



Translating NAM Innovation into Regulatory Practice

FDA Progress and Collaborative Opportunities

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CDER/OTS/OCP



Disclaimer

This presentation reflects the views of the presenter and should not be construed to represent FDA's view or policies.

Important Milestones since the Last CiVM Workshop



- ✓ FDA Announces Plan to Phase Out Animal Testing Requirement for Monoclonal Antibodies and Other Drugs - Roadmap published in April 2025
- ✓ GAO publishes “Human Organ-on-a-Chip” report in May 2025
- ✓ CDER establishes CDER NAMs Coordinating Committee CDERNAMS@fda.hhs.gov in June 2025
- ✓ IStand becomes a permanent qualification program for innovative approaches in drug review in July 2025

FDA Roadmap to Reducing Animal Testing in Preclinical Safety Studies

Executive Summary

This roadmap outlines a strategic, stepwise approach for FDA to reduce animal testing in preclinical safety studies with scientifically validated new approach methodologies (NAMs), such as organ-on-a-chip systems, computational modeling, and advanced *in vitro* assays. By partnering with federal agencies like NIH and VA through K12CVM, FDA can accelerate the validation and adoption of these human-relevant methods, improving predictive accuracy while reducing animal use. This transition will enhance public health by streamlining drug development and ensuring safer therapies reach patients faster, while positioning FDA as a global leader in modern regulatory science and innovation.

Background

There is growing scientific recognition that animals do not provide adequate models for human disease. Over 90% of drugs that appear safe and effective in animals do not go on to humans predominantly due to safety and/or efficacy issues (1). Animal-based poor predictors of drug success for multiple common diseases including cancer, inflammatory diseases (4). Some medications which are generally recognized as safe may have never passed animal testing (5). Conversely, some compounds which models have been lethal in human trials (5). These examples highlight basic physiological differences between humans and other animal species.

Due to the limitations of animal testing as well as ethical concerns about animal use, increased focus within the scientific community on New Approach Methodologies (NAMs) such as *in vitro* human-based systems, *in silico* modeling, and other innovative platforms evaluate immunogenicity, toxicity, and pharmacodynamics in humans and prove the predictive relevance of preclinical drug testing while reducing or replacing an enormous cost saving potential (6).

Recent legislative changes have signaled Congress is simultaneously open to new approaches. In late 2022, Congress passed the FDA Modernization Act 2.0, which explicitly supports animal alternatives (cell-based assays, computer models, etc.) to support an in vitro application and “removed” a requirement to use animal studies for biocatalysis (BLA) (7). This landmark policy empowered FDA to accept NAMs in lieu of animal studies. The FDA provided comprehensive recommendations on how to use scientifically validated NAMs.

Public sentiment is also supportive of this transition with a recent survey finding Democratic and Republican-identifying adults felt that animal experiments should be replaced with modern methods. “Together, scientific advances and policy drivers create FDA to chart a roadmap to reduce animal testing while improving drug development.”

May 2025

United States Government Accountability Office

Report to Congressional Addressees

TECHNOLOGY ASSESSMENT

Human Organ-on-a-Chip

Technologies Offer Benefits Over Animal Testing but Challenges Limit Wider Adoption

May 2025

FDA Advances Drug Development Innovation by Establishing IStand as Permanent Qualification Program

July 2025

CIVM Qualification Pathway Considerations



FDA'S Development Tools and Programs

Drug Development Tools (DDT) Program

Includes qualification programs for:

- Animal models
- Biomarkers
- Clinical Outcome Assessment
- I STAND →

Medical Device Development Tools (MDDT)

Innovative Science and Technology Approaches for New Drugs

(ISTAND) Pilot Program specifically lists tissue chips (i.e., microphysiological systems) as a tool that may advance our understanding of drugs and might be considered for the I STAND program (along with i.e., use of artificial intelligence (AI)-based algorithms). I STAND applicability should be stated in the submission (not COA, and not biomarker).

3-Step Qualification Process:



ISTAND Accepted Submissions - 1



Project #	Acceptance Date (R indicates reviewable date)	Requester	Project Title
DDTIST0006	QP 2025-01-08 LOI 2022-07-01	Integral Molecular, Inc.	Specificity Screening of Biotherapeutics for Improved Safety Profiling in IND Applications Using the Membrane Proteome Array (MPA)
DDTIST0014	LOI 2023-11-30	Deliberate Solutions, Inc.	AI-COA™ for Automated Depression and Anxiety Severity Measurement
DDTIST0015	LOI 2023-01-23	Fresenius Kabi Deutschland GmbH	Local tolerance of epidurally/intrathecally administered leachables in vitro
DDTIST0016	QP 2025-07-08 LOI 2024-09-03	Emulate	Human Liver-Chip for Prediction of Drug-Induced Liver Injury
DDTIST0020	QP 2025-09-16R LOI 2024-03-08	AstraZeneca	Automating Identification, Detection, and Adjudication (AIDA) of Clinical Events using Artificial Intelligence (AI) and Machine Learning (ML)
DDTIST0027	LOI 2024-12-12	Brigham and Women's Hospital	The Heart Failure Natural Language Processing (HF-NLP) Model
DDTIST0028	LOI 2024-12-27	Dr. Yaoshi Wu	Interval-Specific censoring set adjusted Kaplan-Meier estimator (WKE) to estimate the survival function for the time-to-event endpoints in clinical trials.
DDTIST0032	LOI 2025-01-29	Charles River Laboratoires, Inc., (CRL)	Use of Retrogenix Platform Specificity/Off-target Screening to Enhance Biotherapeutic Safety Assessment
DDTIST0034	LOI 2025-06-23	Organ Pathobiology and Therapeutics Institute, U Pitt	Liver acinus microphysiological system (LAMPS) for determining drug candidate dosing in clinical trials of liver disease.

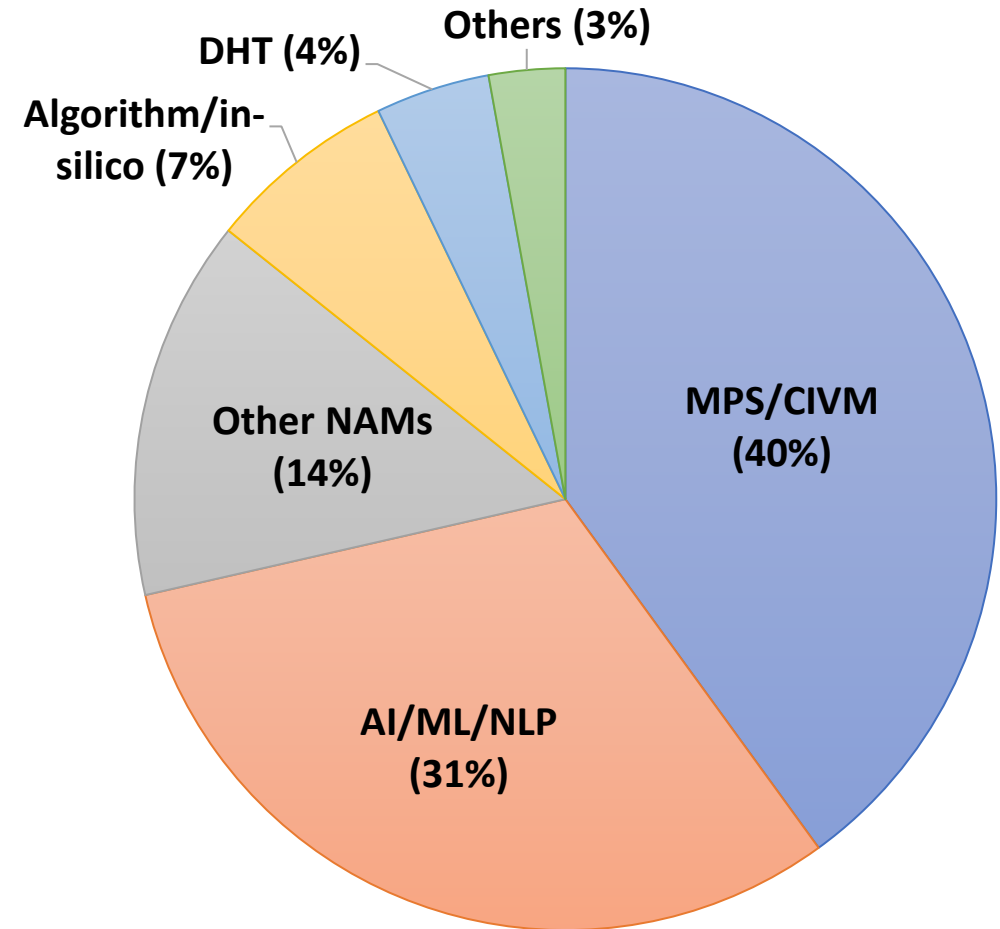
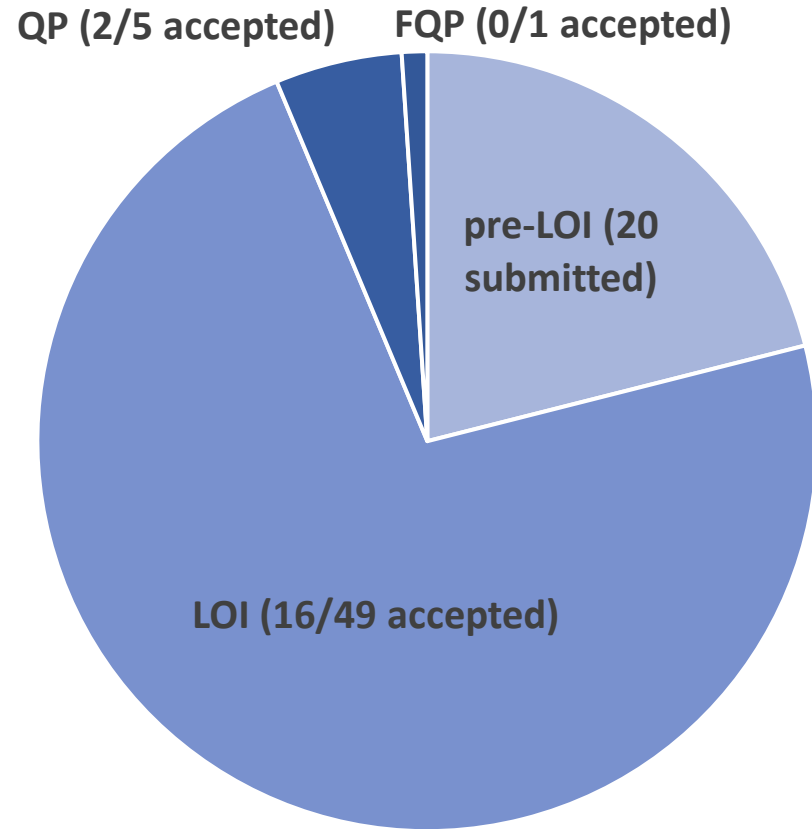
ISTAND Accepted Submissions - 2



Project #	Acceptance Date	Requester	Project Title
DDTIST0043	LOI 2026-01-14	3Rs Collaborative	Microphysiological Systems to Investigate Clinical Drug Induced Liver Injury Risk
DDTIST0044	LOI 2025-11-25	Organ Pathophysiology and Therapeutics Institute	Quantifying hepatotoxicity using the liver acinus microphysiological system (LAMPS) for determining drug candidate dosing in clinical trials of liver disease
DDTIST0045	LOI 2025-11-13	Icahn School of Medicine at Mt. Sinai	Human Kidney Chip for Assessment of Relative Nephrotoxicity
DDTIST0046	LOI 2025-12-19	Johnson and Johnson	Remote Disease Severity Assessment for Psoriasis Drug Clinical Trials: At-Home Image Collection and Artificial Intelligence-Based Scoring Models
DDTIST0047	LOI 2025-11-13	Texas A&M University	Human chorio-decidual interface organ on chip for derisking positive rodent DART studies for new modality investigational new drug candidates
DDTIST0048	LOI 2026-01-21	AIRA Matrix Private Limited	Artificial Intelligence-based solution for automated spermatogenic staging and toxicity assessment in rats. (AIRAToxStage)
DDTIST0049	LOI 2025-12-19	Axion BioSystems	Human iPSC-Cardiomyocyte MEA Assay for Prediction of Clinical Cardiovascular Repolarization Risk

Submissions and FDA letters are available: <https://force-dsc.my.site.com/ddt/s/>

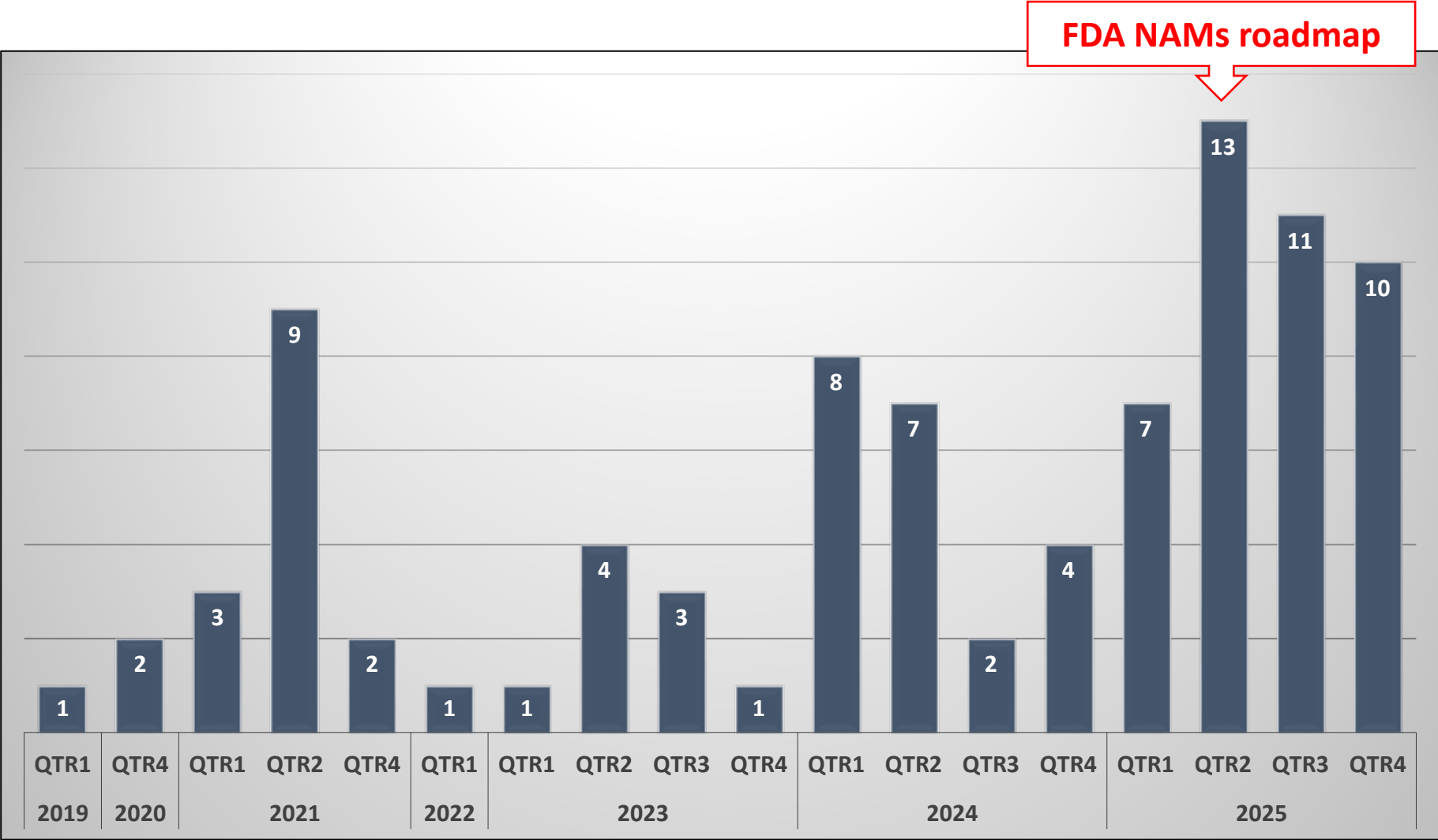
ISTAND Submissions as of Feb 25, 2026



Acknowledgement: York Tamita and the IStand and the Biomarker qualification Teams

ISTAND@fda.hhs.gov

Qualification Submissions per Quarter



* As of 12/31/2025

Collaboration Opportunities: Division of Applied Regulatory Science (DARS)



DARS VISION

To move new science into the FDA regulatory process and address emergent regulatory and public health questions

DARS MISSION

To engage stakeholders in mission-critical laboratory, computational, and clinical applied research to inform regulatory decision-making and to address public health

DARS has a multi-disciplinary approach available in a single unit

Computational



Laboratory

Complex In Vitro Models Laboratory (CIVM Lab)

The DARS CIVM lab develops in vitro models to assess drug effects on vital organs, toxicity, and drug transfer/pharmacokinetics.

Current Capabilities:

- Nonclinical human NAMs
- hiPSC derived tissues
- Microphysiological systems
- High-content imaging and functional analysis

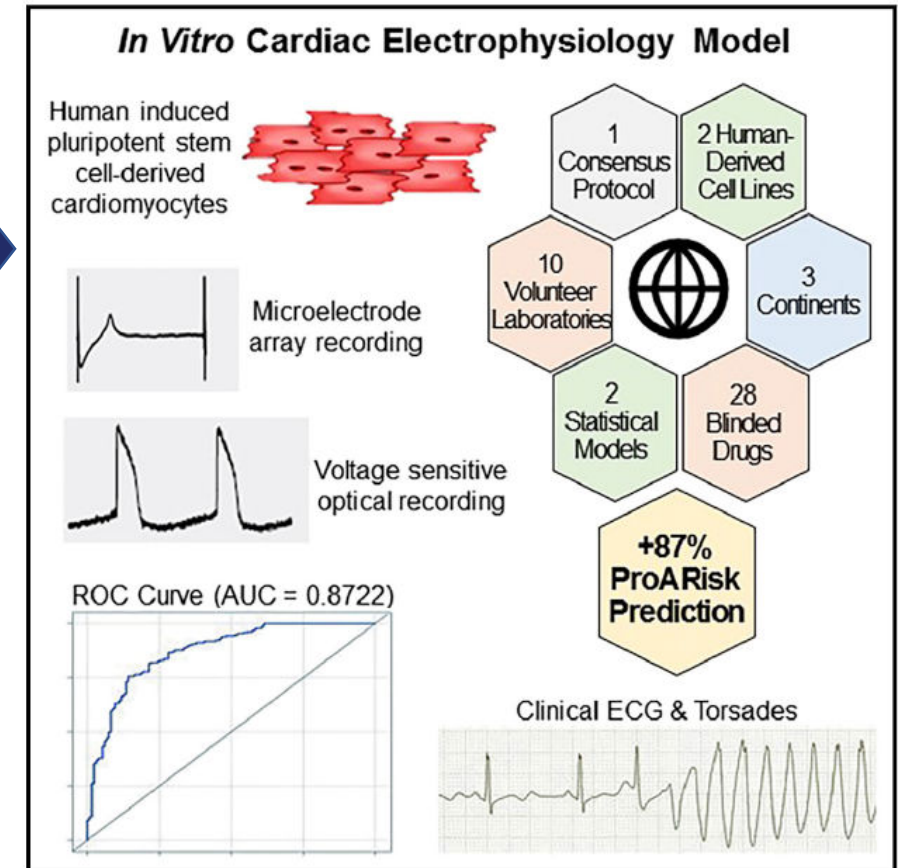
Cardiac NAMs

CiPA Paradigm and hiPSC-CM Validation Study



CiPA: A shift from reliance on the traditional clinical TQT studies to a mechanistic assessment of proarrhythmic risk

E14 and S7B Clinical and Nonclinical Evaluation of QT/QTc Interval Prolongation and Proarrhythmic Potential — Questions and Answers
Guidance for Industry
August 2022

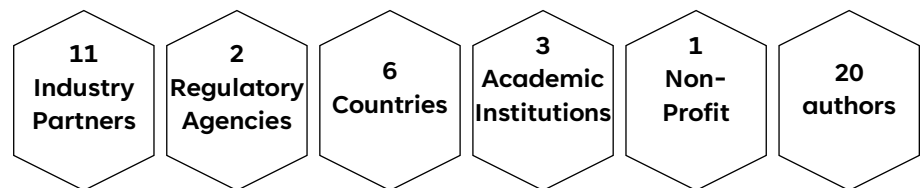


International Multisite Study of Human-Induced Pluripotent Stem Cell-Derived Cardiomyocytes for Drug Proarrhythmic Potential Assessment
Ksenia Blinova¹, Qianyu Dang², Daniel Millard³, Godfrey Smith⁴, Jennifer Pierson⁵, Liang Guo⁶, Mathew Brock⁷, Hua Rong Lu⁸, Udo Kraushaar⁹, Haoyu Zeng¹⁰, Hong Shi¹¹, Xiaoyu Zhang¹², Kohei Sawada¹³, Tomoharu Osada¹⁴, Yasunari Kanda¹⁵, Yuko Sekino¹⁶, Li Pang¹⁷, Tromondae K Feaster¹⁸, Ralf Kettenhofen¹⁹, Norman Stockbridge²⁰, David G Strauss²¹, Gary Gintant²²

[Cell Reports, 2018, 24\(13\):3582-3592](#)



Best Practice Recommendations for hiPSC Assays
Volume 117, November 2020



[Gintant et al., Reg Tox and Pharm, 2020](#)

hiPSC-CM assay categorized drugs into high and intermediate vs. low TdP risk groups with 0.87 accuracy

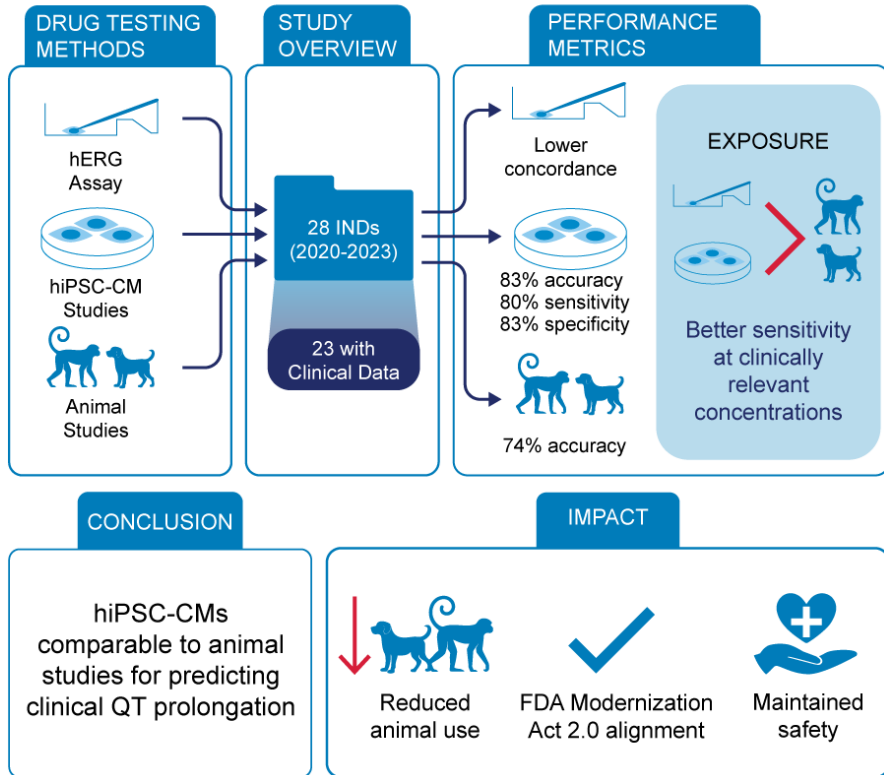
hiPSC-CM = human induced pluripotent stem cell derived cardiomyocytes;
CiPA = Comprehensive in vitro Proarrhythmia Assay

hiPSC-CM Assay in Context: Comparison with hERG, In Vivo, and Clinical QT Data



CDER-led hiPSC-derived cardiomyocyte assay for drug-induced QT prolongation assessment

hiPSC-CMs: A Promising Alternative to Animal Testing for Cardiovascular Safety Assessment

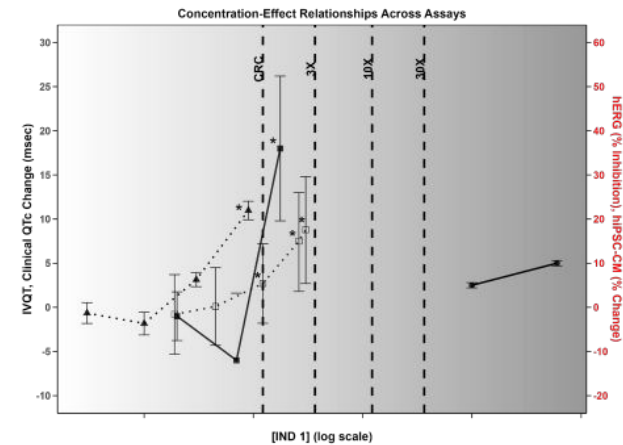


hERG, Animal, and hiPSC assays predictions of Clinical QT prolongation

Nonclinical studies compared to clinical QTc prolongation ≥ 10 msec

Endpoint	Concordance	Sens	Spec	PPV	NPV	MCC	LR+	LR-	PPT	NPT
hERG block at $\leq 10 \mu\text{M}$	0.61	0.60	0.61	0.30	0.85	0.18	1.54	0.65	28%	14%
hiPSC-CM	0.83	0.80	0.83	0.57	0.94	0.57	4.80	0.24	54%	6%
hERG+hiPSC-CM	0.57	0.80	0.50	0.31	0.90	0.25	1.60	0.40	29%	9%
IVQT ≥ 10 msec	0.74	0.40	0.83	0.40	0.83	0.23	2.40	0.72	37%	15%
IVQT ≥ 10 msec + Other	0.78	0.80	0.78	0.50	0.93	0.50	3.60	0.26	47%	6%

Pre-Test Probability 20%



Simpson & Feaster et al. 2026 (Under Review)

Increased hiPSC-CM use in drug development and submissions to FDA to support regulatory decision making. 100+ hiPSC-CM study reports submitted. CDER concordance analysis revealed cardiac NAMs are a promising alternative to animal testing for QT prolongation assessment.

hiPSC-CM MEA Assay Review Teaching Tool



Teaching Tool: hiPSC-CM MEA Assay Review

Using this Teach Tool: The following Teach Tool provides an example of a high-quality GRP review for the given topic. Extra hints and tips are referenced (look for **highlights**) as footnotes. Hints and tips communicate valuable rationale and/or provide helpful explanation where the author deems necessary. While this Teach Tool is one example of expert review, you are encouraged to consult with your team leader/supervisor regarding expectations for review style, focus, and length.

Study Title: Effect of TK123 on Electrophysiological Endpoints in **Human Stem Cell-Derived Cardiomyocytes**¹

Study No.: 12345

Study Date: DATE

GLP Compliance: **No**²

Testing Facility: Name of Facility, City, State (or country)

Test article: TK123 (dihydrochloride salt form, lot # NAM-11-121-BB1-18; purity ≥98.5%)

Objective³

To evaluate the functional effects of TK123 on human stem cell-derived cardiomyocytes electrophysiological properties and assess TdP risk potential.

Method/Study Design

Test article was prepared in **DMSO**⁴ and stored frozen and protected from light. Final test article concentrations (0.1, 0.3, 1, 3, 10, 30, 100, and 300 μM)⁵ were prepared on the day of testing by diluting the stock solution in assay medium. Final concentrations were selected based on preliminary studies. Samples of the test article formulation solutions collected from each well were **analyzed for**

¹ Cell line validation: iCell Cardiomyocytes² (iCCM2) are the most common cells used and the only commercially available CiPA validated cells. These cells are normally cryopreserved at approximately day 30 of differentiation and have been extensively validated in Blinova et al. (2018).

² **GLP consideration:** Given this is considered a safety pharmacology study, it is expected to be conducted according to GLP standards however this is not yet a requirement for the hiPSC-CM assays. Best practices described in **Gintant et al. (2020) and E14 Q&A** should be followed for experimental design and conduct.

³ Study objective: The hiPSC-CM MEA cardiac liability assay is a drug development tool used to assess the delayed repolarization risk and TdP risk potential of small molecule candidate drugs in adults to create human-relevant data for the candidate drug's IND submission.

⁴ Vehicle specifications: Low DMSO concentration should be used. Vehicle control groups should be included on each plate with time-matched controls. Some sites in Blinova et al. (2018) reported solubility issues requiring sonication, 37°C incubation, or doubled DMSO content (0.2%) for certain compounds.

⁵ Concentration range: Test substance should be evaluated at an appropriate concentration range relevant to expected clinical exposure. Suggested concentration range (0 to 100 μM at a minimum) should be below, include, and exceed estimated C_{max}. Blinova et al. (2018) used four concentrations per drug with either logarithmic or half-logarithmic intervals.

Purpose

This tool outlines how to review and interpret hiPSC-CM repolarization waveform parameters and can be used as a tool to ensure that all required information is present in a study report. This will provide a faster response to sponsors and more consistent review of hiPSC-CM repolarization assay study report submissions, reducing the need for additional consults, animal studies, and re-review rounds.

Context-of-use (COU)

The hiPSC-CM MEA cardiac liability assay is a drug development tool used to assess the delayed repolarization risk and TdP risk potential of small molecule candidate drugs in adults to create human-relevant data for the candidate drug's Investigational New Drug (IND) submission, providing greater evidence of safety assurance for regulatory decision making that enables Phase I clinical trials.

TdP Risk Assessment Categorization (TRAC) Calculator

TdP Risk Assessment Categorization (TRAC) Calculator

Introduction

The TdP risk assessment categorization calculator is used to assess the TdP risk of small molecule compounds using three (3) hiPSC-CM electrophysiological response predictors as part of the evolving Comprehensive In Vitro Proarrhythmia Assay (CIPA) paradigm.

Predictor Inputs

Did drug-induced arrhythmia-like event occur at any concentration? (Predictor 1)
0

Did drug-induced arrhythmia-like event occur at any concentration? (0=none arrhythmia, 1=type A arrhythmia, 2=any other arrhythmia type. (Predictor 2)
0

Maximum Repolarization ($\Delta\Delta APD_{90c}$ or $\Delta\Delta APD_{90c}$) (Predictor 4)
20.0000

Repolarization at Cmax ($\Delta\Delta APD_{90c}$ or $\Delta\Delta APD_{90c}$) (Predictor 7)
6.0000

Drug-induced repolarization change at expected Cmax (ms) (ms)

Instructions

- For details on how to use the hiPSC-CM CIPA TdP Risk Categorization Tool, read the [Context of Use \(CoU\)](#), which includes [limitations of use](#).
- Insert the model predictor input parameters in the "Predictor Inputs" section. Hovers for Predictor 4 and Predictor 7 are shown in the input fields upon startup, they will be replaced when user inputs are entered.
- Read the outputs in the "Program Outputs" section to obtain the TdP risk categorization estimated by the selected parameters.
- Graphical depiction of the estimated TdP risk potential will be displayed in the "Program Outputs" section.

Cmax Interpolation

Cmax (μM) 4

Arrhythmia Type: None

Concentration - Repolarization inputs

Concentration (μM)	$\Delta\Delta APD_{90c}$ or $\Delta\Delta APD_{90c}$ (ms)	
0	6.1	-
.1	-1	-
3	10	-
1	20	-
3	-10	-
10	7	-
30	3	-
100	2	-
300	-13	-

Program Outputs

The background calculation uses a logistic regression model. The model outputs are:

- High or Intermediate TdP Risk Probability: 54.1%
- Low TdP Risk Probability: 45.9%

Hill Fit Curve (only available when input is filled in Cmax Interpolation)

References

- Ritova K, Dang O, Millard D, Smith B, Plerson J, Guo L, Brock M, Lu HR, Kraushaar U, Zeng H, Qin H, Zhang X, Savasid K, Casati T, Kanda Y, Sakira Y, Pang L, Feaster TK, Kellenhofen R, Stockbridge N, Strauss DG, Garbat G. International Multicenter Study of Human-Induced Pluripotent Stem Cell Derived Cardiomyocytes for Drug Proarrhythmic Potential Assessment. *Cell Reports*. 2018 Sep 25;24(13):3582-3592. doi: 10.1016/j.celrep.2018.08.079. PMID: 30257217; PMCID: PMC6228939

TRAC Calculator

Open-source web-based online tool for quick evaluation of Torsades de Pointes (TdP) risk for in vitro hiPSC cardiomyocytes models. Streamlines TdP risk estimation for routine regulatory use

Software Available: <https://github.com/FDA/TRAC-Calculator>

TdP Risk Categorization Calculator Program

Predictor Inputs

Predictor 1

Did drug-induced arrhythmias occur at any concentration? 0=no arrhythmia, 1=type A arrhythmia, 2=any other arrhythmia type.

0

Predictor 4

Maximum repolarization change observed at any concentration (ms).

e.g. 25

Predictor 7

Drug-induced repolarization change at expected Cmax (ms).

e.g. 15

Program Outputs

Model 1 TdP Risk

Instructions

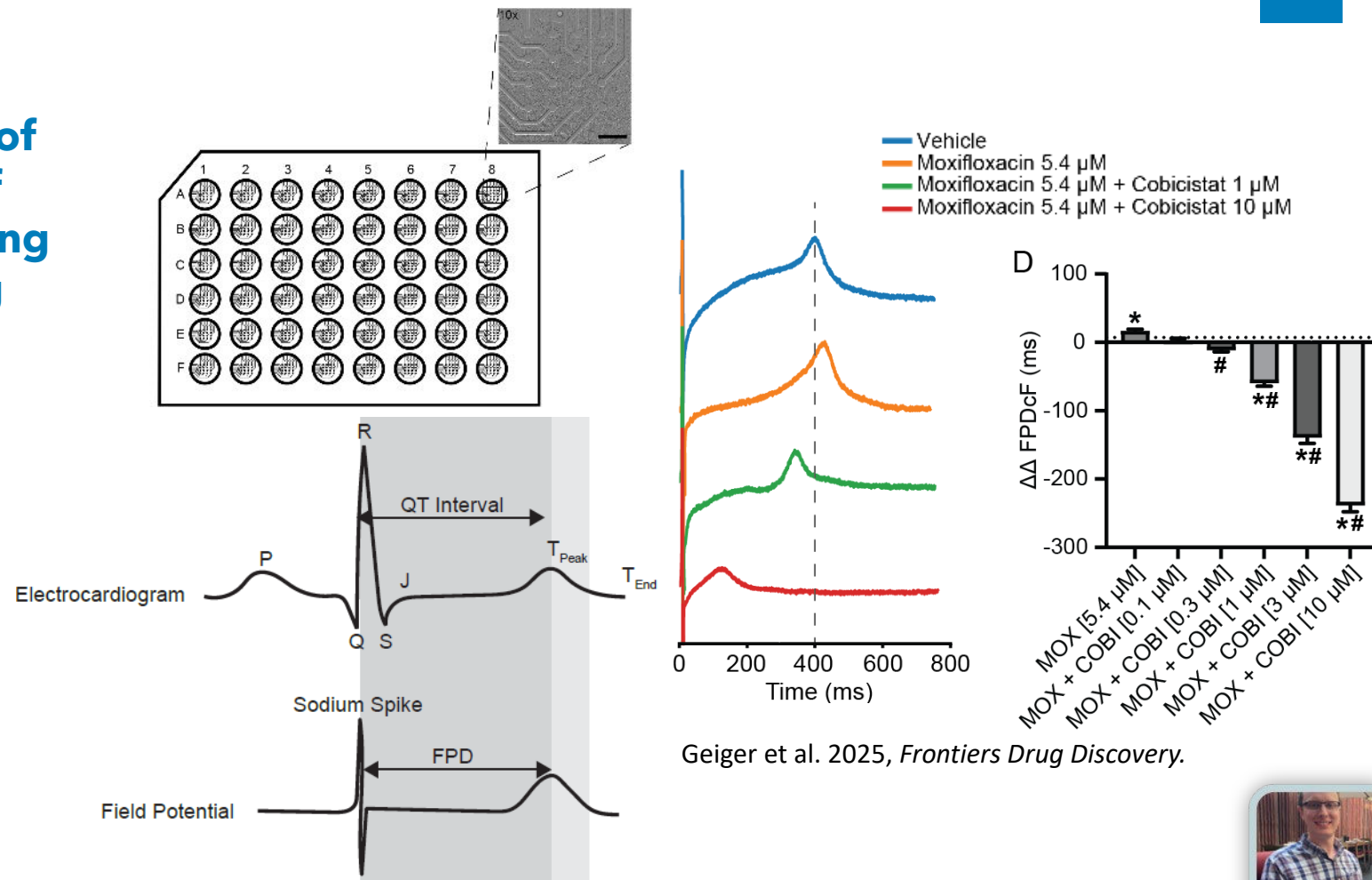
- For details on how to use the hiPSC-CM CIPA TdP Risk Categorization Tool, read the [Context of Use \(CoU\)](#), which includes [limitations of use](#).
- Insert the model predictor input parameters in the "TdP input parameters" table. Hover over the information icons next to each section header for definitions and range of use. Check changes in the waveform parameter interactive visual.
- Read the outputs in the "Program Outputs" table to obtain the TdP risk categorization estimated by the selected parameters.
- Graphical depiction of the estimated TdP risk potential will be displayed in the "TdP Risk Categorization Estimation" section. The concentration-response curves (Hill Curve) update with the estimated Cmax for the selected pulse parameters.

Cardiac NAMs for Assessing Proarrhythmic Risk of Drug Combinations: A Case Study



CDER led project evaluating the use of a cardiac NAM to assess the safety of moxifloxacin (a drug known to prolong repolarization) and cobicistat (a drug known to shorten repolarization).

- hiPSC-CM are plated onto a multielectrode array. Drug induced changes in the field potential duration (FPD) are measured.
- Studies have shown that the FPD measured in vitro correlates well with the QT interval measured in the clinic.



Geiger et al. 2025, *Frontiers Drug Discovery*.



This assay can be used to understand the net electrophysiological effect of a drug combination prior to clinical trials.

Human Cardiac Microphysiological System for Drug Testing

Ensuring Reproducibility in Cardiac MPS Models and Functional Evaluation of Vanoxerine Using Cardiac MPS

Overview

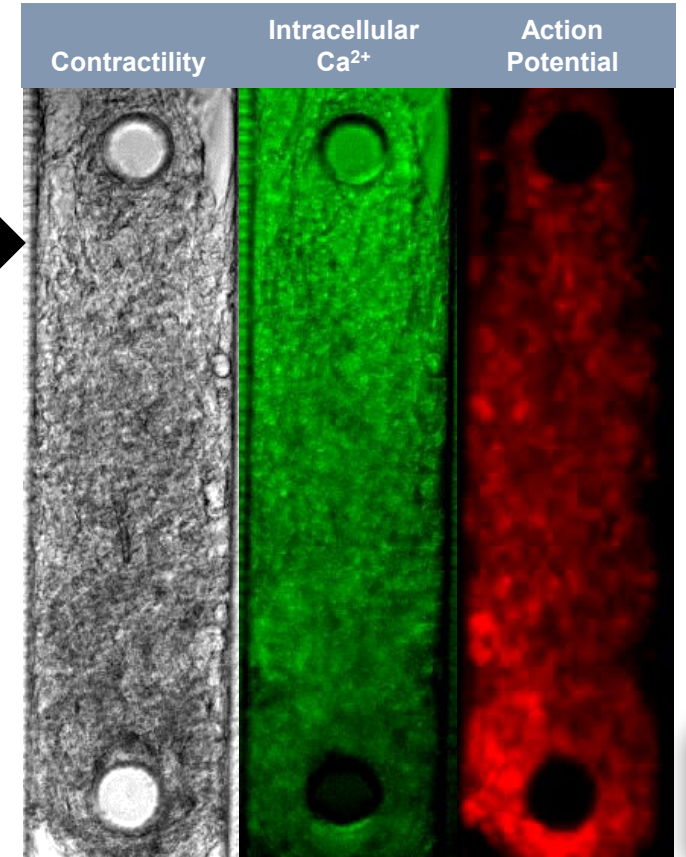
- Organ-on-a-chip platform mimicking human cardiac tissue.
- Integrated media inlet/outlet for nutrient/drug exchange.
- Central cell chamber loaded with in-house derived iPSC-CMs.
- Enables assessment of drug-induced cardiac function changes.

Key Features

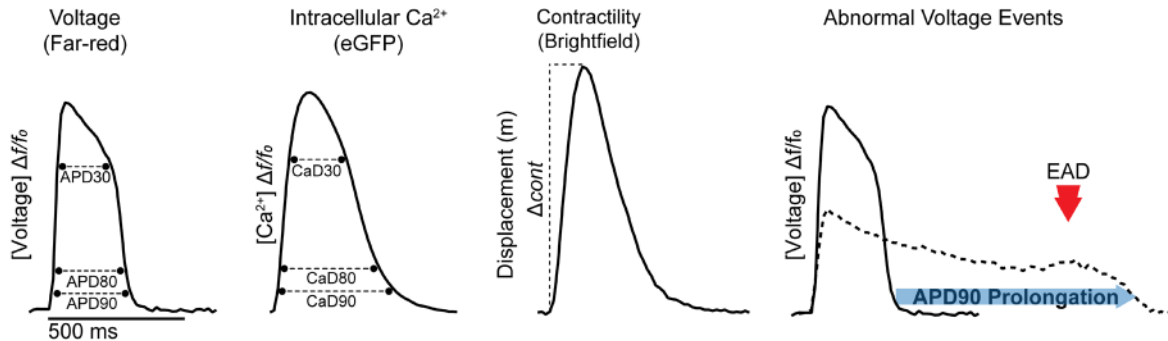
- Real-time imaging of cardiac function
- Calcium handling via genetically encoded fluorescent indicator.
- Membrane potential changes via non-toxic voltage-sensitive dye.
- Cardiac contraction



Garcia et al. 2025, *Nature Protocols*



Functional Readouts



Garcia et al. 2025, *J. Cardiovasc. Dev. Dis.*



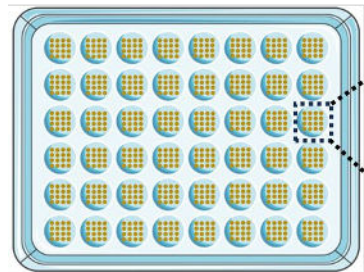
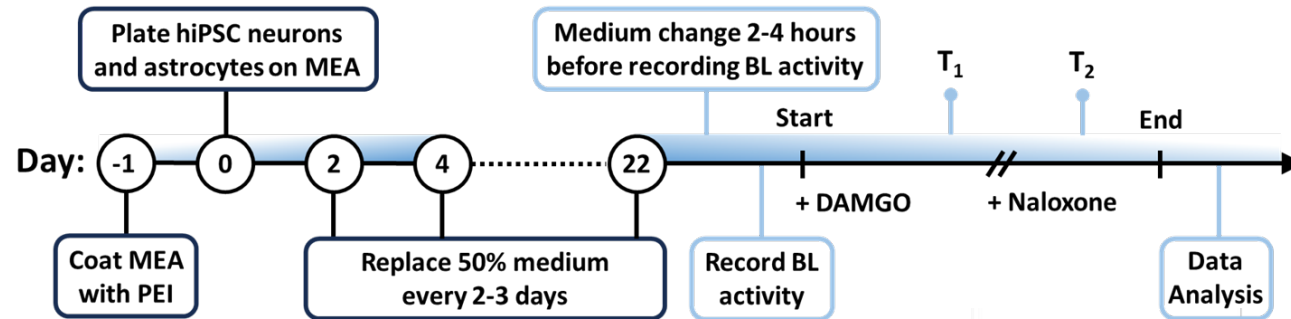
This work evaluated human-based NAMs to assess how drugs affect heart function. Using this model, vanoxerine was shown to cause delayed repolarization and irregular heart rhythms. This shows NAMs can be used to assess whether multi-channel blockers are proarrhythmic or not, supporting their use for safer and more predictive drug testing.

Neural NAMs

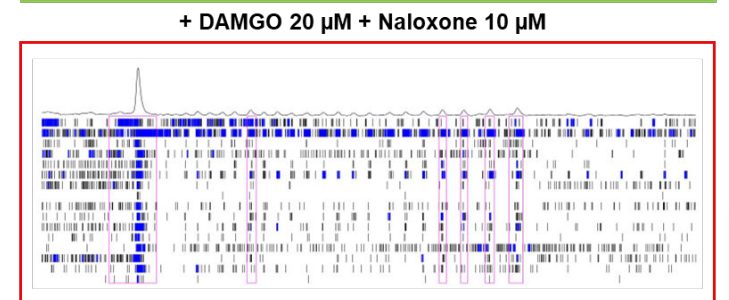
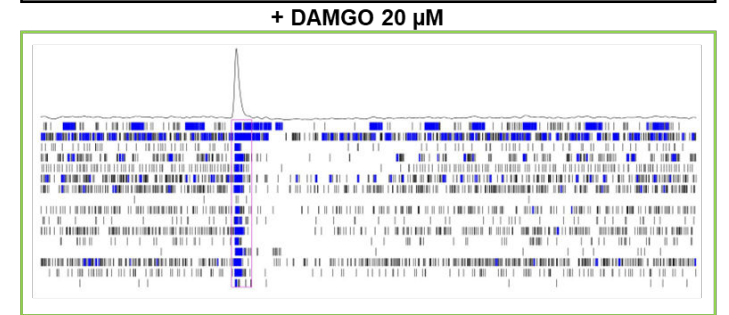
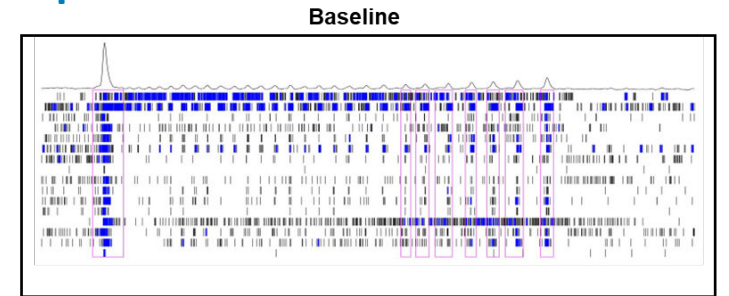
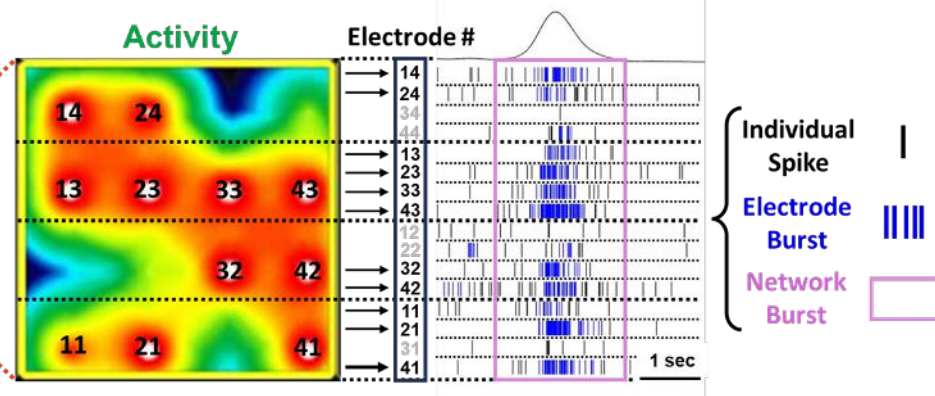
Neural NAM for Electrophysiological Assessment of Opioid Agonist and Antagonist Combination



CDER-led hiPSC-derived neural co-culture assay using MEA platform to assess CNS opioid interactions in combination with rescue antagonist (Naloxone)



Serna et al. 2025, NAM Journal



0 Time (s) 100



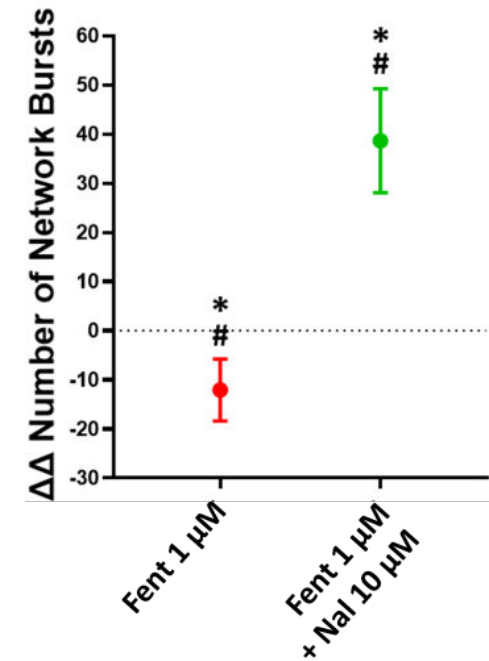
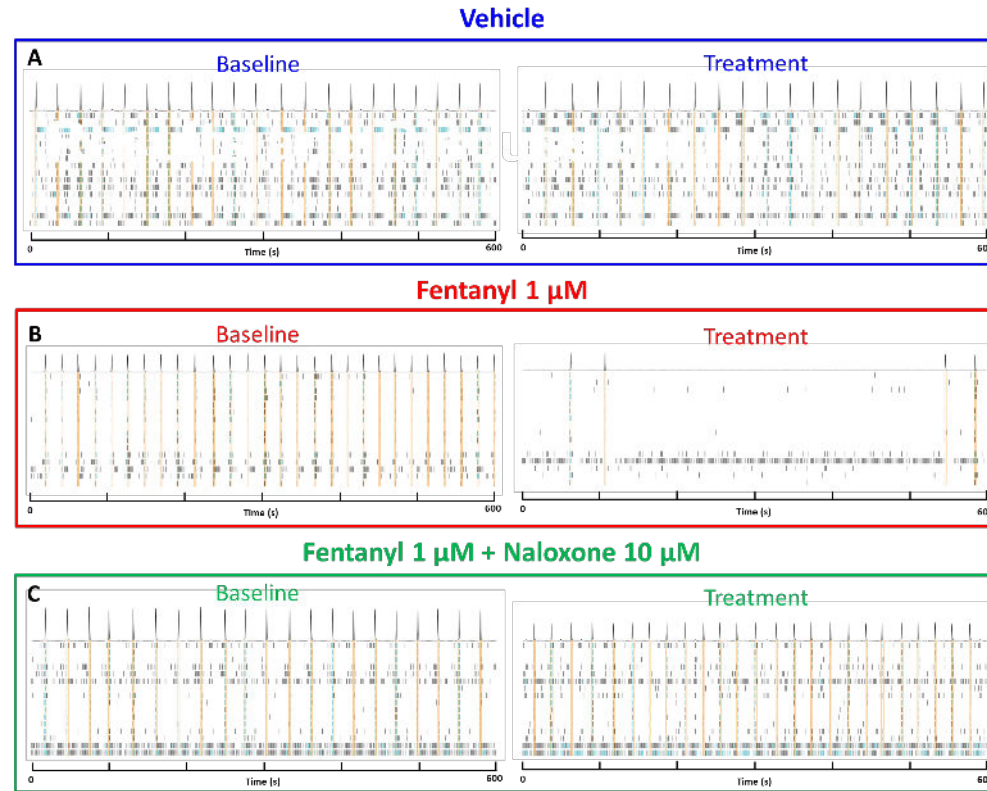
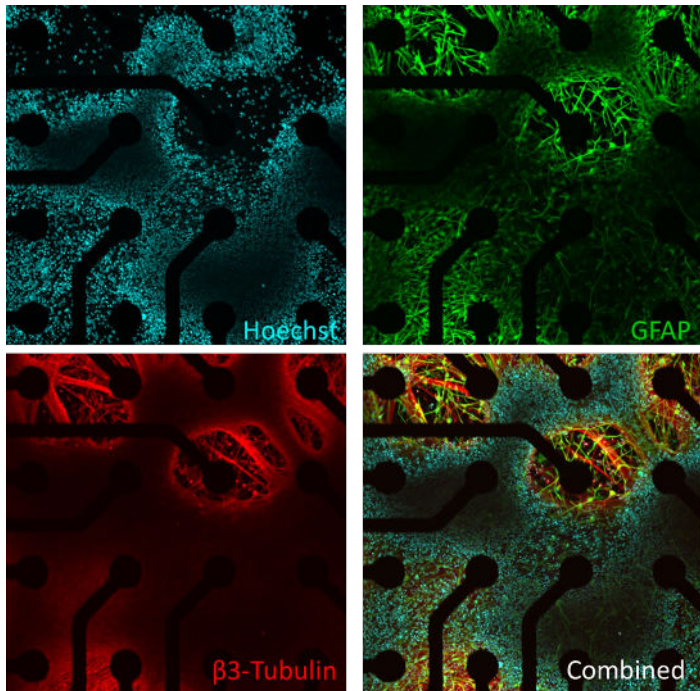
Analysis of MEA output metrics show neural co-culture responding to opioid agonist DAMGO and reversion towards baseline behavior through application of antagonist Naloxone.

This study provides a foundation for the nonclinical evaluation of opioid agonist and antagonist on human neuronal electrophysiological activity to support safety and efficacy assessment.

Clinically Relevant Opioid Agonist and Antagonist Combination in Neural NAM



Fentanyl significantly reduced network burst activity, while co-administration with naloxone reversed opioid-induced network suppression



Serna et al. 2026, (In preparation)



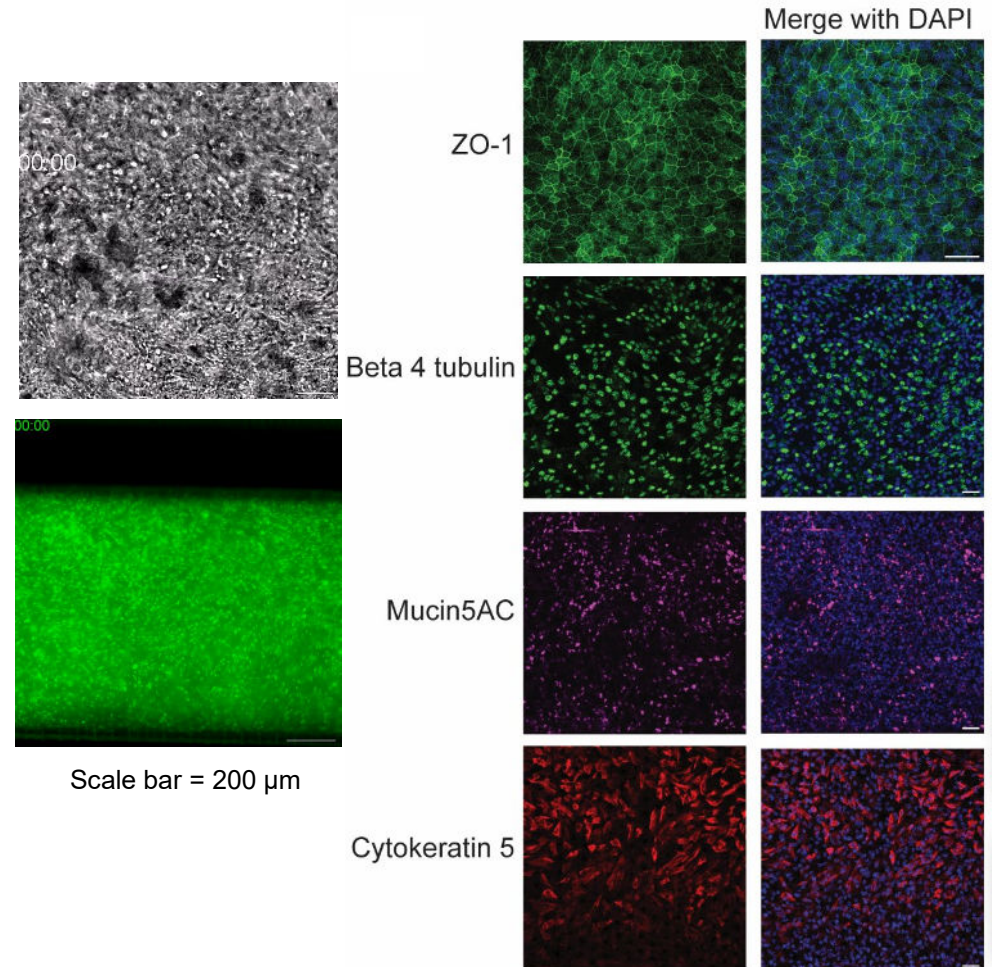
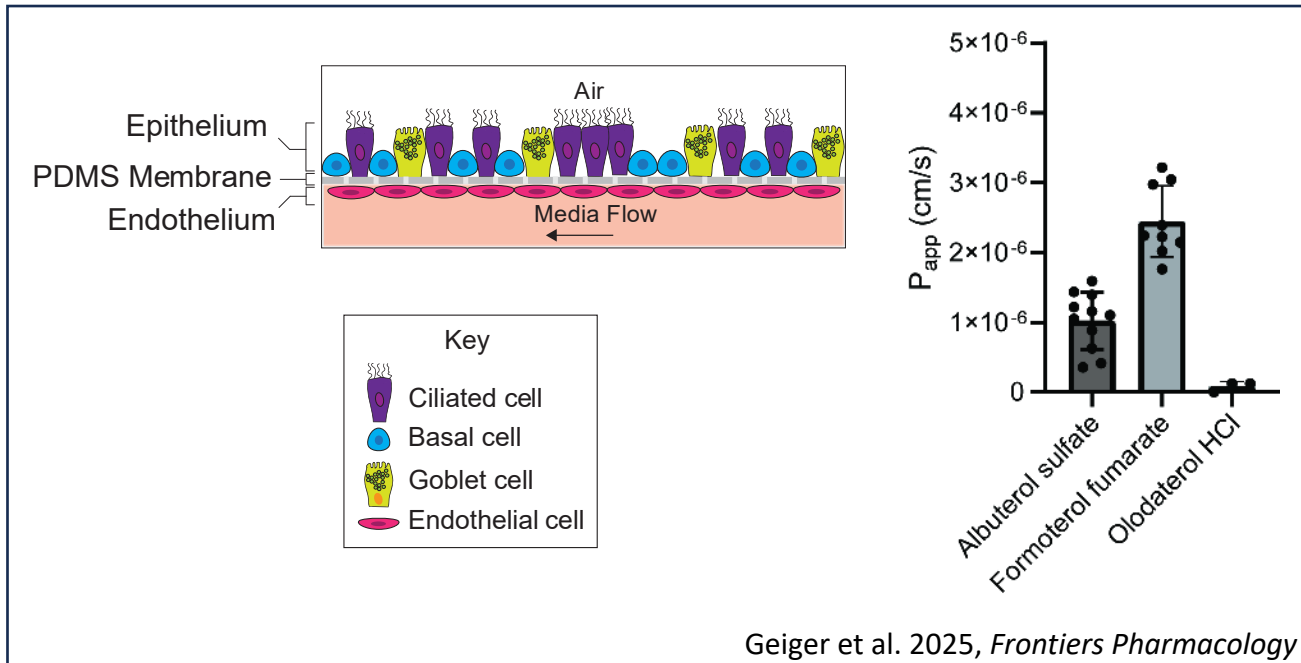
These findings contribute to addressing the opioid epidemic by providing a nonclinical platform to evaluate expanded treatment options for opioid overdose reversal.

Respiratory NAMs

Small Airway MPS Assessment of Apparent Permeability for Inhaled Drugs



CDER-led project evaluating human lung MPS for relevant cell types and potential to measure the apparent permeability of inhaled drugs



Rahman et al. 2025, *ACS Pharmacol Transl Sci*

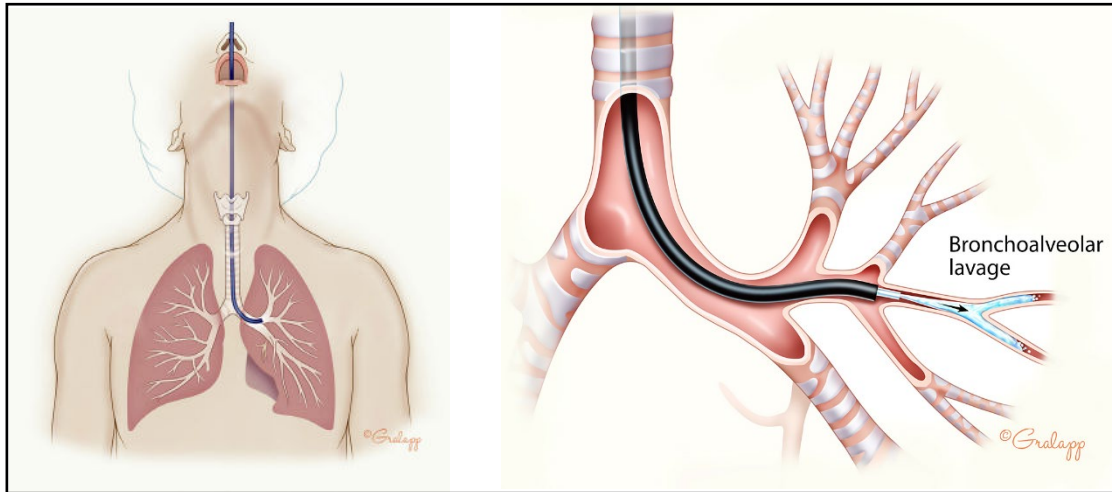
Scale bar = 50 μm



This project establishes quality control criteria for the small airway MPS and is consistent with the 3Rs as the *ex vivo* rat lung is often used to assess to evaluate inhaled drug permeability.

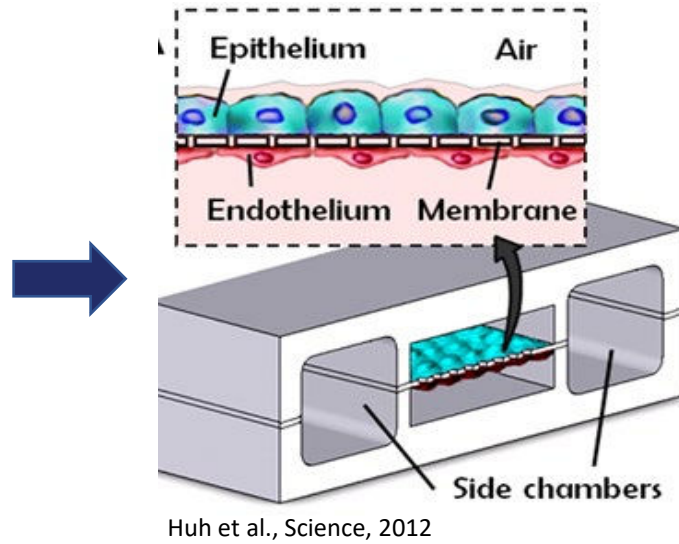
Lung MPS for Predicting Anti-Infective Drug Penetration

CDER-led project evaluating human lung MPS for relevant cell types and potential to measure the apparent permeability of inhaled drugs



<https://psnet.ahrq.gov/web-mm/one-bronchoscopy-two-errors>

Phase 1 epithelial lining fluid (ELF) studies use bronchoscopy and bronchoalveolar lavage (BAL), which is labor-intensive, unpleasant, and yields lung penetration results with high variability



Emulate MPS for modeling lung alveoli

The model includes:

- Alveolar cells
 - Type 1
 - Type 2
- Endothelial cells
- Interstitial space



This study will compare lung MPS data with existing clinical data to evaluate whether MPS could serve as an alternative or supplementary approach to current methods. The results may influence FDA regulatory decision making for anti-infective drugs and could encourage pharmaceutical companies to increasingly adopt MPS technology in their nonclinical testing and regulatory submission processes.

Blood-Milk Barrier NAMs (Lactation)

Application of MPS to Predict Drug Transfer Across the Blood-Milk Barrier



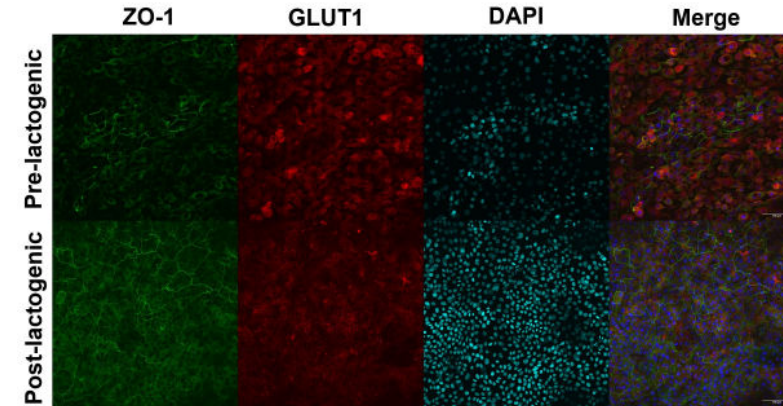
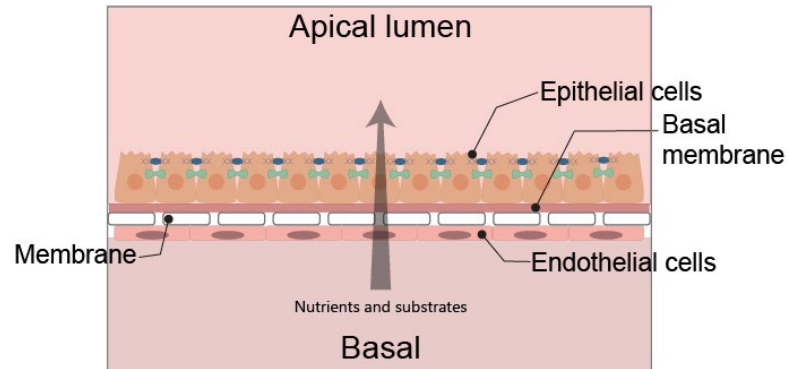
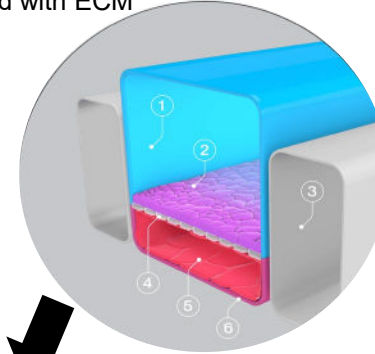
Objectives

- Evaluate a MPS model that mimics the human blood-milk barrier.
- Validate model predictions by comparing to existing clinical data on drug transfer into breast milk.

Key Features

- Breastfeeding is vital, but medication safety knowledge is limited.
- Traditional methods struggle to predict drug transfer into milk accurately.
- The MPS model mimics human mammary tissue function and structure.
- MPS technology provides a novel tool to support safety assessments of medication use during breastfeeding.

1. Blood (mother side)
2. Mammary endothelial cells
3. Porous membrane coated with ECM
4. Mammary epithelial cells
5. Breast milk (infant side)



Garcia et al. 2026, (In preperation)



The development of MPS to model drug transfer across the blood-milk barrier addresses a critical knowledge gap in medication safety for breastfeeding mothers and infants. Providing a human-relevant model that mimics mammary epithelium physiology, offer a powerful tool to better predict infant drug exposure during lactation. This advancement supports informs regulatory guidance on medication use in breastfeeding populations and promotes the inclusion of lactating women in drug development. Ultimately, MPS have the potential to accelerate regulatory decisions while enhancing maternal and infant health by ensuring safer medication use during breastfeeding.

Conclusions

- **Commitment to Modernization:** FDA is committed to phasing out animal studies where scientifically valid alternatives exist, advancing more predictive, human-relevant methods.
- **Coordinated Leadership in NAMs:** CDER has established the **CDER NAMs Coordinating Committee** to serve as a central point of contact for FDA and external stakeholders, ensuring alignment, transparency, and strategic integration of NAMs.
- **Growing Momentum in IStand:** Uptake of IStand submissions continues to increase, with approximately 40% focused on MPS and CiVM technologies — demonstrating strong innovation in this space. Workshops like this one are critical to accelerating scientific exchange and regulatory readiness.
- **Collaborative Regulatory Research:** DARS regulatory science initiatives provide meaningful opportunities for collaboration to generate the evidence needed to support qualification, adoption, and implementation of novel methods.

