NCATS

COLLABORATE. INNOVATE. ACCELERATE.

Tissue Chips for Drug Screening Program

Interagency Coordinating Committee on the Validation of Alternative Methods Public Forum May 18-19, 2023

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NCATS, NIH

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National Center for Advancing Translational Sciences

Re-engineering the Translational Pipeline

NCATS addresses long-standing bottlenecks in the translational research pipeline so that new treatments reach people faster.

Translational Problems:

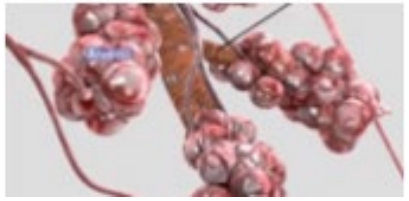
- 90% of clinical drug development fails
- Average time to develop a drug takes 10-15 years
- Average to develop a drug to market, including cost of failures cost is $2.6 billion
- Insufficient tools and technologies to predict toxicity and efficacy of new drugs

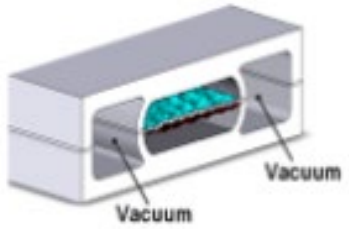
NCATS Solutions:

- Better predictive tools and human-based model systems
- Models that mimic the structure and function of human tissues
- Models that meet the needs for new therapeutic modalities that are human-specific and personalized

NCATS Tissue Chips for Drug Screening Program

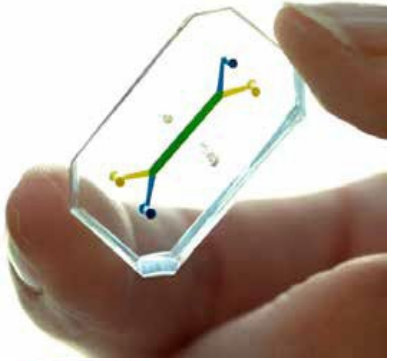
- Program Goal:
  - Develop an *in vitro 3-D* culture system (**tissue chips/microphysiological systems**) that emulates organ physiology and function **using human cells and tissues** through advances in stem cell biology, microfluidics and bioengineering for risk assessment to accurately evaluate the efficacy, safety and toxicity of promising therapies

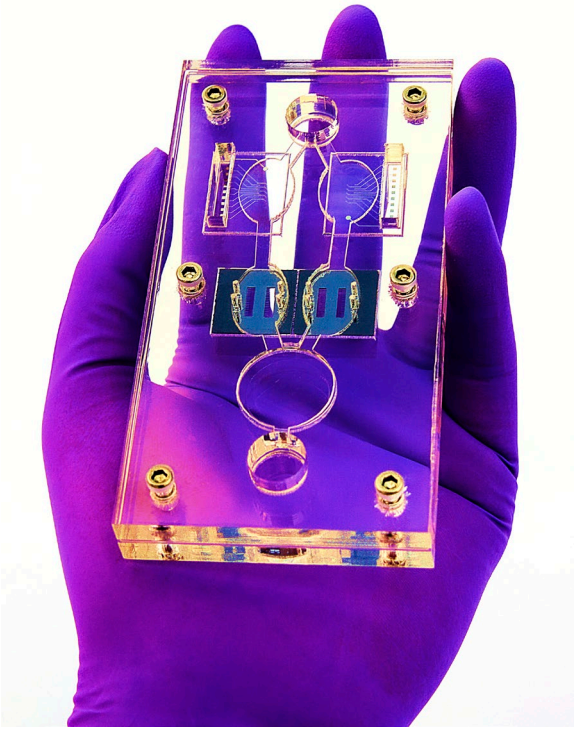




- **Represents 10 Major Organ Systems**
  - **Circulatory**
  - **Endocrine**
  - **Gastrointestinal**
  - **Immune**
  - **Skin**
  - **Musculoskeletal**
  - **Nervous**
  - **Reproductive**
  - **Respiratory**
  - **Urinary**

Emulate
Single organ chip





Hesperos 5-organ chip

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Tissue Chips Consortium 1.0 to Predict Drug Safety

- James A. Thomson; Morgridge Institute for Research at the University of Wisconsin-Madison
Human induced pluripotent stem cell and embryonic stem cell-based models for predictive neural toxicity and teratogenicity

- John P. Wikswo; Vanderbilt University
Neurovascular unit on a chip: Chemical communication, drug and toxin responses

- Steven C. George; University of California, Irvine
An integrated in vitro model of perfused tumor and cardiac tissue

- D. Lansing Taylor; University of Pittsburgh
A 3-D biomimetic liver sinusoid construct for predicting physiology and toxicity

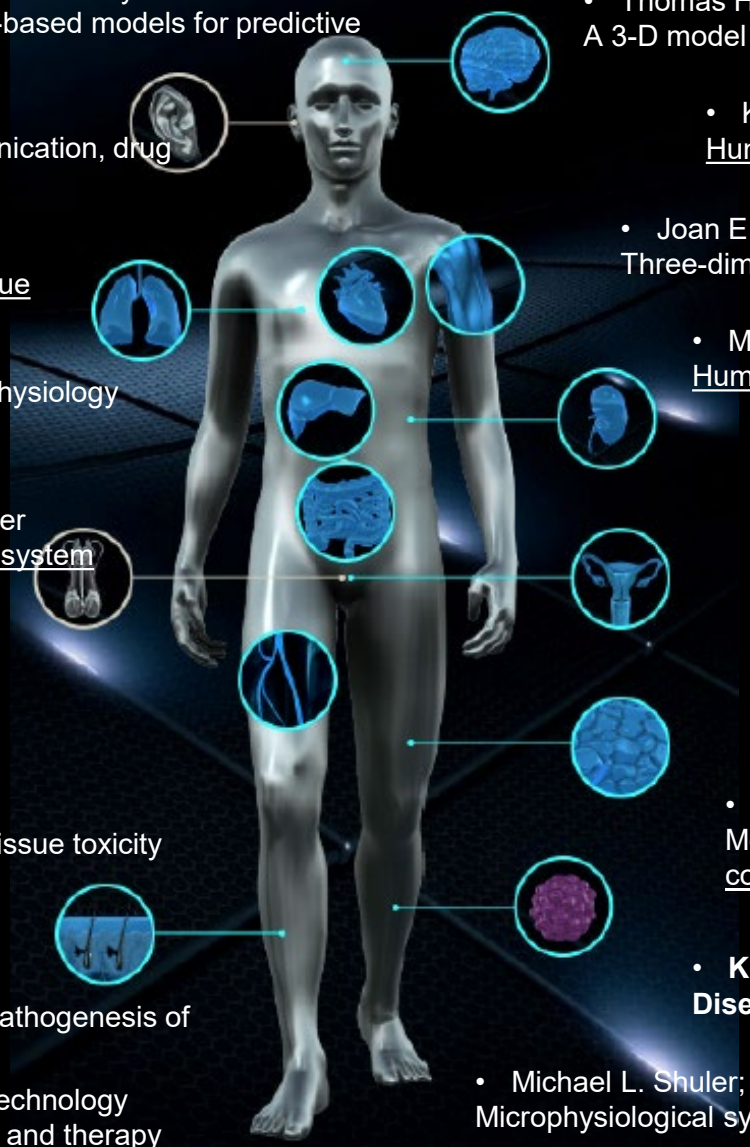
- James M. Wells; Cincinnati Children's Hospital Medical Center
Generating human intestinal organoids with an enteric nervous system

- John P. Lynch; University of Pennsylvania
Modeling oxidative stress and DNA damage using a gastrointestinal organotypic culture system

- George A. Truskey; Duke University
Circulatory system and integrated muscle tissue for drug and tissue toxicity

- Rocky S. Tuan; University of Pittsburgh
Three-dimensional osteochondral micro-tissue to model pathogenesis of osteoarthritis

- Linda Griffith; Massachusetts Institute of Technology
All-human microphysical model of metastasis and therapy



- Thomas Hartung; Johns Hopkins University
A 3-D model of human brain development for studying gene/environment interactions

- Kevin K. Parker; Harvard University
Human cardio-pulmonary system on a chip

- Joan E. Nichols; The University of Texas Medical Branch at Galveston
Three-dimensional human lung model to study lung disease and formation of fibrosis

- Mark Donowitz; Johns Hopkins University, Baltimore
Human intestinal organoids: Pre-clinical models of non-inflammatory diarrhea

- **Teresa Woodruff; Northwestern University**
Ex Vivo Female Reproductive Tract Integration in a 3-D Microphysiologic

- Jonathan Himmelfarb; University of Washington, Seattle
A tissue-engineered human kidney microphysiological system

- Gordana Vunjak-Novakovic; Columbia University Health Sciences
Integrated Heart-Liver-Vascular Systems for Drug Testing in Human Health and Disease

- Angela Christiano; Columbia University Health Sciences
Modeling complex disease using induced pluripotent stem cell-derived skin constructs

- **Kevin E. Healy; University of California, Berkeley**
Disease-specific integrated microphysiological human tissue models

- Michael L. Shuler; Cornell University
Microphysiological systems and low cost microfluidic platform with analytics

NCATS, NIH Common Fund, NIBIB, NCI, NICHD, NIEHS, ORWH

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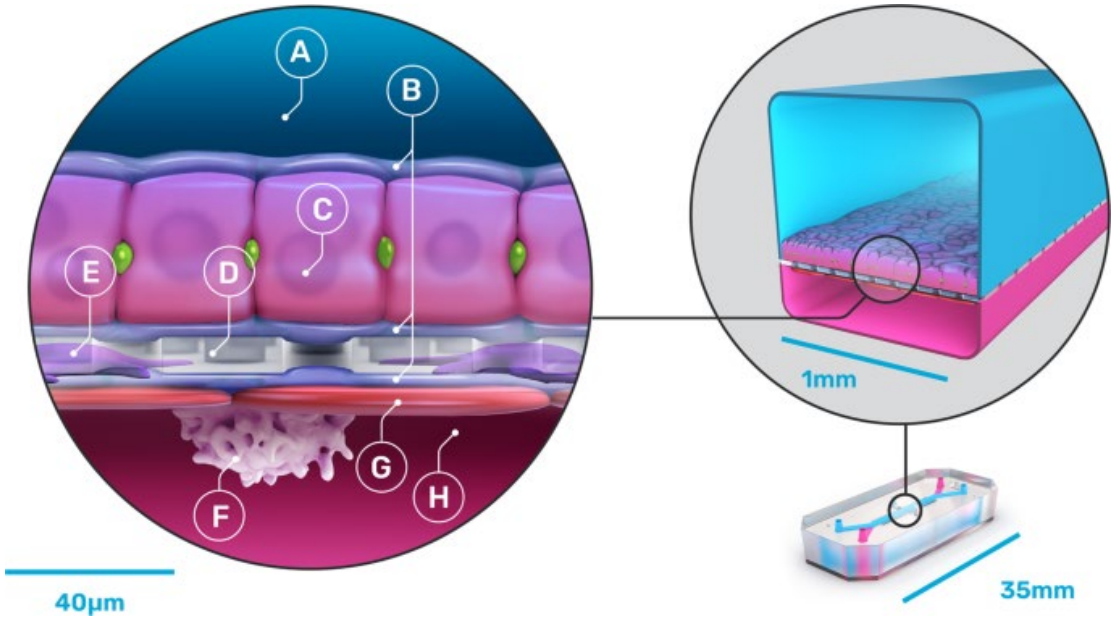
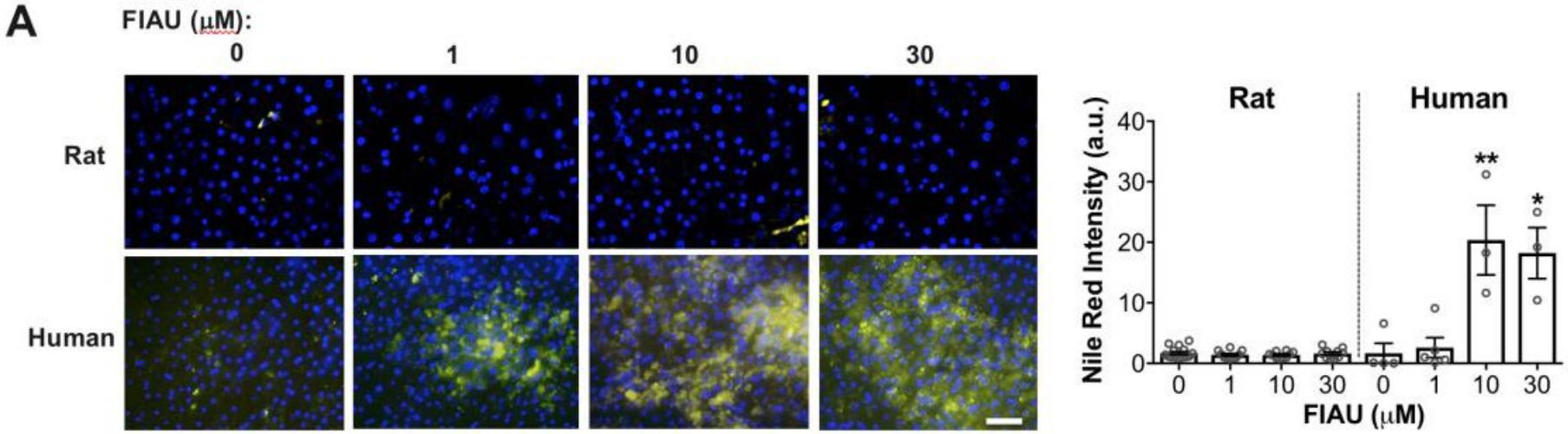
Are Tissue Chips Better Predictors of Human Physiological Response

- Liver is responsible for concentrating and metabolizing a majority of medications
- Drug-induced liver injury (DILI) is the most common cause of acute liver failure (15-20 per 100,000)
- Adverse drug reactions are an important cause of liver injury that may require discontinuation of the drug, hospitalization, or even liver transplantation



- A - parenchymal channel
- B - extracellular matrix
- C - human hepatocytes
- D - porous PDMS membrane
- E – stellate cells
- F - Kupffer cells
- G - endothelial cells
- H - vascular channel

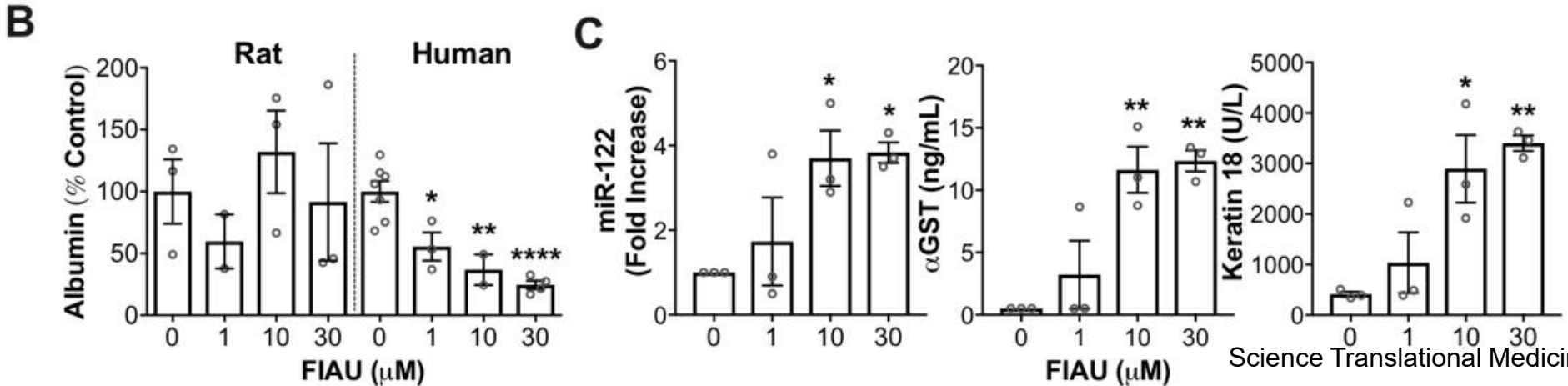
Differences in Steatosis (Fat Deposits) in Rat and Human Liver Chips following Fialuridine (FIAU) Treatment



Follow up blinded study to predict DILI caused by 22 compounds with known hepatotoxic (was advanced to human use based on previous preclinical data but was withdrawn due to toxicities which collectively are responsible for more than 200 patient deaths and 10 liver transplants, and (5) non-hepatotoxic compounds – liver chips showed an 87% sensitivity and 100% specificity in predicting drug toxicity, far outperforming liver spheroids (a common preclinical model) which showed a sensitivity of only 47%.

BioRxiv 2022, doi: https://doi.org/10.1101/2021.12.14.472674

Nature Commun Med 2022: 2; 154- 170.



Science Translational Medicine, 11: 2019

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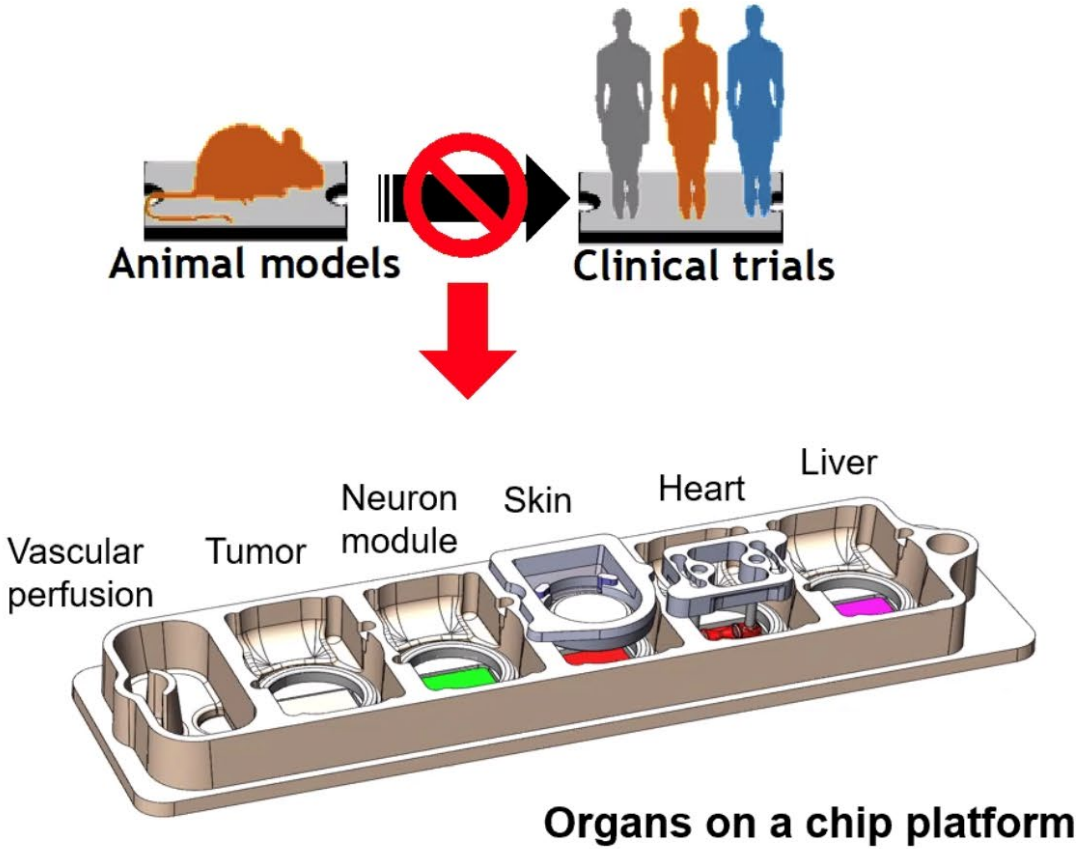
Tissue Chips 2.0 for Disease Modeling and Efficacy Testing



Translational Needs:

- Able to recapitulate in vivo functions and responses in both normal and disease states
- Capture the pathophysiology, mutation spectrum and phenotypic diversity of human diseases
- Stable tissue phenotype over weeks and months
- Reflect the multi-organ pathology and organ crosstalk
- Real-time functional readout and surrogate markers

Ronaldson-Bouchard et al, ***Cell Stem Cell*** *(2018); Tavakol et al* ***Cell Stem Cell*** *(2021);*

Tissue Chips for Disease Modeling and Efficacy Testing

Li-Huei Tsai, MIT
Alzheimer's Disease and related dementias

Kam Leong, Columbia U
Proteus Syndrome and DiGeorge Syndrome

Danielle Benoit, Lisa Delouise, Catherine Ovitt, U Rochester
Radiation-induced xerostomia

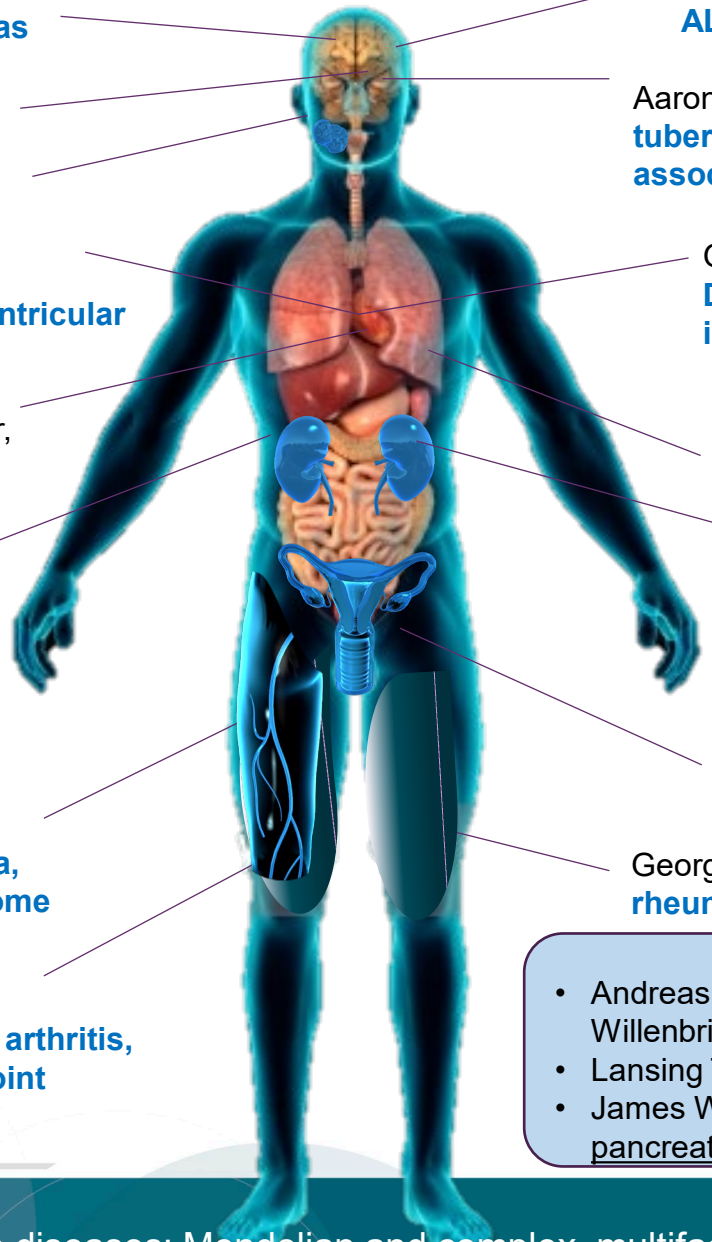
Kevin Kit Parker, William Pu, Harvard U
Barth syndrome, catecholaminergic polymorphic ventricular tachycardia, arrhythmogenic cardiomyopathy

Steven George, David Curiel, Stacey Rentschler, UC Davis and WashU **atrial fibrillation**

Joseph Vincent Bonventre, Luke Lee, Brigham and Women's **autosomal dominant/recessive models of polycystic kidney disease, Focal segmental glomerulosclerosis**

Christopher Hughes, UC Irvine
Hereditary hemorrhagic telangiectasia, Port Wine stain, Sturge-Weber syndrome

Hang Lin, U Pittsburgh
Osteoarthritis, inflammatory arthritis, adipose-mediated diabetic joint complications



Clive Svendsen, Cedars-Sinai
ALS; Parkinson's Disease

Aaron Bowman, Kevin Ess, John Wikswo, Vanderbilt U
tuberous sclerosis complex (TSC) epilepsy, DEPDC5-associated epilepsy, & associated cardiac dysfunction

Gordana Vunjak-Novakovic, Columbia U
Dox induced cardiomyopathy; multi-system pathologies involving heart, liver, skin, bone and vasculature

Donald Ingber, Harvard U
influenza infection, COPD

Jonathan Himmelfarb, U Washington
apolipoprotein L1 mediated kidney disease, drug induced and host-pathogen interaction induced renal thrombotic microangiopathies

Julie Kim, Northwestern U **Polycystic Ovarian Syndrome**

George Truskey, Duke U
rheumatoid arthritis, atherosclerosis

Type-2 Diabetes Mellitus

- Andreas Stahl, Kevin Healy, Matthias Hebrok, Edward Hsiao, Holger Willenbring, UC Berkeley - Pancreatic islet, liver, adipose
- Lansing Taylor, U Pittsburgh – Vascularized liver and pancreatic islets
- James Wells, Moo-Yeal Lee, Cincinnati Children's Hospital - Liver, pancreatic islet and intestine

Modeling common and rare diseases; Mendelian and complex, multifactorial diseases

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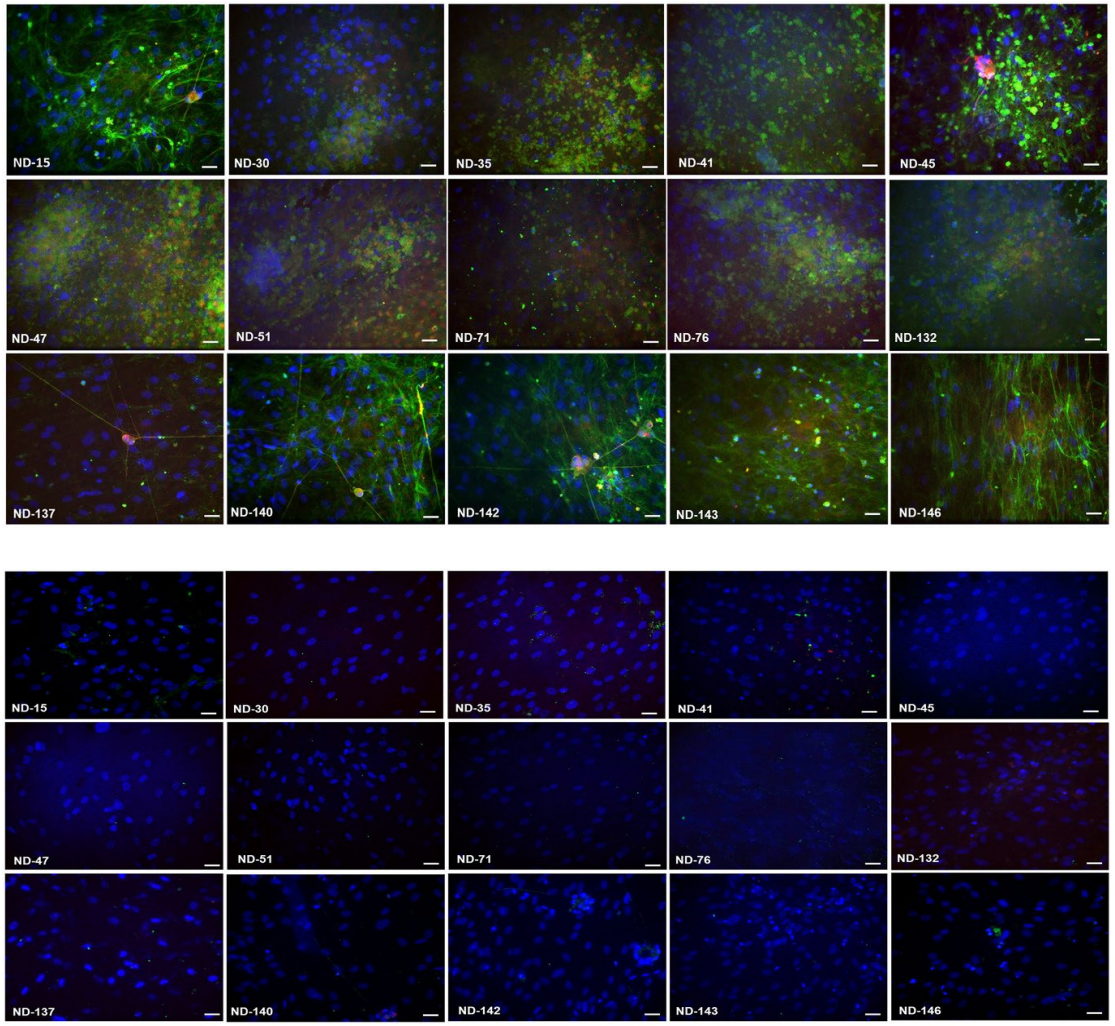
Efficacy: Tissue Chips Model of Rare Autoimmune Demyelinating Neuropathies

- Chronic autoimmune demyelinating neuropathies are a group of rare neuromuscular disorders including **chronic inflammatory demyelinating polyneuropathy (CIDP)** and **multifocal motor neuropathy (MMN)**
- Tissue chip model consisting of co-culture of human primary Schwann cells (SC) and induced pluripotent stem cell-derived motoneurons (MNs)
- CIDP and MMN patient sera contains anti-GM1 IgM and IgG antibodies which is sufficient to activate the classical complement pathway in SC-MN tissue chips, resulting in detection of C3b and C5b-9
- Efficacy of **TNT005**, a monoclonal antibody that **inhibits C1s protease** rescued the serum-induced complement deposition and functional deficits while treatment with an isotype control antibody has no rescue effect
- **Efficacy data included in an investigational new drug application**



Advanced Therapeutics, Volume: 5, Issue: 6,
First published: 05 April 2022, DOI: (10.1002/adtp.202200030)

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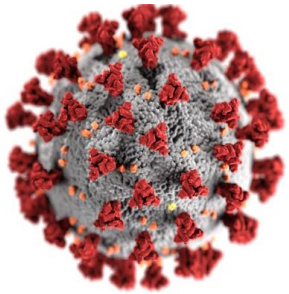
Responding to National Health Emergencies

- **Opioid** crisis
  - **HEAL** awards issued in 2019 for program 'Tissue Chips to Model Nociception, Addiction and Overdose'
    - Sensory/pain circuitry; reward pathways
    - Blood-brain barrier (BBB) and respiratory control for overdose studies
    - Develop novel drug screening platforms for pain, opioid use disorder (OUD) and/or overdose

- **COVID-19** pandemic
  - Through **CARES Act Congressional supplemental funding**, Emergency Awards issued in 2020 for administrative supplements and competitive revisions to:
    - Develop tissue chip models for COVID-19
    - Understand multiple tissue/organ pathologies
    - Model infection
    - Test candidate drugs and vaccines
    - Understand immune responses
    - Model complications from vulnerable and at-risk patient groups



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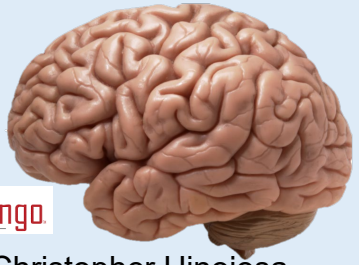
Tissue Chips in Space- A Partnership Involving NCATS, NASA, CASIS and ISS-NL

Goal: **Model age-related diseases under microgravity and to translate that understanding to improve human health on Earth**

Immunosenescence

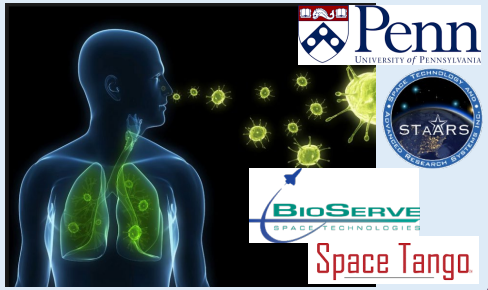
PI: Sonja Schrepfer

Drugs across blood-brain barrier



PI: Christopher Hinojosa

Lung infection

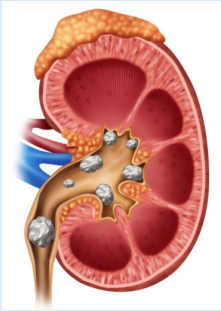


PI: Scott Worthen

Post-traumatic osteoarthritis

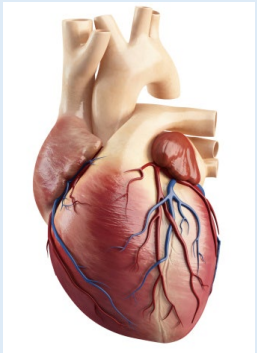
PI: Al Grodzinsky

Proteinuria and kidney stones formation



PI: Jonathan Himmelfarb

Cardiac dysfunction & engineered heart tissues



PI: Deok-Ho Kim

PI: Joseph Wu

Muscle wasting (sarcopenia)

PI: Siobhan Malany

Gut inflammation & Microbiome

PI: Christopher Hinojosa

Aim: study human biology and disease that otherwise would be difficult or take longer on Earth

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LONGEVITY EXTENSION OF 3D TISSUES AND MICROPHYSIOLOGICAL SYSTEMS FOR MODELING OF ACUTE AND CHRONIC EXPOSURES TO STRESSORS

- Partnerships between **NASA, NIH, BARDA and FDA**
- GOALS:
  - To extend the tissue viability and physiological function of tissue chips or microphysiological systems to a **minimum of 6 months**
  - To incorporate automated engineering capabilities for **real-time online readouts** in these complex human in vitro model systems
  - To understand the influence of multiple types of **long-lasting or chronic stressors** on tissue or organ systems and facilitate the translation of results to humans
  - To better understand 1) disease pathomechanisms, 2) drug development, 3) clinical trial design, 4) chemical and environmental exposures and countermeasures, and 5) physiological changes due to the prolonged spaceflight environment

https://science.nasa.gov/science-news/biological-physical/miniature-avatars-take-on-nasas-biggest-challenge

NASA lead – Lisa Carnell

"Clinical Trials" on a Chip to Inform Clinical Trial Design and Implementation in Precision Medicine (2021 – 2025)

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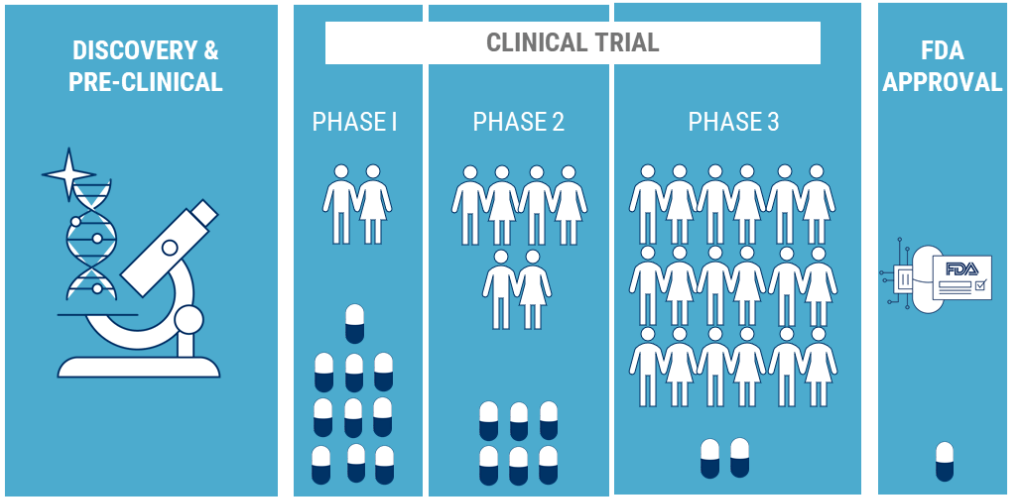
NIH NATIONAL CANCER INSTITUTE

Eunice Kennedy Shriver National Institute of Child Health and Human Development

National Institute of Arthritis and Musculoskeletal and Skin Diseases

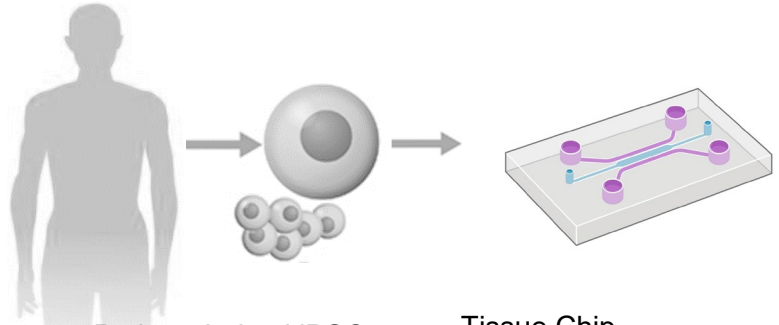


Source: cbinsights.com

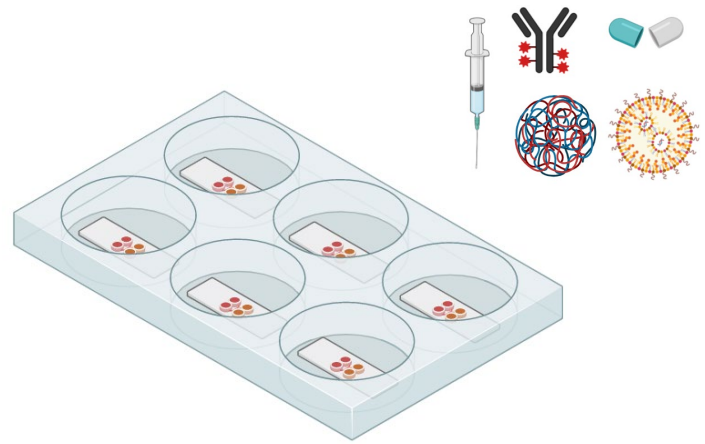
Goal → Inform clinical trial design and execution

1. Establish recruitment criteria
2. Patient stratification
3. Develop clinically relevant biomarkers

Phase 1: Develop and validate rare, pediatric and common disease models containing patient-derived cells representing diversity in patient cohorts



Phase 2: Test potential drugs fc efficacy and safet assessments in clinical trials



Exp Biol Med. 2020, 245:1155-1162

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‘Clinical Trials’ on-a-Chip Projects

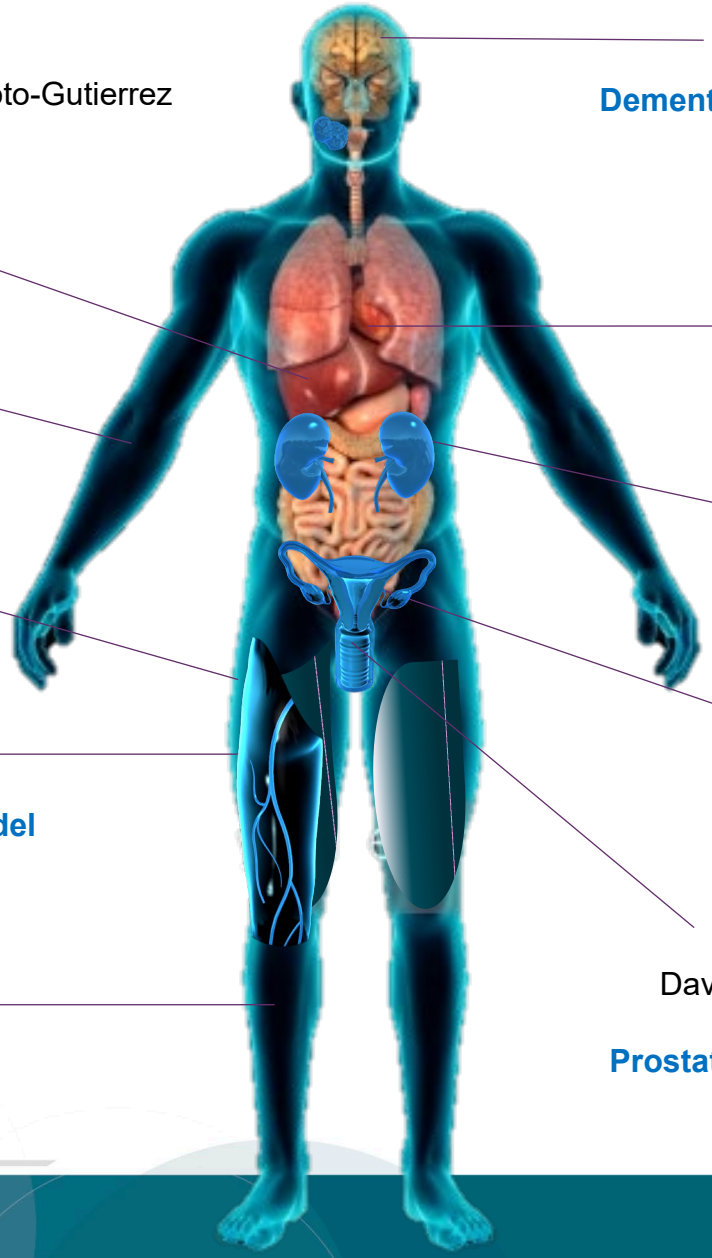
Lansing D. Taylor, Jaideep Behari, Alejandro Soto-Gutierrez
University of Pittsburg
Metabolic fatty liver disease

Angela M. Christiano, Columbia University
Atopic Dermatitis

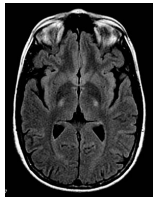
Deok-Ho Kim, David-Alan Kass
Johns Hopkins University
Dystrophin-Deficient Muscular Dystrophy

Yu-Shrike Zhang
Brigham and Women’s Hospital
Progeria - Premature Vascular Aging-on-a-Chip Model

Hani Awad, James Mcgrath, Benjamin Miller
University of Rochester
Tendon inflammation and fibrosis



Clive Svendsen
Cedars-Sinai
Dementia ; Amyotrophic lateral sclerosis (ALS)

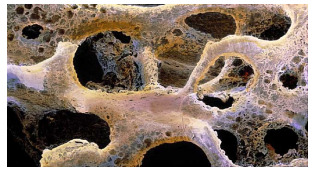


William Pu & Kevin Kit Parker
Harvard University
CPVT Heart diseases

Jonathan Himmelfarb & Matthias Kretzler
University of Washington
Polycystic Kidney diseases

Arum Han & Ramkumar Menon
Texas Engineering Experiment Station
Pre-term birth - Maternal-fetal interface on a chip

David Beebe & Joshua Michael Lang
University of Wisconsin
Prostate cancer bone marrow metastasis



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Building Confidence Towards Technology Adoption: Tissue Chip Validation Framework

Comput Struct Biotechnol J.(2016) 14: 207–210

3) Industrial (2019…)

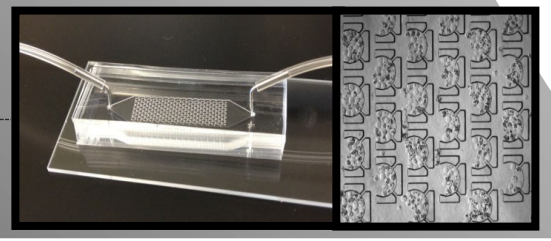
- Use by industry and regulatory agencies
- Proprietary set of compounds
- CRO-type environment

2) Analytical (2017…)

- Independent: testing for **robustness, reproducibility, reliability, relevance**
- Validation set of compounds, biomarkers, assays
- TC Testing Centers

1) Physiological (2012…)

- Organ function and structure
- Training set of reference compounds
- TC developers



Path to Adoption and Commercialization

- **Javelin Biotech** (spin off from MIT)
  - CRO business model
- **Texas A&M Tissue Chip Testing Consortium**
  - Play for pay model with academia, government and industry
- **BioSystics Analytic Platform**
  - University of Pittsburgh

- **Tissue Chip Testing Centers:**
  - Massachusetts Institute of Technology
  - Texas A&M University
- **MPS Database:** https://mps.csb.pitt.edu/
  - University of Pittsburgh

Publications: (as of Oct 2017)
A total of 506 original and review articles (cited over 5600 times) published in top tier journals, including *Nature Medicine, Nature Communications, Nature Materials, PNAS, Science, Science Translational Medicine, etc.*

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The MPS-Db is designed to aggregate, analyze and model MPS experimental data relative to human and animal exposure data

Human Preclinical MPS Data,
Non-preclinical *in vivo* Data

General MPS Data,
Other *in vitro* Data

Specific Portals
Preclinical Trials
Cell Sources
Covid-19

Proprietary Databases

Proprietary Tools

BioSystics -AP

ChEMBL
Unichem

CDC/NAMCS
OpenFDA

DrugBank,
EMA, CT.gov
Health Canada

LiverTox
PubChem

Clinical Data

Preclinical Data

Information

- Experimental model reproducibility
- Compound safety and efficacy
- Mechanism(s) of disease progression
- Mechanism(s) of compound action(s)
- Computational models of ADME/Tox & disease

Actionable Knowledge

- Optimized experimental model design
- Improved ADME/Tox predictions
- Predicted drug/therapeutic candidates
- 'Preclinical' trial outcomes
- Design of clinical trials
- Create patient digital twins

Federated database supported by NCATS mps.csb.pitt.edu/ www.biosystics.com/

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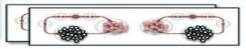
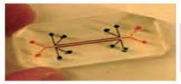
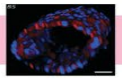
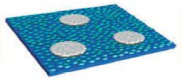
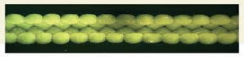
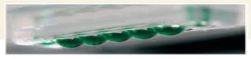
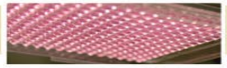
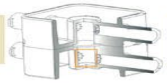
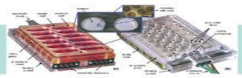
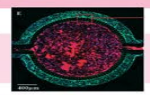
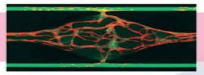
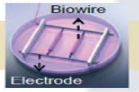
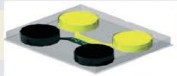
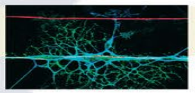
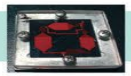
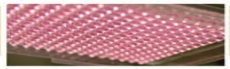
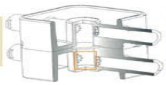
Commercial Activities around Tissue/Organ-on-chip Technologies

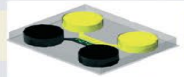
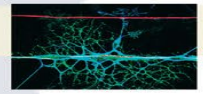
		Scientific founders	Selected products
Body on-a-Chip			
Hesperos®		Michael Shuler James Hickman	Multi-Organ Chip (2, 4 organs) (5-10 organs)*
TISSUSE Emulating Human Biology		Uwe Marx	2-Organ-Chip (2-OC) 4-Organ-Chip (4-OC) Human-on-a-Chip (HoC)*
Tissue interface on-a-Chip			
emulate		Donald Ingber	Lung on-a-Chip Airway on-a-Chip Gut on-a-Chip Kidney on-a-Chip Bone Marrow on-a-Chip
AlveoliX In-vitro models inspired by nature		Olivier Guenat	Lung-on-a-chip array
NORTIS		Thomas Neumann	Kidney on-a-Chip Vessel on-a-Chip
Quorum		Axel Guenther	Artery on-a-Chip
Parenchymal tissue on-a-Chip			
Hepregen		Sangeeta Bhatia	HepatoPac® HepatoMune™
organovo™		Gabor Forgacs Keith Murphy	ExVive3D™ Liver ExVive3D™ Kidney*
Aspect biosystems		Tamer Mohamed Konrad Walus Sam Wadsworth Simon Beyer	Lab-on-a-Printer™ 3DBioRing™ Airway
insphero		Jan Lichtenberg Jens M. Kelm Wolfgang Moritz	3D Insight™ Liver 3D Insight™ Islet 3D Insight™ Tumor
3D Biomatrix™ Three-Dimensional Cell Culture		Nicholas Kotov	PERFECTA3D® HANGING DROP PLATES
HμREL CORPORATION		Greg Baxter Robert Freedman	HμRELhuman™ HμRELflux™ HμRELTox™ HμRELflow™
KIYATEC®		Matthew R. Gevaert	3DKUBE™
VAXDESIGN		William L. Warren	MIMIC® Technology

		Scientific founders	Selected products
CNBio innovations		Linda G Griffith	LiverChip® LiverChip® 36
DRAPER		Joseph Charest	Microphysiological Systems
MIMETAS the organ-on-a-chip company		Jos Joore Paul Vulto Thomas Hankemeier	OrganoPlates®
SYNVIVO		Kapil Pant B. Prabhakar Pandian	SynTumor SynBBB SynRAM SynTox
4DBio 4DESIGN BIOSCIENCES		G. Wesley Hatfield Christopher Hughes Steven George Abraham Lee	Vascularized micro-organ (VMO) platform
AIM BIOTECH		Roger Kamm	3D cell culture chips
TARA		Milica Radisic Gordana Vunjak-Novakovic	Cardiac Biowire™ II AngioChip*
μOrgano		Kevin Healy	μOrgano
EHT Technologies		Thomas Eschenhagen	Engineered Heart Tissue (EHT)
myriamed		Wolfram-Hubertus Zimmermann	3D Cardiac Systems
AxoSim		Michael Moore	Nerve-on-a-Chip™
xona MICROFLUIDICS		Noo Li Jeon Carl W. Cotman Anne Taylor	Standard / Triple Chamber Neuron Device
MicroBrain BT		Bernadette Bung	Neuronal Diode
ananda™		Margaret Magdesian	Neuro Device

National Center for Advancing Translational Sciences

Commercial Activities around Tissue/Organ-on-chip Technologies

		Scientific founders	Selected products
Body on-a-Chip			
Hesperos®		Michael Shuler James Hickman	Multi-Organ Chip (2, 4 organs) (5-10 organs)*
TISSUSE Emulating Human Biology		Uwe Marx	2-Organ-Chip (2-OC) 4-Organ-Chip (4-OC) Human-on-a-Chip (HoC)*
Tissue interface on-a-Chip			
emulate			
AlveoliX In-vitro models inspired by nature			
NORTIS			
Quorum			
Parenchymal tis			
Hepregen			
organovo™			
Aspect biosystems			
insphero		Jens M. Kelm Wolfgang Moritz	3D Insight™ Tumor
3D Biomatrix™ Three-Dimensional Cell Culture		Nicholas Kotov	PERFECTA3D® HANGING DROP PLATES
HµREL CORPORATION		Greg Baxter Robert Freedman	HµRELhuman™ HµRELflux™ HµRELTox™ HµRELflow™
KIYATEC®		Matthew R. Gevaert	3DKUBE™
VAXDESIGN		William L. Warren	MIMIC® Technology

		Scientific founders	Selected products
CNBio innovations		Linda G Griffith	LiverChip® LiverChip® 36
DRAPER		Joseph Charest	Microphysiological Systems
			OrganoPlates®
			SynTumor SynBBB SynRAM SynTox
			Vascularized micro-organ (VMO) platform
			3D cell culture chips
			Cardiac Biowire™ II AngioChip*
			µOrgano
			Engineered Heart Tissue (EHT)
		Zimmermann	3D Cardiac Systems
AxoSim		Michael Moore	Nerve-on-a-Chip™
xona MICROFLUIDICS		Noo Li Jeon Carl W. Cotman Anne Taylor	Standard / Triple Chamber Neuron Device
MicroBrain BT		Bernadette Bung	Neuronal Diode
ananda		Margaret Magdesian	Neuro Device

- **NIH supports a number of spinoff and startup organoid and tissue chip companies**
- **At least 30 companies providing CRO-like services and/or selling a variety of tissue chip platforms and consumables**
- **Global Organ On Chip market is projected to reach $601.6 million by 2028 from an estimated $80 million in 2022, at a CAGR of 39.9% during 2023 and 2028**

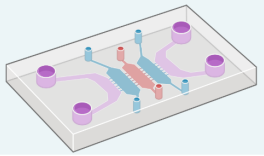
Tissue Chip Applications and Impact in Pharmaceutical Drug Development

A recent survey of 15 pharmaceutical experts forecast that within 5 years, **tissue chips would save between 10% and 26%** of drug development R&D cost.

Drug Discovery Today
24:1720–1724 (2019)

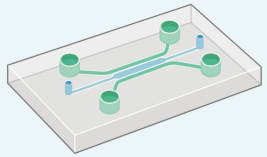
1 Target Identification and Validation

- Validation of targets in more physiologically relevant models of human disease
- Biomarker identification
- Assessment of on/off target toxicity

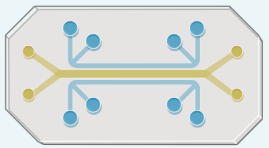


2 Lead Identification

- Provide insight where simple models fail ("fail fast, fail early")
- Reduce animal studies
- Evaluation of disease-associated risk factors within physiologically relevant models

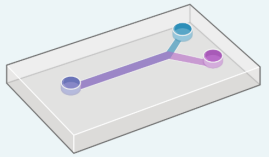


3 Lead Optimization



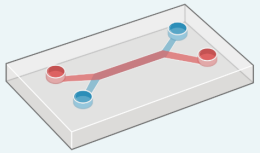
4 Preclinical Safety

- Improve *in vivo* study design
- Identify species-specific drug responses
- Aid species selection



5 Clinical Assessment

- Follow up of human clinical findings
- Computational modeling/digital twin technology to accurately and more quickly predict patient-specific drug response



Adapted from Nature Reviews Drug Discovery, Low et al. 2020

National Center for Advancing Translational Sciences

Engaging Next Generation Scientists and Engineers

- ✓ Global harmonization of regulatory use and standardization of platforms – MPS World Summit
- ✓ Train next generation of MPS scientists – International MPS Society

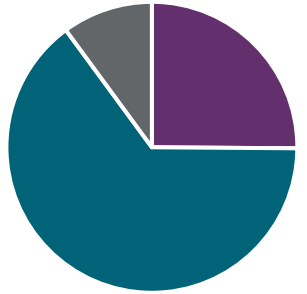
MPS WORLD SUMMIT
CONNECT, EXCHANGE, EDUCATE

2022 New Orleans, LA, USA
2023 Berlin, Germany (June 26-30)
2024 Seattle, WA USA
2025 ?

https://mpsworldsummit.com/

- 22 domestic travel awards for students and postdocs
- 13 International travel awards for students and postdocs
- 8 Best Poster and 7 Oral Awards

Inaugural Attendees
665 Total – 107 Trainees

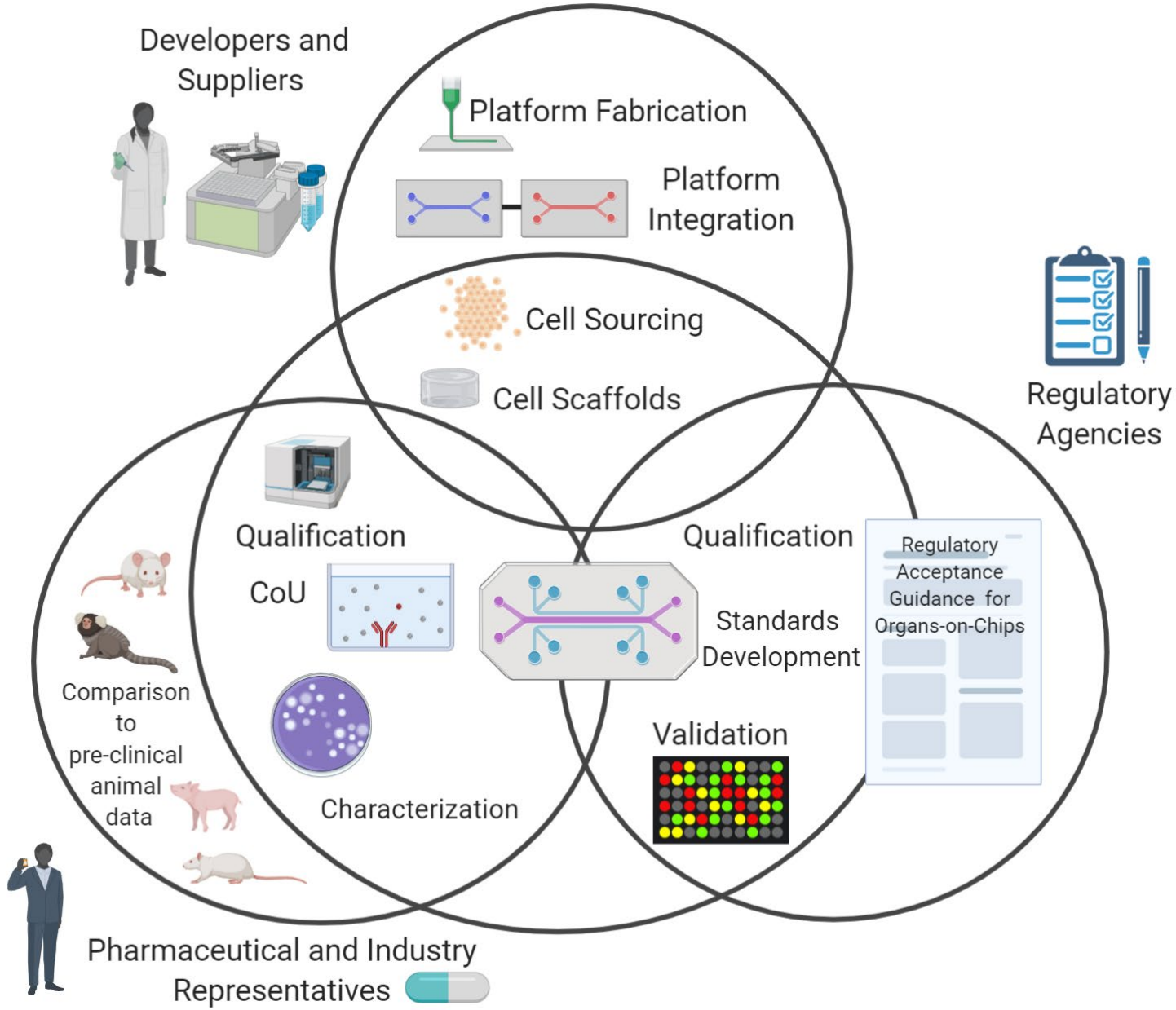


INTERNATIONAL MPS SOCIETY
CONNECT, EXCHANGE, EDUCATE

https://impss.org/

National Center for Advancing Translational Sciences

Summary of Tissue Chips Program



- ✓ Demonstration and validation for tox & safety studies
- ✓ Establishment of Testing Centers and Database Center
- ✓ Demonstration and validation for rare and common disease modeling and efficacy studies
- ✓ Clinical Trials on Chips
- ✓ Adoption and use by pharma in drug development
- ✓ Global harmonization for regulatory use and standardization of platforms – MPS World Summit
- ✓ Train next generation of MPS scientists – International MPS Society
- Regulatory qualification as drug development tools – Translational Centers for MPS

National Center for Advancing Translational Sciences

NCATS
COLLABORATE. INNOVATE. ACCELERATE.

- FDA
- International Space Station – National Lab
- Center for Advancement of Science in Space
- NASA
- IQ Consortium MPS Affiliate
- BARDA, VA

Tissue Chips Consortium

Program Lead: Danilo A. Tagle

Program Officers:
Passley Hargrove-Grimes
Dmitriy Kripkey
Program Analyst:
Kris Sunderic

Trans-NIH MPS Working Group:

55 Program Officers from NCATS, NCI, NHLBI, NIA, NIAID, NIAMS, NIBIB, NICHD, NIDA, NIDCR, NIDCD, NIDDK, NEI, NIEHS, NIMH, NINDS, ORWH/OD

NIH
National Center for Advancing Translational Sciences