Artificial Intelligence and Technology for Aging: Insights from the Johns Hopkins AITC

Engineering Innovations to Change Aging

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“Why wasn’t I told earlier?”

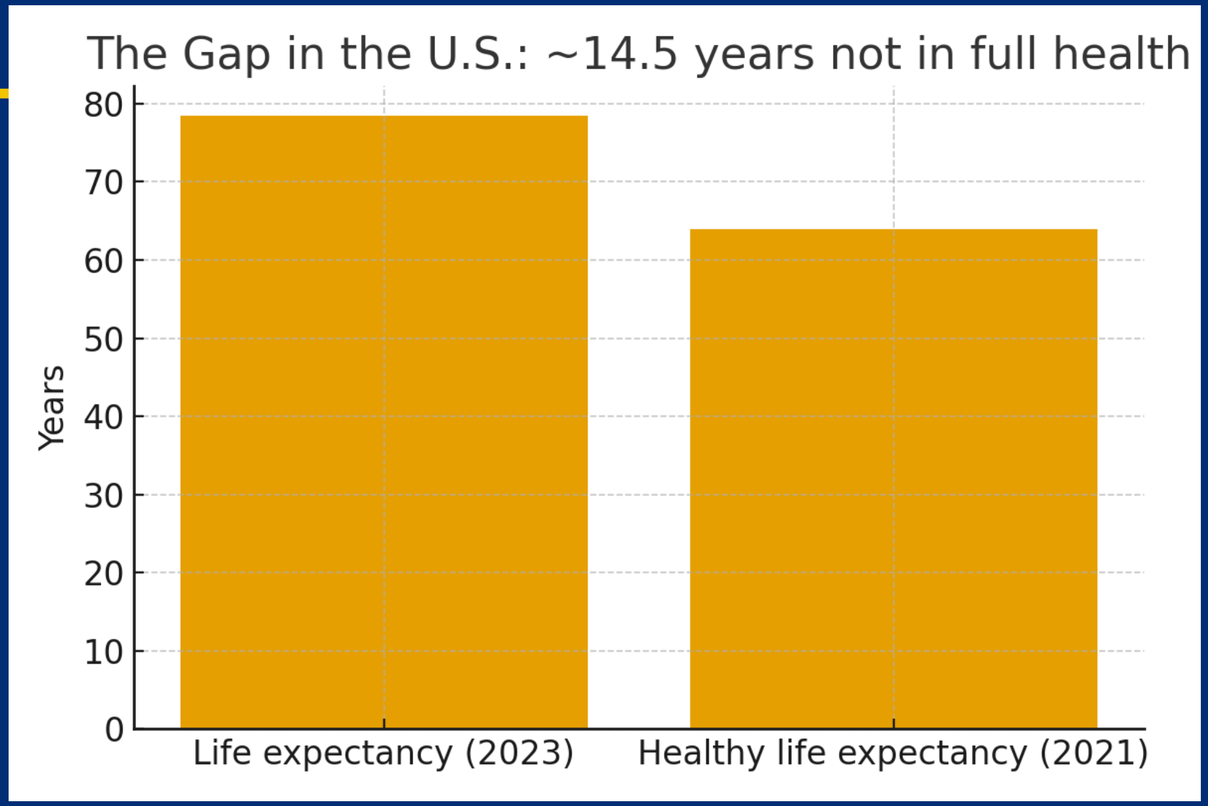
A professor shared:

“A few months ago, I fell. My PCP assessed me and referred me to PT. Since then, I haven’t had any more falls. Why couldn’t my PCP warn me earlier?”

- Clinical reality: short visits and many competing priorities
- Clinic tests (gait, balance, cognition) are intermittent and often coarse snapshots
- Early changes in mobility and cognition can be subtle and fluctuate over days/weeks
- Net effect: risk is hard to recognize early enough to prevent the first serious fall

Closing the Healthspan–Lifespan Gap

- U.S. life expectancy: 78.4 years (2023)
- U.S. healthy life expectancy: 63.9 years (2021)
- **Implication: ~14.5 years lived with significant morbidity/disability**



Closing the Healthspan–Lifespan Gap

- By 2030, ~1 in 5 Americans will be aged 65+
- Complex multimorbidity, frailty, cognitive decline → heavy clinical and caregiver burden
- We need scalable ways to detect risk early and intervene before crisis

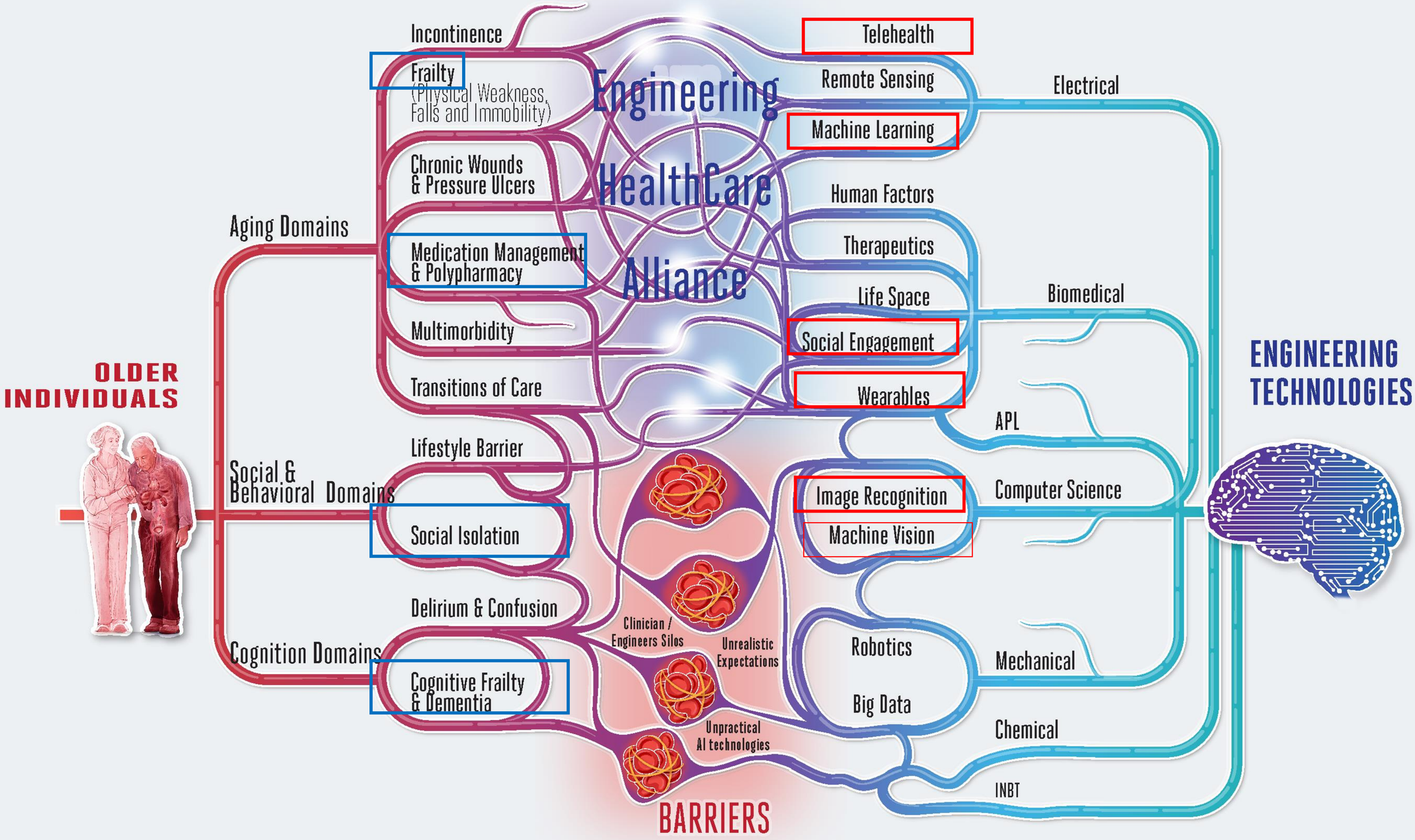
Johns Hopkins Intelligence and Technology Collaboratory (AITC) For Aging Research

Three awarded in the U.S. (JHU, UPenn and UMass)

$20 Million Total Awarded to JHU to **Develop new uses of AI and Technology that improve the health and** function **of older adults**

Over 900 **Unique Proposals** received **from Around the US**, 129 of which were selected for funding.

Opportunities JHU AITC Solutions



CLIN TRANSLATION AND VALIDATION
Drs. Abadir and Chellappa

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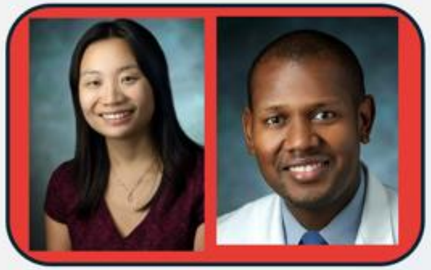
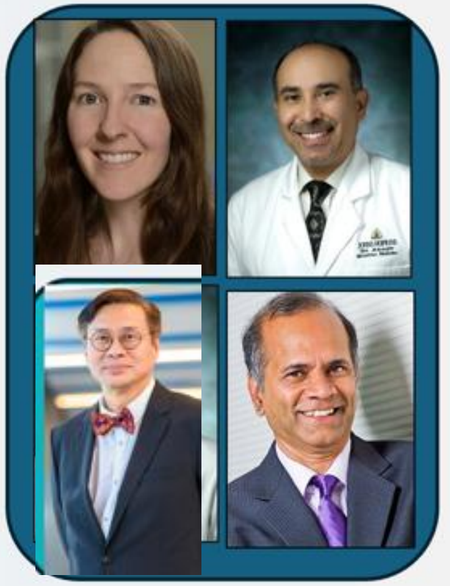


KEYSTAKE HOLDERS ENGAGEMENT
Drs. Schoenborn and Cudjoe

6

PILOT CORE A (Dementia)
Drs. Oh, Dehak and Samus



PRINICPAL INVESTIGATORS
Drs. Abadir, Battle, Walston and Chellappa

2

DATA QUALITY & INTEGRITY
Dr. Chris Chute

3

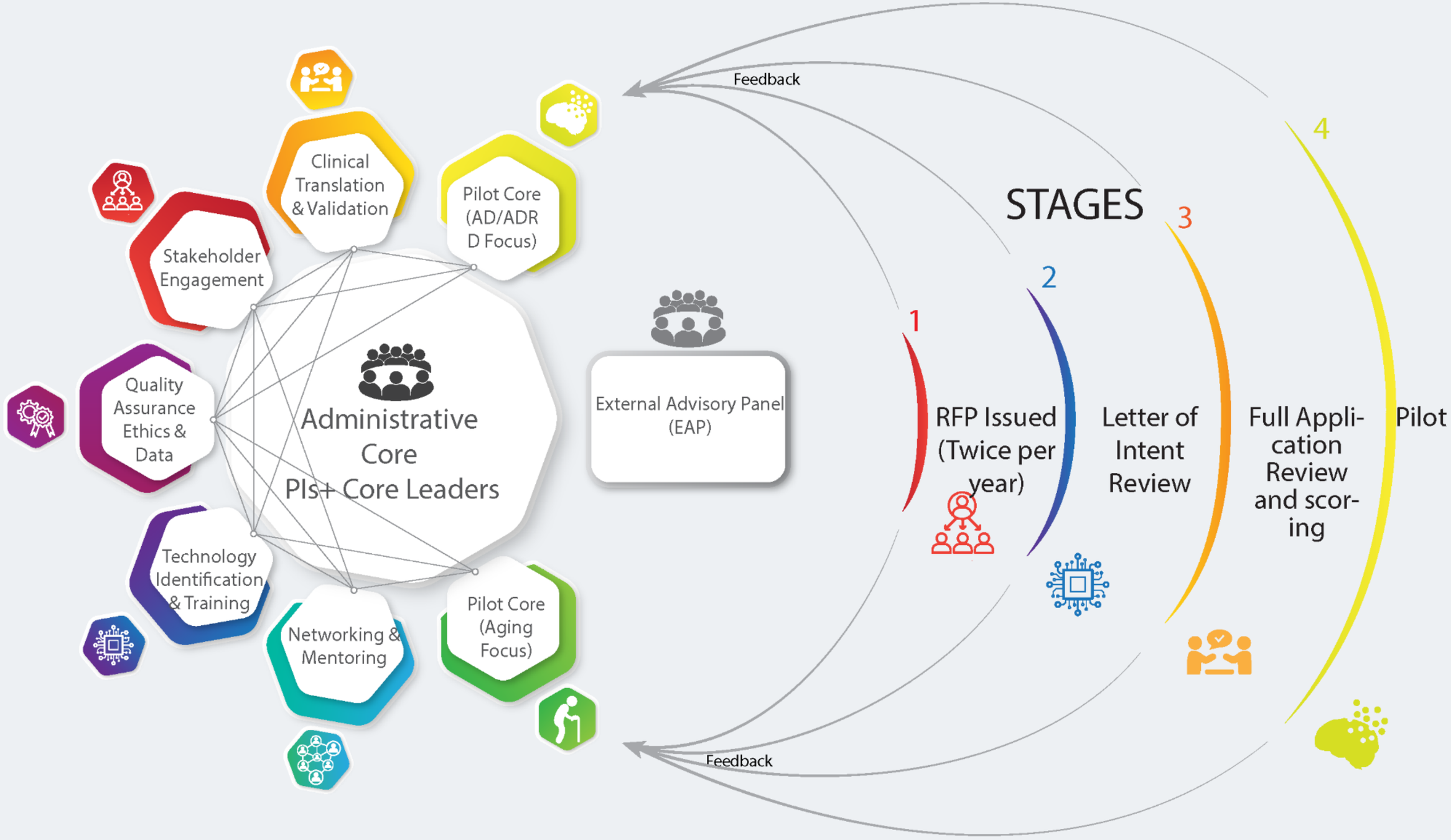
TRAINING & TECH IDENTIFICATION
Drs. Arbaje and Unberath

5

PILOT CORE B (Aging)
Drs. Schrack, El-Hilali and Walston

4

NETWORKING & MENTORING
Dr. Phil Phan


Clinical Translation & Validation
Pilot Core (AD/ADRD Focus)
Stakeholder Engagement
Quality Assurance Ethics & Data
Technology Identification & Training
Networking & Mentoring
Pilot Core (Aging Focus)
Administrative Core
PIs+ Core Leaders
External Advisory Panel (EAP)
Feedback
Feedback
STAGES
1
RFP Issued (Twice per year)
2
Letter of Intent Review
3
Full Application Review and scoring
4
Pilot

ZOOM Interview for Top Scoring Applicants

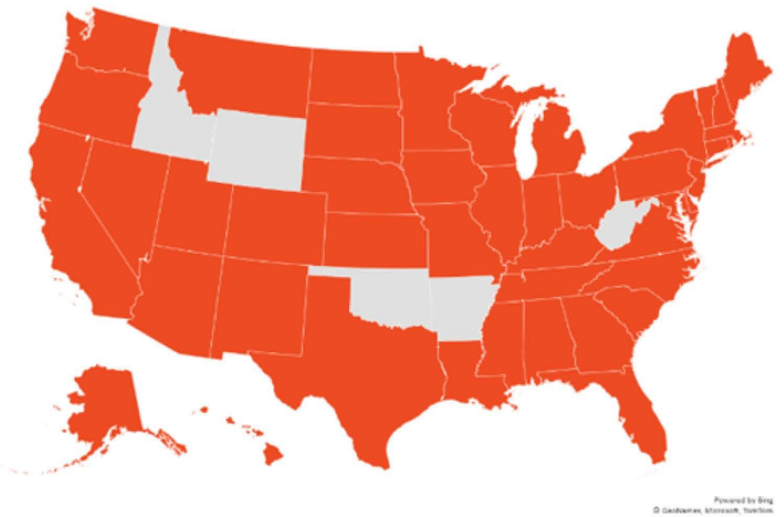
- Key points of discussion: Explanation of the project and its aims.
- Details of the technology to be used and the envisioned final product.
- Participant criteria and numbers, IRB plans.
- Utilization of AITC resources, commercialization progress, and funding sources for the first milestone.

Post-Funding Review Categories for Grant Applicants

- **Commercialization Aspects of Product/Prototype Development** Focus on commercialization milestones, MVP(minimum viable product) readiness, tech validation, and scalability.
- **Data Sharing Considerations** as well as assessment of leadership structure, team cohesion, diversity, and capacity to execute. |
- **Intellectual Property concerns:** Evaluation of potential for IP, patient outcomes, regulatory pathways. |
- **Ethical Review of the application and approach**. |

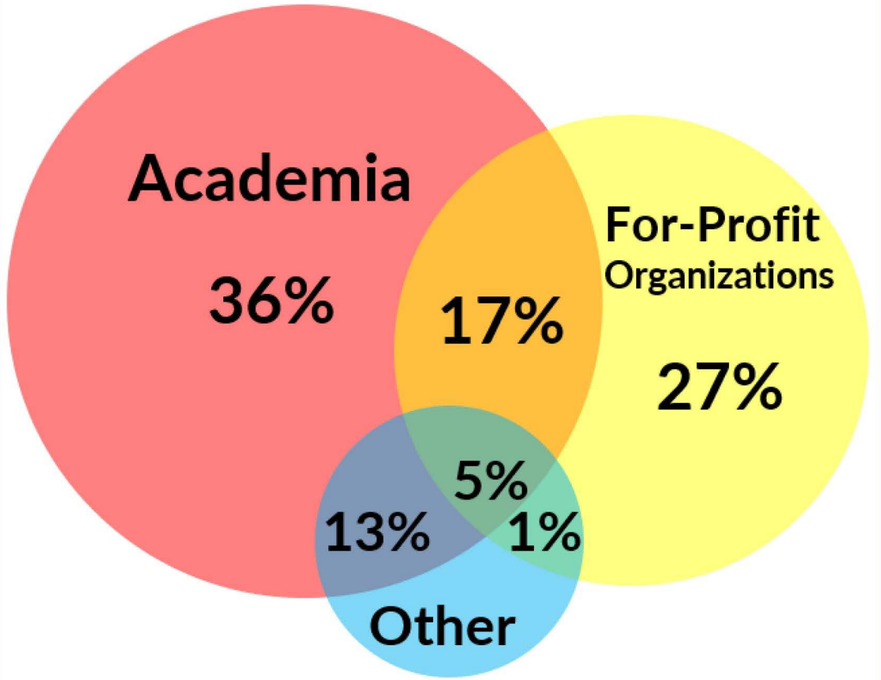
NATIONAL AND CROSS-SECTOR COMPETITION

Applicant Locations, FY2022-24



N = 45 states and Washington, D.C., Puerto Rico, and the U.S. Virgin Islands

Composition of Pilot Teams, FY2022-24



Predicting Adverse Events from Sovrinti In-Home ADL Sensing

AREA OF NEED: The need to identify rising health risks in Aging individuals to enable interventions before the issue becomes acute.

OPPORTUNITY: Develop and test, change models that use in-home ADL sensors to identify and predict rising risk of acute conditions in Aging individuals.

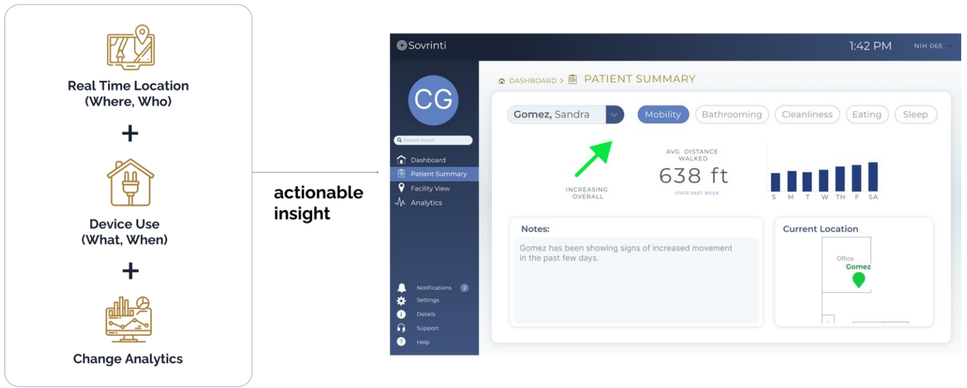
DATA: From recently completed NIA study: 117 ADRD Caregiver-Care recipient dyads with an average of 12 months of in-home sensors data and coincident monthly ADCS surveys and health conditions information. 800 reported health incidents

TECH APPROACH: Leverage real time location and device utilization data to identify behavioral anomalies associated with described incidents. Utilize various ML/AI techniques to develop a predictor of acute conditions from sensor data.

PI(s): John Fitch

COHORT: GY1

AI/ML Based ADL Change Detection



RetreatVR – A Senior Wellness Tool

AREA OF NEED: Mitigating senior loneliness through Virtual Reality

OPPORTUNITY: Develop, test, and implement shared immersive experiences to enhance social interaction

DATA: Correlation study analyzing the correlation between the level of engagement with RetreatVR and the level of social engagement

TECH APPROACH: Designed and developed a senor-friendly VR platform that included immersive and interactive 3D experiences to tap memories and encourage social interaction

PI(s): Ellie Giles

COHORT: GY1

Enjoying Immersive experiences

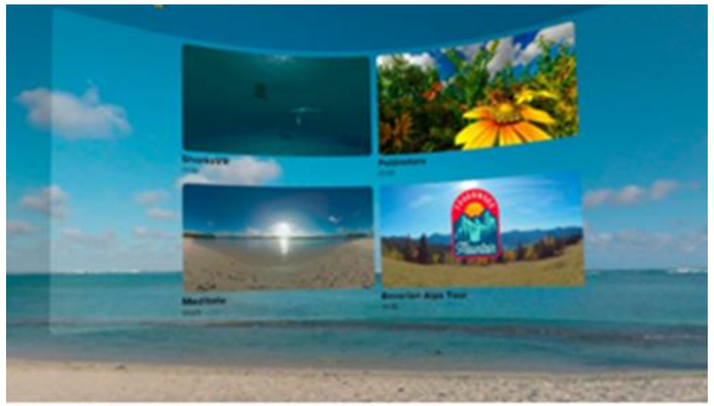


Figure 1: Eye-gaze-activated menu

Robot + AI-based Facial Expression Analysis to Detect Agitation in Persons with AD/ADRD

AREA OF NEED: Physical and verbal agitation, found in 80% of nursing home residents with AD/ADRD, can pose a major problem for the resident and their family and professional caregivers. The inability to successfully manage dementia behaviors often results in increased burden on caregivers, use of physical restraints, and/or pharmacological interventions. Use of antipsychotic and psychotropics medications increases the risk of death and of falls and fractures in patients with dementia.

OPPORTUNITY: Integrate an AI-based facial expression analysis software on an autonomously navigating robot to test and validate that it can detect agitation in nursing home residents with dementia. The ultimate goal is to use this information and the robot to deliver non-pharmacological interventions to reduce agitation.

DATA: Collecting comprehensive raw data of facial expressions of 10 nursing home residents with dementia known to be agitated during three days of simultaneous observations twice per hour for 13 hours per day by the robot and two research assistants.

TECH APPROACH: Using the ability of the autonomously navigating robot to come to a resident's room in a nursing home as frequently and for as long a time as necessary, and through its video camera capture facial expressions and use the facial expression analysis software to analyze the images and validate that a signal can be seen when a resident is agitated as determined by the research assistants.

PI(s): Yuval Malinsky, MD

COHORT: GY1

Visilant: Equitable Access to Eye Care Through Telemedicine and Artificial Intelligence

AREA OF NEED: Lack of access to cataract screening prevents disadvantaged populations from seeking care, leading to disease progression, functional limitations, and worse outcomes

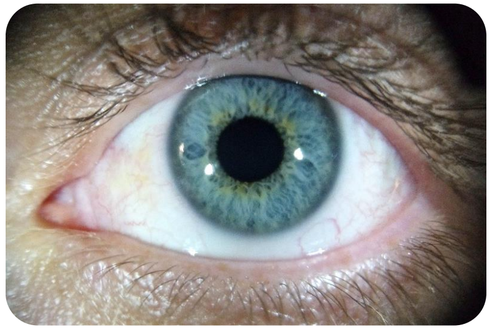
OPPORTUNITY: Develop a simple and inexpensive anterior segment imaging and telemedicine system to allow for remote eye screening facilitated by non-ophthalmologists

DATA: Project will build a database of at least 2,200 images of eyes with no cataract, immature cataract, and mature cataract and validate a diagnostic AI algorithm in 100 patients against a gold-standard exam

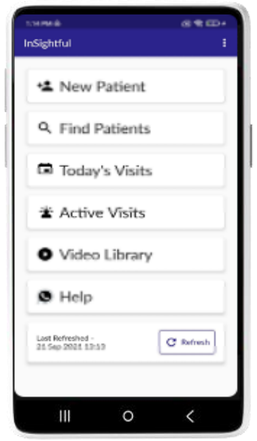
TECH APPROACH: Visilant system includes a mobile app with AI and telemedicine capabilities, a proprietary smartphone attachment for ocular imaging, and a patient management dashboard and provider portal. The ML approach uses eye segmentation, classification with a CNN, and domain adaptation technique to mitigate bias.

PI(s): Kunal Parikh, PhD
Nakul Shekhawat, MD, MPH

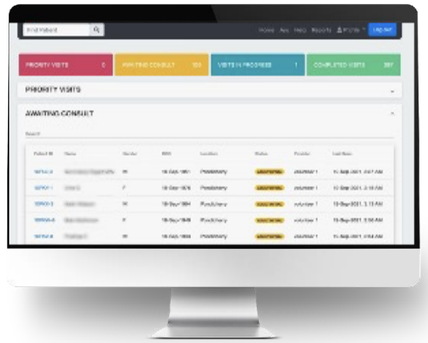
COHORT: GY1



Proprietary smartphone attachment for simple, high quality anterior segment imaging



Mobile app with AI and telemedicine capabilities



Patient management dashboard and provider portal

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Enhancing Slow-Wave Sleep in Older Adults

Sequoia

AREA OF NEED: Growing prevalence of dementia in older adults highlights a pressing need for early-stage therapies. Specifically, there's a noticeable gap in therapies targeting the underlying pathology of sleep disruptions in patients experiencing cognitive challenges.

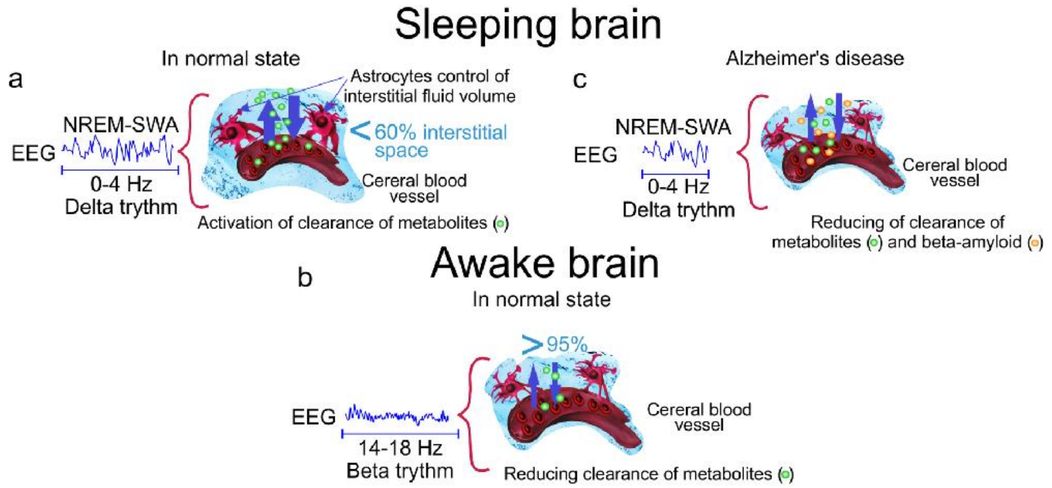
OPPORTUNITY: To take a lab-based technique, which modulates critical brain oscillations, and translate it into a non-invasive wearable technology for everyday at-home use. This technology would focus on enhancing slow wave sleep using closed-loop neuromodulation.

DATA: Collecting comprehensive sleep EEG data, from 20 older adults totaling 150 nights of data.

TECH APPROACH: The key lies in precision. By employing sound as the medium, our closed loop technology is designed to deliver precise stimulation, aiming to optimize oscillations during deep sleep, thereby enhancing its restorative effects on cognition.

PI(s): Joshua Blair, MS
Spencer Shumway, MS
Youseph Yazdi, PhD

COHORT: GY1



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Feasibility and Acceptability of a Robotic Assistant for Early-Stage ADRD Care

CASE WESTERN RESERVE UNIVERSITY
Weatherhead School of Management

AREA OF NEED: The aging population and increasing prevalence of Alzheimer's Disease and Related Dementias (ADRD) pose challenges for caregiving, as staffing shortages and costs limit access to consistent, high-quality support. Robotic assistants may help by enhancing safety, independence, and social engagement for older adults living alone, whether in private residences or within assisted-living settings.

PROJECT GOAL: Evaluate feasibility and acceptability of a prototype robotic aid from NaviGAIT Inc. for individuals with early-stage ADRD through real-world deployments, stakeholder input, and mixed-methods analysis.

METHODS: Gathering qualitative and quantitative data through focus groups, supervised short visits, and extended overnight placements of the robotic assistant in residents' homes, along with insights from family caregivers and professional staff.

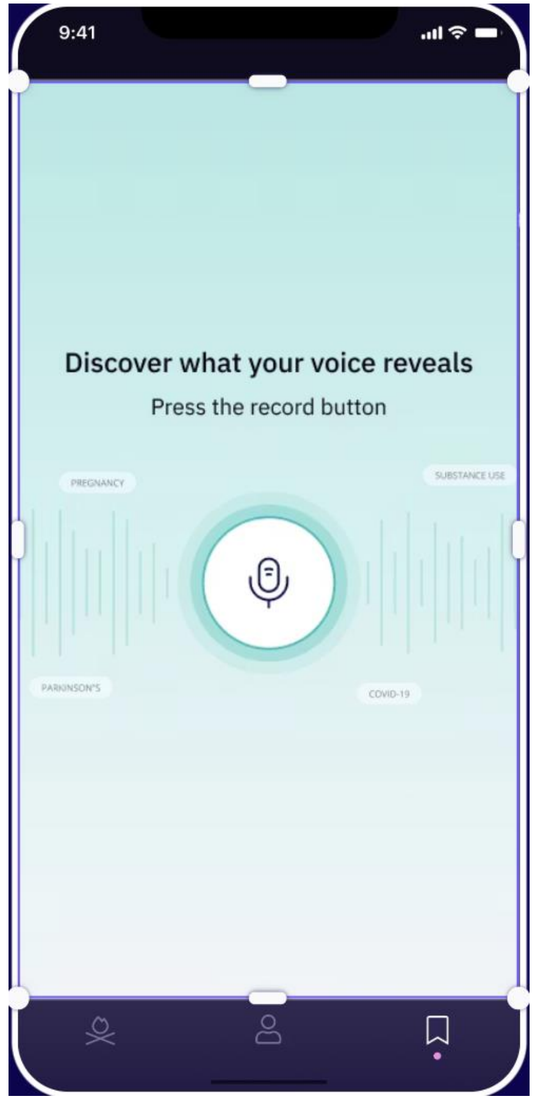
IMPACT: Assessing robotic capabilities in real-world environments, including monitoring, reminders, and social engagement. Developing an evaluation framework to guide the design of robotic technologies that support aging in place.

INVESTIGATORS: Philip A. Cola, Peter Whitehouse, and Stefan Agamanolis

COHORT: GY4

Acceptability of Voice Clones in Agents for Aging Adult Wellness Monitoring

AREA OF NEED:	Familiarity in caring for the elderly population is of paramount importance. The ability to provide consistent interaction results in improved outcomes, but time is limited for most caregivers.
OPPORTUNITY:	The goal of this study is to understand how Virtual Agents, including Voice Clones, can enhance digital interactions for older adults.
DATA:	Collect survey data from participant who experience interactions with voice clones of someone close to them with a reflection on their well being
TECH APPROACH:	Utilize generative AI technologies to create voice clones of caregivers/loved ones to study impact on participants.
PI(s):	Amit Mehta, MD Camille Noufi, PhD
COHORT:	



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Frailty subtyping to identify paths to healthy aging

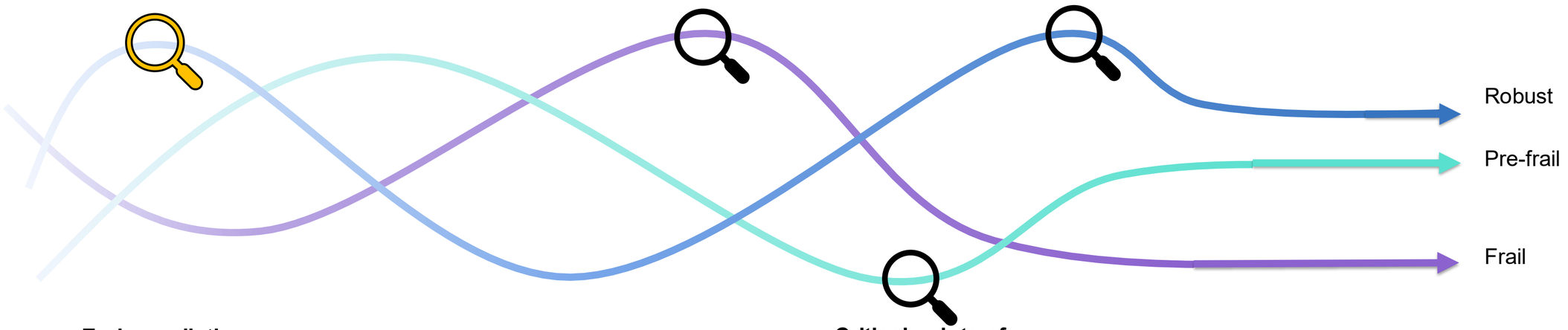
Area of Need: Everyone experiences aging uniquely, however we model frailty uniformally. A tailored approach to modeling frailty will facilitate the identification of personalized interventions to promote healthy aging.

Opportunity: In collaboration with the Rush Alzheimer's Disease Center, we have access to longitudinal data on over 5,000 individuals capturing aspects of their physical, cognitive, and social wellbeing over time.

Approach: We will develop an AI model to identify and predict frailty subtypes and characterize them macroscopically and molecularly. Clinicians may use our model to guide people toward a healthier state.

PI: Dr. Rebecca Keener

Cohort: GY4



A Novel Insole Solution Used in Daily Life to Identify and Mitigate Falls and Frailty

AREA OF NEED: Need for real-time data providing insight in how to treat or track fall risk. Falls are associated with immobility, mortality, and decreased independence; 1 of 4 individuals over 65 years old suffers a fall each year.

OPPORTUNITY: Validate a new portable pressure sensing insole technology, enabling more efficient and effective collection of clinically relevant balance data to predict and treat falls in the elderly.

DATA: Collect gait and balance data from 50 individuals > 50 years old and compare insole data to gold standard. Conduct focus groups to validate usability of data.

TECH APPROACH: AI algorithms will be used to develop fall risk classification models utilizing insole data and gold standard parameters. The data will be utilized to develop a protocol for remote therapeutic monitoring to assist in the prevention of falls.

PI(s): Linda Denney, PT, PhD, MAppSc (Manip)
Dan Peterson, PhD

COHORT: GY2

Smartphone-Based Fall Prevention Therapy and Monitoring for Older Adults

AREA OF NEED: Falls are among the greatest threats to healthy aging. Fall-prevention physical therapy programs may be effective, but suffer from limits in accessibility, scalability, and personalization.

OPPORTUNITY: Develop, validate, and test automated delivery of balance assessments and fall prevention exercises using the Brightway PT mobile application.

DATA: Collecting movement data for balance assessments and fall prevention exercises, as well stakeholder input and user testing.

TECH APPROACH: Leverage computer vision models on the Brightway PT platform, validate with laboratory-grade motion analysis, and prototype personalized real-time feedback for automated support to users.

PI(s): Dennis Anderson, PhD (BIDMC)
Yannick Coehn (Brightway Health)

COHORT: GY3

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Leveraging Conversational AI to Detect Cognitive Impairment and Dementia in the Home

WellSaid.ai

AREA OF NEED: Few validated, scalable approaches to early detection of AD/ADRD exist, limiting potential to introduce targeted pharmacologic and lifestyle interventions

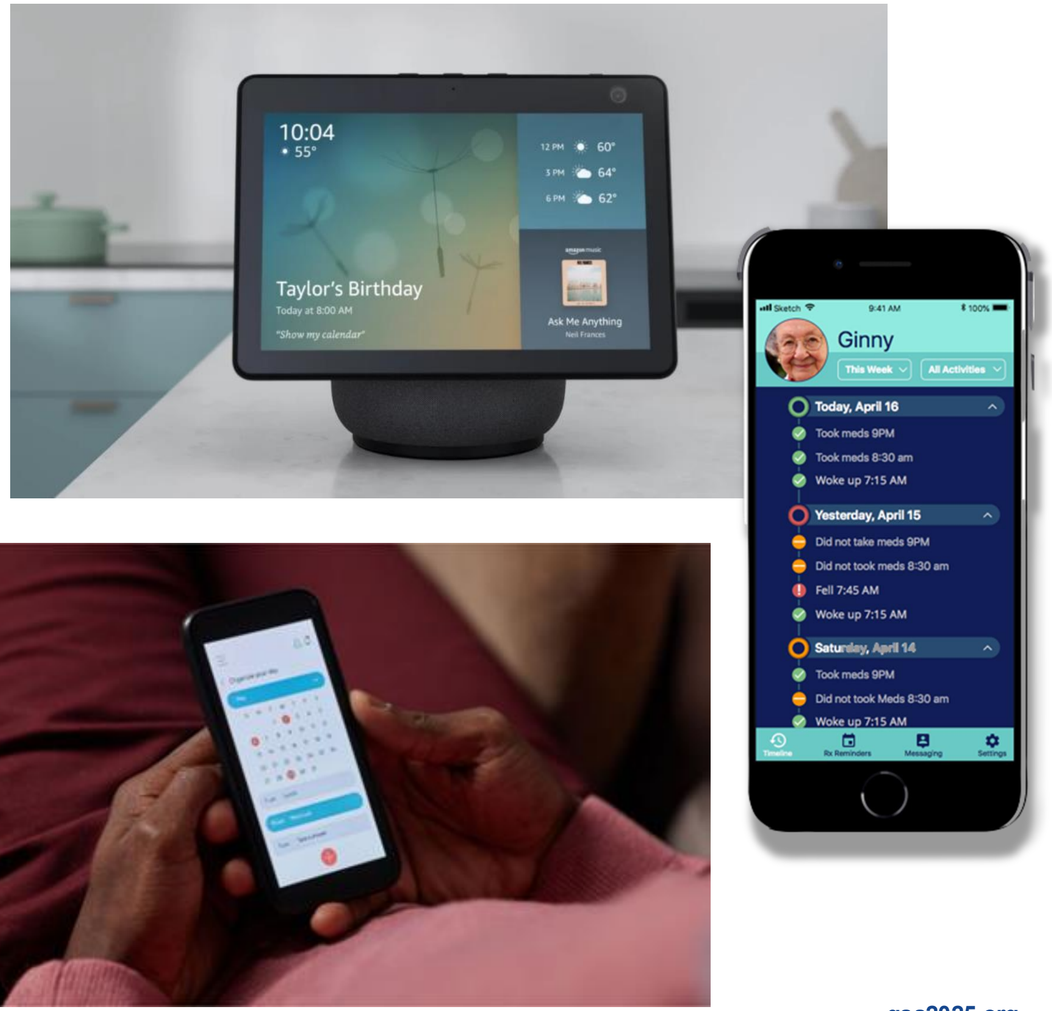
OPPORTUNITY: Develop, test, and validate machine learning models that use conversational AI to identify and accurately predict the cognitive status of older adults at home

TECH APPROACH: Leverage consumer-friendly voice assistant technologies (e.g., Amazon, Google) equipped with scientifically validated, clinical-grade cognitive assessments and a personalized digital coach to provide and coordinate support

DATA: Collecting comprehensive cognitive assessment data, including raw audio data, from 160 patient-caregiver dyads

PI(s): Randall Williams, MD

COHORT: GY1



Automatic Assessment of Neuropsychiatric Symptoms Using Non-Intrusive Contactless Ambient Intelligence Technologies

AREA OF NEED: Neuropsychiatric symptoms (NPS) in dementia patients are often missed due to subjective assessments based on clinician observation and caregiver interviews. Accurate methods for assessing and monitoring NPS are urgently needed.

OPPORTUNITY: With better detection of not only NPS, and the more pervasive Mild Behavioral Impairment, there is potential to improve care and optimize the quality of life for patients at risk of MCI and AD.

DATA: We are recruiting participants with a history of behavioral changes and installing sensors in their homes to monitor their NPS for up to 90 days.

TECH APPROACH: We will develop a Computer Vision NPS Assessment (CVNA) system using ambient intelligence to provide objective and personalized detection of NPS subsyndromes across the preclinical and clinical spectrum of dementia. To quantify NPS, we adopt the Mild Behavioral Impairment Checklist (MBI-C).

PI: Ehsan Adeli, PhD
Co-Is: Christine Gold, PhD; Vankee Lin, PhD, RN

COHORT: GY2

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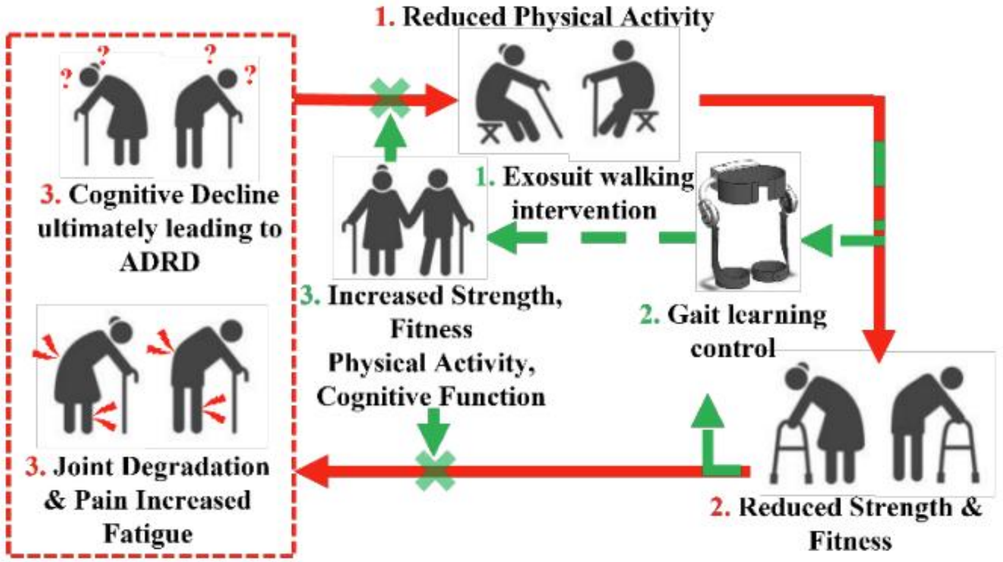
Picasso Intelligence: Improving Mobility for Dementia Alleviation in Older Adults via AI-Powered Affordable Exosuits

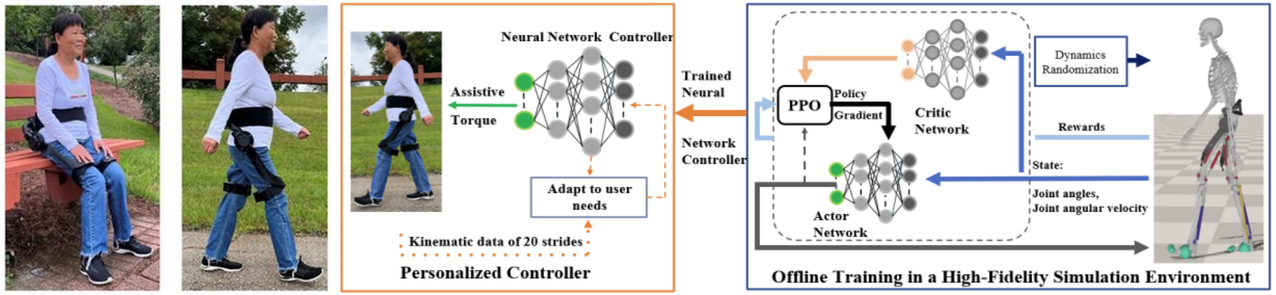
AREA OF NEED: Reduction in physical activity have detrimental effects on the health of older adults as it initiates a cycle of declining health which increases the risk of Alzheimer's disease and related dementias (ADRD)

OPPORTUNITY: Leverage lightweight and affordable exosuits in concert with learning-based personalized control to promote physical activities in everyday settings and ultimately decrease the risk of cognitive decline which leads to dementia in older adults.

DATA: Analysis will be on data collected in human studies in community settings involving 20 older adults aged 65+ over 9 visits.



TECH APPROACH: Deep reinforcement learning framework with the actor-critic method and high-fidelity musculoskeletal modeling method to automatically train the exosuit controller to generate continuous assistive torque during versatile activities common in community settings



PI(s): Chien-Ming Huang, PhD Hao Su, PhD, Junxin Li, PhD

COHORT: GY2

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Thank You