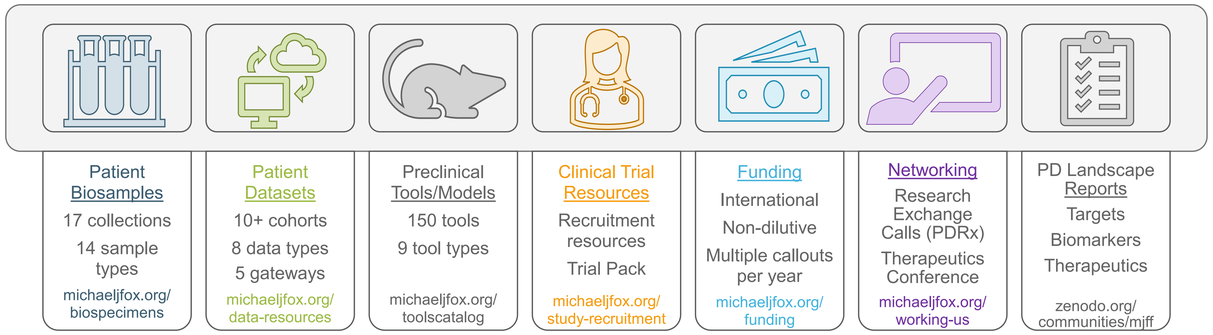
RESEARCH RESOURCES AVAILABLE THROUGH THE MICHAEL J. FOX FOUNDATION FOR PARKINSON'S RESEARCH

Nicole K. Polinski, Gloria Thakuria, Anna Schwartz, Elisia Clark, Leslie Kirsch, Josh Gottesman, Dave Alonso, Yasir Karim, Jamie Eberling

The Michael J. Fox Foundation for Parkinson's Research, New York, NY, USA

Introduction

For the past 23 years, MJFF has supported the Parkinson's disease (PD) research community by funding research in PD biology, biomarkers, and preclinical through clinical therapeutic developments. Over the past 15 years, MJFF has also expanded our role in the PD research space to provide non-financial resources to align the field and speed new discoveries and developments. These resources include (1) biosamples from a number of PD clinical studies, (2) clinical, genetic, biologic, and patient-reported outcome data from PD clinical studies, and (3) preclinical tools such as antibodies, proteins, cell lines, viral vectors, rodent models, etc. Herein we provide an overview of the many resources MJFF makes available to the research community, with details on how to browse and access resources that are currently available. We also provide insights into upcoming resources that are currently in development for folks to understand what will be available in the future. Finally, we provide information on how to contact MJFF to ask questions about existing resources, provide feedback, and suggest additional resources MJFF could consider developing for the research community.



Preclinical Research Tools and Models

The MJFF Preclinical Tools Program supports researchers by providing access to high-quality reagents and models. This allows scientists to focus on answering key research questions for PD rather than generating reagents for experiments. In addition, this Program improves reproducibility by providing a common toolset across labs.

Figure 1. Overview of the MJFF Preclinical Research Tools Mission and Programs.
The MJFF Preclinical Tools Program was designed to address a number of issues in the research tools space that were causing wasted research funds, slow progress, and issues in comparing findings across research groups. The MJFF Tool Generation Program develops and distributes critical tools when no options currently exist to address the field-wide gap. The MJFF Sponsored Tools Program addresses gaps by transferring tools from academic/industry labs to repositories for open access.

Table 1. Overview of the Preclinical Tools in Development in 2023.
Projects in "Project Scoping/Due Diligence" are in the project design phase; the work is a priority for MJFF but tool development is yet to begin. Projects in "Early Development" are underway but in a phase of development where success is not guaranteed. Projects in "Late Development" are successful and the tools are moving towards commercial distribution. Projects in "Available as of 2023" were recently launched; you can find these and other MJFF tools MJFF has available in our online Tools Catalog (michaeljfox.org/research-tools-catalog). Parentheses denote that the tool was developed by a separate research group and made available to the research community through MJFF's Sponsored Tools Program (michaeljfox.org/sponsored-tools-program).

Project Scoping/Due Diligence	Early Development	Late Development
GCase Probes (Vocadlo)	aSyn Substrate for SAAs	pS65 Ubiquitin Assay (Mitokinin)
Rb anti-GlcSph Antibody	pH Sensor-Tagged aSyn Cell Line	Rb anti-pS65 Ubiquitin Antibody (IHC)
Rb anti-Mouse PINK1 Antibody	LRRK2 KO MEF Cell Line	Rb anti-pS65 Parkin Antibody
Rb anti-EEA1 Antibody for Endo-IP	LRRK2 G2019S MEF Cell Line	Rb anti-pT86 Rab3 Antibody
Rb anti-SYP Antibody for SV-IP	LRRK2 R1441C MEF Cell Line	Ms anti-Rab10 Antibody
Rb anti-ATP10B Antibody	Halo-tagged LRRK2 MEF Cell Line	Ms anti-LRRK2 (UDD3) Antibody
Rb anti-TMEM175 Antibody	Rb anti-Rab12 Antibody	pT73 Rab10 Protein
Rb anti-INPP5F Antibody	Rb anti-aSyn 1-119 Truncation Antibody	BAG3 Protein (Brennan)
Rb anti-VPS13C Antibody	Rb anti-aSyn 1-122 Truncation Antibody	Cathepsin B Protein (Brennan)
Rb anti-Miro1 Antibody	Rb anti-N-Terminal aSyn Antibody	DGKQ Protein (Brennan)
Rb anti-Auxilin Antibody	Rb anti-pS940 AAK1 Antibody	FYN Protein (Brennan)
Rb anti-Ms MHC-II Antibody (ICC)	Rb anti-pS625 INPPF5 Antibody	GAK Protein (Brennan)
Rb anti-MHC-I Antibody (ICC)	Rb anti-Ubiquitinated aSyn Antibody	GPNMB Protein (Brennan)
Rb anti-RILPL2 Antibody	Rb anti-Ubiquitinated TOMM20 Antibody	INPP5F Protein (Brennan)
Rb anti-pS106 Rab12 Antibody (IP)	Rb anti-pS228 PINK1 Ab	STK39 Protein (Brennan)
Rb anti-SCD5 Antibody	Rb anti-Human GCase Antibody	**Available as of 2023**
Rb anti-GALC Antibody	Rb anti-Mouse GCase Antibody	SNCA 0-4 copy iPSCs (Schuele)
Rb anti-ASAH1 Antibody	Rb anti-Glucosylceramide Antibody	Hu/Ms aSyn Aggregate ELISA
INPP5F KO HeLa Cell Line	Rb anti-TMEM115 Antibody for Golgi-IP	Hu/Ms pS129 aSyn ELISA
VPS13C KO HeLa Cell Line	Rb anti-OMP25 Antibody for Mito-IP	AAV2/5 WT Human aSyn Viral Vector
GALC KO A549 Cell Line	Rb anti-TMEM192 Antibody for Lyso-IP	Rb anti-pS65 Ubiquitin Antibody
ASAH1 KO A549 Cell Line	GCase Antibody – NFP only (Roche)	Ms anti-Rab8A Antibody
ATP10B KO Cell Line	Floxed Parkin Mouse (Dawson)	BAC aSyn Mouse (Yang)
		BAC aSyn 1-120 Mouse (Yang)

Patient Biospecimens

Through the MJFF Access Data and Biospecimens (ADB) Program, researchers are able to obtain a variety of different biosamples from clinical studies. These biosamples enable a deeper understanding of the genetic and biologic components of PD for disease research and biomarker development. Availability of these precious samples speeds research by providing multiple groups access to well-characterized cohorts.

Figure 2. Overview of the Available Biosample Types from the MJFF Biospecimens Program.
MJFF offers biospecimens from 17 unique study collections for the research community. Each study differs in terms of the sample types collected, patient populations enrolled, and nature of the study (eg observational vs interventional, single visit vs longitudinal, etc). MJFF recommends different cohorts based on the research intent, with some cohorts suitable for early-stage biomarker discovery and other studies accessible only for established, well-validated assays. Biosamples are accompanied by clinical, genetic, biologic, and/or imaging data. Researchers can access the biosamples through an application that is reviewed by the Parkinson's Disease Biospecimen Review Access Committee (PD BRAC) or PPMI Biospecimen Review Committee (PD BRC).

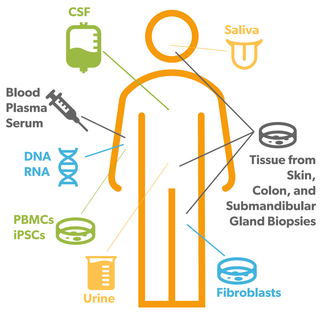


Table 2. PPMI iPSC Lines
As patient-derived cells present a valuable model for disease research, iPSCs were generated within a PPMI sub-study. PBMCs were reprogrammed into iPSCs by Cellular Dynamics International (CDI) and deposited in the PPMI Indiana University (IU) biorepository. Multiple clones have been generated for some patients. Quality control testing was performed at CDI, including karyotype analysis, identity confirmation (genotyping of 38 SNPs), pluripotency testing (gene expression of 48 mRNAs), and mycoplasma testing. All lines are available through the PPMI biospecimen request process. License fees only apply to industry users and are tiered based on company size and screening plans. Of note, each patient who contributed PBMCs also contributed clinical, imaging, and biosample data. Mutation-corrected isogenic lines are actively in development. Additional fibroblast-derived iPSCs from a separate study are available through PPMI as well.

PD Status	Cohort	Subgroup	Sex	# Patients	# Lines
Not Manifesting PD	Healthy Control	N/A	Male	6	12
			Female	4	6
	SWEDD	N/A	Male	1	1
			Female	0	0
	Prodromal	RBD	Male	2	2
			Female	0	0
		Hyposmic	Male	3	4
			Female	2	2
	GBA Mutation	N370S	Male	7	9
			Female	10	14
	LRRK2 Mutation	G2019S	Male	7	10
			Female	11	17
		G2019S + N2081D	Male	1	1
			Female	1	1
		R144G	Male	1	1
			Female	0	0
	GBA+LRRK2 Mutation	N370S + G2019S	Male	1	1
			Female	1	2
		T369M + G2019S	Male	1	1
			Female	0	0
	SNCA Mutation	G209A	Male	0	0
			Female	2	3
Manifesting PD	Idiopathic PD	N/A	Male	27	31
			Female	11	19
	GBA Mutation	N370S	Male	10	18
			Female	6	10
		E326K	Male	0	0
			Female	1	2
	LRRK2 Mutation	G2019S	Male	10	15
			Female	3	7
		R144G	Male	1	1
			Female	1	2
	SNCA Mutation	G209A	Male	2	4
			Female	1	1
	SNCA+GBA Mutation	G209A + A456P	Male	1	1
			Female	0	0

Patient Datasets

MJFF facilitates research community access to a multitude of data resources generated from MJFF sponsored and funded studies, ensuring findings can be used across programs to accelerate research breakthroughs.

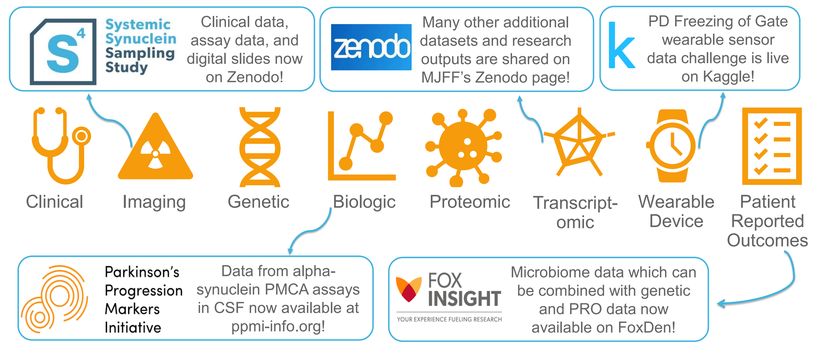


Figure 3. Overview of the Available Data Types with Callouts for Recent Additions.
MJFF data ecosystem includes many different data types from a variety of studies. Recent additions include – Systemic Synuclein Sampling Study (S4): data from this study includes cross-sectional clinical measurements and analysis of assays, including digital slide images taken from skin, colon tissue, and submandibular gland tissue which are now available on the MJFF Zenodo page (https://zenodo.org/record/7821869). Parkinson's Progression Markers Initiative (PPMI): PPMI recently released data analyzing CSF samples via the alpha-synuclein Protein Misfolding Cyclic Amplification (PCMA) assay, which can be accessed on the PPMI website alongside other data from these patients (ppmi-info.org/access-data-specimens/download-data). Fox Insight: microbiome data from 650 participants is now available alongside genetic and patient-reported outcome (PRO) data from people with and without Parkinson's disease on FoxDen (foxden.michaeljfox.org). Kaggle: a data challenge is live on Kaggle for groups to analyze wearable sensor data from patients to better understand freezing of gate (http://kaggle.com/competitions/tlvmc-parkinsons-freezing-gait-prediction). Zenodo: the MJFF page on Zenodo hosts data from various studies in addition to MJFF internal landscape analyses for biomarker and discovery efforts for PD (https://zenodo.org/communities/mjff).

Get Involved

There are many ways to engage with MJFF. Here are some ideas to get you started.

Industry-Specific Opportunities

PPMI Industry Scientific Advisory Board
- Provide feedback on study parameters and receive regular updates on the study through teleconferences and an in person annual meeting

Research Tools Consortium
- Nominate tools for MJFF development and receive pipeline updates in quarterly teleconferences

Molecular Imaging Consortium
- Nominate new targets/tracers to be studied, receive study updates in quarterly teleconferences, and gain permission to use the tracers tested in your clinical studies.