

Artificial Intelligence for Health Equity and Diversity (AIHED)

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CUNY School of Medicine	The City College of New York	Division of Science	The City College of New York	Grove School of Engineering	The City College of New York
Colin Powell School for Civic and Global Leadership		The City College of New York		Spitzer The Bernard & Anne Spitzer School of Architecture The City College of New York	

Faculty Members – Team 1 (AIHED)

Faculty Name	Expertise Critical in Project (up to 2)
Ashiwel Undieh, Team Lead	Leadership; Medical and epigenomics data
Victoria Frye, Core A Lead	Social determinants of health; Electronic health records (EHR)
Jie Wei, Core B Lead	AI Software applications; Medical computing
N. Madamopoulos, Core C Lead	Hardware device development; Photonics sensors
Karen Hubbard, Core D Lead	Community linkages; Community participatory research
Ahu Aydogan	Environmental determinants of health (EDOH); Air quality and health
Akira Kawaguchi	AI Software applications; Augmented reality
Bingmei Fu	AI image processing; AI-assisted disease diagnosis
Bruce Kim	Microelectronics; Wearable sensors
Kevin Foster	Economic determinants of AI deployment; Cost-benefit analysis
Noel Manyindo	Social determinants of health; Community linkages
Reza Khanbilvardi	EDOH; Environmental surveillance data acquisition
Sang-Woo Seo	Hardware development; Physical sensors and actuators
Zhigang Zhu	Data engineering; Multimodal analytics

Framing Question

TEAM 1: AI for Health Equity and Diversity

How might individual and community health improve if wellness and healthcare delivery were infused with inclusive and equitable Artificial Intelligence (AI) technologies?



Artificial Intelligence for Health Equity and Diversity

Problem Statement:

- AI's Contingencies: As foundation of the 4th IR, AI is being embedded into nearly every aspect of life with the potential for spectacular or disastrous outcomes.
- AI for Health: Rapid growth of health-related data (HER, PDAs, SEDOH) has increased opportunity for AI development to improve individual and community health.
- Lacking data diversity: Current AI systems lack validated input data on diverse populations, utilize opaque algorithms, generate outputs that lack inclusivity, or propose inaccessible apps and devices.
- Lack of personnel diversity: Abject lack of diversity among AI researchers could further accentuate the risk of creating and perpetuating harmful biases in AI algorithms.
- CCNY should Lead in Equitable AI: CCNY can leverage the potential of AI to accelerate medical innovation and lead the nation in developing and deploying equitable AI technologies to improve wellness and healthcare for New Yorkers and beyond.

Objectives

Using data from EHRs and SEDOH, AIHED research will uncover strategies and prototypes for equitable AI use in health by addressing the following objectives:

- **Objective 1: Data**

Collect EHR/SEDOH data to develop workflows for diversifying and de-biasing health data and data collection pipelines to promote engagement of disparate communities in AI research.

- **Objective 2: Algorithms**

Generate use-case algorithms to characterize parameters of inclusive and transparent algorithm development for driving AI subsystems and microdevices aimed toward medical and wellness applications.

- **Objective 3: Devices**

Design and prototype a cardiovascular diagnostic/monitoring device to demonstrate principles for developing portable and inclusive AI-driven medical devices using neuromorphic photonic strategies and computing tools.

Outreach activities to engage the community as participants in research conception, data collection, and product deployment will be embedded in all objectives.

Intellectual Merits and Broader Impacts

■ Intellectual Merits

1. AI is creating landscape changes in broad fields and processes due to advances in capabilities of hardware, ML/DL algorithms, and data sources.
2. The expanding AI revolution is yet to substantially impact the health of New York residents, particularly UR communities.
3. AIHED teams CCNY researchers in AI, medical science, and SEDOH, to build cohesive capacity and demonstrate the feasibility of equitable AI technologies.

■ Broader Impacts

1. Formulated workflows for inclusive curated debiased multimodal data for health AI
2. Created electronic design automation tools to help harness EHR, SEDOH, and other health data toward improved health applications
3. Prototyped strategies for innovative device design to equitably impact CV health.
4. Built CCNY's capabilities and infrastructure for AI research for health, education, etc.

Technical Approach

▪ Core A: Data sourcing, curation and pipelining

Faculty: Frye (Lead); Aydogan, Akira, Fu, Foster, Manyindo, Khanbilvardi, Zhu, Wei

- **Premise:** AI systems can be “biased” based on the system design as well as the diversity, quality, range, and coding of data fed into the system.
- Develop data streams and use-cases relating to bias elimination
- Explore new data hypotheses such as the “serial dilution” approach to feeding training data into AI
- Develop use-cases on the efficacy of remediation efforts
- Explore multimodal data integration from individuals, patients, and diverse communities for predictive or diagnostic decisioning.
- Explore, develop, validate and disseminate strategies for standardizing the collection, labeling, and use of AI training data, focusing on eliminating biases that could foster or perpetuate disparities.

Technical Approach

- **Core B: Algorithm development and adaptation to address equity considerations**

Faculty: Wei (Lead); Kawaguchi, Fu, Kim, Seo, Zhu

- **Premise:** Brains of AI are algorithms that process data (human-prescribed code) and labels that interpret outputs (human-provided dictionary). Humans determine AI ethics.
 - Develop use-cases based on diversified and debiased EHR and SEDOH data (from Core A) for disease diagnosis, patient stratification, and treatment planning.
 - Develop use-cases based on indoor air quality data to examine efficacy of remediation strategies
 - Strengthen institutional capacity in multimodal medical data analysis, and genomics.
 - Test AI improvements afforded by neuromorphic photonic technologies (Core C)
 - Characterize and disseminate parameters of inclusive and transparent algorithm development for driving AI subsystems and microdevices aimed toward medical and wellness applications.

Technical Approach

- **Core C: AI device development for inclusivity from design to prototyping**

Faculty: Madamopoulos (Lead); Kim, Seo, Zhu, Wei, Undieh

- **Premise:** Core technology, design efficiency, and business interests are major factors driving affordability of AI engines, apps and devices.
 - Develop framework for preference of photonics over all-electronics solutions
 - Develop a first-of-its-kind hand-held multimodal medical sensing device (Laser Doppler Vibrometer) to enable low-cost fast data acquisition of CV vital signs.
 - Design basic framework for photonic neuromorphic computing using data (Core A) and algorithms (Core B) to validate the design functionalities, sub-nanosecond latencies, and specifications for future photonics-based neural networks.
 - Demonstrate principles for developing inclusive medical devices that are accessible, affordable, fit-for-use, and usable with individuals from diverse backgrounds.

Technical Approach

▪ Core D: Community outreach and participation

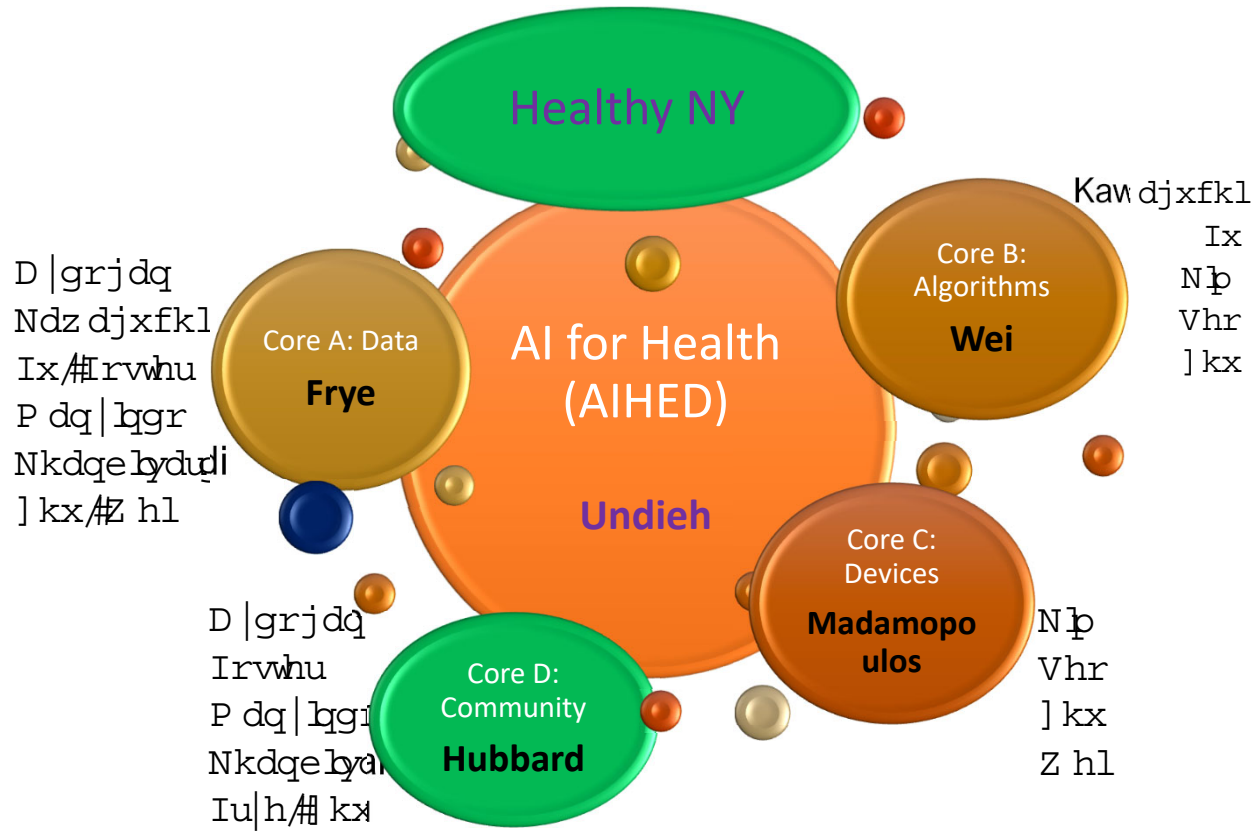
Faculty: Hubbard (Lead); Aydogan, Foster, Manyindo, Khanbilvardi, Frye, Undieh

- **Premise:** The ideas, challenges and aspirations of marginalized communities can inform innovative and inclusive technologies that are nevertheless profitable.
 - Recruit key stakeholders from representative NY communities to contribute input into key conception and implementation efforts of each AIHED Core.
 - Establish a Community Advisory Board and conduct community consultation meetings for exchanges on issues of interest or concern related to AI in health.
 - Undertake designed studies on community perceptions of AI and health disparities and identify best practices in communication of our research and applications.
 - Overall, linking scientists with clinicians and diverse communities could help to uncover software and hardware strategies for expanding the benefits of AI for improved health and wellbeing for New Yorkers and beyond.

Team Milestones

Milestones	Deliverables	Due
1. AI Data: Procure, curate and pipeline data for health AI training	1. Procure access to EHR and SEDOH data, delineate test variables	1/31/23
	2. Examine strategies for data diversification, bias reduction/elimination	6/30/23
	3. Formulate workflows for data diversification, debiasing, standardization	8/31/24
2. AI Algorithms: Develop and adapt health AI algorithms to address equity considerations.	1. Design, develop AI/ML algorithms prioritizing health equity & inclusion	8/31/23
	2. Use debiased/diversified data to test AI/ML algorithms showcasing feasibility of equity-enhancing strategies	8/31/24
	3. Validate, adjust, adapt apps with more data and use cases, test initial online deployments	8/31/25
3. AI Devices: Design and prototype an AI device for diverse, inclusive and accessible deployment to improve cardiovascular health and wellness.	1. Photonic Integrated Circuit Design, modeling and simulation	8/31/23
	2. Create initial lab prototype based on bulk/fiber-optic components with AI-enabled functionality	8/31/24
	3. Prototype Photonic Integrated Circuit LDV for “closed course” trials	8/31/25
4. Summation	Write reports, manuscripts, presentations and grant proposals	8/31/25

Team Qualifications



Management Plan

Core elements of the AIHED management plan are as follows:

- The **Research Team** (Team) consists of 14 faculty across six CCNY Schools
- Policy decisions are made by the team as a whole.
- Work is done at the **Core** Level, coordinated by a Core Lead
- Cores report to the Team during regular Team meetings
- The **Executive Committee** comprised of the PI and Core Leads are responsible for managing the regular operations of AIHED
- The Chair of the Executive Committee will be the project PI who has extensive experience in managing these kinds of teams and programs.
- An external **Advisory Board** will be established to help guide AIHED's strategy, planning, implementation and outreach.

Future Funding Prospects and Self-Sustaining Plan

- First, create a cohesive scientific team focused on AI and health and generate pilot data, use-cases and innovative concepts suitable for papers or grants
- Submit funding applications to existing and emerging opportunities at NYS, NIH, NSF, DOD, DOE, corporations and foundations.
Our recent \$48M NIH proposal was reviewed up to panel interview stage.
- Products from our research could earn patents and deals toward commercial development, which would further strengthen and support the AIHED vision.
- AIHED's ultimate goal is for CCNY to become a recognized center of research and innovation in equitable AI applications and devices for health and wellness
- Future directions may include recruiting additional faculty and expanding our AI applications to other areas such as security and education.

Thank You

