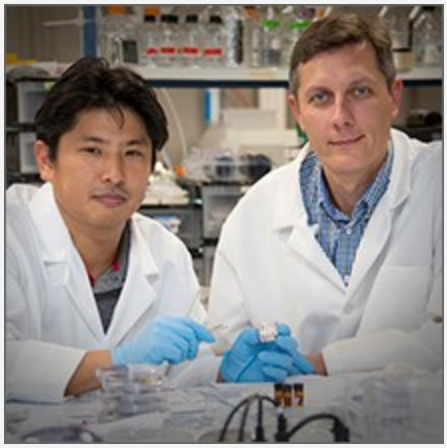
NCATS

National Center for Advancing Translational Sciences

ncats.nih.gov/tissuechip



U.S. Department of Health and Human Services
National Institutes of Health
NIH…Turning Discovery Into Health

Tissue Chip for Drug Screening

Program Overview

During human clinical trials, approximately 90 percent of candidate drugs fail because they are unsafe (~30 percent[1]) or ineffective (~60 percent[2]). Even when pre-clinical cell and animal studies seem promising, problems occur because drugs tested with these models often do not have the same response in humans.

To streamline the therapeutic development pipeline, NCATS — in collaboration with the Defense Advanced Research Projects Agency (DARPA) and the U.S. Food and Drug Administration — leads the Tissue Chip for Drug Screening program to improve the translational science process for predicting whether drugs will be safe and effective in humans.

Multiple NIH Institutes and Centers, as well as pharmaceutical industry representatives, have joined this initiative, which launched in 2012. The aim is to develop 3-D human tissue platforms (or "chips") that model the structure and function of human organs, such as the lung, liver and heart, and then combine these chips into an integrated system that can mimic complex functions of the human body.

Tissue Chip Initiatives

Tissue Chip Testing Centers

NCATS is supporting several Tissue Chip Testing Centers to provide a way to independently test tissue chip platforms developed through the program. These efforts will help validate tissue chip technology and promote the adoption of this technology by the broader research community.

Tissue Chips for Disease Modeling and Efficacy Testing

NCATS' Tissue Chips for Disease Modeling and Efficacy Testing initiative will support further development of tissue chip models of human disease. The goals are to support studies to develop disease models using primary tissue or induced pluripotent stem cell (iPSC)-derived patient cell sources on tissue-/organ-on-chips platforms and to test the effectiveness of candidate drugs and therapeutics.

Tissue Chips in Space

NCATS partners with the Center for the Advancement of Science in Space (CASIS) on the NCATS Tissue Chips in Space initiative to refine tissue- and organ-on-chip platforms for in-flight experiments at the International Space Station U.S. National Laboratory, so that scientists can better understand diseases and translate those findings to improve human health on Earth.

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[1] Arrowsmith J, Miller P. Trial watch: phase II and phase III attrition rates 2011-2012. *Nat Rev Drug Discov*. 2013;12(8):569.

[2] Cook D, Brown D, Alexander R, March R, Morgan P, Satterthwaite G, Pangalos MN. Lessons learned from the fate of AstraZeneca's drug pipeline: a five-dimensional framework. *Nat Rev Drug Discov*. 2014;13(6):419-31.

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For More Information

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Tissue Chip Initiatives & Projects

ncats.nih.gov/tissuechip/projects

How the Tissue Chip Program Works

ncats.nih.gov/tissuechip/about/operations

Tissue Chip Video

youtu.be/zVlEr8c-OJk

Meet Interactive "Chip"

ncats.nih.gov/tissuechip/chip

Fall 2016

Working Toward an Integrated System

Initially, NIH-supported researchers developed individual human tissue chips that demonstrated organ functionality and mimicked human biological responses more accurately than traditional cell studies and animal models. These tissue chips included the heart, liver, blood-brain barrier, blood vessels, kidney, gastrointestinal system, skin, muscle, nervous system, female reproductive system, adipose tissue (fat), and models of tumors and metastasis (the spread of cancer).

Currently, NIH- and DARPA-funded researchers are collaborating and sharing resources with each other to refine existing 3-D human tissue chips. Building on initial successes, scientists now are combining the chips into integrated systems. The two project teams funded by DARPA work alongside NIH-funded researchers to develop platforms that mimic the human body's natural environment, and they are working to support 10 organ systems linked together. View the current projects. NIH-funded tissue chip researchers are using compounds supplied by pharmaceutical companies, including GlaxoSmithKline, Pfizer and AstraZeneca, to perform functionality tests on microphysiological platforms funded through the Tissue Chip program.

Because these tissue chip systems will closely mimic human function, the knowledge gained from studies using such chips may provide critical clues to disease progression and insights into the development of potential therapeutics. Once the models have been developed and integrated, researchers can use them to predict whether a candidate drug, vaccine or biologic agent is safe or toxic, and evaluate its effectiveness in humans in a faster and more cost-effective way than current methods.

Program scientists hope to commercialize the tissue chips and systems. In the future, researchers may use the tissue chips in a variety of applications, from studying rare diseases to testing environmental toxins to advancing precision medicine.

About NCATS and Translational Science

NCATS is one of 27 Institutes and Centers at the National Institutes of Health. The Center was established to transform the translational process so that new treatments and cures for disease can be delivered to patients faster.

Translation is the process of turning observations in the laboratory, clinic and community into interventions that improve the health of individuals and the public — from diagnostics and therapeutics to medical procedures and behavioral changes.

Translational science is the field of investigation focused on understanding the scientific and operational principles underlying each step of the translational process. NCATS studies translation as a scientific and operational problem.

NCATS focuses not on specific diseases, but on what is common among them. The Center serves as an adaptor to enable other parts of the research system to work more effectively.

Through its cross-cutting programs in rare diseases, translational technologies, strategic alliances and other areas, NCATS is:

- Developing new approaches, technologies, resources and models;
- Demonstrating their usefulness; and
- Disseminating the data, analysis and methodologies to the community.