

AWARD NUMBER: W81XWH-18-1-0509

TITLE: Interactions of gut microbiome, genetic susceptibility and environmental factors in Parkinson's disease

PRINCIPAL INVESTIGATOR: David Standaert, MD, PhD

CONTRACTING ORGANIZATION: University of Alabama at Birmingham

REPORT DATE: October 1, 2022

TYPE OF REPORT: Annual Progress Report

PREPARED FOR: U.S. Army Medical Research and Development Command
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for Public Release;
Distribution Unlimited

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE 09/29/2021		2. REPORT TYPE Annual		3. DATES COVERED 01 Sep 2021 - 31 Aug 2022	
4. TITLE AND SUBTITLE Interactions of gut microbiome, genetic susceptibility and environmental factors in Parkinson's disease				5a. CONTRACT NUMBER W81XWH-18-1-0509	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) David Standaert, MD, PhD E-Mail: dstandaert@uabmc.edu				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) University of Alabama at Birmingham UAB 701 S 20 th St Birmingham, AL 35294-0001				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Medical Research and Development Command Fort Detrick, Maryland 21702-5012				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; Distribution Unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT Genetic and environmental factors explain a fraction of Parkinson disease risk, prompting the question if microorganisms in the gut may be the trigger. The main goal of this proposal is to validate and investigate the mechanisms of interaction in a pre-clinical mouse model of PD. To do this, we have created a germ-free (GF) and specific pathogen free (SPF) pre-clinical mouse model in which alpha-synuclein is constitutively expressed under the Thy1 promoter (Thy1-SNCA). We have successfully established stable mouse colonies in both settings and both confirmed the transgene established alpha-synuclein expression via PCR and protein expression in the brain of Thy1-SNCA mice via western blot. In order to test whether pathogenic microorganisms present within the gut trigger PD-like pathology, we have transferred Corynebacteria amycolatum (identified through the work of the Partnering Project) to GF and SPF Thy1-SNCA mice. We have established cultured conditions for C. amycolatum, a PCR method to detect it, and performed transfers to both germ free and specific pathogen free mice. We have shown that in GF mice, this produces stable colonization. In the SPF mice, however, Corynebacteria amycolatum colonization does not occur. During the last research period, we have bred a colony of GF Thy1-SNCA transgenic mice sufficient to test the study outcomes and collected tissue samples for both one month and six month endpoints. In the next cycle, we will complete the analysis of the histological and behavioral data, and prepare a manuscript describing the results for publication.					
15. SUBJECT TERMS Parkinson Disease, microbiome, mouse models, alpha-synuclein, gnotobiotic					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Unclassified	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON USAMRMC
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified			19b. TELEPHONE NUMBER (include area code)

TABLE OF CONTENTS

	<u>Page</u>
1. Introduction	4
2. Keywords	4
3. Accomplishments	4
4. Impact	9
5. Changes/Problems	9
6. Products	9
7. Participants & Other Collaborating Organizations	9
8. Special Reporting Requirements	10
9. Appendices	10

INTRODUCTION:

Genome-wide studies have identified 28 independent genetic risk variants for idiopathic Parkinson Disease (PD), but each has a small effect, and together, they account for a fraction of the genetic component in PD. Epidemiological studies have associated several elements with PD, most notably, exposure to herbicides/pesticides with increased risk, and cigarette smoking and caffeinated coffee consumption with reduced risk of PD, but as with genetic factors, individual effects are small. Many groups have tested interaction between the genetic and environmental risk factors of PD in hypotheses-driven studies, and we have conducted hypothesis-free genome-wide gene-environment interaction studies. These studies discovered modifier genes with critical clues to PD pathogenesis, but they were unable to produce any gene-environment interactions that could explain PD risk completely. There must be more to gene-environment interaction in PD than the human genome and the environmental factors that we know of. This research program, awarded under the Partnering PI option, is based on preliminary data that indicates the gut microbiome is the missing link. Dr. Payami is the Initiating PI and will provide a separate progress report. This component of the project, led by the coordinating PI Dr. Standaert, encompasses Aim 5 of the overall proposal: To investigate the mechanisms of interactions. Hypothesis: *Corynebacterium* will increase alpha-synuclein and accelerate parkinsonian phenotypes in a mouse model. Rationale: Transplant of a PD microbiome has been shown to enhance parkinsonian phenotypes in alpha-synuclein over-expressing mice, but the responsible microorganisms are unknown. Research strategy: We will use Thy1-SNCA specific pathogen-free and germ-free mice and test the effect of introducing *Corynebacterium* on alpha-synuclein and relevant phenotypes.

1. KEYWORDS

Parkinson Disease, microbiome, mouse models, alpha-synuclein, gnotobiotic

2. ACCOMPLISHMENTS

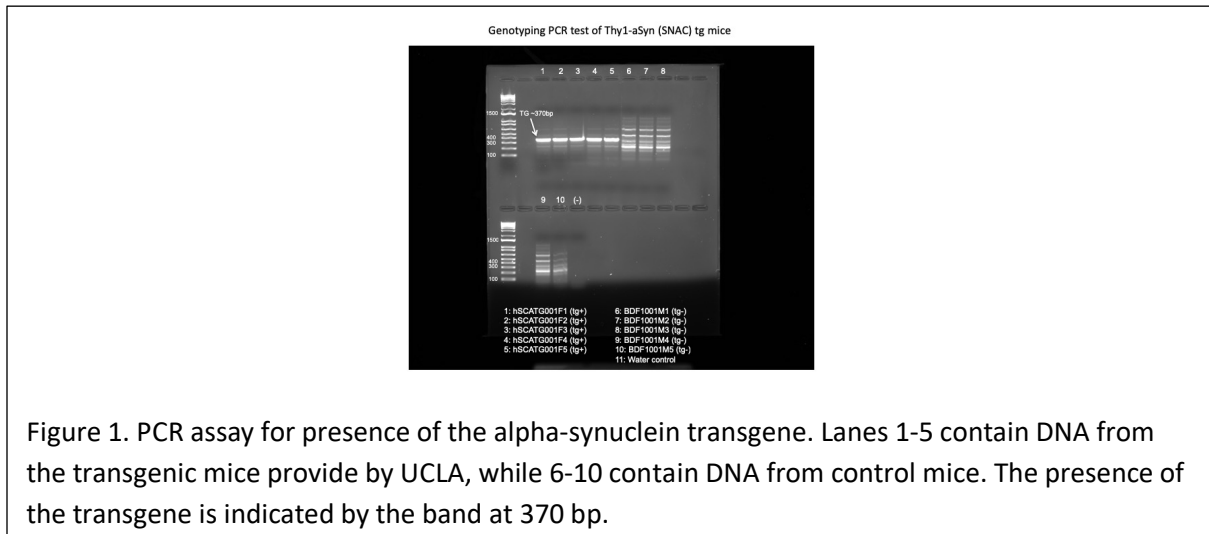
What were the major goals of the project? The goals of this Partnering PI project are as described in the original Statement of Work, and are listed in the Table below.

Major Goals	Timeline in months	% Complete
Aim 5. Investigate the mechanisms of interactions in model organisms.		
Major Task 1: Re-deriving Thy1-SNCA mouse in gnotobiotic facility and breeding of SPF mice		
Subtask 1: Re-derive Thy1-SNCA mouse in gnotobiotic facility	1-12	100%
Subtask 2: Breeding of GF Thy1-SNCA mouse in gnotobiotic facility	6-24	100%
Subtask 3: Breeding of SPF Thy1-SNCA mouse in conventional housing facility	1-24	100%
Major Task 2: Transfer of <i>Corynebacterium</i> to SPF and GF mice for 1 month time point		
Subtask 1: Transfer of <i>Corynebacterium</i> to SPF and GFP mice	12-24	100%
Subtask 2: Confirmation of stable <i>Corynebacterium</i> infection by fecal PCR	12-24	100%
Subtask 3: Collection of tissues for 1 month analysis	24-36	100%
Subtask 4: 1 month data collection/analysis	24-36	50%
Major Task 3: Transfer of <i>Corynebacterium</i> to SPF and GF mice for 6 month time point		
Subtask 1: Transfer of <i>Corynebacterium</i> to SPF and GFP mice	24-36	100%
Subtask 2: Collection of tissues for 6 month analysis	36-48	100%
Subtask 3: 6 month data collection/analysis	36-48	50%
Milestone #6: Co-author manuscript on <i>Corynebacterium</i> in Thy1-SNCA mouse model of PD	48	20%

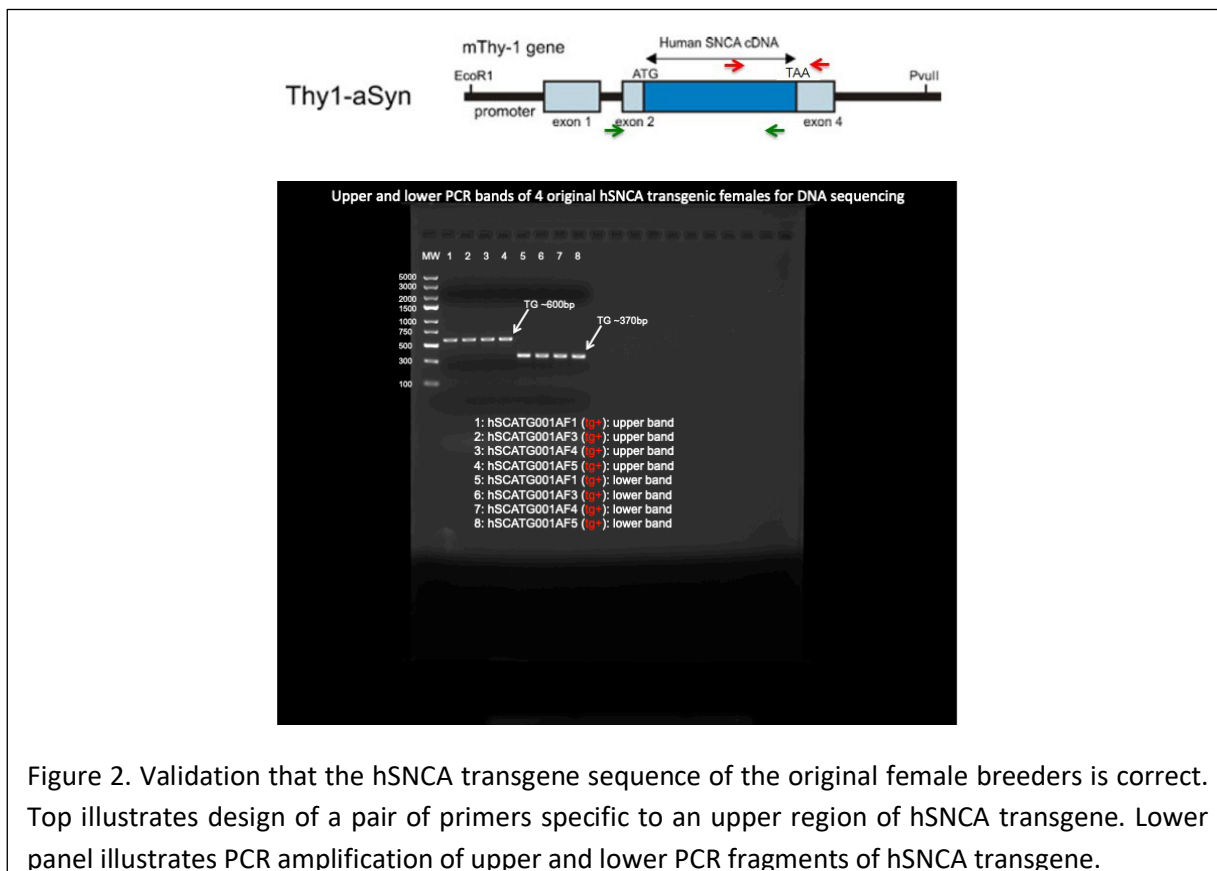
What was accomplished under these goals?

During this four year reporting period, we have:

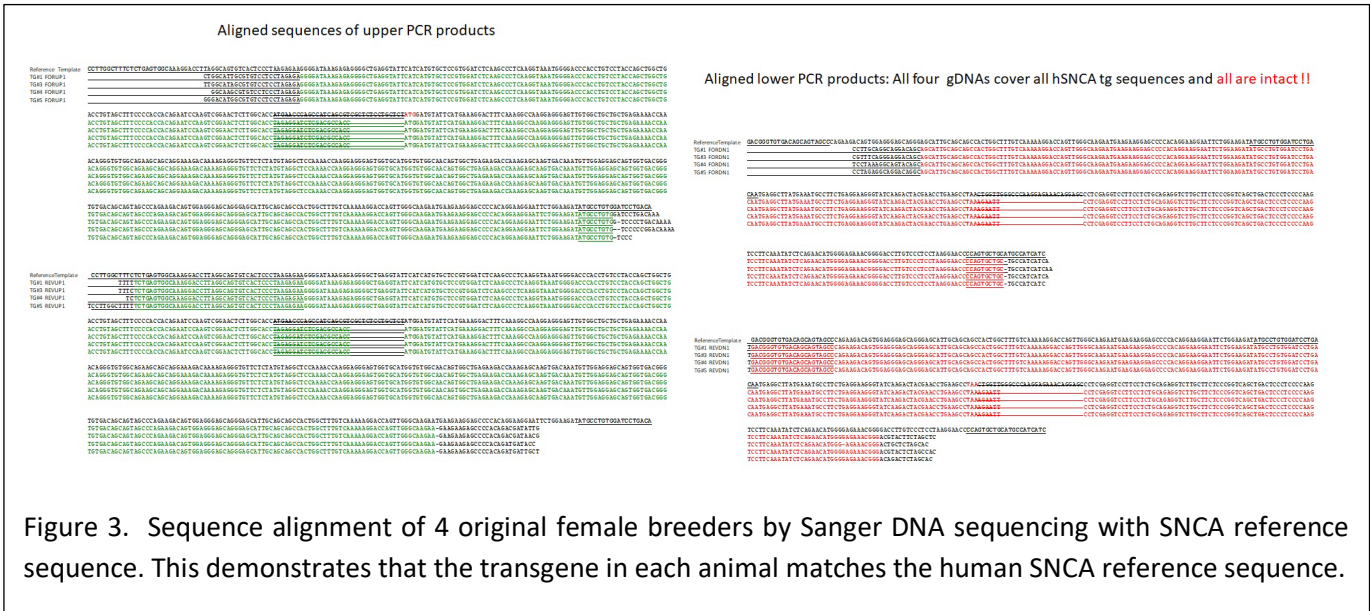
1. Successfully executed a Materials Transfer Agreement with the University of California, San Diego (UCSD), the source of the mouse line required for these studies.
2. Obtained Thy1-aSyn (SNCA) transgenic mice from UCSD. A total of 5 female mice were received.
3. Established a genotyping protocol to identify the transgenic animals. With the collaboration of UCSD investigators, we purchased appropriate DNA primers and established a PCR assay to detect the presence of the transgene (Figure 1, below).



4. Established breeding of the transgenic animals in a standard mouse housing facility.
5. In order to validate the mouse line, we designed two pairs of PCR primers spanning the transgene (Figure 2) and sequenced the PCR products covering the whole hSNCA transgene and neighboring regions (Figure 3).



We confirmed that the transgenes of original 4 breeder females are of the correct sequence, an important authentication of the animals.



- Established breeding of the transgenic animals in a standard mouse housing facility. We have successfully obtained twenty-seven litters of pups derived from our five female founders. Of the pups genotyped so far, 55 are transgene positive. These animals were aged for up to 18 months and their brains at different time points (6, 12, and 18 month) and stools were collected as control materials for germ free TG mouse tissues.
- We have successfully completed an alpha-synuclein selective western blot to confirm transgene expression in the cortex (CTX), ventral midbrain (MB), and cerebellum (CB) in the transgenic positive animals (Figure 4). Anti-vinculin was blotted as a loading control.

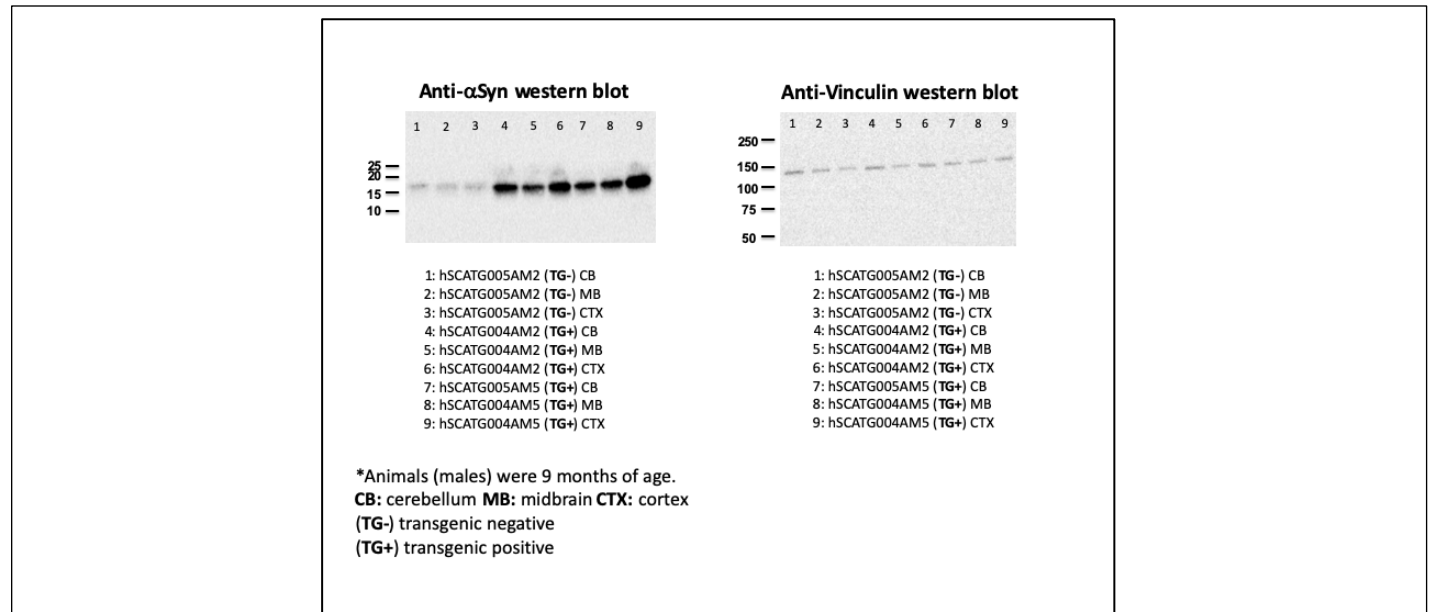


Figure 4: Western blot detecting the overexpression of alpha-synuclein in the cerebellum, ventral midbrain, and cortex of 9 month old transgenic positive (TG+) animals. Anti-vinculin was blotted in the same samples as a loading control.

8. We initially obtained 3 transgenic germ-free females and 9 non-transgenic control male breeders by germ-free mouse derivation, confirmed their germ-free status, and have expanded the germ-free mouse colonies (Figure 5). In addition to GF mouse, specific pathogen free mouse colony has been continuously maintained. Both remain fostered within the facility.



Figure 5. Genotyping PCR results of pups bred from germ-free hSNCA transgenic breeders.

9. Fecal transfer and colonization of target bacterium: We have chosen *Corynebacterium amycolatum* as the specific species to transfer. This is based on work by Dr. Payami in the Partnering Project (NPJ Parkinsons Dis 2020 Jun 12;6:11. doi: 10.1038/s41531-020-0112-6). The bacterium stock was obtained from ATCC, and established in culture. We developed a PCR method to test for the presence of this specific bacterium, as illustrated below. We have tested the colonization of *C. amycolatum* into GF mice by fecal transfer (by naturally feeding stools). They were stably colonized into guts of GF mice for long period of time (up to 6 months) (data is not shown here). Interestingly, the bacteria transferred well to the gut of GF mice, but it did not colonize in that of SPF mice, probably due to the competition with pre-existing gut microbiota (Figure 6).

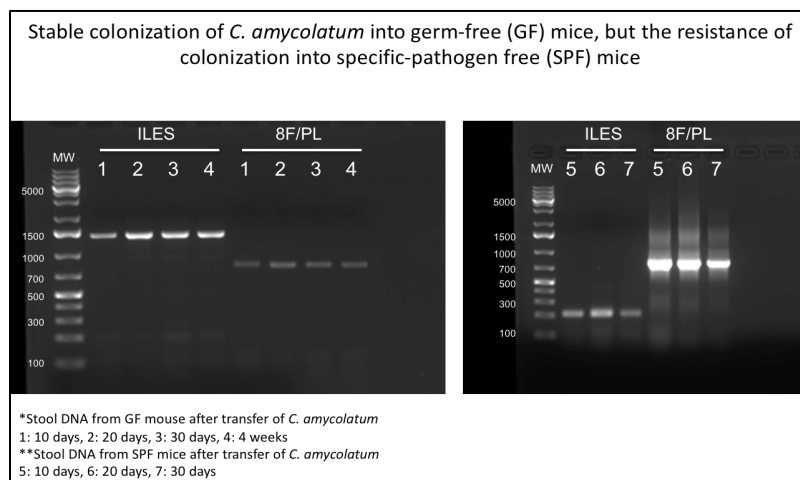
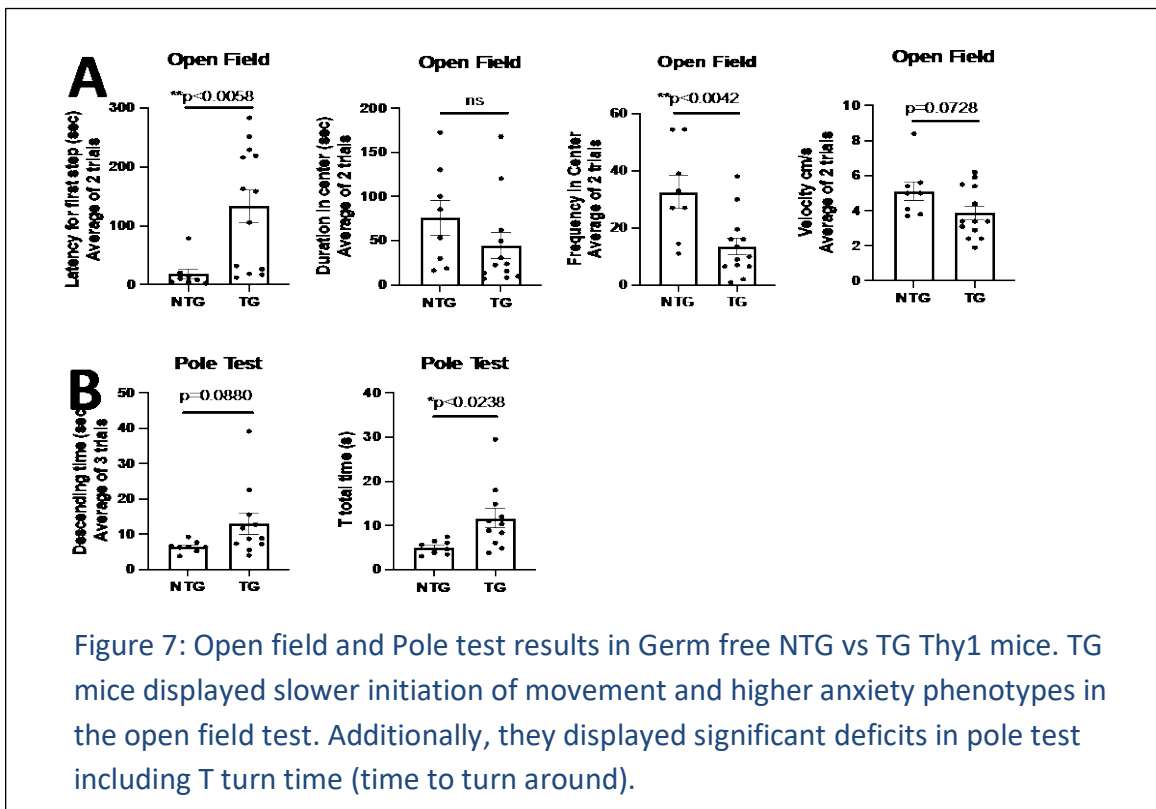


Figure 6. Stable colonization of *C. amycolatum* into germ-free mice, but not into SPF mice

10. During year 4, we generated a large number of experimental TG males by large breeding set-ups (9-10 breeding pairs). As a result, we have produced 49 GF TG males and will have more TG males for back-up. Of these mice, we transferred *Corynebacterium amycolatum* to 15 germ-free transgenic mice along with 11 cohort mice without bacteria for our 6 month experiment.
11. On the 6 month germ free cohort, we have performed behavioral testing including pole test and open field prior to processing tissues to determine whether germ free conditions change behavioral outcomes. We have confirmed alpha-synuclein specific changes in behavioral phenotypes (Figure 7) and are currently analyzing whether *Corynebacterium amycolatum* altered the behavioral phenotypes.



12. One month and 6 months post transfer, we have currently processed the cohorts, cryoprotected, sectioned and performed immunohistochemistry for IBA-1 (microglial marker) and GFAP (astrocyte marker). We are currently performing microscopy and analysis in the hippocampus, cortex, striatum, and ventral midbrain to determine whether *Corynebacterium amycolatum* transfer exacerbates micro and astrogliosis.

What opportunities for training and professional development has the project provided?

- We currently have recruited and trained an undergraduate, Nikhita Mudium, to assist with microscopy and image analysis.

How were the results disseminated to communities of interest?

- Nothing to Report

What do you plan to do during the next reporting period to accomplish the goals?

- 1) Finish microscopy, behavior, and image analysis for the one month and 6 month cohorts to determine whether *Corynebacterium amycolatum* transfer enhances inflammation.
- 2) Write a manuscript reporting the results and submit to a peer-reviewed journal.
3. **IMPACT:** *Describe distinctive contributions, major accomplishments, innovations, successes, or any change in practice or behavior that has come about as a result of the project relative to:*
 - **What was the impact on the development of the principal discipline(s) of the project?**
 - *Nothing to Report*
 - **What was the impact on other disciplines?**
 - *Nothing to Report*
 - **What was the impact on technology transfer?**
 - *Nothing to Report*
 - **What was the impact on society beyond science and technology?**
 - *Nothing to Report*
4. **CHANGES/PROBLEMS:**
 - **Changes in approach and reasons for change**
 - *The project is proceeding as planned. No changes to report.*
 - **Actual or anticipated problems or delays and actions or plans to resolve them**
 - *There have been some minor delays due to the impact of COVID-19, estimated at about 3 months. Overall, these have not delayed the project greatly, and we expect to be able to complete the project on time.*
 - **Changes that had a significant impact on expenditures**
 - *Nothing to report*
 - **Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents**
 - *Nothing to report*
5. **PRODUCTS:**
 - **Publications, conference papers, and presentations**
Nothing to report
 - **Website(s) or other Internet site(s)**
Nothing to report
 - **Technologies or techniques**
Nothing to report
 - **Inventions, patent applications, and/or licenses**
Nothing to report
 - **Other Products**
Nothing to report

6. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

What individuals have worked on the project?

Name:	David Standaert, MD, PhD
Project Role:	Principal Investigator
Researcher Identifier (e.g. ORCID ID):	0000-0003-2921-8348
Nearest person month worked:	0.5 CM (for year)

Contribution to Project: Dr. Standaert oversaw the project start up, and has conducted ongoing meetings with project personnel to design, implement, and troubleshoot experiments.

Name: Ashley Harms, PhD

Project Role: Co-Investigator

Researcher Identifier (e.g. ORCID ID): 0000-0002-7054-2812

Nearest person month worked: 1.56 CM (for year)

Contribution to Project: Dr. Harms managed the day to day operation of the project and supervised the Research Associate assigned to this project.

Name: Woong-Jai Won

Project Role: Research Associate

Researcher Identifier (e.g. ORCID ID): N/A

Nearest person month worked: 3 CM (for year)

Contribution to Project: Dr. Won has been responsible for monitoring animal care and breeding, collecting tail DNA, extracting DNA, developing and performing the genotyping assay.

- **Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?**
 - There have been changes in the active other support for Dr. Standaert and Dr. Harms. Please see attached Other Support documents with changes highlighted.
- **What other organizations were involved as partners?**
 - Nothing to report

7. SPECIAL REPORTING REQUIREMENTS

- **COLLABORATIVE AWARDS:**
 - This report encompasses reporting for the Collaborating PI of the this award. The Initiating PI, Dr. Haydeh Payami, will submit a separate report.

8. APPENDICES:

- There are no appendix materials.

Current/Pending/Previous Support

David Standaert

Current Support, continuing since last reporting

Title: Identification and Rescue of Striatal Circuit Abnormalities in Models of GNAL Dystonia

Role: Co-Investigator

Time Commitment: 0.12 CM

Support Agency: The Michael J. Fox Foundation for Parkinson's Research

Funding Agency Grants officer:

Sabrina Franklin

212.509.0995 Ext. 234, sfranklin@michaeljfox.org

Performance Period: 12/1/19 – 11/30/22

Total Costs: \$40,000

Project Goals: The goal of this project is to study striatal circuit abnormalities in GNAL knockout rat and mouse models of dystonia.

Specific Aims:

Aim 1: Identifying the mechanisms by which GNAL deficiency leads to altered striatal excitability.

Aim 2: Effects of GNAL deficiency on corticostriatal plasticity and potential pharmacological rescue.

Potential Overlap: None.

Title: APDA Advanced Center for Parkinson's Research

Role: PI

Time Commitment: 0.12 CM

Support Agency: American Parkinson's Disease Association

Funding Agency Grants officer:

Leslie A. Chambers

Parkinson Plaza

135 Parkinson Ave

Staten Island, NY 10305

Performance Period: 9/1/06-8/31/23

Total Costs: \$1,887,605

Project Goals: The APDA advanced center supports pilot and investigational projects in Parkinson's disease.

Potential Overlap: None.

Title: The Parkinson's Progression Markers Initiative (PPMI)

Role: Site PI

Time Commitment: 0.6 CM

Support Agency: The Michael J. Fox Foundation for Parkinson's Research

Funding Agency Grants officer:

Todd Sherer

Grand Central Station

PO Box 4777

New York, NY 10163-4777

Performance Period: 7/27/10 – 12/31/23

Total Direct Costs: \$2,230,007

Project Goals: The primary objective of this study is to identify clinical, imaging and biologic markers of PD progression for use in clinical trials of disease-modifying therapies.

Specific Aims:

Aim 1: Establish standardized protocols for acquisition, transfer and analysis of clinical, imaging and biomic data that can be used by the PD research community.

Aim 2: Develop a comprehensive and uniformly acquired clinical and imaging dataset and biological samples that can be used to estimate the mean rates of change and the variability around the mean of clinical, imaging and biomic outcomes in early PD patients.

Aim 3: Investigate existing and identify novel clinical, imaging and biomic Parkinson disease progression markers to identify quantitative individual measures or combination of measures that demonstrate optimum interval change in PD patients in comparison to healthy controls or in sub-sets of PD patients defined by baseline assessments, progression milestones and/or rate of clinical, imaging or biomic change.

Aim 4: Conduct preliminary verification studies on promising biological markers using stored collected samples.

Potential Overlap: None.

Title: UAB Cannabidiol Program

Role: PI

Time Commitment: 1.2 CM

Support Agency: Alabama Department of Commerce

Funding Agency Grants officer:

Angela Till

401 Adams Ave

PO Box 304106

Montgomery, AL 36130

Performance Period: 4/1/14 – 6/30/24

Total Direct Costs: \$5,000,000

Project Goals: The goal of this program is to establish a research study which will provide access to cannabidiol for epileptic conditions and gather data on outcomes in both adults and children.

Potential Overlap: None.

Title: Innate and Adaptive Immunity in Parkinson Disease: Core A – Administrative Core; (P50NS108675)

Role: PI

Time Commitment: 0.96 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

Neuroscience Center, Room 2223

6001 Executive Blvd, MSC 9525

Bethesda, MD 20892-9525

Performance Period: 9/30/18 – 7/31/23

Total Costs: \$238,349

Project Goals: The primary mission of the Administrative Core is to promote the integration and function of the Udall Center components and activities, and provide the infrastructure required for Center communication, decision-making and administration and the activities of the Program Director.

Specific Aims:

Aim 1: Promote the integration and function of the Alabama Udall Center components and activities, and provide the infrastructure required for Center communication, decision-making and administration and the activities of the Program Director.

Aim 2: Support and organize periodic meetings of the Center Executive Committee, project staff, Internal Advisory Committee, External Advisory Committee, and collaborators.

Aim 3: Coordinate activities that fulfill the Alabama Udall Center Mission Statement for Training: “Training for physicians, scientists and the community today to accelerate progress in PD research and treatment, and education to develop the scientific workforce and community partnerships of the future.”

Aim 4: Enhance the integration of the Alabama Udall Center with UAB internal Parkinson disease research programs.

Aim 5: Promote the integration of the Alabama Udall Center with other Udall Centers and national programs in PD research

Aim 6: Develop and conduct outreach activities for the local and national Parkinson community, including an annual Alabama Udall Center symposium to present research results to the local community.

Aim 7: Coordinate interactions of the Alabama Udall Center with NINDS staff, including providing advance notice of manuscripts and publications to the NINDS program officer and working with the NINDS Office of Communications and Public Liaison on press releases highlighting Center accomplishments.

Aim 8: Organize an annual retreat of the Alabama Udall Center investigators, Internal Advisory Committee, collaborators, and other investigators in related areas. This will also include an annual evaluation of the Alabama Udall Center progress and directions by the External Advisory Committee.

Aim 9: Maintain an accounting of resource generation and related utilization, and steps taken to maximize the research utilization of these resources within and beyond the Alabama Udall Center. Coordinate data and resource sharing both between Alabama Udall Center investigators and with other Udall Centers and outside investigators and organizations.

Aim 10: Ensure that all components of the Alabama Udall Center maintain compliance with NIH policy requirements.

Aim 11: Prepare and submit annual progress reports for the Alabama Udall Center.

Aim 12: Support the Alabama Udall Center web site and social media outreach.

Aim 13: Coordinate attendance of the Center Director, Center Administrator, and Project and Core Leads at the annual Udall Centers meeting.

Potential Overlap: None.

Title: Innate and Adaptive Immunity in Parkinson Disease: Project 1 - Role of Innate Immune Cells in Human Parkinson Disease (P50NS108675)

Role: Project Leader

Time Commitment: 1.8 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

Neuroscience Center, Room 2223

6001 Executive Blvd, MSC 9525

Bethesda, MD 20892-9525

Performance Period: 9/30/18 – 7/31/23

Total Direct Costs: \$583,397

Project Goals: The goal of this project is to explore the overarching hypothesis that innate immune cells are activated towards a pro-inflammatory phenotype early in PD. We theorize that blocking this activation will protect from PD progression.

Specific Aims:

Aim 1: In the same population of 60 patients with de novo PD and 60 age- and sex-matched controls, determine whether there is change over time in monocytes populations assessed by flow cytometry or in blood cytokines and chemokines.

Aim 2: Determine the relationship between baseline measures of inflammation and longitudinal clinical outcomes, particularly cognition, in this population of early de novo PD subjects.

Title: Innate and Adaptive Immunity in Parkinson Disease: Project 4 - Innate and Adaptive Immunity in Lewy Body Dementia (P50NS108675)

Role: Co-Investigator

Time Commitment: 0.36 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

Neuroscience Center, Room 2223
6001 Executive Blvd, MSC 9525
Bethesda, MD 20892-9525

Performance Period: 8/1/20 – 7/31/23

Total Costs: \$371,250

Project Goals: The goal of this project is to extend the Udall projects to examine whether immune activation is present early in DLB and whether differences exist between PD and DLB in immune activation.

Specific Aims:

Aim 1: In a population of 20 patients with early DLB, determine whether peripheral immune activation or differentiation is associated with CNS inflammation through integrated analysis of blood monocytes, blood and CSF cytokines and chemokines, and brain imaging with the TSPO ligand 18F-DPA-714, and whether the pattern of inflammatory markers is related to specific cognitive impairments.

Title: Interactions of Gut Microbiome, Genetic Susceptibility and Environmental Factors in Parkinson's Disease (W81XWH1810509)

Role: PI

Time Commitment: 0.6 CM

Support Agency: Department of Defense

Funding Agency Grants officer:

Jason Kuhns

Performance Period: 9/1/18 – 8/31/22, NCE requested to 2/28/23

Total Costs: \$635,001

Project Goals: The goal of this study is to identify the organisms in the gut that interact with genetic and environmental risk factors of PD. Microbiome can be easily altered; thus, successful completion of this project will provide feasible means to predict, prevent and treat PD.

Specific Aims:

Aim 5. Investigate the mechanisms of interactions. Hypothesis: Corynebacterium will increase alpha-synuclein and accelerate parkinsonian phenotypes in a mouse model. Rationale: Transplant of a PD microbiome has been shown to enhance parkinsonian phenotypes in alpha-synuclein over-expressing mice,²⁴ but the responsible microorganisms are unknown. Approach: We will use Thy1-SNCA specific pathogen free and germ-free mice and test the effect of introducing Corynebacterium on alpha-synuclein and relevant phenotypes.

Potential Overlap: None.

Title: A 52-Week, Open-Label, Single-Arm Study to Evaluate The Safety and Tolerability of 24-hour Daily Exposure of Continuous Subcutaneous Infusion of ABBV-951 in Subjects with Parkinson's Disease

Role: Site Investigator

Time Commitment: 0.12 CM

Support Agency: AbbVie, Inc

Funding Agency Grants officer:

Edward Buell

Associate Director, Abbvie Inc.

Performance Period: 8/27/19 – 8/26/24

Total Costs: \$589,347

Project Goals: The primary objective of this study is to assess the local and systemic safety and tolerability of ABBV-951 delivered as a CSCI for 24hours daily for up to 52 weeks.

Potential Overlap: None.

Title: Adaptive Immunity in the Etiology and Progression of Parkinson's Disease

Role: Co-Investigator

Time Commitment: 0.6 CM

Support Agency: The Michael J Fox Foundation for Parkinson's Research pass through Research Foundation for Mental Hygiene Inc./NY State Psychiatric Hospital

Performance Period: 9/7/20 – 9/6/23

Total Costs: \$1,766,999

Project Goals: This project will investigate how antigen presenting cells and neurons activate T cells, characterize antigen-specific T cells in blood and the enteric nervous system over the course of PD, discover how the gut microbiome regulates antigen-specific T cells, establish the molecular steps by which CNS dopaminergic neurons present antigen, and ultimately determine the extent that the cellular and molecular changes we observe in patient blood and animal models are found in PD and age-matched healthy control donor brain tissue.

Specific Aims for UAB team:

Aim 1: Define gut mucosal adaptive immune response in early PD mouse models.

Aim 2: Elucidate antigen presentation by SN DA neurons.

Potential Overlap: None.

Title: Advanced Parkinson's Disease: Double-Blind, Double-Dummy, Active- Controlled, Efficacy and Safety Study of ABBV-951 Versus Oral Carbidopa/Levodopa

Role: Site PI

Time Commitment: 0.12 CM

Support Agency: ABBVIE, Inc.

Funding Agency Contact:

Maurizio Facheris, MD, MSc

AbbVie Inc.

Dept. R48S, Bldg. AP32-1

1 North Waukegan Road

North Chicago, IL 60064

Performance Period: 9/21/20 – 9/20/23

Total Costs: \$647,902

Project Goals: This study is conducted to assess the efficacy, safety, and tolerability of ABBV-951 versus oral CD/LD in advanced PD patients whose motor fluctuations are inadequately controlled by their current medications.

Potential Overlap: None.

Title: Cytokine Production by Adaptive Immune Cells from Patients with Parkinson's Disease: Response to Diverse Biological Stimuli

Role: Co-Investigator

Time Commitment: 0.6 CM

Support Agency: The Michael J. Fox Foundation for Parkinson's Research

Funding Agency Grants officer:

Todd Sherer

Grand Central Station

PO Box 4777

New York, NY 10163-4777

Performance Period: 8/1/20 – 7/31/23

Total Costs: \$500,000

Project Goals: This project will assess the capability of T-cells and B-cells to secrete cytokines in response to biologically relevant stimuli.

Potential Overlap: None.

Title: Alabama Project on Alzheimer Disease and Related Disorders

Role: PI

Time Commitment: 1.2 CM

Support Agency: Alabama Innovation Fund

Funding Agency Grants officer:

Jonathan West
Director of Administration
Alabama Department of Commerce
401 Adams Ave, Suite 624
Montgomery, AL 36104
Performance Period: 10/1/20 – 9/30/23
Total Costs: \$2,000,000

Project Goals: This project aims to build on existing resources in Alzheimer's disease and related disorders at UAB by creating new educational and outreach activities, expanding ongoing research activities that further the search for more effective means of diagnosing and treating AD and related disorders, and making these new treatments available to all of the diverse populations in the state of Alabama. Work will be focused in five major areas: community outreach, molecular diagnosis, biomarkers and brain banking, bioinformatics support, and discovery science.

Potential Overlap: None.

Title: An Open-Label Extension Of Study M15-736 To Evaluate The Safety And Tolerability Of 24-Hour Daily Exposure Of ABBV-951 In Subjects With Advanced Parkinson's Disease

Role: Site PI

Time Commitment: 0.12 CM

Support Agency: ABBVIE, Inc.

Funding Agency Contact:

Maurizio Facheris, MD, MSc

AbbVie Inc.

Dept. R48S, Bldg. AP32-1

1 North Waukegan Road

North Chicago, IL 60064

Performance Period: 2/16/21 – 2/15/23

Total Costs: \$727,802

Project Goals: This study is conducted to assess the efficacy, safety, and tolerability of ABBV-951 versus oral CD/LD in subjects with advanced Parkinson's disease (aPD) whose motor fluctuations are inadequately controlled by their current treatment.

Potential Overlap: None.

Title: An Open-Label Extension of Study M15-741 to Evaluate The Safety and Tolerability of 24-hour Daily Exposure of Continuous Subcutaneous Infusion of ABBV-951 in Subjects with Parkinson's Disease

Role: Site PI

Time Commitment: 0.12 CM

Support Agency: ABBVIE, Inc.

Funding Agency Contact:

Maurizio Facheris, MD, MSc

AbbVie Inc.

Dept. R48S, Bldg. AP32-1

1 North Waukegan Road

North Chicago, IL 60064

Performance Period: 11/16/20 – 11/15/24

Total Costs: \$560,306

Project Goals: This study will assess the safety and tolerability of continued use of ABBV-951 in Parkinson's disease (PD) patients who completed Study M15-741 (the parent study).

Potential Overlap: None.

Title: Parkinson Disease Genetics in the Black American Population

Role: Site PI

Time Commitment: 0.12 CM

Support Agency: The Michael J. Fox Foundation for Parkinson's Research

Funding Agency Contact:

Todd Sherer

Grand Central Station

PO Box 4777

New York, NY 10163-4777

Performance Period: 1/27/21 – 11/31/22

Total Costs: \$49,150

Project Goals: This study will help researchers understand genetic factors associated with Parkinson disease in the Black/African American population as part of the Global Parkinson's disease Genetics.

Potential Overlap: None.

Title: UAB Research Education Program for Residents and Fellows in Neuroscience

Role: PI

Time Commitment: 0.36 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Stephen J. Korn

NSC BG RM 2187

6001 Executive Blvd

Rockville, MD 20852

Performance Period: 8/15/22 – 6/30/24

Total Costs: \$ 379,678

Project Goals: The goal of this education program is to train residents in neuroscience for careers as physician-scientists.

Specific Aims: The Specific Aim of this proposal is to establish an R25 education program at UAB to train residents in neurology, neurosurgery, radiology, anesthesiology and neuropathology, and to prepare them for careers as physician-scientists. The program will incorporate leadership from two clinician-scientists who will serve as Director and Associate Director, a group of experienced mentors, and strong residencies programs from which candidates will be drawn.

Potential Overlap: None.

Pending Support

Title: Innate and Adaptive Immunity in Parkinson Disease: Core A – Administrative Core; (P50NS132789)

Role: PI

Time Commitment: 1.2 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

Neuroscience Center, Room 2223

6001 Executive Blvd, MSC 9525

Bethesda, MD 20892-9525

Performance Period: 7/1/23 – 6/30/28

Total Costs: \$ 631,125

Project Goals: The primary mission of the Administrative Core is to promote the integration and function of the Udall Center components and activities, and provide the infrastructure required for Center communication, decision-making and administration and the activities of the Program Director.

Specific Aims:

Aim 1: Provide the infrastructure for Center organization, integration, function, decision-making, activities, and

reporting.

Aim 2: Promote the integration of the Alabama Udall Center with local and national Parkinson disease research programs.

Aim 3: Develop and conduct outreach activities and communications for the local and national Parkinson community.

Aim 4: Coordinate interactions of the Alabama Udall Center with NINDS and ensure compliance with NIH policies

Aim 5: Coordinate activities that fulfill the Alabama Udall Center's training mission.

Potential Overlap: None.

Title: Project 1: Role of Innate and Adaptive Immunity in Human Parkinson Disease (P50NS132789)

Role: Project Leader

Time Commitment: 1.8 CM yrs 1-3; 2.4 yrs 4-5

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

Neuroscience Center, Room 2223

6001 Executive Blvd, MSC 9525

Bethesda, MD 20892-9525

Performance Period: 7/1/23 – 6/30/28

Total Direct Costs: \$ 1,429,737

Project Goals: The goal of this project is to explore the overarching hypothesis is that intrinsic brain immune cells are activated early in PD and are a key driver of progressive symptoms. We theorize that blocking this activation will protect from PD progression.

Specific Aims:

Aim 1: In our existing cohort of 58 patients with newly diagnosed PD and 62 age- and sex-matched controls, determine the relationship between baseline measures of brain inflammation and longitudinal cognitive and motor progression.

Aim 2: In the existing cohort of 58 patients with newly-diagnosed PD and 62 age- and sex-matched controls, determine whether there is change over time in brain inflammation, as measured with repeated [18F]DPA-714 imaging, and how the changes in [18F]DPA-714 signal relate to clinical progression and blood biomarkers.

Aim 3: In a newly recruited cohort of 25 patients with newly diagnosed PD and 25 age- and sex- matched controls, determine the extent of brain inflammation using the COX1 PET ligand [11C]-PS13, and examine the relationship between this microglial inflammatory marker and the TSPO signal from [18F]-DPA-714. These measures of brain inflammation will be correlated with CSF and blood cytokines and chemokines.

Title: Peripheral Biomarkers for Early Diagnosis of Mixed Pathologies in AD/ADRD

Role: Co-Investigator

Time Commitment: 0.6 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Alessandra Rovescalli

rovescaa@nih.gov

Performance Period: 4/1/23 – 3/31/28

Total Direct Costs: \$ 3,676,221

Project Goals: The overall goal to develop peripheral tissue biomarkers for accurate and differential diagnosis of Alzheimer's disease (AD), non-AD tauopathies, Lewy body dementia (LBD), and their comorbidities.

Specific Aims:

Aim 1: Establish dual skin RT-QuIC biomarker assays for mixed tauopathies/synucleinopathies using neuropathologically confirmed cases

Aim 2: Assess skin tau and aSyn detected by RT-QuIC as reliable biomarkers for premortem diagnosis of mixed tauopathies and synucleinopathies

Aim 3: Evaluate skin tau/aSyn biomarker assays for improving the differential diagnosis of mixed tauopathies/synucleinopathies through longitudinal follow-up

Previous Support

Title: DUOdopa/Duopa in Patients with Advanced Parkinson's Disease (PD) – A Global Observational Study Evaluating Long-Term Effectiveness (DUOGLOBE)

Role: Site Investigator

Time Commitment: 0.12 CM

Support Agency: AbbVie, Inc

Funding Agency Grants officer:

Lars Bergmann, MD

Global Medical Director

Global Medical Affairs Neuroscience

AbbVie Europe

10, rue d'arcueil

94150, Rungis

France

Performance Period: 2/8/16 – 2/7/21

Total Direct Costs: \$84,420

Project Goals: The primary objective of this post-marketing observational study (PMOS) is to assess the effectiveness of LCIG treatment on OFF time as reported by the patient at scheduled visits from baseline to 36 months in advanced Parkinson's disease patients who are treated in accordance with the approved local product label and reimbursement criteria under the conditions of routine clinical care.

Potential Overlap: None.

Title: National Resource Center for High-Impact Clinical Trials in Medical Rehabilitation (P2CHD086851)

Role: Executive Committee, Pilot Projects Associate Director

Time Commitment: 0.24 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Ralph Nitkin

BG 6710B RM 2116

6710B Rockledge Dr

Bethesda, MD 20817

Performance Period: 9/17/15 – 6/30/20

Annual Direct Costs: \$202,763

Project Goals: The goal of this project is to catalyze high-impact, interdisciplinary clinical trials nationally that will: (i) reveal fundamental underpinnings; (ii) define optimal intervention strategies; and (iii) streamline translation to clinical and community-based application.

Aim 1: To advance the research of medical rehabilitation investigators nationally, we will provide effective consultative and/or educational services and collaborative arrangements that will facilitate all aspects of clinical trial design and conduct, and competitive funding will be awarded nationally for innovative pilot projects needed to shape large-scale, definitive clinical trials (e.g., dosing trials, adaptive, delayed start, withdrawal and futility trials, and trials evaluating the interactions of complex mixtures of treatment modalities, etc.).

Aim 2: To encourage medical rehabilitation researchers to take full advantage of the national resource Center's unique resources and expertise by effectively promoting and disseminating all of the Center's programs.

Aim 3: To develop, validate, and provide state-of-the-art techniques and tools that will strengthen high-impact clinical trials nationally by enabling medical rehabilitation researchers to conduct more rigorous trials yielding higher quality data with potentially greater influence on clinical practice and health care delivery.

Potential Overlap: None.

Title: UAB Neuroscience Core Center – Core B: Molecular Detection and Stereology Core (P30NS047466)

Role: Core Leader

Time Commitment: 0.6 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Randall Stewart

NSC BG RM 2135

6001 Executive Blvd

Rockville, MD 20852

Performance Period: 8/1/16 – 5/31/20

Annual Direct Costs: \$107,420

Project Goals: The major goal of this grant is to provide core support services for a highly productive group of 19 NINDS-funded investigators and their neuroscience research activities. The proposed cores are designed in response to investigators inputs and will promote better science, reduce costs to individual investigators and increase productivity. The goal is to enhance the research environment by providing high quality research core support services within a scientifically stimulating multidisciplinary setting.

Specific Aims:

Aim 1: Provide cost-effective, reproducible, high-throughput ISH and IHC detection on “routine” specimens.

Aim 2: Assist investigators in the development and implementation of advanced detection techniques including multi-label IHC, dual label ISH/IHC, ultrasensitive TSA Plus detection and quantum dot labeling procedures.

Aim 3: Assist users in the performance of precise, unbiased state-of-the-art stereologic/morphometric image analysis of histological preparations.

Potential Overlap: None.

Title: MJFF Emerging Targets Committee Membership

Role: PI

Time Commitment: 0.12 CM

Support Agency: The Michael J. Fox Foundation for Parkinson’s Research

Funding Agency Grants officer:

Todd Sherer

Grand Central Station

PO Box 4777

New York, NY 10163-4777

Performance Period: 6/1/16 – 6/30/20

Total Direct Costs: \$3,200

Project Goals: The goal of this committee is to advise the MJFF on its Emerging Target initiatives, focused on identifying and assessing novel therapeutics approaches for Parkinson’s patients.

Potential Overlap: None.

Title: Molecular Etiology of Early Onset Dystonia (P01NS087997)

Role: Co-Investigator

Time Commitment: 4%

Support Agency: National Institutes of Health, pass through Massachusetts General Hospital

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

Neuroscience Center, Room 2223

6001 Executive Blvd, MSC 9525

Bethesda, MD 20892-9525

Performance Period: 7/1/15 – 6/30/20

Annual Direct Costs: \$186,975

Project Goals: This project explores cholinergic and dopaminergic mechanisms in mouse models of dystonia.

Specific Aims:

Hypothesis 1: Defects in THAP1 (DYT6) and deficiency of the G α olf regulatory G protein (DYT25) produce abnormalities in cholinergic transmission and downstream signaling similar to those observed in DYT1 dystonia models.

Aim 1a. Using in vitro slice electrophysiology, evaluate the membrane properties of striatal cholinergic interneurons and their response to muscarinic and dopaminergic agonists and antagonists in THAP1 C54Y mutation knock-in and G α olf heterozygous knock-out mice.

Aim 1b. Using in vitro slice preparations, evaluate striatal long-term synaptic depression (LTD) and the effects of muscarinic antagonists, D2 receptor agonists and A2a receptor antagonists on striatal plasticity in THAP1 C54Y mutation knock-in and G α olf heterozygous knock-out mice.

Aim 1c. Using in vitro slice preparations, evaluate the role of downstream signaling pathways (identified by Projects 1 and 2) on the properties of cholinergic and striatal medium spiny neurons in these models.

Hypothesis 2: Cholinergic dysfunction in dystonia and disruption of downstream signaling leads to abnormal regulation of striatal dopamine release.

Aim 2a. Using in vivo microdialysis in the knock-in model of DYT1 dystonia, determine whether muscarinic

or nicotinic inhibitors of cholinergic receptors can normalize amphetamine-stimulated dopamine release.

Aim 2b. Using in vivo microdialysis, evaluate the effect of amphetamine on striatal dopamine release in THAP1 C54Y mutation knock-in and G α olf heterozygous knock-out animals, and the modulation of dopamine release by muscarinic and nicotinic receptors.

Aim 2c. Using in vivo microdialysis, evaluate the modulation of dopamine release in these models by downstream signaling pathways (identified by Projects 1 and 2) in cholinergic and dopaminergic neurons.

Hypothesis 3: Subtype selective muscarinic antagonists and modulators can reverse abnormalities in striatal dopamine release plasticity and motor function in DYT1, THAP1, and GNAL models of dystonia.

Aim 3a. Determine the effects of selective muscarinic antagonists and allosteric modulators on the electrophysiological properties of cholinergic neurons and on striatal plasticity in slice preparations from DYT1, THAP1, and GNAL mouse models in vitro.

Aim 3b. Determine the effects of selective muscarinic antagonists and allosteric modulators, delivered by reverse dialysis, on striatal dopamine release in DYT1, THAP1, and GNAL mouse models in vivo.

Aim 3c. Determine the effect of a selective M1 antagonist (VU0255035) and a selective M4 positive allosteric modulator (VU0152100) on motor phenotypes in DYT1, THAP1 and GNAL models.

Potential Overlap: None.

Title: UAB Bachmann-Strauss Dystonia and Parkinson's Disease Center of Excellence

Role: PI

Time Commitment: 0.12 CM

Support Agency: The Bachmann-Strauss Dystonia & Parkinson Foundation, Inc.

Funding Agency Grants officer:

Todd Sherer

Grand Central Station

P.O. Box 4777

New York, NY 10163-4777

Performance Period: 09/15/13 – 09/14/18

Annual Direct Costs: No cost extension

Project Goals: This program establishes a Center of Excellence with the mission of integrating the elements of research and clinical care for patients with dystonia and Parkinson's disease, and it supports pilot research projects in dystonia.

Specific Aims:

Aim 1: To establish a clinical center of excellence, which will provide patients with an integrated approach to multi-disciplinary care for dystonia and Parkinson disease. This will include community outreach, coordination of care, and facilitation of access to multidisciplinary treatment including movement disorder specialists,

physical, occupational and speech therapy, botulinum toxin treatment, neurosurgical treatment, and genetic counseling.

Aim 2: To enhance the access of patients to clinical trials in dystonia and Parkinson disease, and enable conduct of trials which will advance the fields.

Aim 3: To facilitate the interactions between clinicians, basic scientists, and members of the community, and promote cross-culture efforts to translate new discoveries.

Aim 4: To train the next generation of dystonia and Parkinson disease clinicians and scientists, through support of clinical and basic/translational fellowships.

Potential Overlap: None.

Title: 18F-AV-1451-A09: 18F-AV-1451 Injection for Brain Imaging of Tau in Subjects with Progressive Supranuclear Palsy (PSP), Subjects with Corticobasal Degeneration (CBD) and Healthy Volunteers

Role: Sub-investigator (backup)

Time Commitment: 0.01 CM

Support Agency: Avid Radiopharmaceuticals

Funding Agency Grants officer:

Sean R. Doyle, MSc

Clinical Research Associate II

Avid Radiopharmaceuticals

3711 Market Street, Suite 710

Philadelphia, PA 19104

Performance Period: 8/7/14 – 8/6/18

Total Direct Costs: \$104,512

Project Goals: The major goal of this study is to determine the pattern of tau deposition in PSP using AV-1451 PET imaging.

Specific Aims:

Aim 1: To conduct a preliminary evaluation of 18F-AV-1451 for brain imaging of tau in subjects with progressive supranuclear palsy (PSP), subjects with corticobasal degeneration (CBD) and healthy volunteers.

Aim 2: To obtain information regarding the safety of 18F-AV-1451 in these populations. Exploratory objectives include:

1. To correlate 18F-AV-1451 imaging with clinical features of PSP and CBD; and
2. To evaluate change in 18F-AV-1451 imaging over 9 months in PSP and CBD subjects.

Potential Overlap: None.

Title: Causes, Treatment, and Prevention of Corticobasal Degeneration

Role: Sub-investigator (backup)

Time Commitment: 0.01 CM

Support Agency: University of California, San Francisco

Funding Agency Grants officer:

Adam Boxer, M.D., Ph.D.

UCSF Memory and Aging Center

675 Nelson Rising Lane, Box 1207

San Francisco, CA 94158

Performance Period: 7/1/14 – 9/30/18

Annual Direct Costs: \$30,242 (subaward to UAB)

Project Goals: The major goal of this study is to determine the efficacy of a new microtubule stabilizing drug in 4R tauopathies.

Specific Aims:

Aim 1: To determine the safety and tolerability [maximum tolerated dose (MTD) within planned dosing range] of intravenous (IV) infusions of TPI 287 administered once every 3 weeks for 9 weeks (for a total of 4 infusions) in patients with primary four repeat tauopathies (4RT), corticobasal syndrome (CBS) or progressive supranuclear palsy (PSP).

Aim 2: To determine the pharmacokinetic (PK) profile of TPI 287 in plasma after a single IV infusion of TPI 287 and the steady-state cerebrospinal (CSF) concentration of TPI 287 1 week after completion of the fourth infusion.

Potential Overlap: None.

Title: BTK Inhibitors and Their Potential Role in Inhibiting the Pro-Inflammatory Microenvironment Associated with Neurodegeneration

Role: PI

Time Commitment: 0.24 CM

Support Agency: Acerta Pharma B.V.

Funding Agency Grants officer:

Cecile Krejsa, PhD

15400 SE 30th Place Suite 206,

Bellevue, WA 98007

Performance Period: 1/1/15 – 12/5/16

Annual Direct Costs: \$100,679

Project Goals: The goal of this project is to evaluate whether the administration of ACP-196 can reduce the pro-inflammatory micro-environment caused by over-expression of α -syn and subsequently reduce the neurodegeneration associated with the chronic inflammation.

Specific Aims:

Aim 1: Determine whether the administration of ACP-196 can reduce the inflammatory micro-environment associated with α -syn.

Aim 2: Determine whether the administration of ACP-196 protects against α -syn induced neurodegeneration.

Aim1 (yr 2): Determine if the LRRK2G2019S mutation enhances the spread of pathogenic α -syn across interconnected neurons, consequently resulting in increased dopaminergic neuron death.

Aim 2 (yr 2): Determine if the absence of LRRK2 reduces the spread of α -syn across interconnected neurons and protects from α -syn inclusion-induced neuron death.

Potential Overlap: None.

Title: Validation of the Class II MHC Transactivator (CIITA) in Models of PD

Role: Co-Investigator

Time Commitment: 0.6 CM

Support Agency: Michael J. Fox Foundation for Parkinson's Research

Funding Agency Grants officer:

Sonal Das

Grand Central Station

PO Box 4777

New York, NY 10163-4777

Performance Period: 1/14/14 – 1/13/16

Annual Direct Costs: \$100,000

Project Goals: The goal of this project is to determine whether blocking or down-regulating expression of CIITA is sufficient to attenuate the inflammatory process and neurodegeneration induced by α -syn in animal models.

Specific Aims:

Aim 1: Determine if knocking out CIITA expression in α -syn treated primary microglia attenuates MHCII expression and antigen processing.

Aim 2: Develop and test lenti-viral siRNA (lenti-siRNA) vectors to knockdown CIITA expression in primary microglial cultures treated with α -syn and IFN γ

Aim 3: Determine if lenti-siRNA knockdown of CIITA attenuates MHCII expression and antigen processing in primary microglia stimulated with α -syn and IFN γ .

Aim 4: Determine if siRNA knockdown of CIITA attenuates α -syn-induced neuroinflammation and neurodegeneration in vivo using an AAV2-SYN model of PD.

Potential Overlap: None.

Title: Role of MHC II proteins in Parkinson's-related inflammation

Role: Co-PI

Support Agency: RJG Foundation

Funding Agency Grants officer:

Anne B. Young

485 Madison Ave Fl 23

New York, NY 10022

Performance Period: 12/1/11 – 11/30/14

Annual Direct Costs: \$100,000

Project Goals: The goal of this project is to determine whether a critical step in α -syn induced inflammation is microglial antigen presentation to T lymphocytes mediated by MHCII, leading to downstream induction of inflammatory mediators and neurodegeneration.

Specific Aims:

Aim 1: Using primary microglia cultures, determine whether alpha-synuclein internalization by microglia leads to MHCII translocation through an IgG and Fc γ R dependent process.

Aim 2: Using primary microglia and T lymphocyte co-cultures, determine whether internalized α -syn triggers MHCII dependent antigen presentation resulting in T cell proliferation and microglial activation

Aim 3: Using our in vivo AAV2-SYN mouse model, determine whether deletion of MHCII proteins attenuates synuclein-induced inflammation and neurodegeneration.

Potential Overlap: None.

Title: Role of HLA/MHCII in Parkinson's Disease Pathogenesis (R01NS092122)

Role: Co-Investigator

Support Agency: National Institutes of Health pass through Emory University

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

Neuroscience Center, Room 2223

6001 Executive Blvd, MSC 9525

Bethesda, MD 20892-9525

Performance Period: 9/30/15 – 6/30/16

Annual Direct Costs: \$32,132

Project Goals: The goal of this project is to investigate the molecular mechanisms underlying the association between a common genetic variant at rs3128892 in the HLA-DRA gene of the Major Histocompatibility Complex-II locus and increased risk for late-onset Parkinson's disease

Specific Aims:

The Standaert laboratory at UAB will recruit 160 patients with idiopathic PD as well as 160 age, and sex-matched healthy control subjects for genotype determination from a saliva sample followed by venipuncture for collection of peripheral blood for immunophenotyping and epigenetic analyses, and a clinical exam in accordance with NINDS guidelines for the Parkinson's Disease Biomarkers Database.

Potential Overlap: None.

Title: Evaluation of the effects of a novel nicotinic agonist, AZD1446, on neurochemical and electrophysiologic endpoints in DYT1 mouse models

Role: PI

Time Commitment: 0.12 CM

Support Agency: Dystonia Medical Research Foundation

Funding Agency Grants officer:

Jan K. Teller, MA, PhD

One East Wacker Dr, Ste 2810

Chicago, IL 60601

Performance Period: 5/1/15 – 10/31/16

Annual Direct Costs: \$50,000

Project Goals: This project will use in vivo microanalysis to evaluate the effect of a novel nicotinic agonist, AZD1446, on striatal dopamine release in DYT1 knock-in animals.

Specific Aims:

Aim 1: In the Standaert lab, we will use in vivo microdialysis to evaluate the effect of a novel nicotinic agonist, AZD1446, on striatal dopamine release in DYT1 knock-in animals.

Aim 2: In the Pisani Lab, we will assess the effects of AZD1446 on striatal electrophysiology, particularly striatal plasticity as measured by LTD, LTP, and depotentiation.

Potential Overlap: None.

Title: The role of the JAK/STAT Pathway in the human of Parkinson's Disease

Role: Co-Investigator

Time Commitment: 0.6 CM

Support Agency: The Michael J. Fox Foundation for Parkinson's Research

Funding Agency Grants officer:

Todd Sherer

Grand Central Station

PO Box 4777

New York, NY 10163-4777

Performance Period: 2/13/17 – 2/12/18

Annual Direct Costs: \$100,000

Project Goals: We will investigate the JAK/STAT pathway by studying immune cells obtained from individuals with PD and healthy controls. Our hypothesis is that monocytes and T-cells (immune system cells) from PD patients will exhibit heightened activation of the JAK/STAT pathway and gene expression compared to controls. This work will establish whether the JAK/STAT pathway is a valid therapeutic target.

Potential Overlap: None.

Title: Clinician-input Study: How the Fox Wearable Companion Mobile Application can Influence Treatment and Care (CIS-PD)

Role: Site PI

Time Commitment: 0.12 CM

Support Agency: The Michael J. Fox Foundation for Parkinson's Research

Funding Agency Grants officer:

Todd Sherer

Grand Central Station

PO Box 4777

New York, NY 10163-4777

Performance Period: 10/1/16 – 11/14/17

Annual Direct Costs: \$46,640

Project Goals: The goal of this clinical trial is to assess feasibility and utility of the remote capture wearable device data from Parkinson's disease patients in clinical practice.

Potential Overlap: None.

Title: Innate and Adaptive Immunity in Parkinson Disease (P20NS092530)

Role: PD/PI

Time Commitment: 0.6 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

Neuroscience Center, Room 2223
6001 Executive Blvd, MSC 9525
Bethesda, MD 20892-9525

Performance Period: 7/1/15 – 6/30/18

Annual Direct Costs: No cost extension

Project Goals: The goal of this project is to create the team, environment, and capability to explore innate and adaptive immunity in PD and lead to the development of a future Udall Center of Excellence focusing on neuroinflammation in PD.

Specific Aims:

Aim 1: Solidify the core collaborative team necessary for a future P50 Udall Center application.

Aim 2: Identify critical neuroimmunological endpoints and test key hypotheses in PD model systems that will provide the feasibility, significance, and impact needed for a successful future P50 application.

Aim 3: Develop the process and pipeline needed to study human subject populations, particularly in very early stages of clinical PD, and establish the operational basis for an effective Udall Center clinical core.

Potential Overlap: None.

Title: UAB Research and Education Program in Neuroscience

Role: PI

Time Commitment: 0.36 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Stephen J. Korn

NSC BG RM 2187

6001 Executive Blvd

Rockville, MD 20852

Performance Period: 7/1/17 – 6/30/23

Total Costs: \$694,383

Project Goals: The goal of this education program is to train residents in neuroscience for careers as physician-scientists.

Specific Aims: The Specific Aim of this proposal is to establish an R25 education program at UAB to train residents in neurology, neurosurgery, radiology, anesthesiology and neuropathology, and to prepare them for careers as physician-scientists. The program will incorporate leadership from two clinician-scientists who will serve as Director and Associate Director, a group of experienced mentors, and strong residencies programs from which candidates will be drawn.

Potential Overlap: None.

Current/Pending/Previous Support

Ashley Harms

Current Support, continuing since the last reporting

Title: Mechanisms of alpha-synuclein mediated inflammation in multiple system atrophy (R01NS107316)

Role: PI

Time Commitment: 3 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

sieberb@ninds.nih.gov

Performance Period: 6/1/18 – 3/31/23

Total Costs: \$1,624,220

Project Goals: The goal of this project is to investigate the contribution of brain-resident and peripheral immune cells in initiating and sustaining inflammation, and target these cells as a novel way of blocking disease progression.

Specific Aims:

Aim 1: Selective deletion of MHCII CNS from resident microglia is protective against α -syn-induced monocyte and T cell invasion, inflammation, demyelination, and neurodegeneration in a model of MSA.

Aim 2: Peripheral deletion of CCR2 and pharmacological blockade of CCR2 attenuate α -syn-induced demyelination, and neurodegeneration in a model of MSA.

Aim 3: Inhibition of T cell entry into the CNS attenuates α -syn-induced monocyte entry, demyelination, and neurodegeneration in a model of MSA.

Potential Overlap: None.

Title: Interactions of Gut Microbiome, Genetic Susceptibility and Environmental Factors in Parkinson's Disease (W81XWH1810509)

Role: Co-Investigator

Time Commitment: 1.56 CM; 0.6 CM during NCE

Support Agency: Department of Defense

Funding Agency Grants officer:

Jason Kuhns

Performance Period: 9/1/18 – 8/31/22; NCE requested to 2/28/23

Total Costs: \$635,001

Project Goals: The goal of this study is to identify the organisms in the gut that interact with genetic and environmental risk factors of PD. Microbiome can be easily altered; thus, successful completion of this project will provide feasible means to predict, prevent and treat PD.

Specific Aims:

Aim 5. Investigate the mechanisms of interactions. Hypothesis: Corynebacterium will increase alpha-synuclein and accelerate parkinsonian phenotypes in a mouse model. Rationale: Transplant of a PD microbiome has been shown to enhance parkinsonian phenotypes in alpha-synuclein over-expressing mice,²⁴ but the responsible microorganisms are unknown. Approach: We will use Thy1-SNCA specific pathogen free and germ-free mice and test the effect of introducing Corynebacterium on alpha-synuclein and relevant phenotypes.

Potential Overlap: None.

Title: Innate and Adaptive Immunity in Parkinson Disease: Project 1 - Role of Innate Immune Cells in Human Parkinson Disease (P50NS108675)

Role: Co-Investigator

Time Commitment: 0.48 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

sieberb@ninds.nih.gov

Performance Period: 9/30/18 – 7/31/23

Total Costs: \$583,397

Project Goals: The goal of this project is to explore the overarching hypothesis that innate immune cells are activated towards a pro-inflammatory phenotype early in PD. We theorize that blocking this activation will protect from PD progression.

Specific Aims:

Aim 1: In the same population of 60 patients with de novo PD and 60 age- and sex-matched controls, determine whether there is change over time in monocytes populations assessed by flow cytometry or in blood cytokines and chemokines.

Aim 2: Determine the relationship between baseline measures of inflammation and longitudinal clinical outcomes, particularly cognition, in this population of early de novo PD subjects.

Potential Overlap: None.

Title: Adaptive Immunity in the Etiology and Progression of Parkinson's Disease

Role: PI

Time Commitment: 3 CM

Support Agency: The Michael J Fox Foundation for Parkinson's Research pass through Research Foundation for Mental Hygiene Inc./NY State Psychiatric Hospital

Performance Period: 9/7/20 – 9/6/23

Total Costs: \$1,766,999

Project Goals: This project will investigate how antigen presenting cells and neurons activate T cells, characterize antigen-specific T cells in blood and the enteric nervous system over the course of PD, discover how the gut microbiome regulates antigen-specific T cells, establish the molecular steps by which CNS dopaminergic neurons present antigen, and ultimately determine the extent that the cellular and molecular changes we observe in patient blood and animal models are found in PD and age-matched healthy control donor brain tissue.

Specific Aims for UAB team:

Aim 1: Define gut mucosal adaptive immune response in early PD mouse models.

Aim 2: Elucidate antigen presentation by SN DA neurons.

Potential Overlap: None.

Title: Co-Pathologies Drive Neuroinflammation and Progression in PD

Role: PI

Time Commitment: 3 CM

Support Agency: The Michael J Fox Foundation for Parkinson's Research pass through Arizona State University

Performance Period: 10/1/21 – 9/30/23

Total Costs: \$993,788

Project Goals: The goals of this project will be achieved in a series of integrated mouse, nonhuman primate and human tissue studies. Further, we plan to modulate the specific co-pathologies in these models using antisense oligonucleotides and/or antibodies and use these immunomodulatory strategies to establish basic mechanisms of function/dysfunction and validate the models created.

Specific Aims for UAB team:

Aim 1: Determine the role of the immune system in co-pathology-mediated inflammation and neurodegeneration in mouse models of PD

Aim 2: Validate the role of neuroinflammation as causative in neurodegeneration and associated behavioral outcomes, using immunomodulatory compounds. Use unique antibody and ASO tools to characterize the co-pathology mechanisms and temporal independencies

Potential Overlap: None.

Current support, new since last reporting

Title: Glial Involvement in REDOX Homeostasis in the Substantia Nigra (R01NS124037)

Role: Co-Investigator

Time Commitment: 0.6 CM

Support Agency: National Institutes of Health pass through Southern Research

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

sieberb@ninds.nih.gov

Performance Period: 7/1/21 – 4/30/26

Total Costs: \$30,554

Project Goals: The goal is to explore the mechanisms by which a deficiency in the expression of the NAD metabolizing enzyme CD38 influences oxidative stress and dopaminergic neuron vulnerability in mouse models of PD.

Potential Overlap: None.

Pending Support

Title: The Role of the Immune System in Multiple System Atrophy (R35NS132193)

Role: Co-Investigator

Time Commitment: 6 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

sieberb@ninds.nih.gov

Performance Period: 4/1/23 – 3/31/31

Total Costs: \$4,151,515

Project Goals: The goal of this R35 application is to study the role of adaptive immunity in multiple system atrophy disease pathogenesis, specifically pathogenic and regulatory T cells, B cells, and oligodendrocyte and oligodendrocyte precursor cells.

Potential Overlap: There is no current overlap. The two active Fox Foundation pass through awards and the pending R35NS132193 have minimum effort requirements of 3 months each for the Fox awards and 6 months for the R35. If the R35 is funded, during the 6 months that the R35 would overlap with the Fox awards (April 2023-September 2023), I will reduce my effort on all other projects to 0 months. Once the Fox awards have ended, I will resume my effort on R01NS124037 and R01NS124037 as originally proposed.

Title: Early Life Stress Induced Mechanisms of Cardiovascular Disease Risk and Resilience (P01HL158500)

Role: Co-Investigator

Time Commitment: 0.36 CM

Support Agency: NIH

Performance Period: 9/1/22 – 8/31/27

Total Costs: \$2,364,039

Project Goals: Dr. Harms will study the role of border associated macrophages in an early life stress mouse model. She will use immunohistochemistry and flow cytometry to characterize and determine border associated macrophages in the brain and meninges of the early life stress model.

Potential Overlap: None.

Previous Support, past 5 years, no change since last reporting

Title: Validation of CD4 T cell dependent neurotoxicity in an alpha-synuclein model of PD

Role: PI

Time Commitment: 1.8 CM

Support Agency: Michael J. Fox Foundation for Parkinson's Research

Funding Agency Grants officer:

To be determined

Grand Central Station

PO Box 4777

New York, NY 10163-4777

Performance Period: 8/1/18 – 11/22/19

Annual Direct Costs: \$90,909

Project Goals: The goal of these studies will be to examine the CD4 T cell infiltration in response to alpha-synuclein overexpression, and explore if genetic knockout of these cells curbs inflammation and neurodegeneration.

Specific Aims:

Aim 1: Determine the timing of α -syn-induced CD4 T cell infiltration.

Aim 2: Determine whether deletion of CD4 is sufficient to attenuate α -syn-induced inflammation via microglia activation and peripheral immune cell infiltration.

Aim 3: Determine whether deletion of CD4 is sufficient to attenuate α -syn-induced inflammation via neurodegeneration.

Potential Overlap: None.

Title: Validation of CCR2-Dependent Monocyte Entry in Alpha-Synuclein-Induced Toxicity (12087.01)

Role: PI

Time Commitment: 0.8 CM

Support Agency: Michael J. Fox Foundation for Parkinson's Research

Funding Agency Grants officer:

Terina Martinez, PhD

Grand Central Station

PO Box 4777

New York, NY 10163-4777

Performance Period: 6/1/18 – 12/9/19

Annual Direct Costs: \$103,131

Project Goals: The goal of these studies will be, for the first time, to examine whether blocking CCR2+ monocyte entry via the small molecule inhibitor RO523444 attenuates α -syn-induced inflammation and neurodegeneration in the AAV2-SYN model of PD.

Specific Aims:

Aim 1: Determine whether the small molecule inhibitor RO525444 blocks CCR2-dependent monocyte/macrophage entry and inflammation in an α -syn model of PD;

Aim 2: Determine whether use of this inhibitor is neuroprotective.

Potential Overlap: None.

Title: Advancing PINK1 KO Rat Animal Models of PD (11380.01)

Role: Collaborator

Time Commitment: 0.36 CM

Support Agency: Michael J. Fox Foundation for Parkinson's Research

Funding Agency Grants officer:

Shalini Padmanabhan

Grand Central Station

PO Box 4777

New York, NY 10163-4777

Performance Period: 11/1/17 – 4/30/19

Annual Direct Costs: \$99,936

Project Goals: The goals of this project are to determine the mechanisms of neurodegeneration in PINK1 KO rats and to determine the extent to which neuroinflammation contributes to hind limb paresis onset or recovery.

Specific Aims:

Aim 1: Determine the mechanisms of neurodegeneration in PINK1 KO rats.

Aim 2: Determine the extent to which neuroinflammation contributes to hind limb paresis onset or recovery in PINK1 KO rats.

Potential Overlap: None.

Title: Targeting MHCII proteins on CNS resident microglia in an alpha-synuclein model of Parkinson disease (8561.01)

Role: PI

Time Commitment: 0.6 CM

Support Agency: Michael J. Fox Foundation for Parkinson's Research

Funding Agency Grants officer:

Julia Keefe

Grand Central Station

PO Box 4777

New York, NY 10163-4777

Performance Period: 11/1/16 – 2/15/19

Annual Direct Costs: No cost extension

Project Goals: The goal of this project is to determine whether selective deletion of MHCII proteins on resident microglia is sufficient to attenuate α -syn-induced inflammation, peripheral immune cell infiltration, and neurodegeneration.

Specific Aims:

Aim 1: Determine if murine MHCII proteins can be selectively deleted from resident CX3CR1-expressing microglia in vivo and the efficiency of doing so.

Aim 2: Determine if selective deletion of MHCII proteins on CX3CR1-expressing microglia attenuates α -syn-induced inflammation and infiltration of peripheral immune cells.

Aim 3: Determine if selective deletion of MHCII proteins on CX3CR1-expressing microglia is protective against α -syn-induced neurodegeneration.

Potential Overlap: None.

Title: Mechanisms of LRRK2 Neurotoxicity (R01NS064934)

Role: Co-Investigator

Time Commitment: 0.6 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

Neuroscience Center, Room 2223

6001 Executive Blvd, MSC 9525

Bethesda, MD 20892-9525

Performance Period: 4/1/16 – 3/31/21

Annual Direct Costs: \$218,750

Project Goals: This project will investigate the cellular contributors to G2019S-LRRK2-mediated neurotoxicity in Parkinson's disease.

Specific Aims:

Aim 1: G2019S-LRRK2 expression in myeloid cells upregulates chemotaxis in response to neuronal α -synuclein inclusions to promote neurodegeneration.

Aim 2: LRRK2 knockout in myeloid cells downregulates chemotaxis in response to neuronal α -synuclein inclusions and protects from neurodegeneration.

Aim 3: LRRK2 scaffolds the assembly of actin filament networks in the leading edge of differentiated and mobile myeloid cells.

Potential Overlap: None.

Title: Validation of CCR2-dependent monocyte entry in alpha-synuclein-induced toxicity (12087)

Role: PI

Time Commitment: 2.4 CM

Support Agency: Michael J. Fox Foundation for Parkinson's Research

Funding Agency Grants officer:

Adria Martig

Grand Central Station

PO Box 4777

New York, NY 10163-4777

Performance Period: 9/1/16 – 8/31/17

Annual Direct Costs: \$90,909

Project Goals: This project will test whether monocyte entry from the periphery is required for α -syn-induced inflammation and neurodegeneration, and that blocking CCR2-dependent monocyte infiltration into the CNS is neuroprotective from α -syn mediated neurodegeneration.

Specific Aims:

Aim 1: To characterize the timing and extent of monocyte entry into the brain in response to α -syn fibrils in mice

Aim 2: To determine whether blocking CCR2 protects against pathologic α -syn induced dopamine neuron death

Potential Overlap: None.

Title: Innate and Adaptive Immunity in Parkinson Disease; Project 1: PD-linked Susceptibilities in Myeloid Cell CNS Infiltration (P20NS092530)

Role: Co-Investigator

Time Commitment: 3.6 CM

Support Agency: National Institutes of Health

Funding Agency Grants officer:

Beth-Anne Sieber

NIH/NINDS

Neuroscience Center, Room 2223

6001 Executive Blvd, MSC 9525

Bethesda, MD 20892-9525

Performance Period: 7/1/15 – 6/30/18 (Dr. Harms support/effort ended 9/30/17)

Annual Direct Costs: No cost extension

Project Goals: The goal of this project is to determine whether G2019S-LRRK2 increase α -syn-induced peripheral myeloid cell entry into the CNS, and whether LRRK2 inhibition blocks this process.

Specific Aims:

Aim 1: G2019S-LRRK2 expression promotes an exaggerated peripheral response of myeloid cell infiltration and pro-inflammatory responses.

Aim 2: LRRK2-knockout mice, or treatment of WT-rodents with orally available LRRK2 kinase inhibitors, will block myeloid cell infiltration and pro-inflammatory responses in the CNS.

Potential Overlap: None.