Spring ADRC Directors Meeting

National Institute on Aging

Los Angeles, CA
May 14, 2022

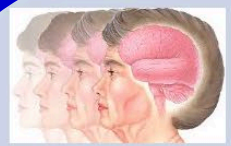
"NIA-DN Update"

Eliezer Masliah, M.D.
Director, Division of Neuroscience,
National Institute on Aging, NIH

Progress toward understanding the pathogenesis of AD- multiple pathways lead to AD/ADRD

Aging Genetics

Proteostasis defects
Mitochondria dysfunction
Oxidative stress
Epigenetic alterations
DNA damage
Senescent cells
Immune surveillance



Aging

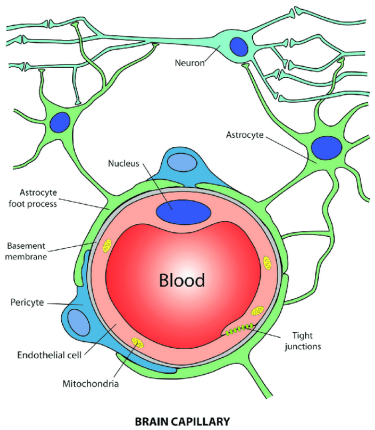
Genetics

APP/Abeta
APOE4
Presenilin
Inflammation genes
Endosomal genes
Synaptic genes
Lipid metabolism genes

Accounts for 70% of the variance

Environment

Toxins, Pollution, Heavy metals, Trauma, Infectious agents



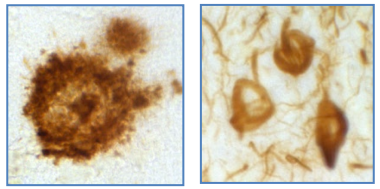
BRAIN CAPILLARY

Neurodegeneration

Synapse damage
Neuronal loss
Vascular damage
Inflammation

Proteinopathy

Abeta
Tau
Synuclein
TDP43



Diagnosis → **MCI/Dementia** ← **Therapeutics**

Alzheimer's Disease Sequencing Project

- *Over 75 risk loci and 20 genes (from the 75 loci) for AD identified*
- *Examples: BIN1, TREM2, CR1, PCALM, ADAM10, ABCD4, PLGC2, ANAX5, MEF2*
- *Involved in immune, neuronal/synaptic, endocytosis, lysosome* ***and*** *lipid metabolism*
- *Common polygenic variation increases risk prediction (APOE+others)*

100,000 WG by 2025 **includes diverse population**

- **Infrastructure**
  - NIAGADS
  - GCAD
  - NCRAD
  - LOAD-FBS
  - USUHS Sequencing
- **Genetics Study & Analysis**
  - ADGC
  - Cohorts Diversity
  - CADRE
  - CHARGE
- **AL/ML Consortium**
- **Phenotype Harmonization Consortium**
- **FunGen-AD Consortium**

- AI/ML to the identify gene variants that cause or contribute to the risk of or protection via analysis of harmonized genetic, biomarker data and phenotypic data
- Characterize functional impact and neurobiological consequence
- Translate genetic findings into mechanistic insight and therapies

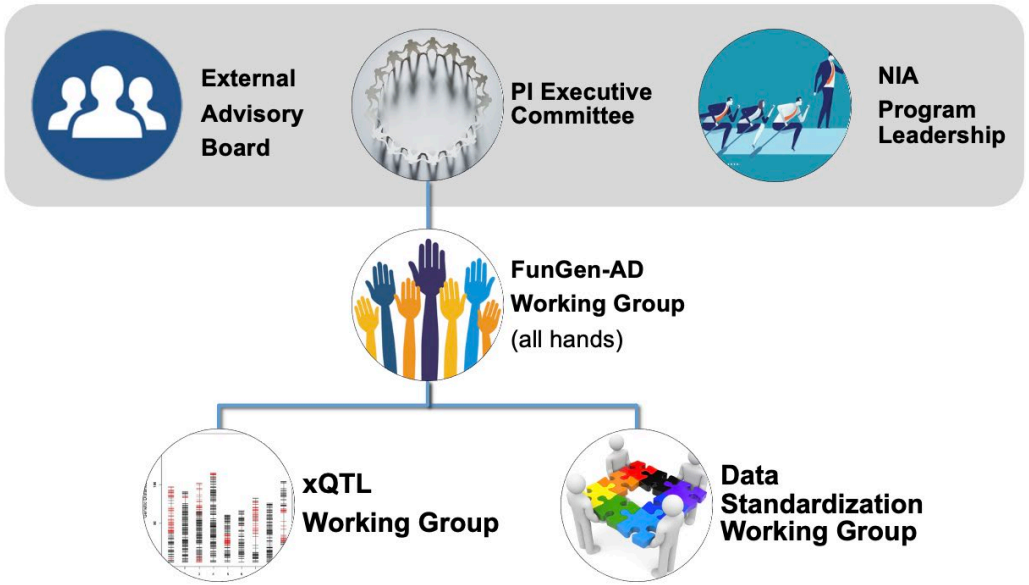
Work Groups across consortia

Scientific collaboration and resource sharing

FunGen-AD
ADSP Functional Genomics Consortium

NIA Program Directors: Marilyn Miller, Alison Yao

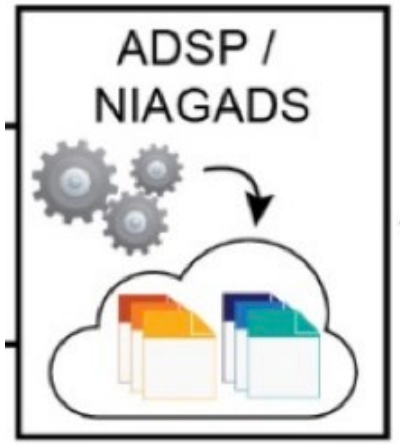
- To understand functional impact underlying the genetic basis of AD/ADRD
- Enable the discovery of genetics-guided targets for the prevention, diagnosis, and treatment of AD/ADRD.

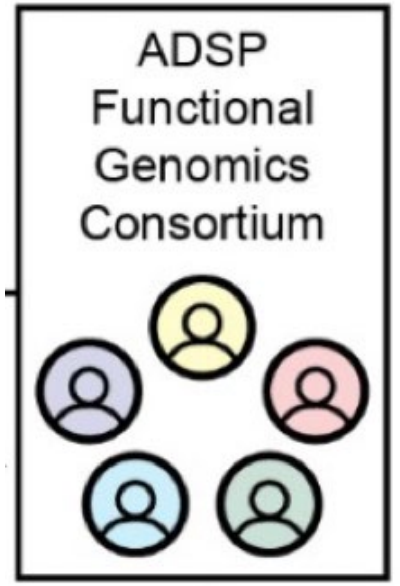


Core Projects

De Jager Columbia U	Shared functional changes across cellular networks
Montine Stanford U	Novel AD variants using hig-throughput and single-cell technologies
Shulman Baylor	Functional Genomic AD in Humans and Drosophila Models
Temple Reg Res Fo	AD Risk Genes on Neuro-Vascular Interactions
Vance U Miami	Diverse populations to characterize risk loci for AD
Zhang Boston U	Circular RNA and interactions with RNBP in AD

- Multi-omics data
- Cell specific atlas
- Genetic targets for therapeutic intervention
- Epigenetic data
- Vascular genes
- Microglia genes
- Diverse populations
- Data sharing





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Towards a comprehensive characterization of AD genome

NIA Program Directors: Marilyn Miller, Alison Yao

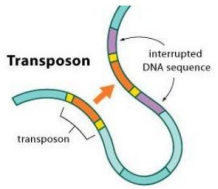
2020 2021 2022

RFA-AG-21-006

Functional Genomics

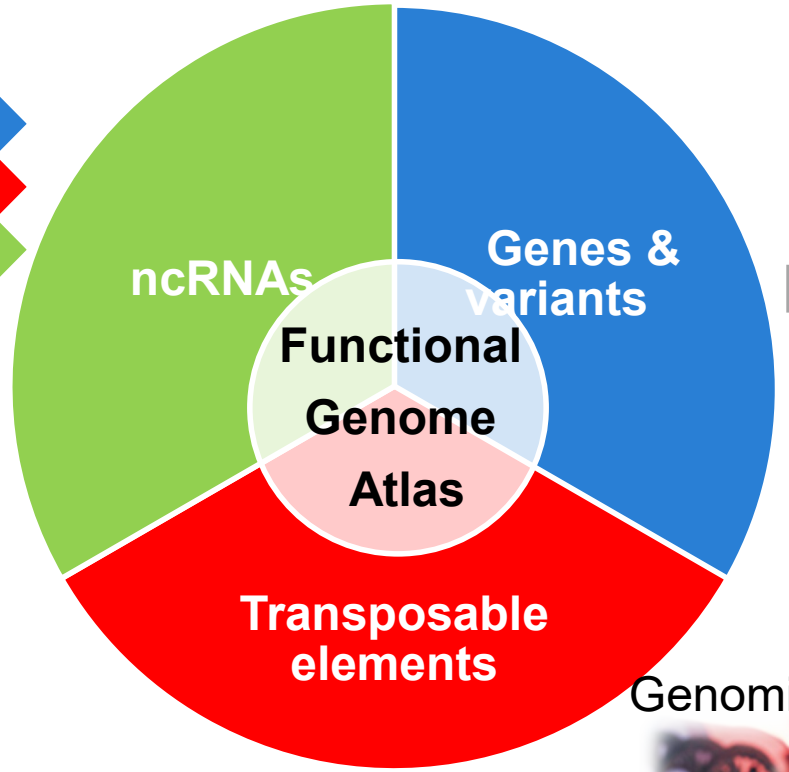
RFA-AG-22-21

Transposable Elements



RFA-AG-23-10

Noncoding RNAs



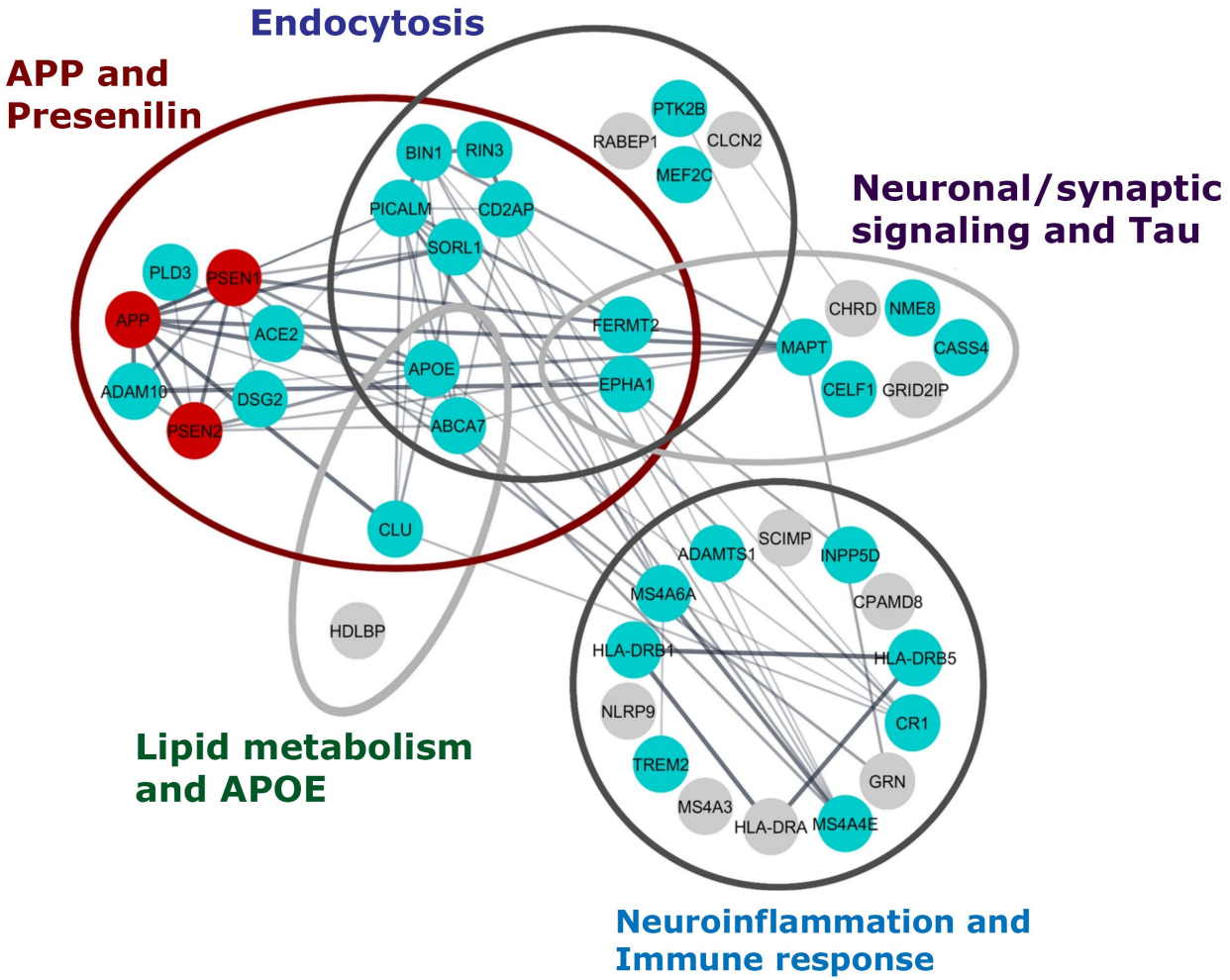
Genomic Medicine for AD

Building the pipeline for genomic medicine

NIH National Institute on Aging

Role of endosomal/lysosomal alterations in AD/ADRD

NOT-AG-21-034 Endosomal Trafficking as a Pathological Hub in AD/ADRD



TMEM 106B (FTD)

LETTERS

nature genetics

2010

Common variants at 7p21 are associated with fronto-temporal lobar degeneration with TDP-43 inclusions

Vivianna M Van Deerlin[1,106*], Patrick M A Sleiman[2,106], Maria Martinez-Lage[1,3,106], Alice Chen-Plotkin[1,4,106], Li-San Wang[1], Neill R Graff-Radford[5], Dennis W Dickson[6], Rosa Rademakers[6], Bradley F Boeve[7],

Cell

CellPress OPEN ACCESS

Article

Homotypic fibrillization of TMEM106B across diverse neurodegenerative diseases

Andrew Chang,[1,2,3,14] Xinyu Xiang,[1,2,3,4,14] Jing Wang,[1,2,3,14] Carolyn Lee,[1,2,3,5,14] Tamta Arakhamia,[1,2,3,14] Marija Simjanoska,[1,2,3,14] Chi Wang,[2] Yari Carlomagno,[6] Guoan Zhang,[7] Shikhar Dhingra,[1] Manon Thierry,[8] Julien Perneel,[9,10] Bavo Heeman,[9,10] Lauren M. Forgrave,[11,12] Michael DeTure,[6] Mari L. DeMarco,[11,12] Casey N. Cook,[6] Rosa Rademakers,[9,10] Dennis W. Dickson,[6] Leonard Petrucelli,[6] Michael H.B. Stowell,[13,*] Ian R.A. Mackenzie,[11,*] and Anthony W.P. Fitzpatrick[1,2,3,15,*]

TMEM 175 (DLB)

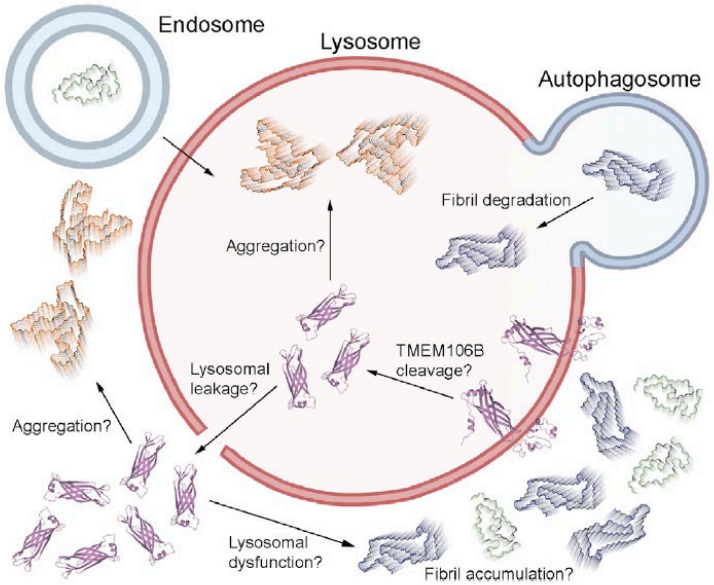
ARTICLES

https://doi.org/10.1038/s41588-021-00785-3

nature genetics

Check for updates

Genome sequencing analysis identifies new loci associated with Lewy body dementia and provides insights into its genetic architecture



NIH National Institute on Aging

TMEM106B fibrillation in aging and AD/ADRD pathogenesis

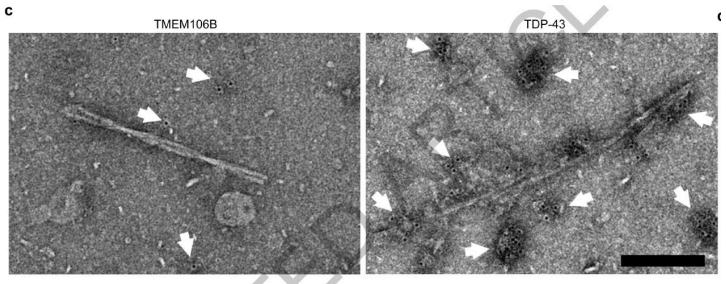
Article

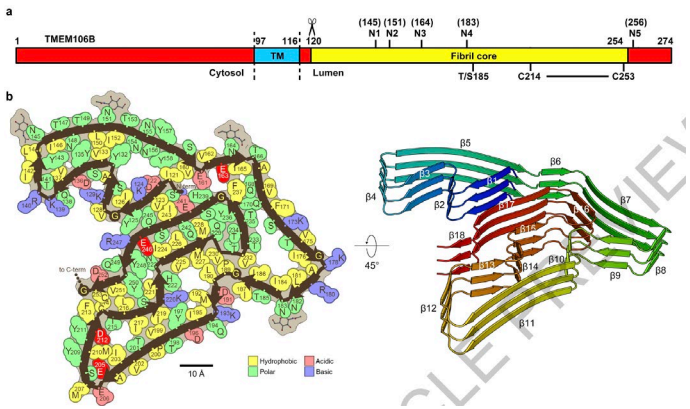
Amyloid fibrils in disease FTLD-TDP are composed of TMEM106B not TDP-43

https://doi.org/10.1038/s41586-022-04670-9
Received: 25 September 2021
Accepted: 22 March 2022
Published online: 28 March 2022

Yi Xiao Jiang[1,2,5], Qin Cao[1,2,5], Michael R. Sawaya[1,2], Romany Abskharon[1,2], Peng Ge[1,2], Michael DeTure[4], Dennis W. Dickson[4], Janine Y. Fu[1], Rachel R. Ogorzalek Loo[1], Joseph A. Loo[1] & David S. Eisenberg[1,2]✉

Frontotemporal lobar degeneration (FTLD) is the third most common



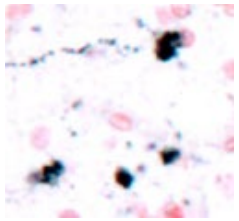


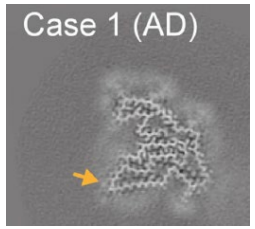
Article

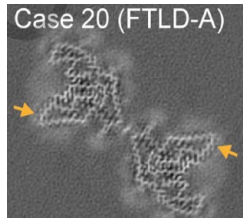
Age-dependent formation of TMEM106B amyloid filaments in human brains

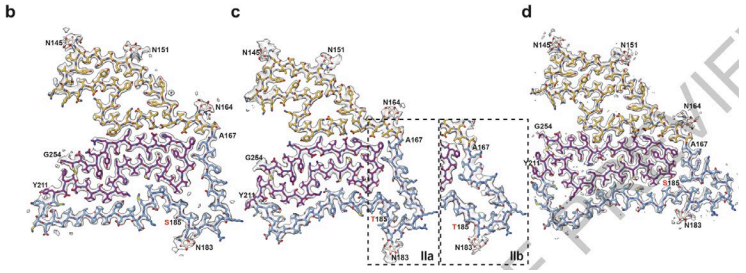
https://doi.org/10.1038/s41586-022-04650-z
Received: 9 November 2021
Accepted: 15 March 2022
Published online: 28 March 2022

Manuel Schweighauser[1,10], Diana Arseni[1,10], Mehtap Bacioglu[2,10], Melissa Huang[1,10], Sofia Lövestam[1,10], Yang Shi[1,10], Yang Yang[1,10], Wenjuan Zhang[1,17], Abhay Kotecha[3], Holly J. Garringer[4], Ruben Vidal[4], Grace I. Hallinan[4], Kathy L. Newell[4], Airi Tarutani[5], Shigeo Murayama[6], Masayuki Miyazaki[7], Yuko Saito[8], Mari Yoshida[9], Kazuko Hasegawa[10], Tammaryn Lashley[11], Tamas Revesz[11], Gabor G. Kovacs[12,13], John van Swieten[14], Masaki Takao[15,16], Masato Hasegawa[5], Bernardino Ghetti[4], Maria Grazia Spillantini[2], Benjamin Ryskeldi-Falcon[1], Alexey G. Murzin[1], Michel Goedert[1,10]✉ & Sjors H. W. Scheres[1,10]✉









Cell

CellPress
OPEN ACCESS

Article

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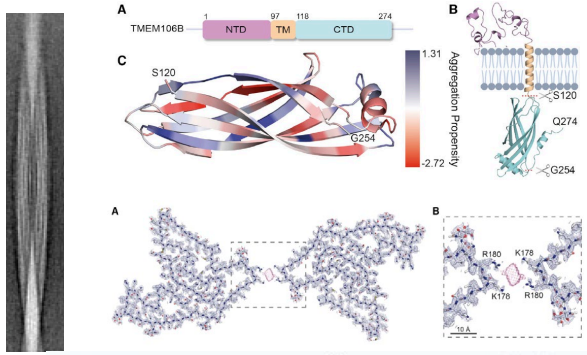

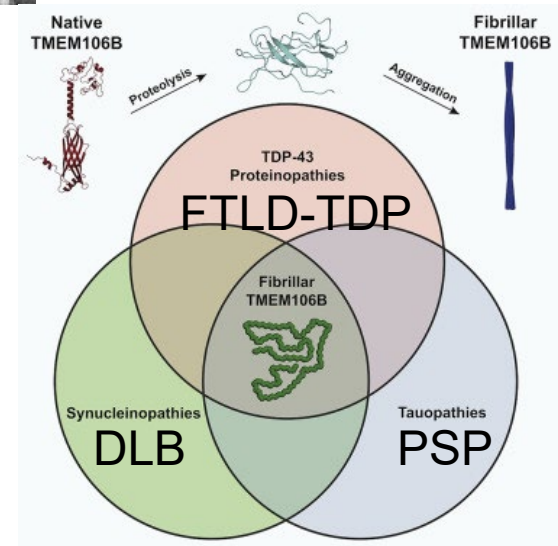

All cryo-EM studies in AD/ADRD feature central contribution from the ADRC's

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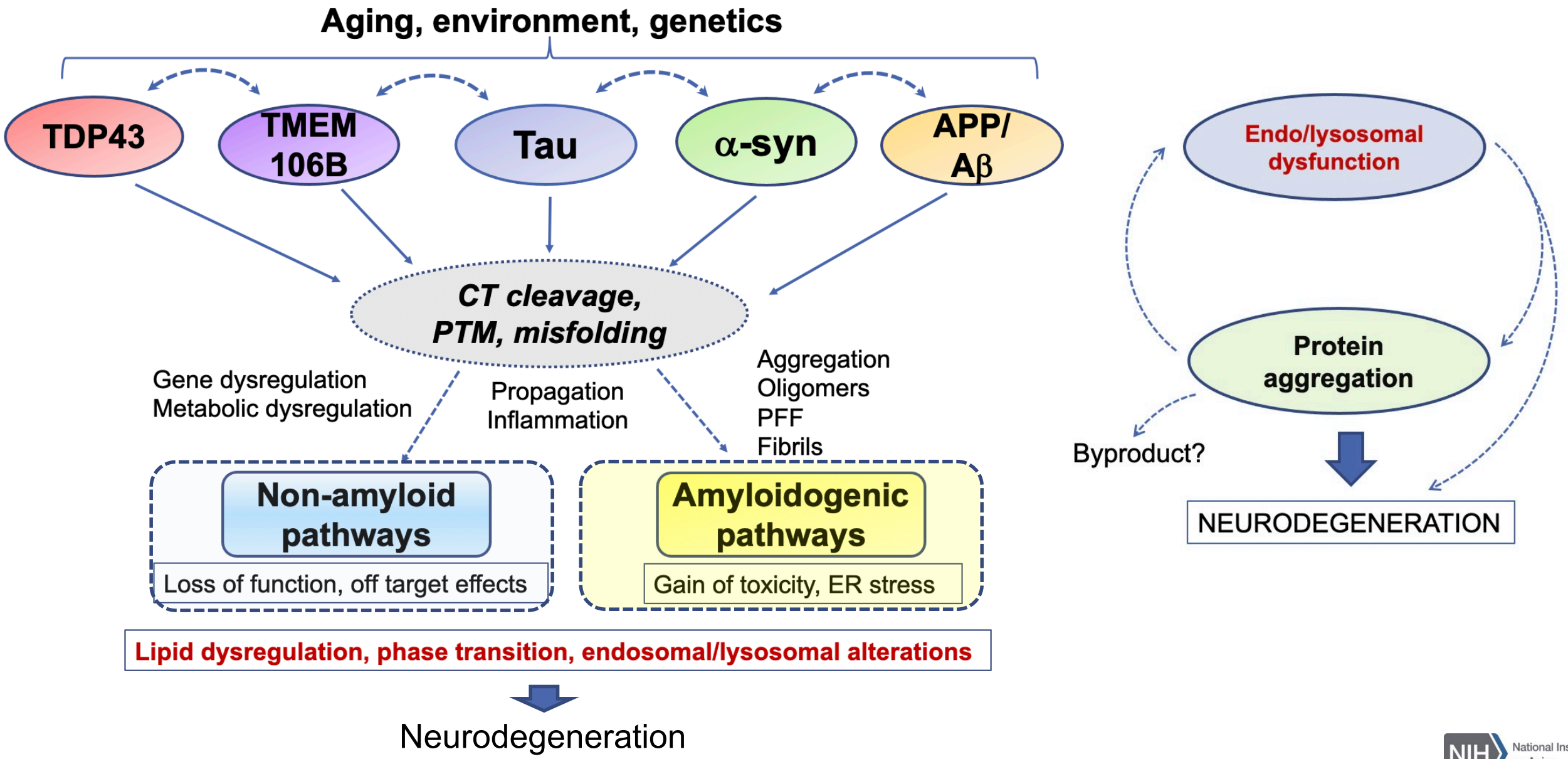
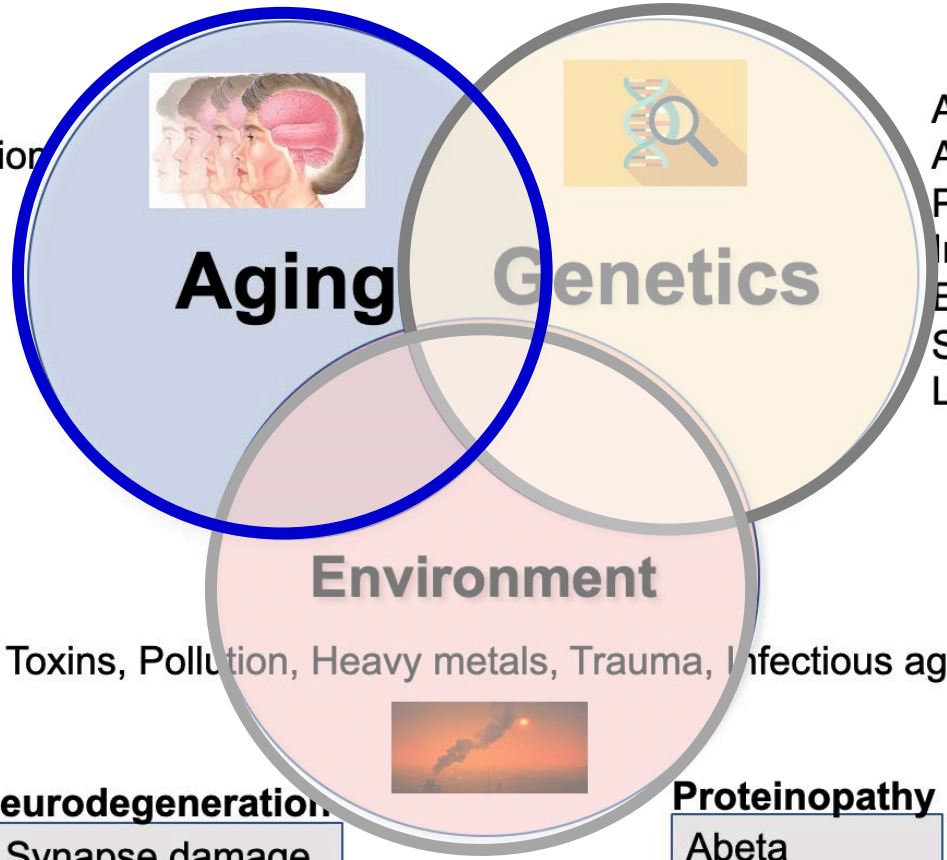
Re-considering the role of protein aggregation in AD/ADRD



Role of aging in the pathogenesis of AD/ADRD

Aging Genetics

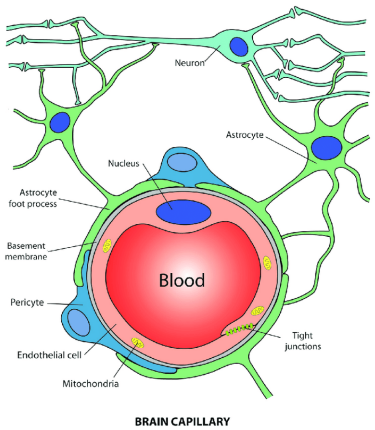
- Proteostasis defects
- Mitochondria dysfunction
- Oxidative stress
- Epigenetic alterations
- DNA damage
- Senescent cells
- Immune surveillance



- APP/Abeta
- APOE4
- Presenilin
- Inflammation genes
- Endosomal genes
- Synaptic genes
- Lipid metabolism genes

Accounts for 70% of the variance

Toxins, Pollution, Heavy metals, Trauma, Infectious agents



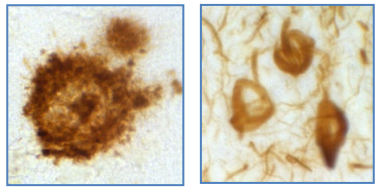
BRAIN CAPILLARY

Neurodegeneration

- Synapse damage
- Neuronal loss
- Vascular damage
- Inflammation

Proteinopathy

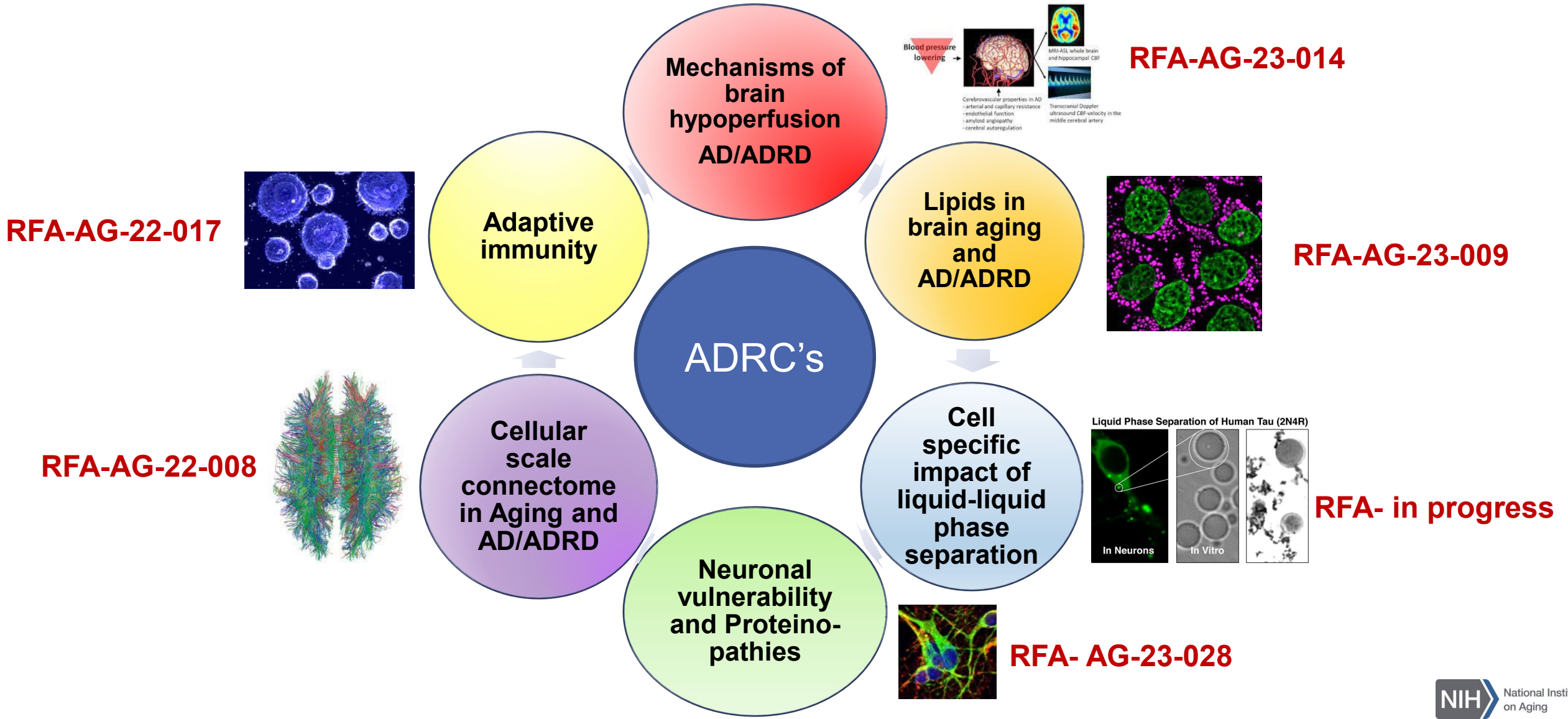
- Abeta
- Tau
- Synuclein
- TDP43



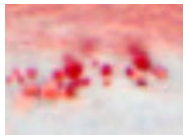
Diagnosis → **MCI/Dementia** ← **Therapeutics**

Contribution of aging mechanisms to AD/ADRD pathogenesis

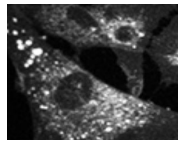
NIA Program Directors: Mack Mackiewicz, Amanda Dibattista, Austin Yang, Brad Wise, Paul Barrett, Lisa Opanasuck



NIA workshop on Lipids in Brain Aging and AD/ADRD April 2021.



NIA organizers: Amanda DiBattista, Paul Barrett, Brad Wise



Session I

Lipid Droplets in Aging and AD/ADRD.

Lance Johnson*, Maria Ioannou, Sarah Cohen, Ana Maria Cuervo, Tony Wyss-Coray

Session II

Myelin in Aging and AD/ADRD.

Robbie Brinton*, Doug Rosene, Xianlin Han, Vivek Swarup, Kim Bruce

Session III

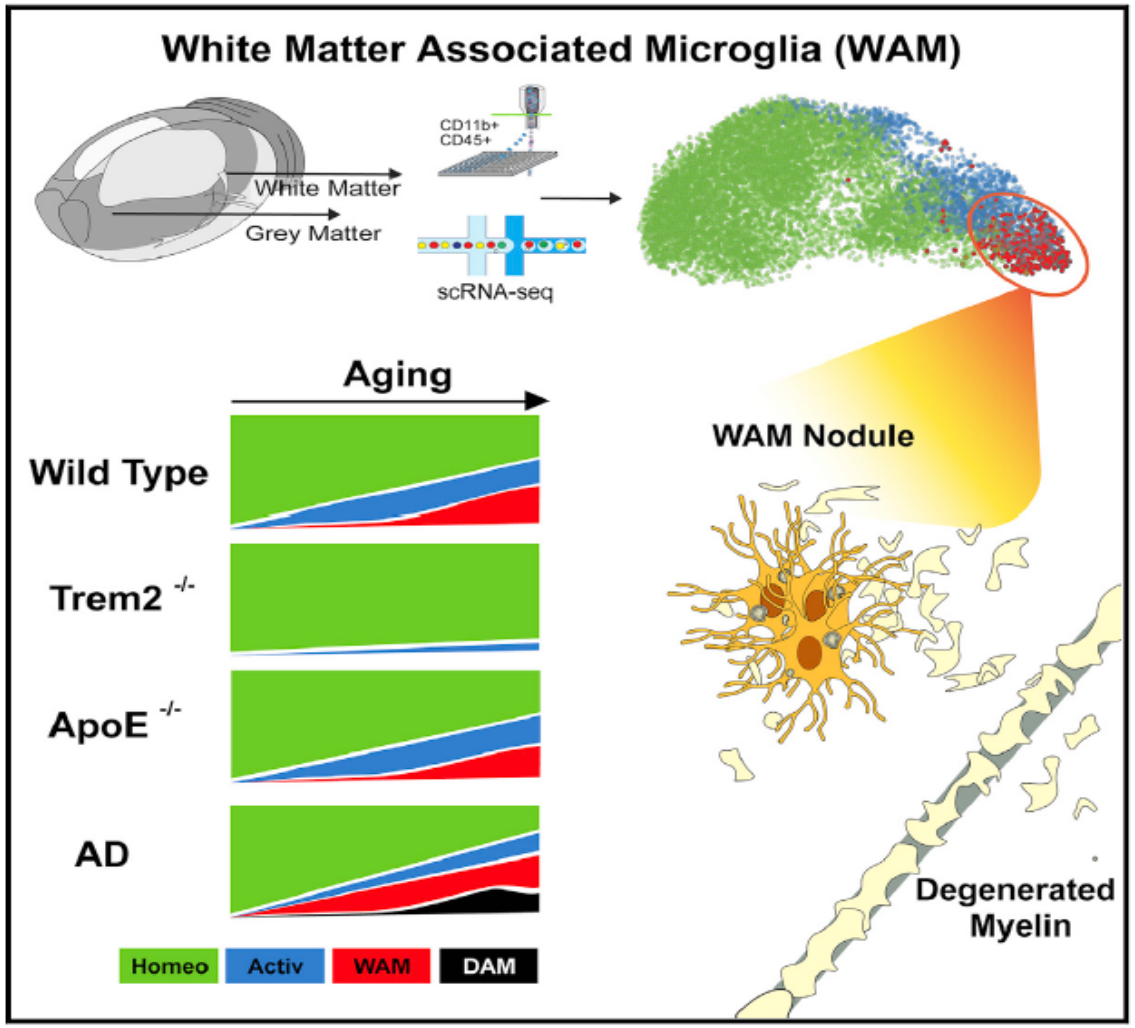
APOE and Lipid Homeostasis in Aging and AD/ADRD.

Guojun Bu*, Ana Valencia-Olvera, Bill Rebeck, Chris Ramsden, Dongming Cai, Fei Yin, Laila Abdullah, Hussein Yassine

Define "normal"	What is the lipid composition of LDs, and more generally in the brain (particularly in myelin), with aging and disease?
Pathological and/or Protective?	What are the consequences of LD accumulation in the aging brain? How does lipid signaling, lipid metabolism, and apoE change during brain aging and AD?
Biomarkers and the periphery	Could lipids represent a target for new central or peripheral biomarkers of aging or disease? Could the periphery be leveraged to understand cognitive outcomes?
Selective Vulnerability	What are the consequences of *APOE* status and/or sex differences on vulnerability to LD accumulation or lipid-related dysfunction?

NIH National Institute on Aging

White Matter Associated Microglia (WAMs) clear lipid-rich degenerated myelin accumulating during aging



Aging induces release of lipid-rich myelin debris that accumulates.

The protective WAM response depends on TREM2, but not APOE, to clear it.

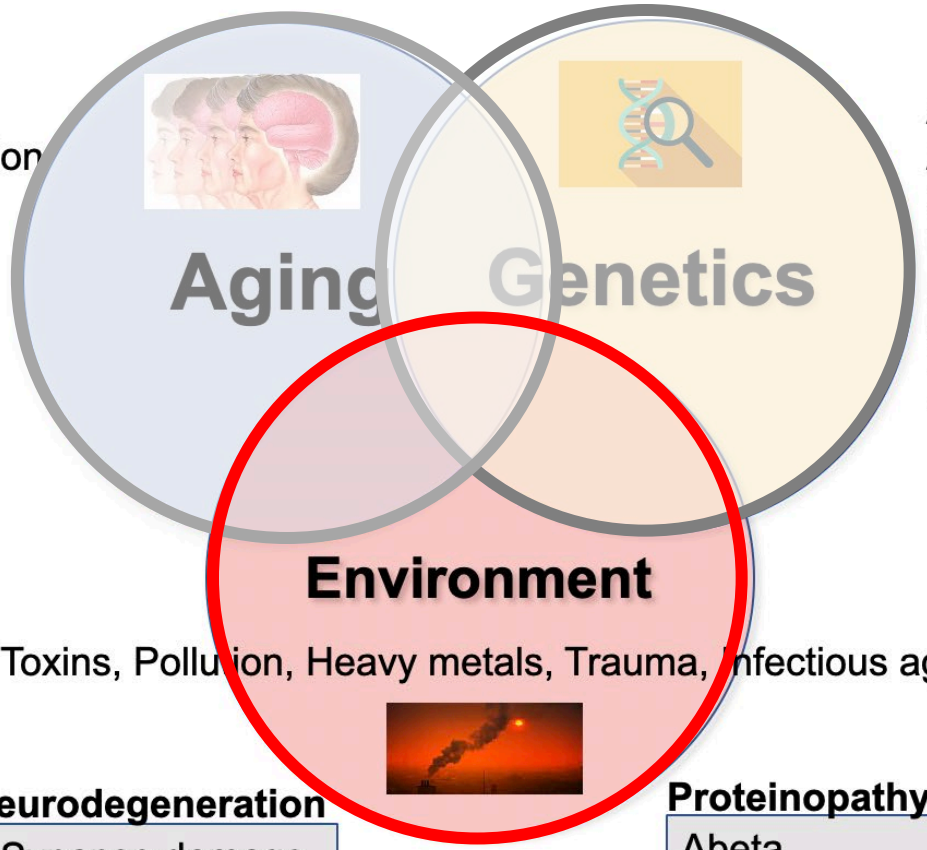
WAM precedes DAM in AD mice, and both activate lipid metabolism genes.

Safaiyan et al., Neuron, 2021

Role of environmental factors in the pathogenesis of AD/ADRD

Aging Genetics

Proteostasis defects
Mitochondria dysfunction
Oxidative stress
Epigenetic alterations
DNA damage
Senescent cells
Immune surveillance



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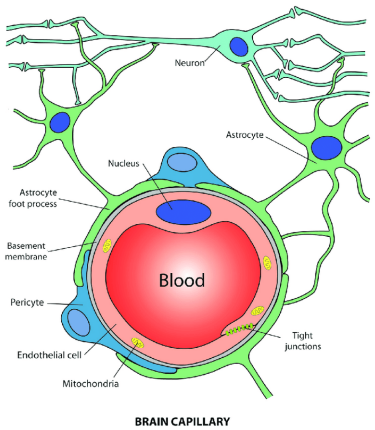

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Vascular damage
Inflammation

Proteinopathy

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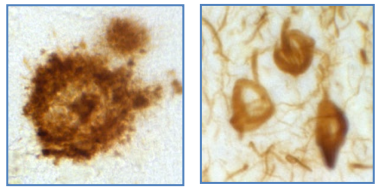
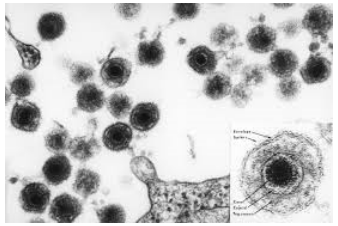


Diagnosis → **MCI/Dementia** ← **Therapeutics**

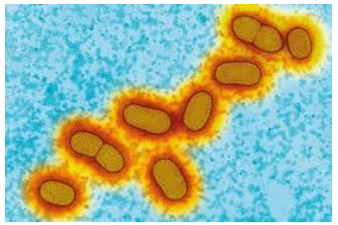
Understanding the Role of the Exposome in Brain Aging, AD and ADRD

NIA Program Directors: Brad Wise, Mackiewicz, Amanda Dibattista, Austin Yang, Paul Barrett, Lisa Opanashuk

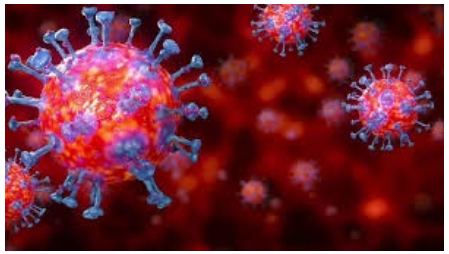


Infectious etiology of AD/ADRD

RFA-AG-21-034



(NOT- AG-21-016)



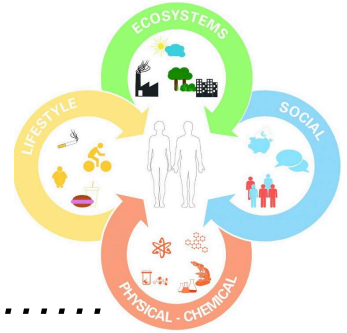
Neuro COVID-19

Microbiome in AD/ADRD

RFA-AG-20-030

RECOVER
Researching COVID to Enhance Recovery

Exposome Workshop



NEW FY2022!

Congress additional appropriation $15M for EXPOSOME CENTERS AD/ADRD

NAPA Milestones on the Exposome 1B, 1E, 2C……

NIH National Institute on Aging

What is the Exposome?

Understanding the Role of the Exposome in Brain Aging, Alzheimer's Disease (AD) and AD-Related Dementias
December 2-3, 2020

NIA- Lisa Opanashuck, Suzana Petanceska, Dallas Anderson, Damali Martin

Plenary Lectures

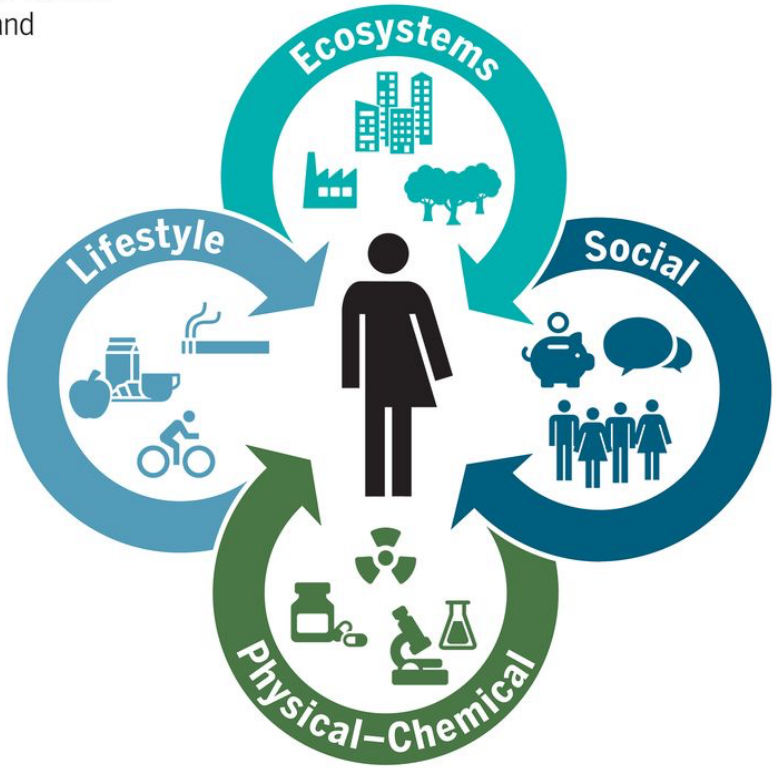
- Chirag Patel (Harvard Medical School): "Quantifying the Impact of Gene and Environment Interactions on Health and Disease"
- Peter James (Harvard Medical School/Harvard Pilgrim Health Care Institute): "Embedding Mobile Health and Deep Learning into Prospective Cohort Studies to Study the Exposome"

- **Session 1**: Translational Epidemiology
- **Session 2**: Overview of NIH Initiatives: ABCD study, NIEHS Exposome/Exposure Programs and Resources, NASEM Environmental Neuroscience Workshop highlights
- **Session 3**: From Clinical Research to Molecular Mechanisms: "Environmental Epigenomics/Mechanisms of Transgenerational Inheritance of Risk and Resilience" (part 1) and "Microbiome and Lifestyle Factors" (part 2)
- **Session 4**: The Impact of Air Pollution on the Etiology of AD

Ecosystems
Food outlets, alcohol outlets
Built environment and urban land uses
Population density
Walkability
Green/blue space

Lifestyle
Physical activity
Sleep behavior
Diet
Drug use
Smoking
Alcohol use

Social
Household income
Inequality
Social capital
Social networks
Cultural norms
Cultural capital
Psychological and mental stress



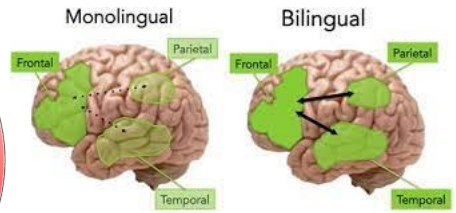
Physical–Chemical
Temperature/humidity
Electromagnetic fields
Ambient light
Odor and noise
Point, line sources, e.g, factories, ports
Outdoor and indoor air pollution
Agricultural activities, livestock
Pollen/mold/fungus
Pesticides
Fragrance products
Flame retardants (PBDEs)
Persistent organic pollutants
Plastic and plasticizers
Food contaminants
Soil contaminants
Drinking water contamination
Groundwater contamination
Surface water contamination
Occupational exposures

Exposome and diversity research in AD/ADRD

NIA Program Directors: Matt Sutterer, Molly Wagster, Damali Martin, Nina Silverberg, Cerise Elliott, Marilyn Miller, Alison Yao, Jennie Larkin, Laurie Ryan, Suzana Petanceska

Leveraging **ADRC's**, NCRAD, NACC, AMP-AD, MODEL, ADNI…

Bilingualism in cognitive reserve and resilience in Aging and AD/ADRD

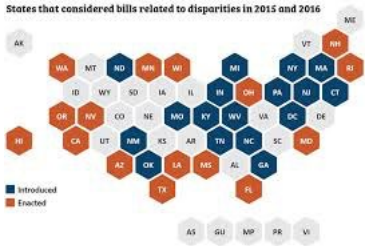


***RFA AG-23-01**

Precision medicine approaches minority health and disparities

RFA- in progress

Health disparities



NOT-AG-21-033

Screening for Cognitive impairment (U24)

RFA-AG-23-007

Collaborative Studies on AD/ADRD

NOT-AG-21-035

NIA Workshop on bilingualism and cognitive reserve and resilience

March 2-3, 2021

NIA organizers: Molly Wagster and Matt Sutterrer

Program and Speakers

Overview: Cognitive Reserve & Resilience in Aging
Dan Mungas

Session I.
Bilingualism across the lifespan and its impact on reserve and resilience

Judith Kroll, Erika Hoff, Arturo Hernandez, Ellen Bialystok

Session II.
Factors complicating the study of bilingualism and its impact on cognition and the brain

Thomas Bak, Miguel Arce Renteria, Boon Lead Tee, Karen Emmorey, Tamar Gollan

Perspective: Is there a bilingual advantage?
Ken Paap

Session III.
Mechanisms by which bilingualism may drive neuroplasticity in brain

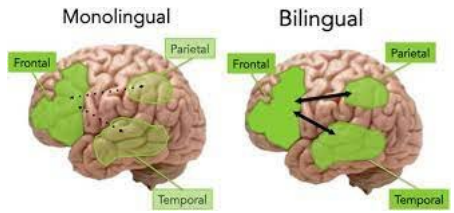
Christos Pliatsikas, John Grundy, Jubin Abutalebi, Suvarna Alladi, Esti Blanco-Elorrieta

Gaps and Opportunities

Improved Measurement of Aging Bilingual populations.
Identify factors of bilingual experience (e.g. age of acquisition, fluency, literacy, etc.)
Develop objective measures of bilingual proficiency and use

Establish new multidisciplinary collaborations.
Better contextualize environmental and sociocultural factors
Integrate bilingualism into existing longitudinal studies of aging

Develop and test new theoretical frameworks of bilingual effects on cognitive reserve/resilience.
Identify mechanisms for bilingual effects for focused data collection and testing
Construct validation of bilingualism as an indicator of cognitive reserve
Incorporate computational modeling approaches

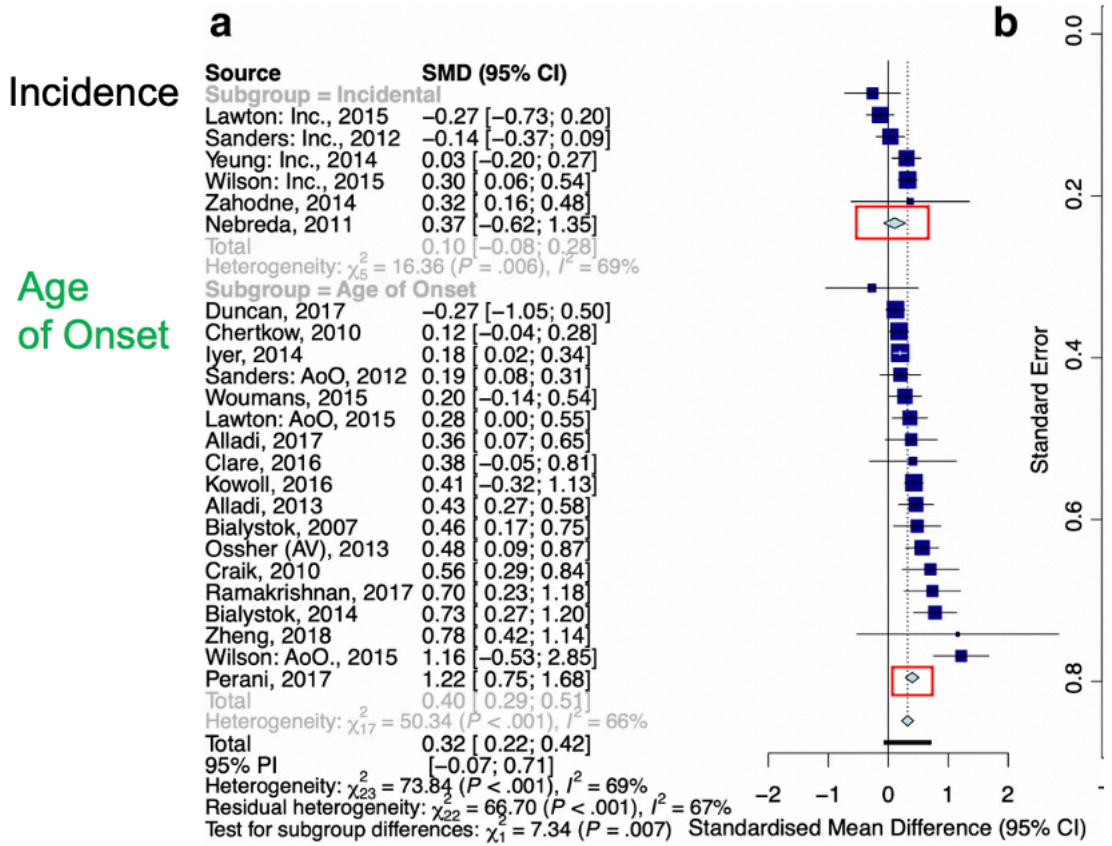


***RFA AG-23-01**

NIH National Institute on Aging

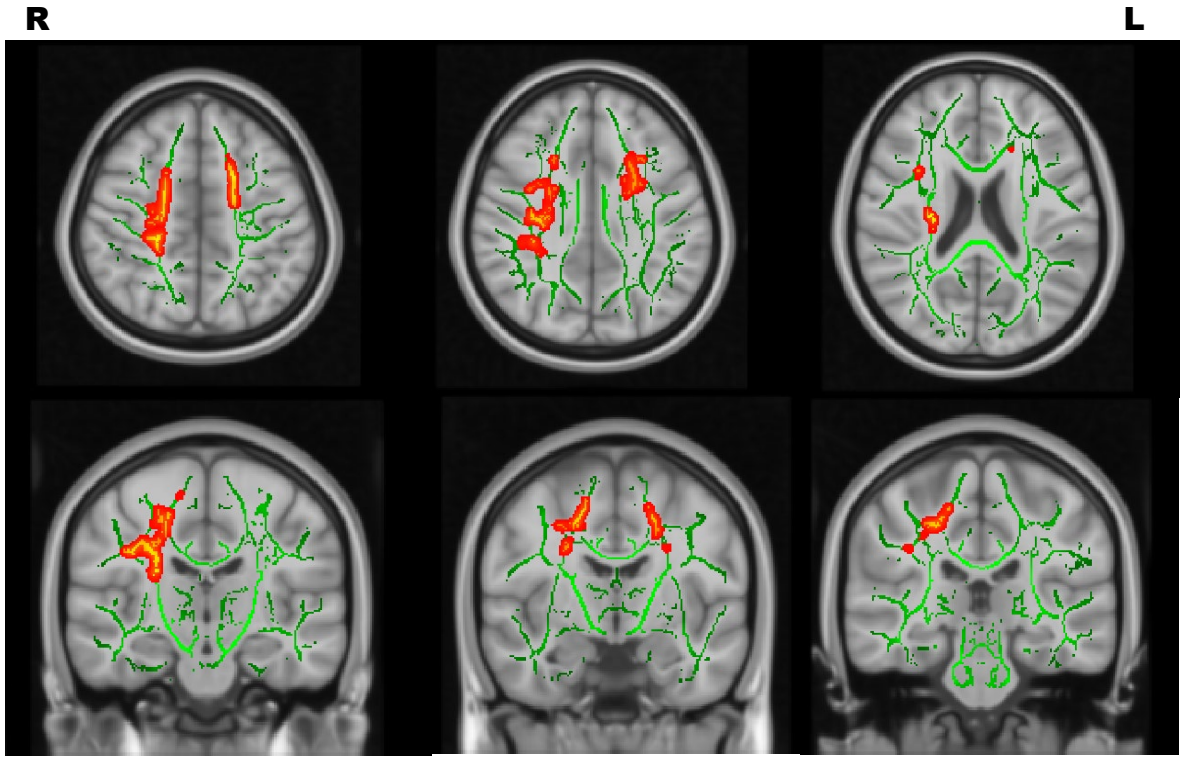
NIA Workshop on bilingualism and cognitive reserve and resilience

Evidence points to Bilingualism influencing age of AD onset, rather than incidence



Anderson, Hawrylewicz, & Grundy (2020), Psychonomic Bulletin & Review

White matter changes in Bilinguals with FTD



Bilinguals demonstrated better FA in bilateral SLF, left ATR, forceps minor, IFOF and right corticospinal tract.

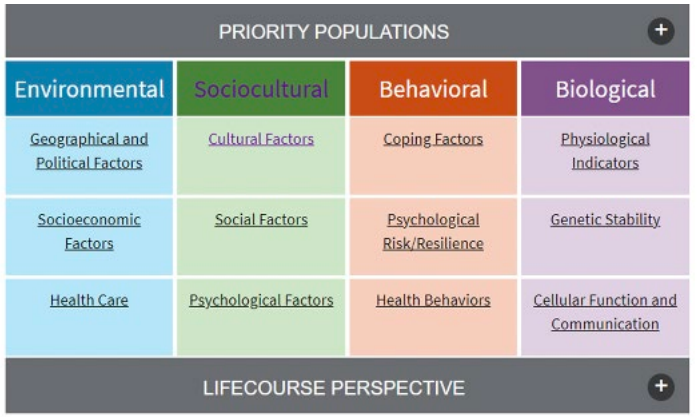
Courtesy of Suvarna Alladi

Building Infrastructure for Precision Medicine approaches in AD/ADRD Minority Health and Health Disparities

NIA Program Directors: Damali Martin, Nina Silverberg, Cerise Elliott

The NIA's Health Disparities Framework:

A need for research that captures neuropathological process along with environmental, sociocultural, behavioral and other demographic factors that often intersect with race and ethnicity.



Objectives:

- Development of **research infrastructure** and resources for **precision medicine** studies of AD/ADRD in **minority** populations.
- Support **pilot projects** to demonstrate feasibility for future larger-scale projects.
- Support formation of transformative, **multi-disciplinary teams** to address disparities and/or burden, or resilience among minority populations.

Milestones:

1A: Enable precision medicine; ensure efforts include special populations, ethnic minorities and other under-represented groups.

1I: Test early mechanistic pathways of multiple etiologies of AD/ADRD health disparities; move forward potential opportunities for precision medicine.

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Diverse Vascular Contributions to Cognitive Impairment and Dementia (VCID)

https://diversevciducdavis.edu/

To use advanced brain imaging and blood-based techniques to understand how vascular changes in late life cause brain injury and cognitive decline among 750 Caucasians, 750 African Americans and 750 Hispanics.

NOW ENROLLING

PI: Charles DeCarli,
UC DAVIS
UNIVERSITY OF CALIFORNIA

MPI: Myriam Fornage,
UTHealth
The University of Texas Health Science Center at Houston

UC DAVIS UNIVERSITY OF CALIFORNIA

UC San Diego

UT Health San Antonio

UNIVERSITY OF MICHIGAN

Penn

WISCONSIN UNIVERSITY OF WISCONSIN–MADISON

JOHNS HOPKINS UNIVERSITY

COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

University of Kentucky

THE UNIVERSITY OF NEW MEXICO

WAKE FOREST UNIVERSITY

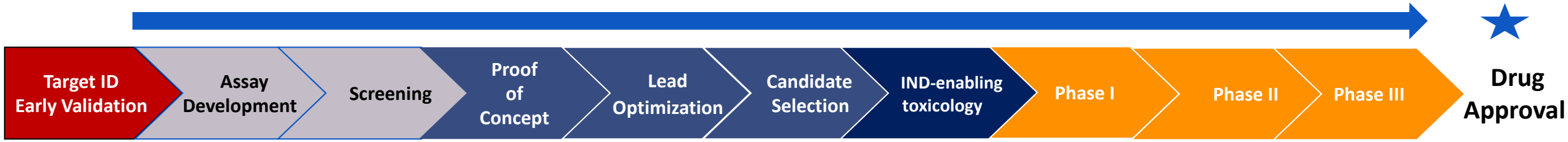
USC University of Southern California

NIH National Institute of Neurological Disorders and Stroke

U19 NS120384

Bridging the "Valley of Death" with A Pipeline of Translational Research Funding Opportunities

NIA Program Directors- Larry Refolo, Suzana Petanceska, Zane Martin Jean Yuan, Kristina McLinden



Discovery of Cell-Based or in vivo Chemical Probes for Novel Brain Targets (R21/R01)

Advancing Basic Neurobiology Toward Translation Through Assay Development (R01)

NEW program!

Drug Discovery for Novel AD/ADRD Target (R61/R33)

Just re-issued!

AD Drug Development ADDP (U01)

Blueprint Neurotherapeutics BPN

Early and Late-Stage Clinical Trials for the Spectrum of Alzheimer's Disease and Age-related Cognitive Decline (R01)

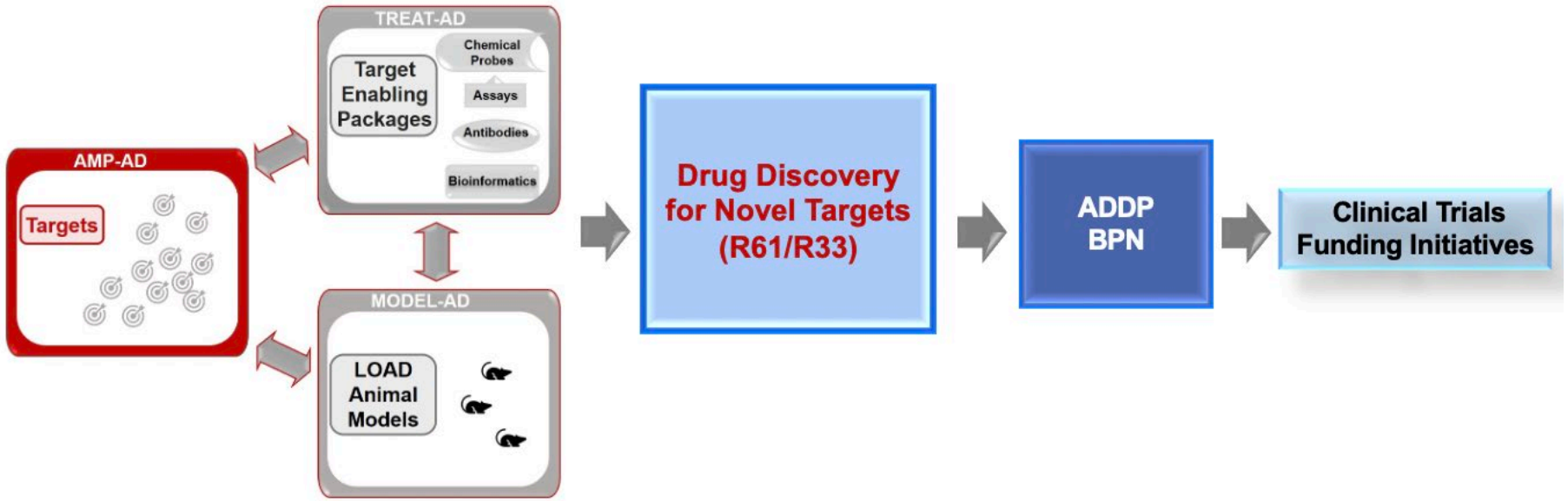
Advancing Research on Alzheimer's and Related Dementias SBIR (R43/44) / STTR (R41/42)

NIH National Institute on Aging

New FOA! Drug Discovery for Novel Targets for AD/ADRD (R61/R33)

NIA Program Directors- Larry Refolo, Suzana Petanceska, Zane Martin

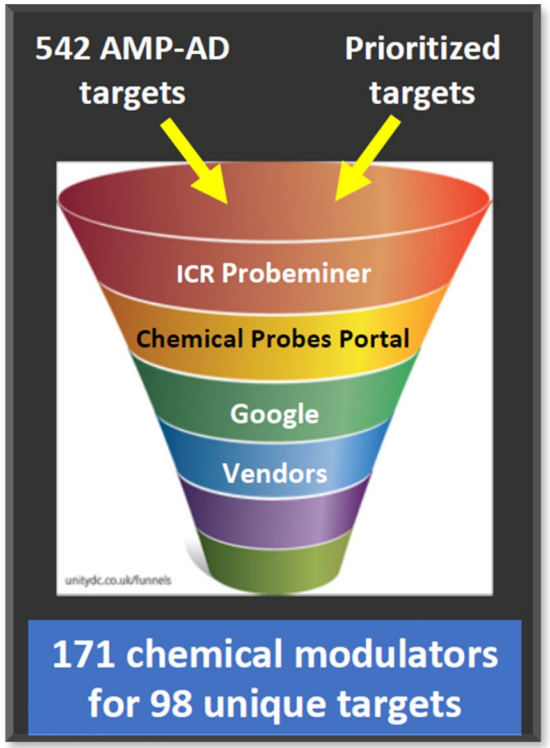
- **Leverage** the NIA investment **in open science discovery programs (AMP-AD, MODEL-AD, TREAT-AD)** to advance novel targets into drug discovery
- **Create a robust** feeder program for the ADDP/BPN preclinical development programs by increasing the number of high-quality, early-stage drug discovery projects for novel targets
- Expand the portfolio of new therapeutic modalities for novel disease-relevant targets
- Enable data-driven, **precision medicine approaches** to AD drug discovery to increase the likelihood of success in



AD Informer Set: Chemical tools to facilitate drug discovery

Current AD Informer Set:

- 171 compounds sourced by UNC:
  - 36 are approved drugs
  - 40 are in clinical trials (Phases 1–4)
  - 68 have advanced into animal-based studies
  - 27 have not been explored beyond cellular studies
- 1–7 compounds per target (98 targets)
  - Ranging from inhibitors, substrates, activators, agonists, or antagonists
- QC'd and registered in laboratory information management system
- Data includes predicted BBB permeability, kinetic solubility measurements, and single concentration (10 μM) results in cell-based assays related to microglial activity.



Uses for the Scientific Community:

- To interrogate target validity in established and emerging AD models
- As positive controls/comparators
- To qualify assays

The AD Informer Set is provided as a single 384-well plate containing 1μL of each compound as a 10mM stock in DMSO. All information about ordering can be found on the AD Knowledge Portal.

TREAT-AD
TaRget Enablement to Accelerate Therapy Development for AD

Potjewyd et al; bioRxiv 2021.07.22.453404; doi: https://doi.org/10.1101/2021.07.22.453404

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NINDS AD/ADRD Current and Planned Funding Announcements: Clinical Trials, Clinical Research and Translation

ANNOUNCEMENT	TITLE
Concept Approved	ADRD, Adverse Childhood Experiences, and **Social Determinants of Health** Ancillary Studies of Existing Longitudinal Cohorts
Concept Approved	**Early-Stage Therapy** Development for ADRD
Concept Approved	Pragmatic Clinical Trials in Community Settings to Decrease or Prevent VCID Outcomes, Including in **Populations that Experience Health Disparities**
Concept Approved	Postmortem Neuropathology, Cellular, and Molecular Analyses, Including Ex-Vivo Imaging, to Assess the Significance of Human TBI and VCID AD/ADRD-Relevant Imaging and Clinical Findings During Life
Concept Approved	**Treatments for Lewy Body Dementias & Frontotemporal Degeneration** - Exploratory Clinical Trial (Related to RFA-NS-21-008)
Concept Approved	**Functional Validation of Novel Targets** in ADRD (Re-issue RFA-NS-19-015)
Concept Approved	**COVID-19 Related Revisions** to NINDS ADRD Human Subjects Cooperative Agreement Programs
PAS-19-316 (NIA leads)	Advancing Research on AD/ADRD SBIR/STTR Programs ***(Clinical Trial Optional);*** **Standard due dates**
PAS-19-317 (NIA leads)	Advancing Research on AD/ADRD SBIR/STTR Programs ***(Clinical Trial Optional);*** **Standard due dates**

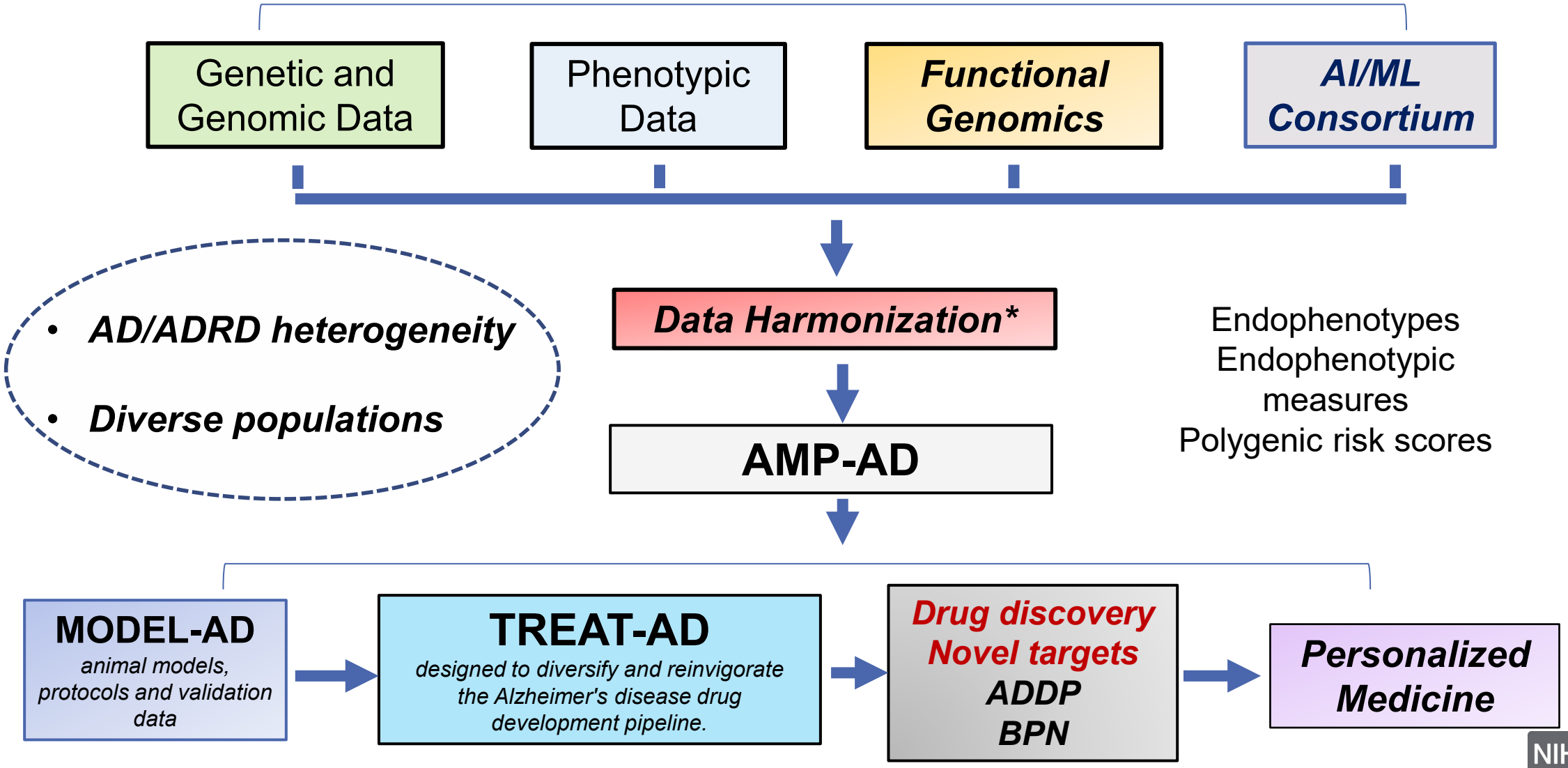
14 NINDS ADRD funding initiatives are planned for FY 2023, for more information see:
https://www.ninds.nih.gov/Current-Research/Focus-Disorders/Alzheimers-Related-Dementias

No RFA is needed to apply!! NINDS special AD/ADRD payline for investigator-initiated research applications to NIH Parent R01 and NINDS R21 (PA-21-219)

Translating AD genomics data to personalized medicine

NIA Program Directors: Marilyn Miller, Alison Yao, Jennie Larkin, Damali Martin, Dallas Anderson

ADSP, ADRC's, Biomarkers and Epidemiology programs

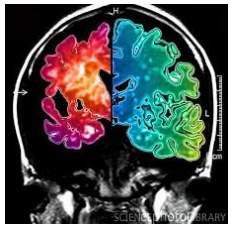


THANKS

Concept Approvals:
https://www.nia.nih.gov/approved-concepts

General FOAs:
https://www.nia.nih.gov/research/funding

Alzheimer's Disease and Related Dementias FOAs:
http://www.nia.nih.gov/AD-FOAs



NIA- Division of Neuroscience
https://www.nia.nih.gov/research/dn

NIH National Institute on Aging