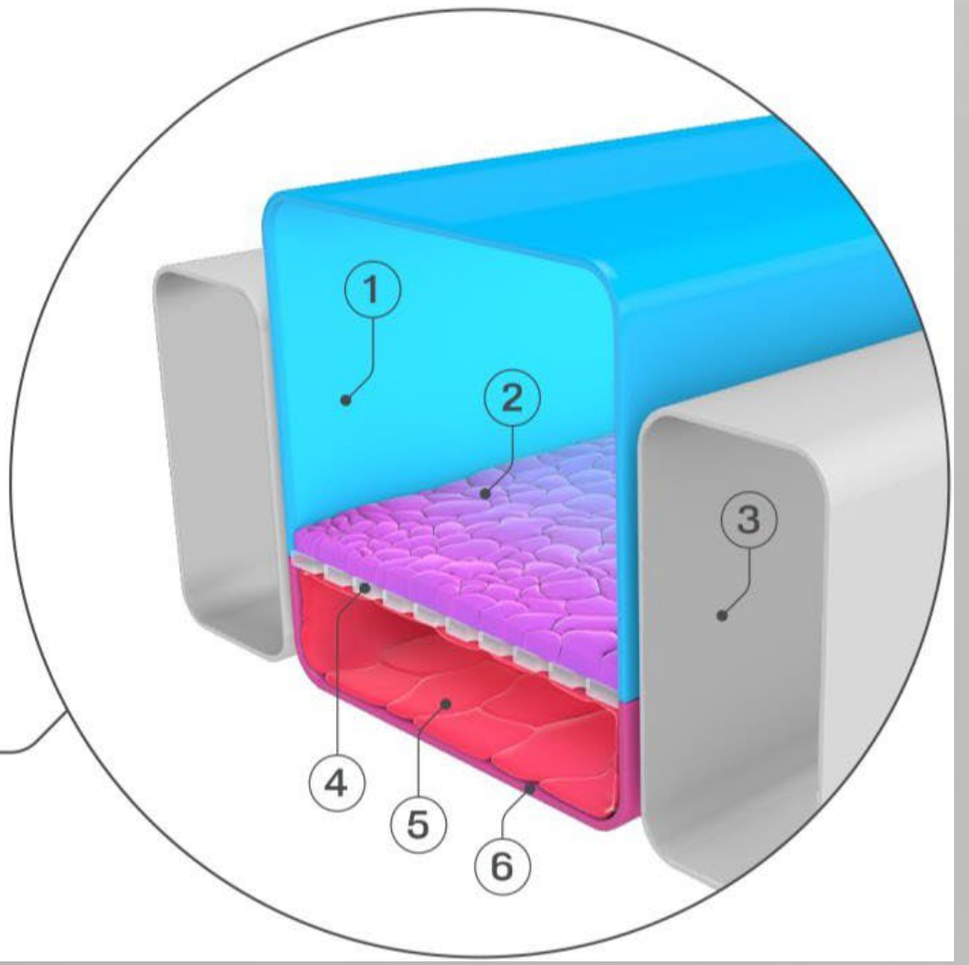
HUMAN EMULATION SYSTEM™

CHIP-S1™

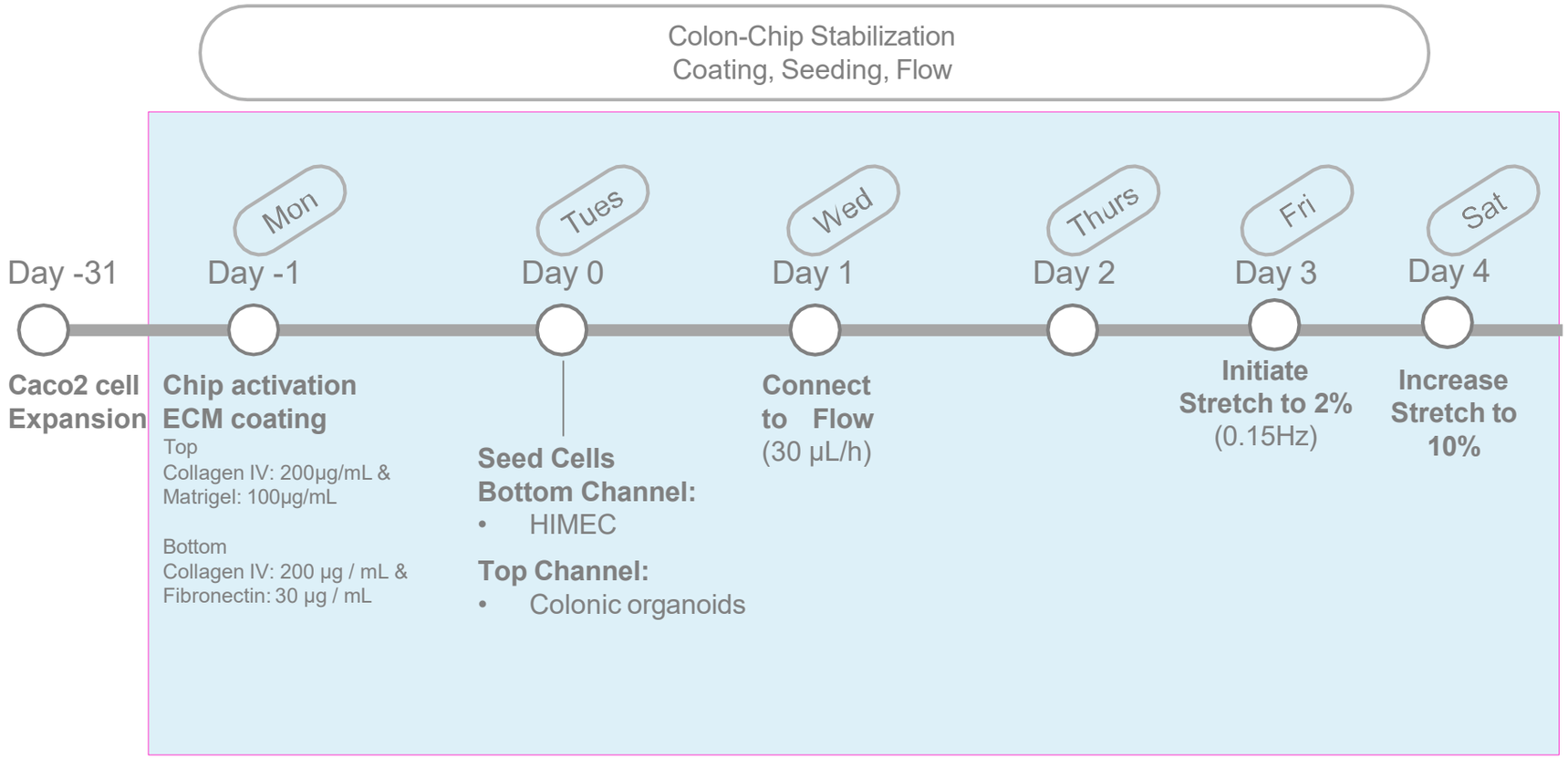
stretchable chip

1. Epithelial Channel
2. Human Epithelial Cells
3. Vacuum Channel
4. Membrane
5. Human Endothelial Cells
6. Endothelial Channel





Experimental Design – Colon Intestine-Chip



Alot of cell handeling

emulate

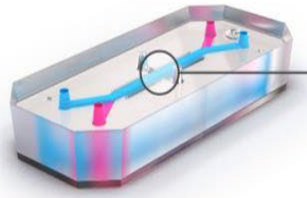
Day 2

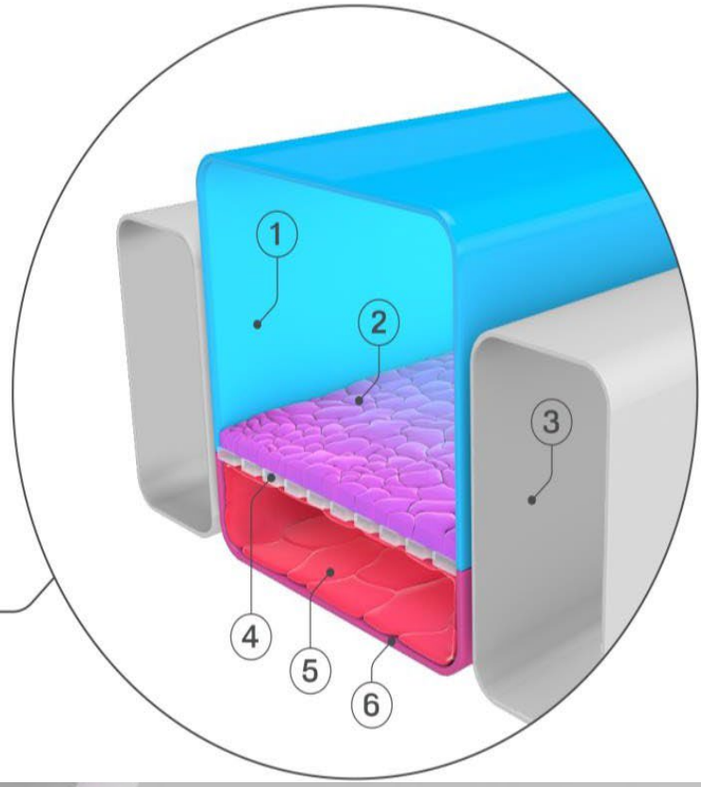
HUMAN EMULATION SYSTEM™

CHIP-S1™

stretchable chip

1. Epithelial Channel
2. Human Epithelial Cells
3. Vacuum Channel
4. Membrane
5. Human Endothelial Cells
6. Endothelial Channel





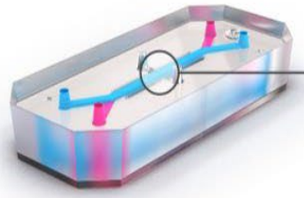
Day 8

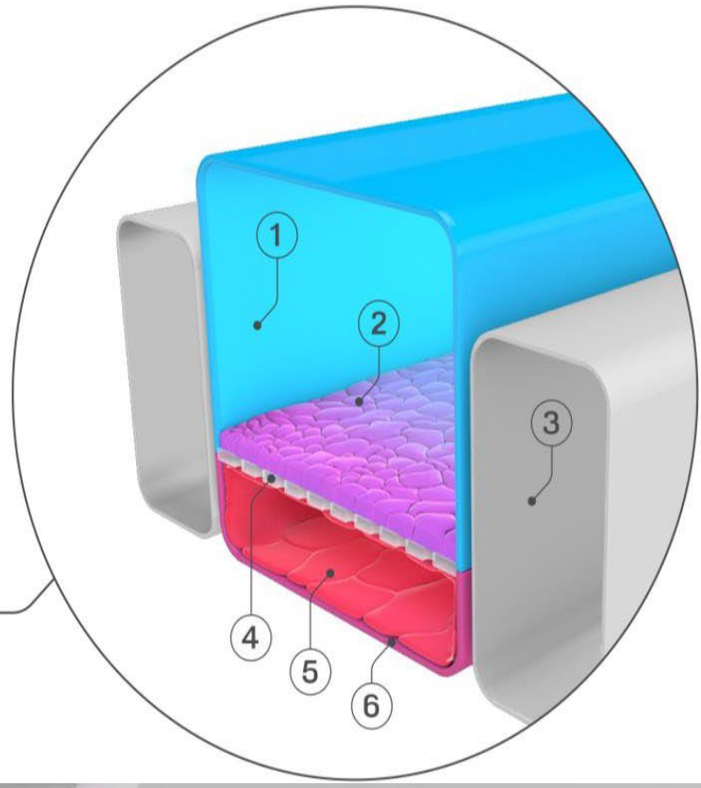
HUMAN EMULATION SYSTEM™

CHIP-S1™

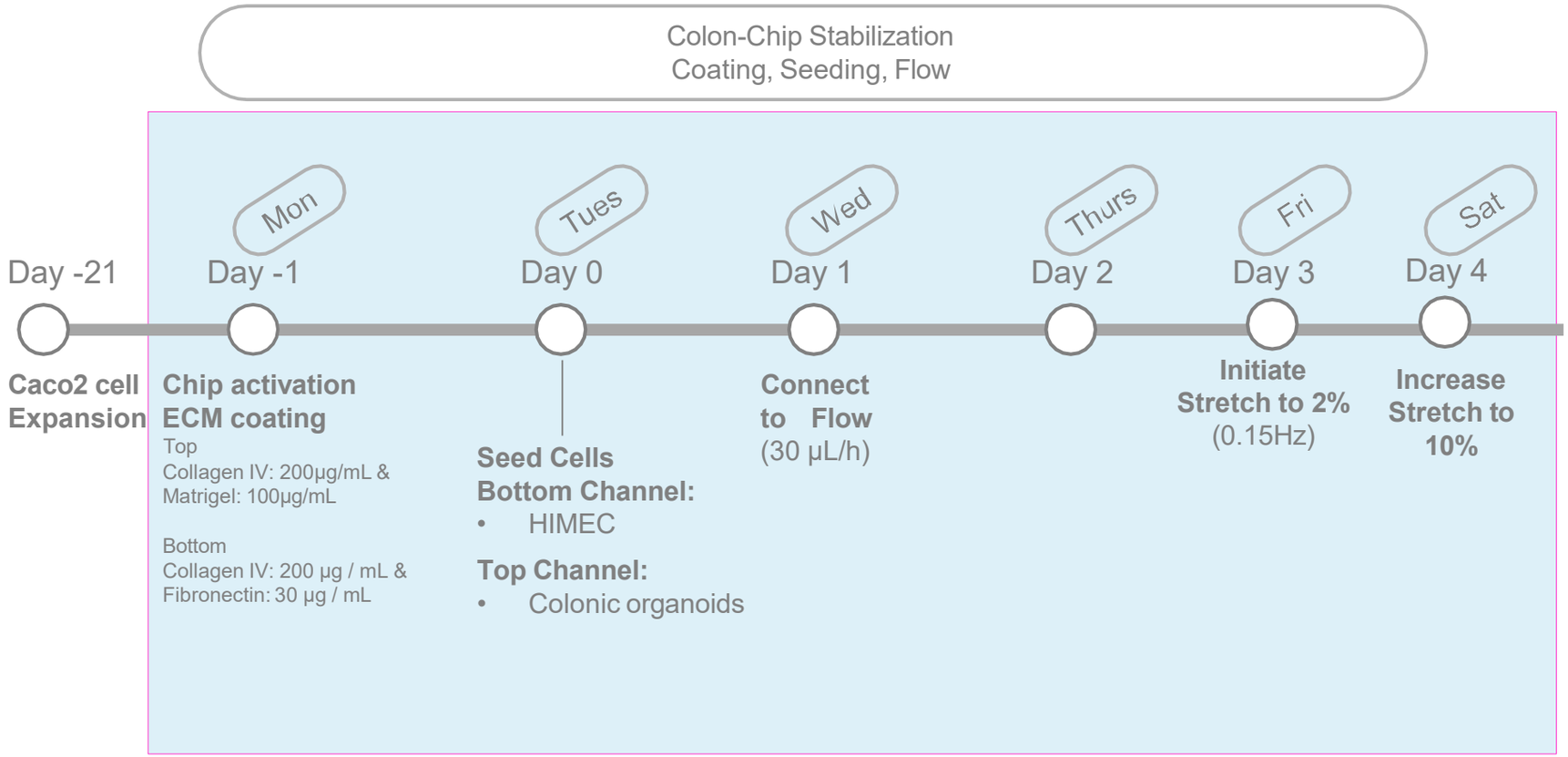
stretchable chip

1. Epithelial Channel
2. Human Epithelial Cells
3. Vacuum Channel
4. Membrane
5. Human Endothelial Cells
6. Endothelial Channel





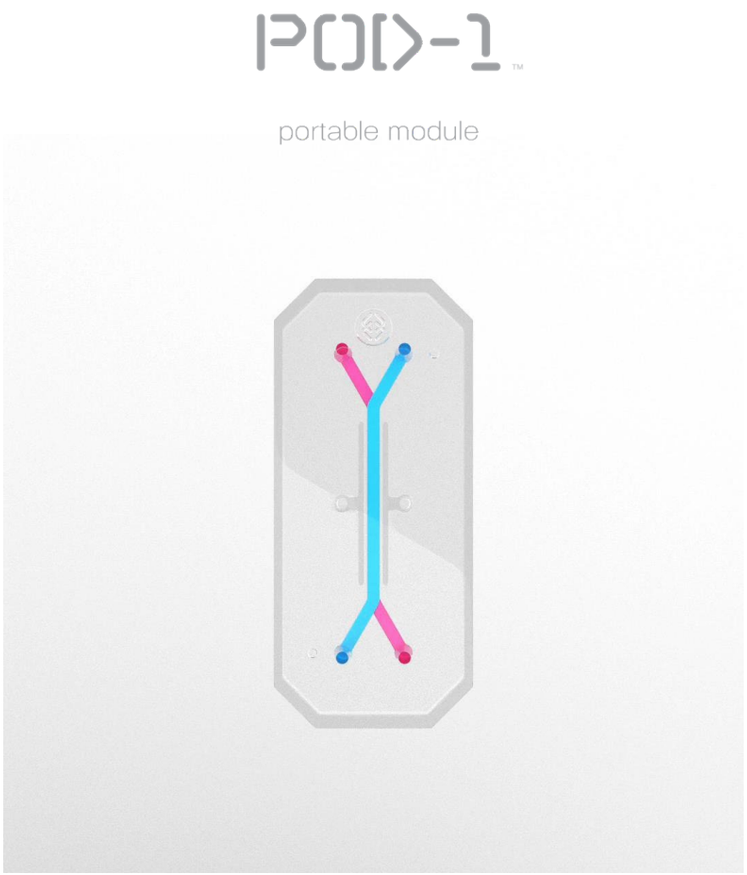
Experimental Design – Colon Intestine-Chip

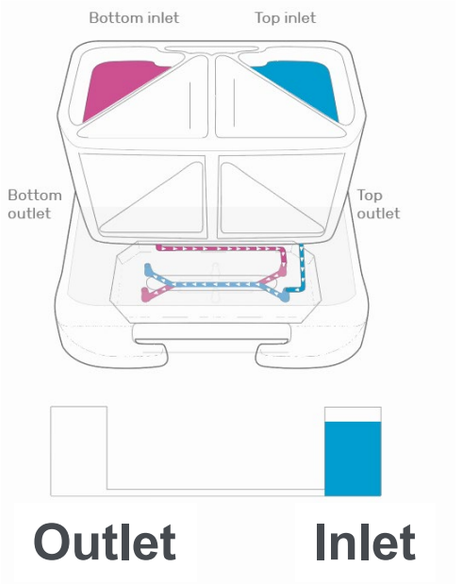


Alot of cell handeling

emulate

Pod Portable Module –
Unidirectional Media Flow & Effluent Sampling



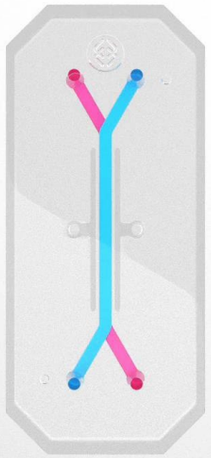


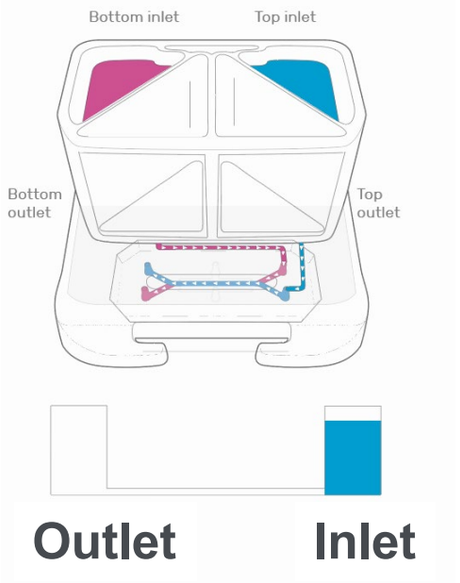
emulate

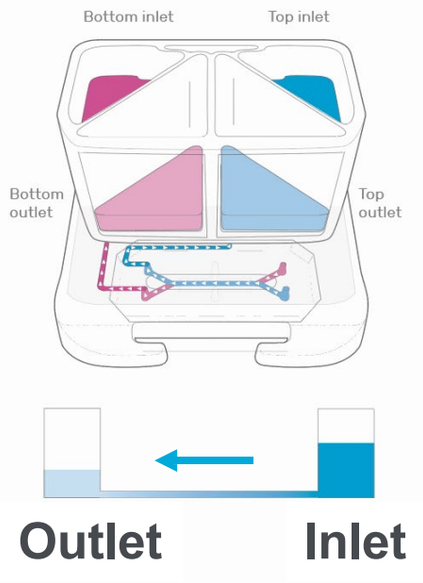
Pod Portable Module –
Unidirectional Media Flow & Effluent Sampling

POD-1™

portable module

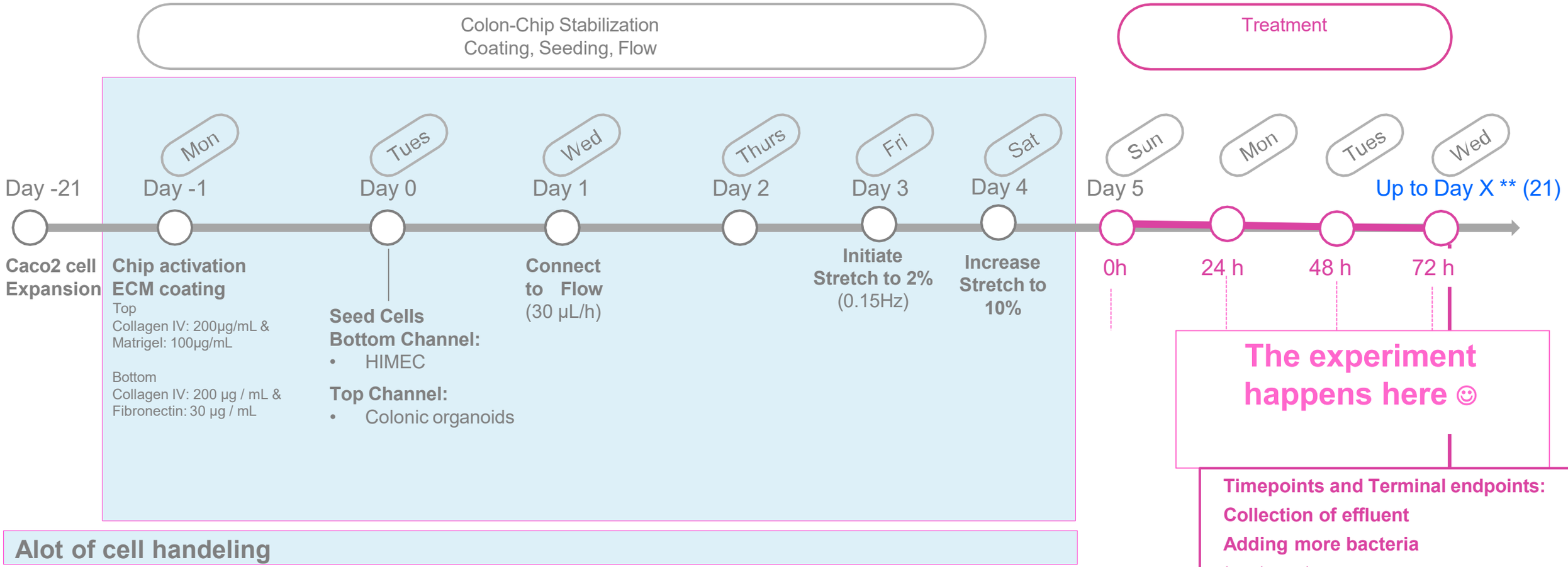






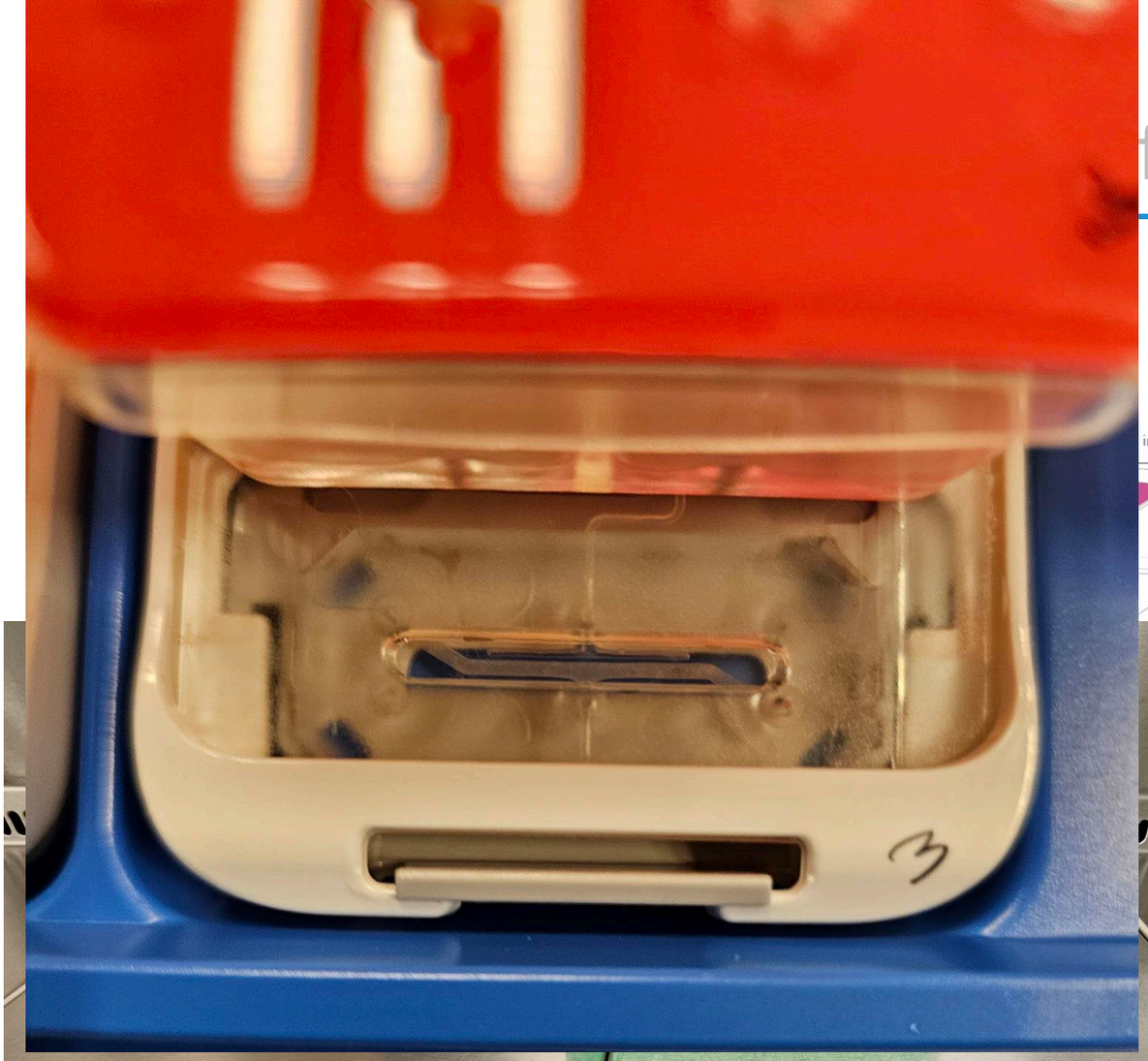
emulate

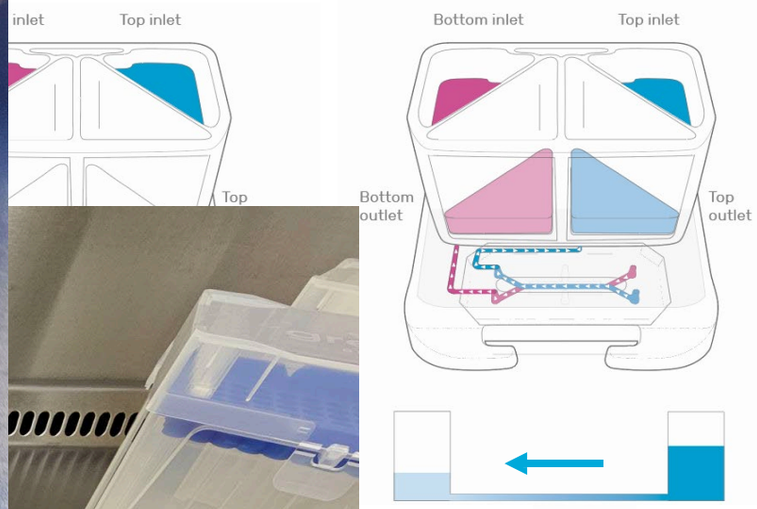
Experimental Design – Colon Intestine-Chip

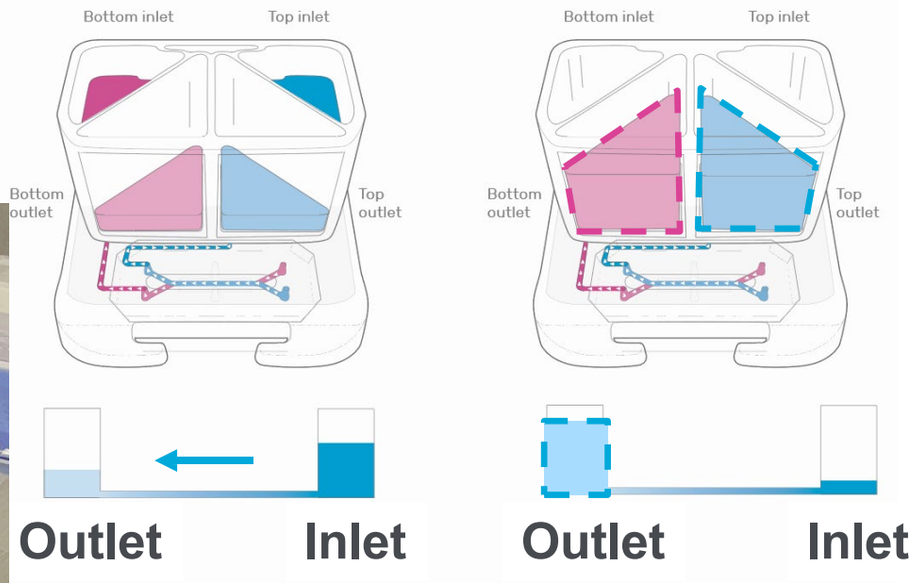


** Longevity of chip varies from cell donor to another

ffluent Sampling



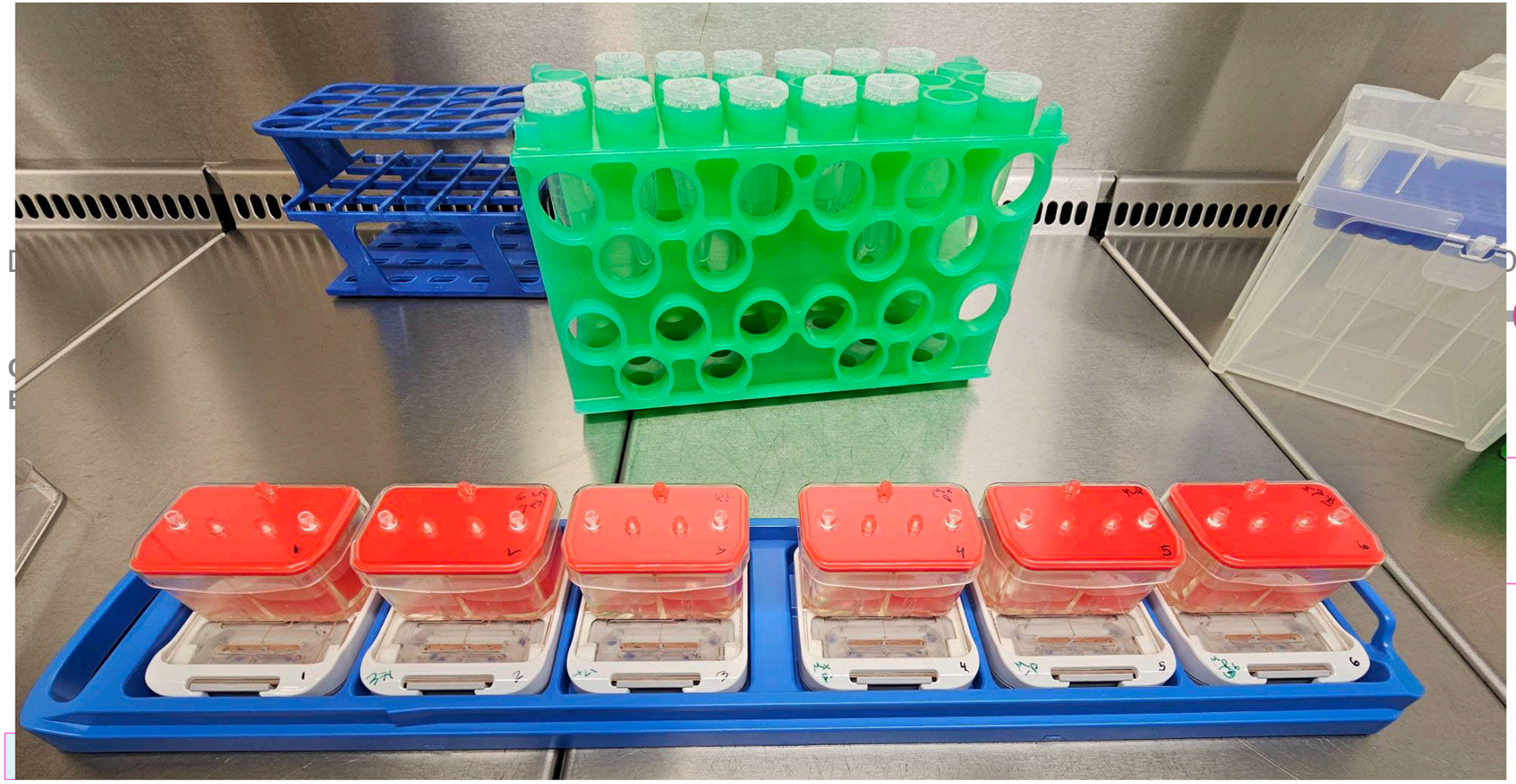


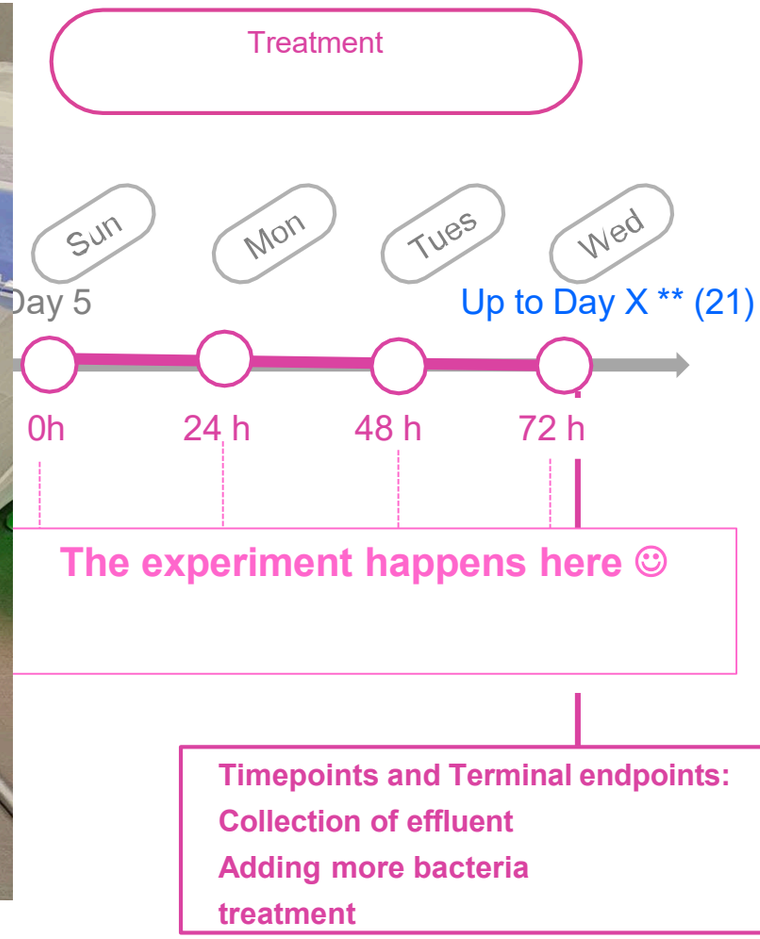


Effluent Analysis

Cytokine Release
Metabolomics Functional/Injury
secreted markers
Bacterial community and
microbiome

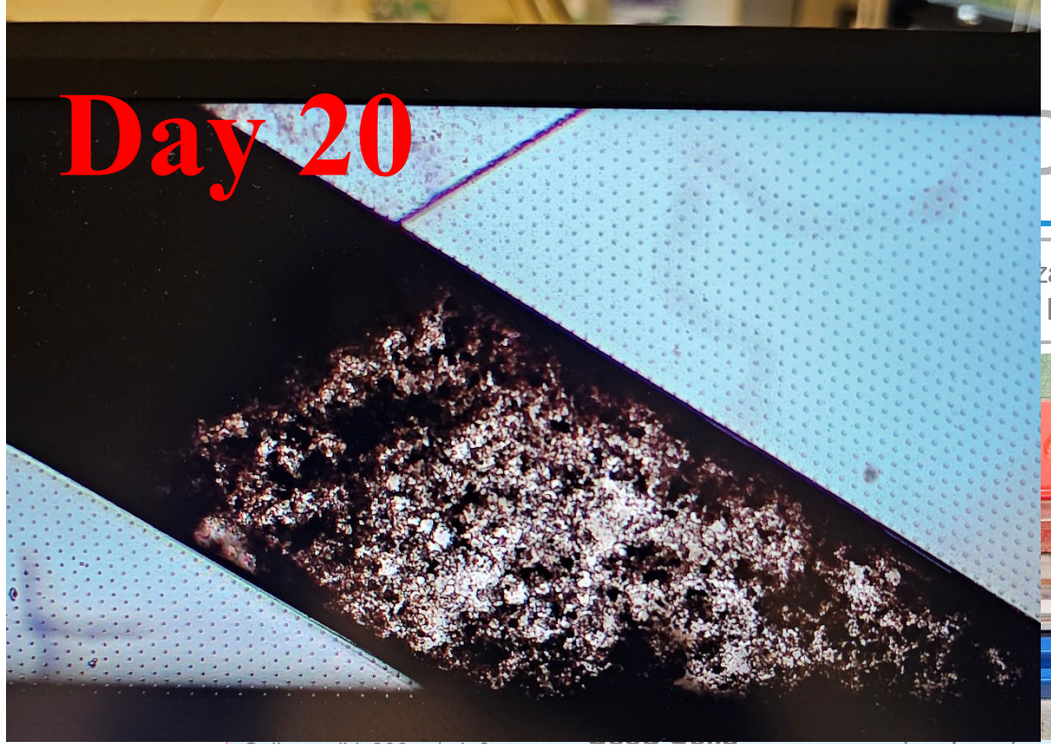
Experimental Design – Colon Intestine-Chip





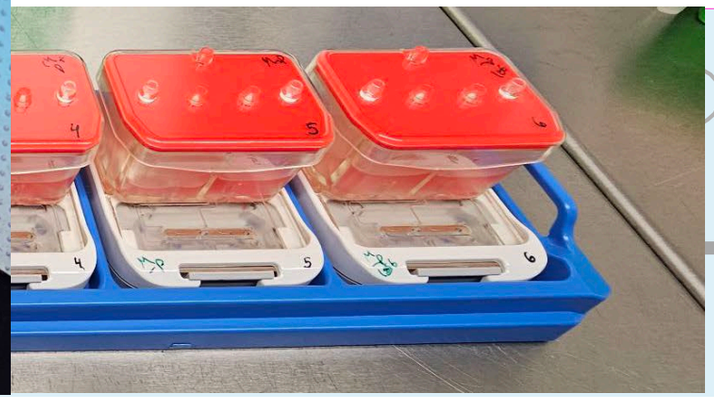
Trial 1: control – *E. coli* wt – *E. coli* cip resis. – (*Lactobacillus, Collinsella, E. faecium, Eubacterium*. con.1) - (*Lactobacillus, Collinsella, E. faecium, Eubacterium.* con.2) - (*Lactobacillus, Collinsella, E. faecium, Eubacterium, Pseudomonas*).

** Longevity of chip varies from cell donor to another

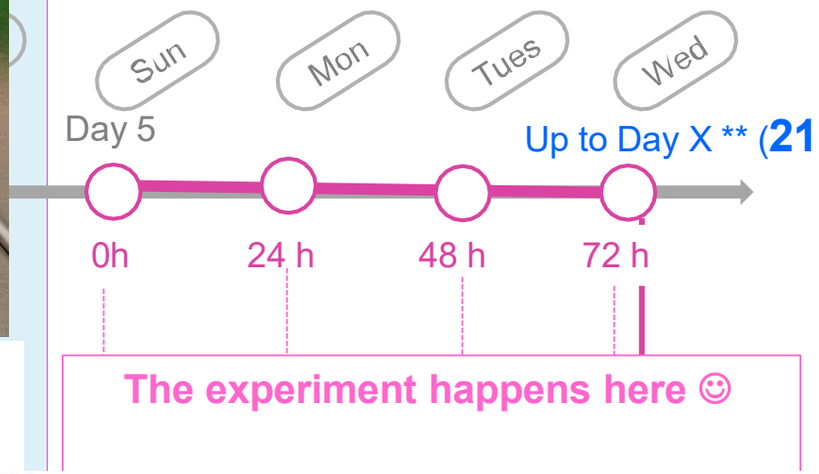


Colon Intestine-Chip

zation
Flow



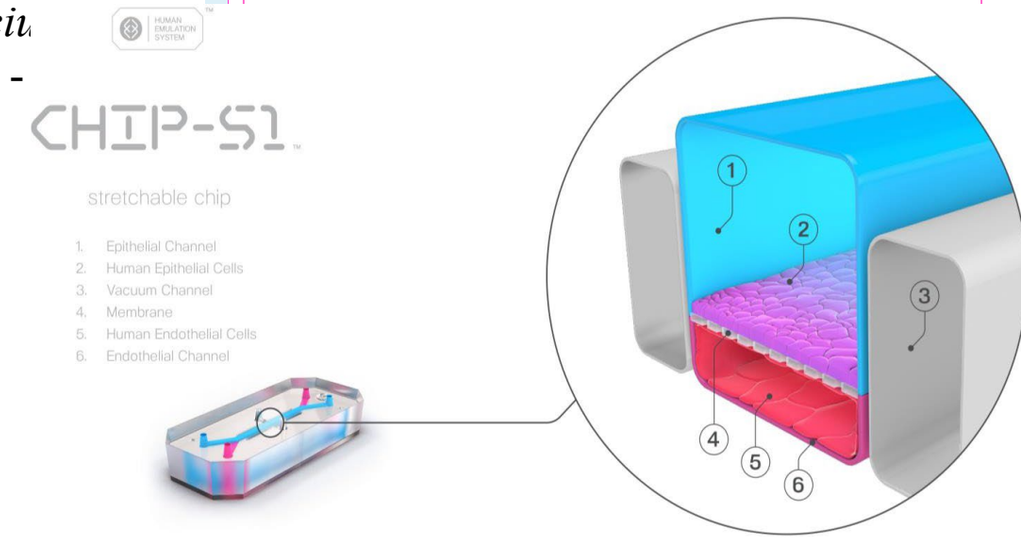
Treatment

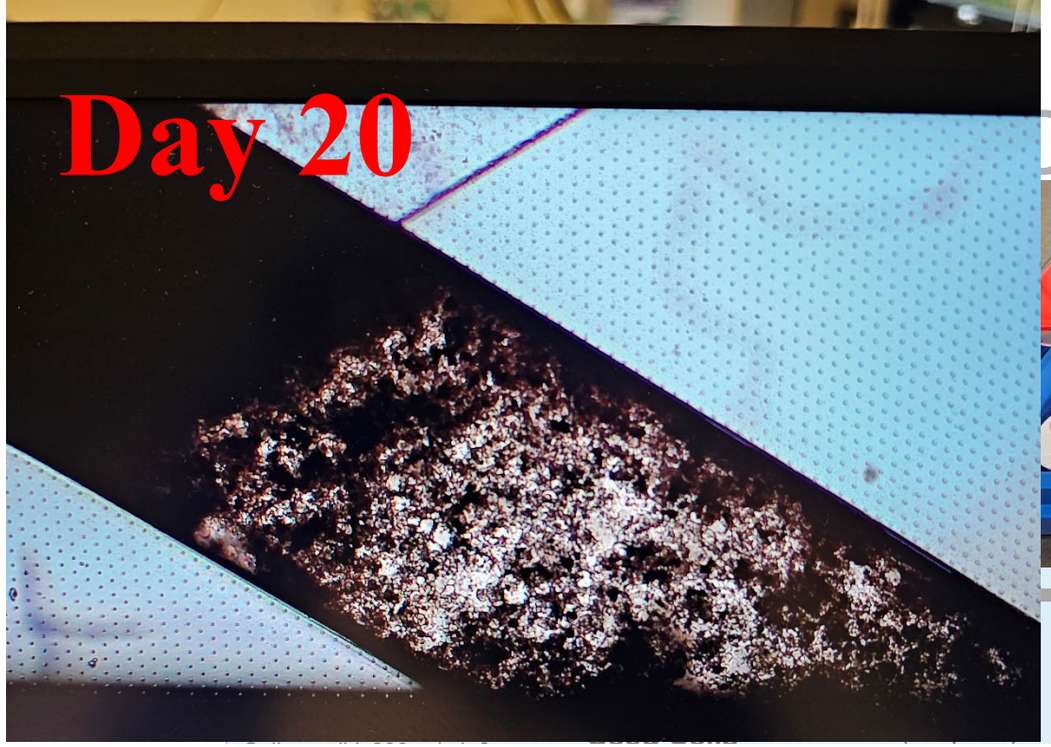


Trial 1: control – *E. coli* wt – *E. coli* cip resis. – (*Lactobacillus, Collinsella, E. faeciu Eubacterium*. con.1) - (*Lactobacillus, Collinsella, E. faecium, Eubacterium.* con.2) - (*Lactobacillus, Collinsella, E. faecium, Eubacterium, Pseudomonas*).

10 days growing.

Sampled the effluent every other day.





Colon Intestine-Chip

Initiate Stretch to 2% (0.15Hz)

Increase Stretch to 10%

0h

24 h

48 h

72 h

The experiment happens here ☺

Timepoints and Terminal endpoints:
Collection of effluent
Adding more bacteria
treatment

Trial 1: from Friday

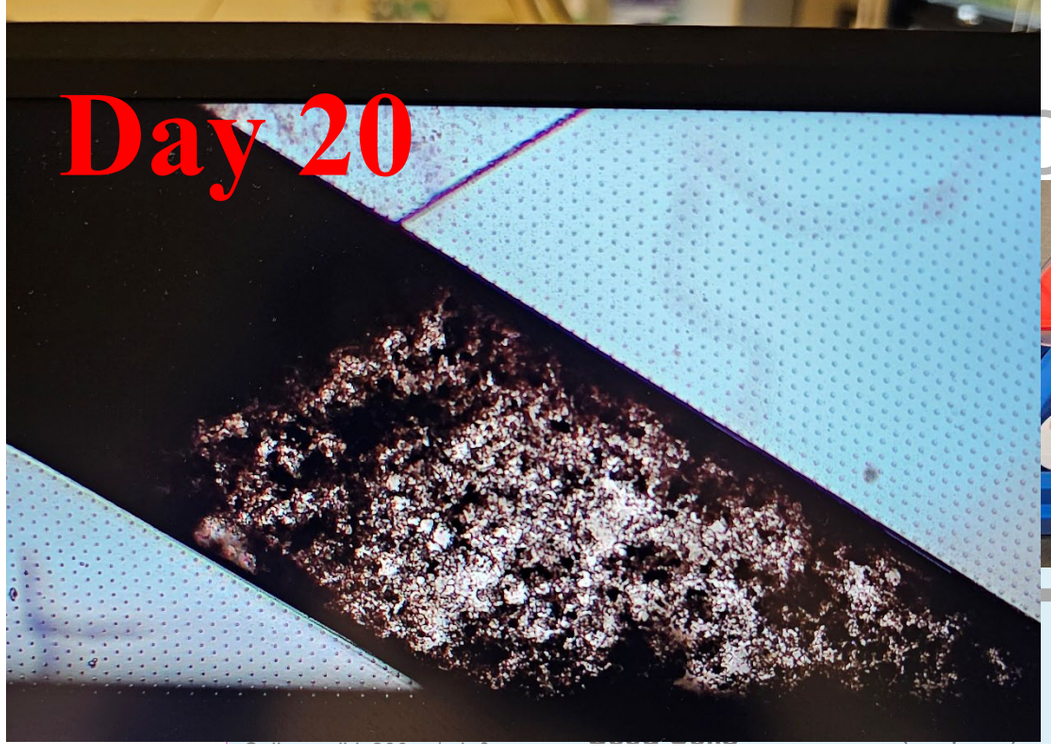
E. coli wt – *E. coli* cip resis

(*Lactobacillus, Collinsella, E. faecium, Eubacterium*. con.1)

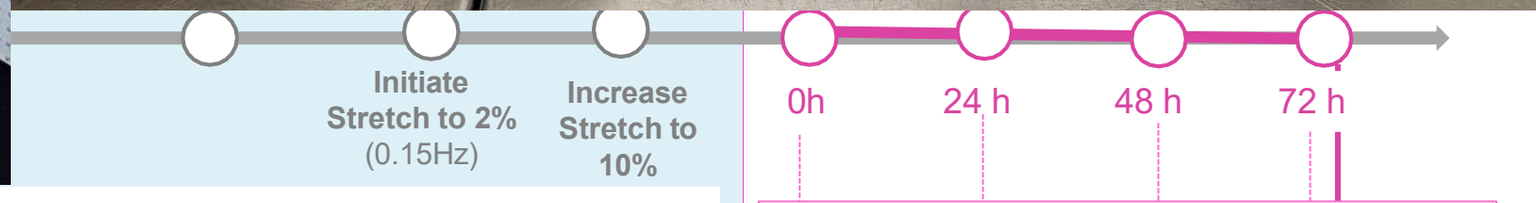
(*Lactobacillus, Collinsella, E. faecium, Eubacterium*. con.2)

(*Lactobacillus, Collinsella, E. faecium, Eubacterium, Pseudomonas*).

** Longevity of chip varies from cell donor to another



Colon Intestine-Chip

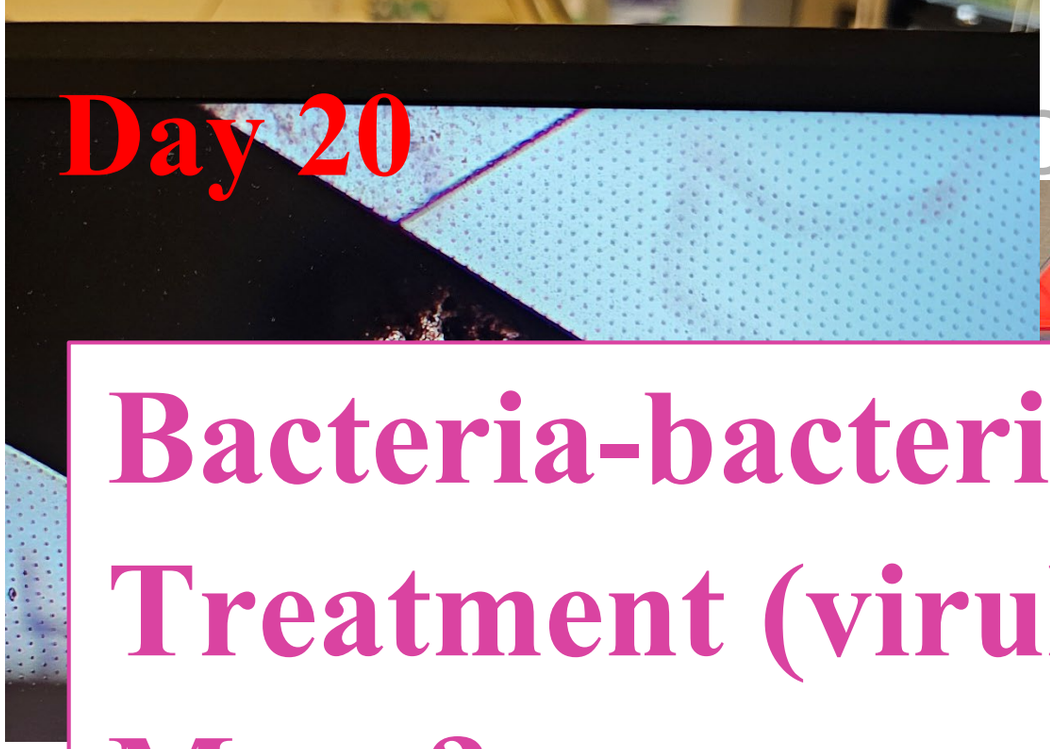


Trial 2 (next):

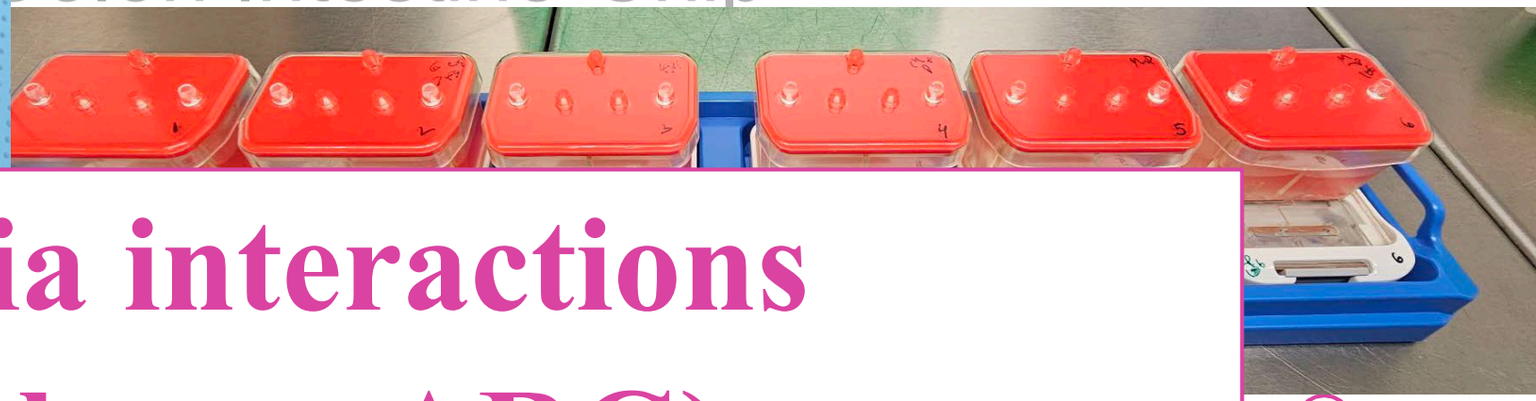
Adding *E. coli* pathogens to the mix.

AB treatment

** Longevity of chip varies from cell donor to another



Colon Intestine-Chip



72 h

ns here ☺

Bacteria-bacteria interactions Treatment (virulence, ARG) More?

Trial 1:

E. coli wt – *E. coli* cip resis

(*Lactobacillus, Collinsella, E. faecium, Eubacterium*. con.1)

(*Lactobacillus, Collinsella, E. faecium, Eubacterium*. con.2)

(*Lactobacillus, Collinsella, E. faecium, Eubacterium, Pseudomonas*).