Project Title: Research and development of artificial intelligence in extraction and identification of spoken language biomarkers for screening and monitoring of neurocognitive disorders

Abstract

Population ageing is a global concern. According to WHO, our world's population aged 60+ will nearly double to 22% by 2050, while Hong Kong's population aged 65+ will rise to 35%. Ageing is accompanied by various high-burden geriatric syndromes, which escalate public healthcare expenditures. This situation, coupled with a shrinking workforce and narrowing tax base, jeopardizes our society's sustainability. Neurocognitive disorders (NCD) – including age-related cognitive decline, mild cognitive impairment, and various types of dementia – are particularly prominent in older adults. Dementia has an insidious onset followed by gradual, irreversible deterioration in memory, communication, judgment, and other domains; care costs are estimated at USD 1 trillion today and are expected to double by 2030. This presents a dire need for better disease screening and management. NCD diagnoses and monitoring are largely conducted by clinical professionals face-to-face using neuropsychological tests. Such testing is limited due to clinician shortages; capturing snapshots of cognition that ignore intra-individual variability; subjective recall of cognitive functioning; inter-rater variability in assessment; and language/cultural biases. To address these issues, we will develop an automated, objective, highly accessible evaluation platform based on inexpensively acquirable biomarkers for NCD screening and monitoring. Platform accessibility enables active, remote monitoring, and the generation of patient alerts for prompt treatment between clinical visits. Collecting individualized "big data" over time enables flagging of subtle changes in cognition for early detection of cognitive decline. These actions will prevent under-diagnosis, enhance disease management, delay institutionalization, and lower care costs. NCD often manifests in communicative impairments. Hence, we target spoken language biomarkers – non-intrusive alternatives to blood tests and brain scans for NCD screening and monitoring. Spoken language can be easily captured remotely. Speech event records (e.g. latencies, dysfluencies) at millisecond resolutions enable sensitive cognitive assessments. We will develop Artificial Intelligence (AI)-driven technologies to automatically extract spoken language biomarkers. Our work is novel in its comprehensive dimensional coverage of conversational spoken language dialogs (from hesitations to dialog coherence), using fit-for-purpose deep learning techniques for feature extraction and selection. Our systems will be highly adaptable across environments to ensure consistent, objective NCD assessments. Our research will offer unprecedented data and technological support for early NCD diagnoses and timely clinical care. This aligns with WHO's plan of making dementia a public health and social care priority at national and international levels. We aim to control the overwhelming burden of NCD through AI-enabled healthcare that better supports patients and caregivers in Hong Kong.