THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

Research Newsletter

INNOVATION DIGEST

Issue 8 | Jun 2026

Smart Ageing:

Driving Prosperity in Life Through Tech and Care



Emerging Tech

Beyond BMI:
How Fat Distribution Shapes the Ageing Brain

Supportive Care

Stepping into Safety:
How Immersive VR Can Help Prevent Falls in Older Adults

INNOVATION DIGEST

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Research Highlights



Beyond BMI: How Fat Distribution Shapes the Ageing Brain

BMI has long been the standard for assessing disease risk. However, latest research suggests that body fat distribution may be a more accurate indicator of brain ageing.



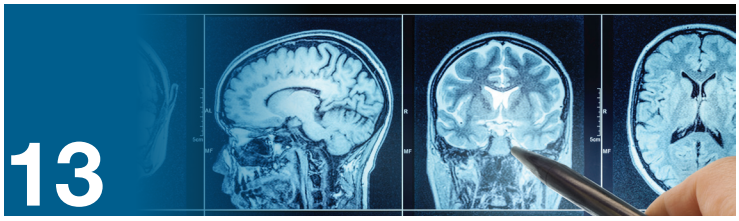
Breaking News: Multilingual AI Cognitive Screening for the Chinese-Speaking Community

AI is enabling earlier detection of cognitive impairment. The top-ranked LLM system at INTERSPEECH 2024 uses speech as a digital biomarker, marking a significant step forward in CI diagnosis.



Beyond the Pandemic: AI Contact Tracing System Safeguards Residential Care Homes

COVID-19 highlighted the need to understand how viruses spread. PolyU's AI-powered indoor digital contact tracing system successfully traced transmission during outbreaks in residential care homes.



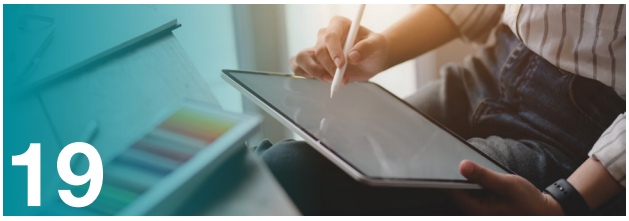
Sound Solution: A Breakthrough Approach to Parkinson's Disease

For some patients with advanced Parkinson's disease, treatment can involve awake brain surgery. New HSN with ultrasound technology may one day offer a less invasive and precise alternative.



Stepping into Safety: How Immersive VR Can Help Prevent Falls in Older Adults

Far from being just entertainment, PolyU's latest immersive VR is helping older adults train balance, build confidence and reduce the risk of falls.



When Digital Painting Meets Dementia Care Support

Technology is opening up new possibilities in elderly care. Hong Kong's first electronic painting platform is helping reduce stress for caregivers of people with dementia through digital art therapy.



Beyond the Hype: Older Adults' Perspectives on Smart Healthcare in Hong Kong

As technological innovation accelerates, smart healthcare technologies are supporting an ageing society. But how willing are older adults to use them, and do they truly benefit?



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Editor's Message

We are pleased to present this issue of *Innovation Digest*, themed "Smart Ageing: Driving Prosperity in Life Through Tech and Care." This issue examines an increasingly important area of research and policy: how ageing societies can be supported through innovation, evidence-based practice and cross-sector collaboration.

Ageing is not only a demographic phenomenon but also a global challenge with significant implications for economic development, healthcare systems and quality of life. As populations age, the need for effective and sustainable responses becomes ever more urgent. In Hong Kong, the matter is particularly salient. By 2046, people aged 65 or above are projected to account for 36% of the population, underscoring the importance of developing strategies that promote healthy, independent and dignified ageing.

As reflected in the 2025 Policy Address of the HKSAR Chief Executive, in which smart ageing and gerontechnology are identified as strategic priorities, the HKSAR Government continues to advance initiatives that foster age-friendly living, healthcare innovation and enhanced support for older adults.

This issue of *Innovation Digest* is organised around two main focuses. The "Emerging Tech" section highlights recent technological developments that support older adults' physical health, including:

- A study investigating fat distribution as an indicator of brain ageing
- The top-ranked large language model system at INTERSPEECH 2024 for cognitive impairment diagnosis
- An AI-based contact tracing system for residential care homes trialled during the COVID-19 outbreak
- A breakthrough approach to the treatment of Parkinson's disease using hollow silica nanostructures in ultrasound brain stimulation

The "Supportive Care" section explores new tools and equipment for physical care, while also examining the mental health and well-being of caregivers:

- Immersive VR for fall prevention among older adults
- An electronic painting platform for caregivers of people with dementia
- An investigation into older adults' perspectives on smart healthcare technologies
- A nature-based mindfulness programme to help relieve stress in caregivers

In the meantime, in "Engagement and Partnership" we continue to exhibit our recent collaborations with external organisations, while in "Student Corner" we proudly spotlight the achievements of our present and past students.

We hope this issue contributes meaningfully to the ongoing dialogue on ageing research and practice, and offers useful perspectives on building a more responsive and inclusive society.



Prof. Cheng DONG
Chairman of the Editorial Committee
Associate Vice President (Mainland Research Advancement)
Chair Professor of Cell Engineering and ImmunoMedicine,
Department of Biomedical Engineering

Beyond BMI: How Fat Distribution Shapes the Ageing Brain

Why Regional Adiposity Matters for Cognition, Brain Health and Ageing

As populations age, protecting brain health has become increasingly important. While previous research has focused mainly on BMI, Prof. Qiu showed that regional fat distribution, especially visceral fat, has distinct links to brain structure, connectivity, white-matter integrity and cognition. This discovery provides valuable new insight into obesity-related brain ageing and cognitive risk.



Prof. Anqi QIU
Global STEM Scholar and Professor,
Department of Health Technology and Informatics
Associate Dean, Graduate School
Director, Mental Health Research Centre

As populations age, protecting brain health has become a central priority for the smart ageing industry. Cognitive decline affects independence, care demand and quality of life, while also increasing the risk of neurodegenerative conditions such as Alzheimer's disease. This has intensified interest in modifiable midlife risk factors that may influence how the brain ages. Obesity is one such factor. However, research has often relied on body mass index (BMI) as the main measure. BMI is useful for estimating general obesity, yet it does not show where fat is stored. That is a major limitation, because fat stored in different parts of the body has different biological properties. Visceral fat, for example, is more strongly linked to inflammation and metabolic dysfunction than fat stored elsewhere. For brain ageing research, this means BMI captures only part of the picture.

A study published in *Nature Mental Health* [1] addresses this gap directly. Using UK Biobank data, Prof. Anqi QIU, Global STEM Scholar and Professor of the Department of Health Technology and Informatics at The Hong Kong Polytechnic University, and her research team proved that regional fat distribution is associated with brain structure, functional connectivity, white-matter integrity and cognition—independently of BMI. Fat stored in the arms, trunk, legs and visceral region showed distinct relationships with the brain, particularly in the sensorimotor, limbic, default mode and subcortical–cerebellar–brainstem systems.

The study also found that older-looking cortical brain systems mediated the relationship between adiposity and poorer cognition. Among all fat depots, visceral adiposity showed the strongest adverse associations with brain integrity and cognitive performance.

The study drew on a very large sample from the UK Biobank. Regional fat measures for arm, leg and trunk adiposity were available in over 23,000 adults with multimodal MRI data, while visceral adipose tissue data were available in nearly 19,000. Regional adiposity was measured by dual-energy X-ray absorptiometry, which provides a more precise estimate of body fat distribution than anthropometric measures. Brain health was assessed using structural MRI, resting-state functional MRI and diffusion imaging. Cognitive tests covered reasoning, executive function, processing speed and memory. This multimodal design allowed the team to examine the brain–fat relationship in far greater detail than studies using BMI alone.

The structural MRI results showed that regional adiposity was associated with selective cortical and subcortical changes. Higher arm, trunk and leg fat percentages were linked to reduced cortical volume and surface area in regions related to the default mode network (*Figure 1*), including the medial prefrontal cortex, posterior cingulate, precuneus and lateral temporal cortex. These regions are highly relevant to ageing and Alzheimer's disease, as the default mode network is frequently implicated in early neurodegeneration. The same adiposity measures were also associated with changes in limbic-related areas such as the medial temporal and orbitofrontal cortex. Arm and trunk fat were additionally linked to reduced cortical thickness in the sensorimotor cortex. Visceral adiposity showed a more focused pattern, with prominent associations in key default mode hubs such as the dorsal medial prefrontal cortex and precuneus. All four adiposity measures were negatively associated with subcortical volumes.

The functional connectivity findings revealed a partly overlapping but distinct pattern. All adiposity measures were associated with reduced connectivity in the sensorimotor network and in subcortical–cerebellar–brainstem circuits. These systems are important for motor control, autonomic regulation and core homeostatic processes. Leg fat showed the strongest negative relationship with connectivity in the limbic network, which is involved in emotion, memory and reward. Arm, leg and trunk adiposity were associated with increased within-network connectivity in the default mode network, whereas visceral fat was not significantly associated with default mode connectivity.

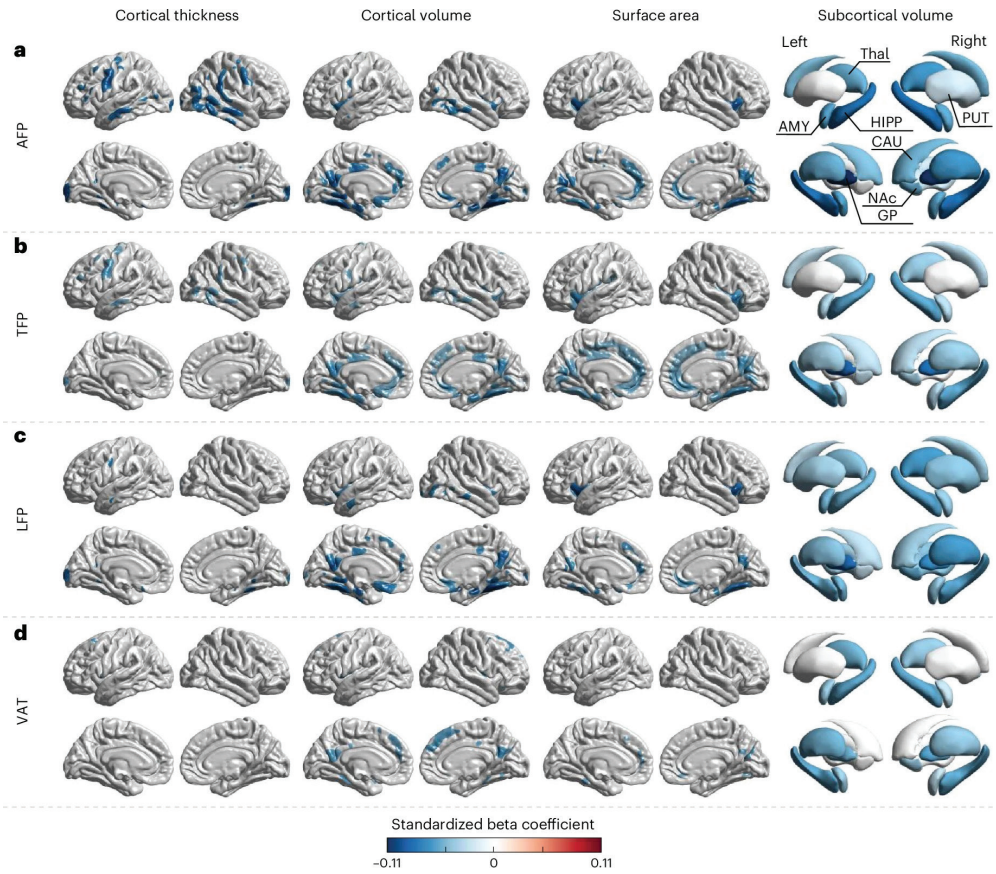


Figure 1. Associations of regional adiposity with cortical and subcortical morphometry. The blue colour indicates negative correlations. AFP: arm fat percentage; TFP: trunk fat percentage; LFP: leg fat percentage; VAT: visceral adipose tissue

This mismatch between structural and functional findings suggests that fat-related brain changes may not occur uniformly across imaging modalities. Structural vulnerability may be detectable before clear connectivity disruption, or compensatory mechanisms may temporarily preserve network function.

The white-matter findings (*Figure 2*) were especially important because they differentiated visceral fat from other depots more clearly. Visceral adiposity was associated with lower neurite density, higher free-water contamination and lower axonal organisation across widespread white-matter tracts which included the corona radiata, internal and external capsules, corpus callosum and cingulum. Taken together, these patterns point to compromised white-matter integrity and possible tissue degeneration.

By contrast, arm, trunk and leg adiposity showed more mixed and less consistently adverse associations with white matter. For ageing research, this is highly relevant because white-matter integrity supports efficient communication across neural systems and underpins cognitive resilience in later life. The data therefore suggest that visceral fat may be especially harmful to the ageing brain.

A major strength of the study is that it went beyond simple association and examined whether brain ageing itself might explain the link between regional adiposity and cognition. The team used multimodal imaging features to estimate brain age gap (BAG) within the four brain systems most strongly associated with adiposity. BAG reflects the difference between a system's predicted biological age and the person's chronological age. A higher BAG indicates an older-appearing brain system.

The mediation analysis showed that BAGs in the sensorimotor, limbic and default mode systems significantly mediated relationships between regional adiposity and cognitive performance in reasoning, executive function, processing speed and memory. In short, greater adiposity was associated with older-appearing brain systems, and these older-appearing systems were associated with poorer cognition. The strongest indirect effects were seen for visceral adiposity.

This is a meaningful result for both neuro-ageing science and Alzheimer's-oriented prevention. Reasoning, memory and executive function are among the most clinically relevant domains in ageing populations. If adiposity contributes to accelerated ageing in cortical systems that support these functions, then body fat distribution may become an important component of cognitive risk profiling. In practical terms, the findings suggest that the brain impact of obesity is not simply a matter of total body mass. Specific fat depots appear to

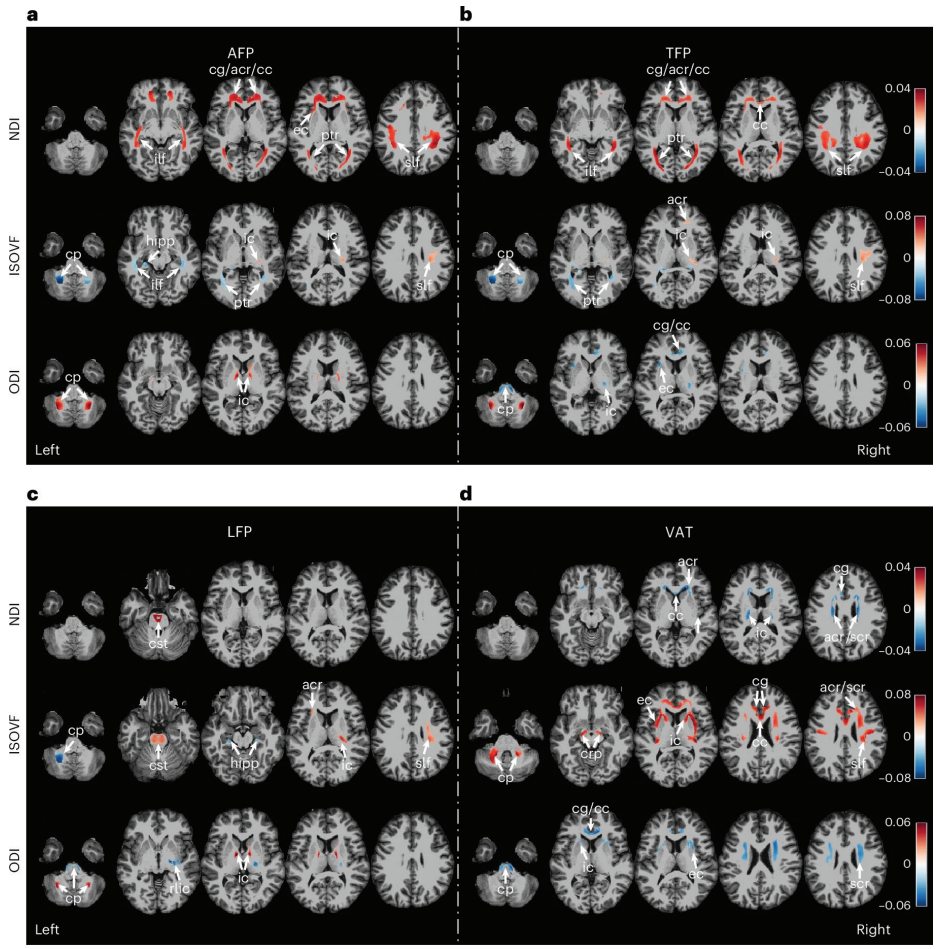


Figure 2. Association of fat distribution with neurite orientation dispersion and density imaging metrics. Regions with significant associations are highlighted. The red colour indicates positive correlations while the blue colour indicates negative correlations. NDI: neurite density index; ISOVF: isotropic volume fraction; ODI: orientation dispersion index

have specific neural correlates, and visceral fat appears to be the most concerning.

This study also makes a strong case for why BMI is not enough. Before adjusting for BMI, regional adiposity measures produced broad brain associations that looked very similar to those of BMI itself. This made it difficult to see whether regional fat distribution had any independent value. However, once BMI-related variance was removed, more specific patterns emerged. Associations became more localised and concentrated in four major brain systems. In some subcortical regions, the direction of association even changed after BMI adjustment, suggesting that BMI can mask more precise effects of regional adiposity.

This is the key conceptual advance of this study. BMI may be useful for screening general obesity, but it cannot distinguish between biologically distinct fat depots or identify which depot is most relevant to brain ageing.

Precision health models increasingly aim to integrate imaging, metabolic and behavioural data to identify at-risk individuals earlier and guide personalised intervention. BMI is too crude for that purpose on its own. Two people with the same BMI may have very different fat distributions and, according to this study, potentially very different neurocognitive risk profiles. Regional adiposity, especially visceral adiposity, may therefore offer a more informative biomarker for brain ageing than general obesity measures alone. Prof. Qiu and her team showed that moving beyond BMI is essential if we want a more precise understanding of obesity-related brain ageing, cognitive decline and Alzheimer's-related risk.

Prof. Qiu has been recognised by Stanford University as one of the top 2% most-cited scientists worldwide (single-year) in the field of neurology and neurosurgery for five years: 2020, 2022 to 2025. In recognition of her outstanding research achievements, she was selected as one of the Top 50 Asia Women Tech Leaders 2025 and was honoured with "Dean's Chair" Associate Professorship in 2017. She was also made a Fellow of the Organisation for Human Brain Mapping (OHBM), class of 2024, and elected as the Chair of OHBM in 2025.

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[1] Zhang, D., Fu, Y., Shen, C. et al. Regional adiposity shapes brain and cognition in adults. *Nature Mental Health* 3, 1168–1180 (2025). https://doi.org/10.1038/s44220-025-00501-8

Breaking News: Multilingual AI Cognitive Screening for the Chinese-Speaking Community

Advancing Early Detection Through Speech-Based Biomarkers in English and Chinese

Cognitive impairment is common among older adults, and early intervention can help delay progression to MCI and Alzheimer's disease. Leveraging AI advances, Prof. Liang's LLM cognitive screening system enables early risk detection and achieved first place in MMSE cognitive score prediction and second place in MCI classification at the INTERSPEECH 2024 TAUKADIAL Challenge, benefiting Chinese-speaking communities.



Prof. Hualou LIANG
Interim Head (Artificial Intelligence and the Humanities) and Chair Professor of Neuroscience and Artificial Intelligence, Department of Language Science and Technology and Department of Data Science and Artificial Intelligence
Associate Director, University Research Facility in Behavioural and Systems Neuroscience

Cognitive impairment, including mild cognitive impairment (MCI) and Alzheimer's disease, is a growing challenge in ageing societies. Early detection is crucial, as timely intervention can improve care planning, monitoring and quality of life. Yet cognitive decline is often identified only after symptoms have become more pronounced, limiting opportunities for support.

Current diagnostic tools remain imperfect. Screening tests such as the Mini Mental State Examination (MMSE) can be influenced by language, education and culture, while neuroimaging and specialist assessments are costly and not always accessible. This has made speech an increasingly attractive digital biomarker. Because speech reflects multiple cognitive processes, subtle changes in fluency, pausing and vocal delivery may provide a non-invasive and scalable route to earlier detection.

Prof. Hualou LIANG, Interim Head (Artificial Intelligence and the Humanities) and Chair Professor of Neuroscience and Artificial Intelligence of the Department of Language Science and Technology and the Department of Data Science and Artificial Intelligence at The Hong Kong Polytechnic University, and his research team advance this line of work in a multilingual context, showing how AI-based speech analysis may support more practical and inclusive cognitive screening.

Their study was conducted as part of the INTERSPEECH 2024 TAUKADIAL Challenge, a task focused on detecting mild cognitive impairment and predicting cognitive scores from spontaneous speech, with the results presented in *Brain Sciences* [1]. The significance of this challenge lies in its multilingual scope. Previous work in speech-based dementia research has been heavily focused on English datasets, leaving uncertain whether reported findings can generalise across languages and cultures. This study directly addresses the gap by examining both English and Mandarin Chinese speech, thereby making a meaningful contribution to the development of more globally relevant cognitive assessment tools.

The dataset was collected through picture description tasks, a well-established format in cognitive assessment because it elicits spontaneous yet structured speech. Participants were required to describe three pictures. Across both languages, the study included 169 participants, comprising individuals with MCI and those with normal cognition, balanced by age and sex to reduce demographic bias. The study addressed two tasks. The first was MCI classification, in which the model distinguished cognitively healthy speakers from those with mild cognitive impairment. The second was MMSE score prediction, a regression task aimed at estimating an individual's cognitive score directly from their speech. Together, these tasks reflect the need for both screening and monitoring, suggesting that speech-based AI could support not only binary risk detection but also more continuous assessment of cognitive status.

At the centre of the approach is Whisper, specifically *whisper-large-v3*, used as a foundation model for acoustic feature extraction. This is a notable methodological choice. Rather than relying on traditional handcrafted features alone, the team used Whisper's encoder to generate 1280-dimensional embeddings from the speech signal. These embeddings provide a rich learned representation of the audio recording and reflect the growing importance of foundation models in speech technology. Their use here signals an important shift in cognitive assessment research: from manually engineered markers towards large-scale, transferable representations capable of capturing subtle acoustic patterns across languages.

The study compared two modelling pipelines (*Figure 1*). The first was a language-agnostic baseline. In this model, Whisper embeddings were extracted, normalised and passed directly into a classifier such as a neural network, without any explicit language identification. This baseline is conceptually attractive because it tests whether a single

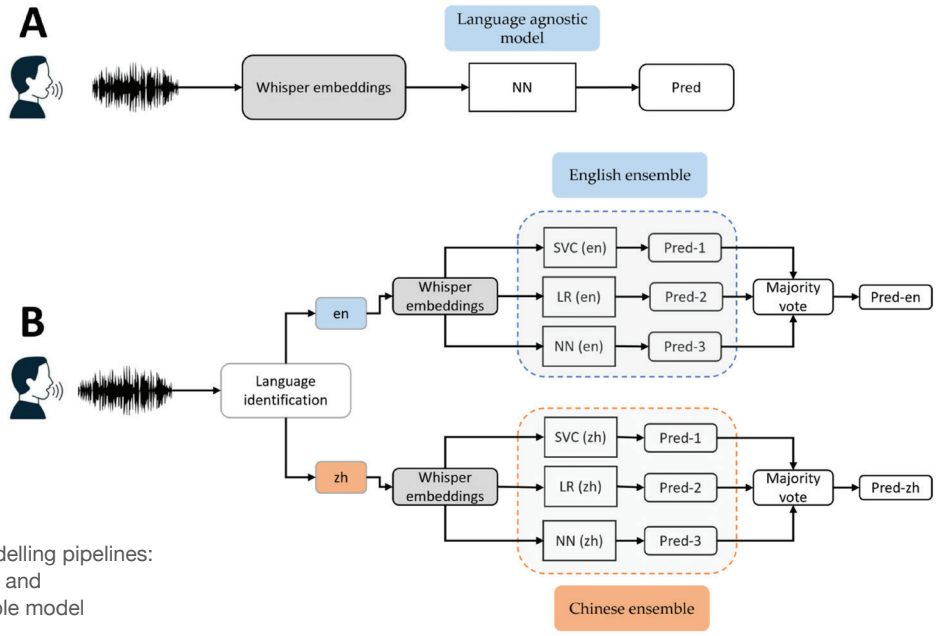


Figure 1. Diagram of two modelling pipelines:
(A) language-agnostic model, and
(B) language-specific ensemble model

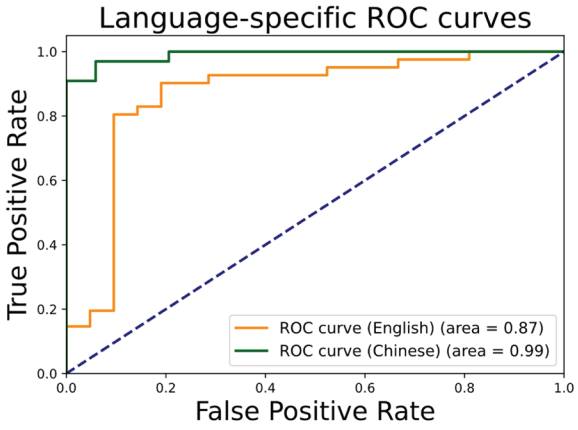


Figure 2. Receiver operating characteristic curves of the language-specific model for Chinese and English datasets

multilingual system can capture common acoustic indicators of cognitive decline across English and Chinese.

The second pipeline was a language-specific ensemble model. Here, the language of each recording was first identified, after which the speech was processed through a language-tailored modelling route. The most interesting part of this design is the way it incorporated the three picture-description tasks. Rather than treating all speech prompts as interchangeable, the team trained models on two tasks and tested on the third, repeating this across all task combinations. This produced three predictions per participant. For MCI classification, the final decision was obtained through majority voting; for MMSE prediction, the outputs were averaged.

For MCI classification, the ensemble included a support vector classifier, logistic regression and a neural network. For MMSE score prediction, the team used Ridge Regression and a neural network. The study also experimented with linguistic text embeddings derived from Whisper transcriptions, using strong language-specific embedding models for English and Chinese.

The results strongly favour the language-specific approach. On the unseen test set for MCI classification, the language-specific ensemble achieved an unweighted average recall of 81.83%, compared with 61.2% for the language-agnostic baseline. This is a substantial improvement and indicates that language-specific nuance remains important even when using a powerful multilingual foundation model. The study also reported strong receiver operating characteristic performance (*Figure 2*), with AUC values of 0.87 for English and 0.99 for Chinese, demonstrating high discriminatory ability within each language.

A similar pattern was found in MMSE score prediction. The language-specific ensemble outperformed the language-agnostic model and achieved an RMSE of 1.196, a strong result given the challenge of estimating cognitive scores from spontaneous speech alone. This suggests that speech-based AI may have value not only for screening but also for more fine-grained, quantitative tracking of cognitive status.

One of the most revealing elements of the study is its examination of between-language transfer. When models trained on one language were applied to the other, performance declined markedly. This finding has important implications. It shows that, although Whisper provides multilingual embeddings, the speech signatures of cognitive impairment are not fully language-independent. They remain shaped by phonetic, linguistic and cultural factors. Multilingual capability does not remove the need for localisation. On the contrary, effective deployment may depend on combining shared representation learning with language-specific adaptation.

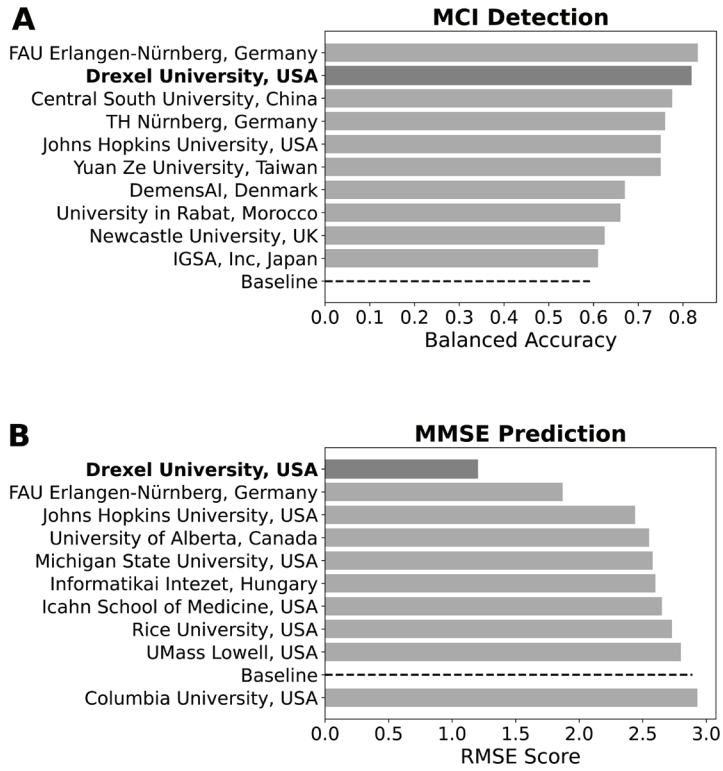


Figure 3. Rankings of the top ten teams and the baseline method in the challenge: **(A)** the model of Prof. Liang's team ranked second (dark grey) for the MCI classification task; and **(B)** it ranked first (dark grey) for the MMSE cognitive score prediction task

The practical significance of this study is reinforced by its standing in the challenge itself. Among all participating teams in the INTERSPEECH 2024 TAUKADIAL Challenge, the proposed model ranked second for MCI classification and first for MMSE prediction (*Figure 3*). These rankings are impressive not merely as competition results, but because they demonstrate that a relatively streamlined system based on spontaneous speech and acoustic embeddings can achieve state-of-the-art performance against an international benchmark. The work therefore strengthens the case for speech as a clinically useful, low-burden digital biomarker.

More broadly, the study points towards a future in which cognitive screening may become more frequent, more remote and more inclusive. It helps define the next stage of research, including multimodal approaches that combine acoustic, linguistic and possibly non-verbal behavioural cues.

INTERSPEECH 2024 is a major international conference in speech science and technology, organised by the International Speech Communication Association. It brings together researchers and industry experts working on speech processing, artificial intelligence, spoken language systems and related applications. In addition to its main research programme, the conference is known for its challenge tracks, which provide shared tasks and benchmark datasets to advance the field through transparent comparison. One of these was the TAUKADIAL Challenge, focused on multilingual detection of cognitive impairment and cognitive score prediction from spontaneous speech.

Prof. Liang has been recognised by Stanford University as one of the top 2% most-cited scientists worldwide (career-long) in the field of artificial intelligence and image processing for six consecutive years, from 2020 to 2025. His research interests focus on neural data science, machine learning and biomedical natural language processing. He is known for pioneering the application of causal functional connectivity measures, particularly Granger causality, to the analysis of complex, high-dimensional neuroscience data. In recognition of his significant contributions to the development of advanced signal processing methods for the analysis of functional brain networks, he is an elected Fellow of the American Institute for Medical Biological Engineering. Prof. Liang is also committed to building collaboration with professionals in advancing research of spoken language processing for healthcare and the development of large language models for dementia prediction. His recent research has been featured in media outlets that include *Psychology Today*, *Jerusalem Post*, *The New York Times* and *IEEE Spectrum*.

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Beyond the Pandemic: AI Contact Tracing System Safeguards Residential Care Homes

An Indoor Bluetooth-Based System Offers a Practical Blueprint for Smarter Infectious Disease Control in Ageing Settings

The COVID-19 pandemic has had a devastating impact on global public health and the economy, highlighting the importance of effective contact tracing. With funding from the Health Bureau of the HKSAR, Prof. Shum, Prof. Yang and their team developed an AI-powered indoor digital contact tracing system and conducted a live operation in a residential care home outbreak, offering valuable insights for future infectious disease response.



Prof. Ho Keung David SHUM
Yeung Tsang Wing Yee and Tsang Wing Hing Professor in Neuropsychology
and Chair Professor of Neuropsychology,
Department of Rehabilitation Sciences
Dean, Faculty of Health and Social Sciences



Prof. Lin YANG
Associate Professor,
School of Nursing

The COVID-19 pandemic changed how the world thinks about infection control, especially in places where vulnerable people live in close proximity. Residential care homes became one of the clearest examples of how quickly an infectious disease can spread when residents share indoor space, require hands-on support and interact regularly with staff and visitors. Even as emergency restrictions have eased, the need for sustainable outbreak preparedness has not disappeared. For the nursing sector, this raises an important question: how can care environments become safer without becoming more restrictive, labour-intensive or intrusive?

A recent study on an AI-empowered indoor digital contact tracing system published in *Infectious Disease Modelling* [1] offers one possible answer. Prof. Lin YANG, Associate Professor of the School of Nursing at The Hong Kong Polytechnic University, and Prof. Ho Keung David SHUM, Yeung Tsang Wing Yee and Tsang Wing Hing Professor in Neuropsychology and Chair Professor of Neuropsychology of the Department of Rehabilitation Sciences at the same university, together with their research team, developed a system for residential care homes in Hong Kong to monitor indoor movements and contact patterns using low-energy Bluetooth technology, while preserving privacy and minimising disruption to daily life.

More than a COVID-19-specific tool, the study provides practical insights into how smart systems can support outbreak management in ageing services. Its value lies not only in the technology itself, but also in what the collected data reveal about contact patterns, targeted quarantine and the design of more resilient care settings.

The team aimed to develop and test an indoor contact tracing system that could automatically capture high-resolution contact data among care home residents, staff and day-care users. Existing digital tracing approaches have often relied on smartphones, GPS or person-to-person app-based exchanges. These methods can be useful at the population level, but they are less suited to residential care environments. Older adults may not always carry a smartphone, battery consumption can be high and privacy concerns can discourage adoption. In contrast, the system developed by the team used wearable low-energy Bluetooth beacons and fixed gateways placed throughout the care home. This made it possible to track room-level location and overlapping presence in a way that was both more practicable for care settings and less dependent on user behaviour.

The system architecture is particularly relevant for those working at the intersection of ageing, digital health and built environment innovation. It comprised three main components: wearable Bluetooth beacons and indoor gateways for data collection; cloud-based algorithms for processing and localisation; and a web portal for visualisation and operational use (*Figure 1*).

Each participant wore a small beacon device, available in card or wrist form. These beacons emitted Bluetooth advertisement signals at regular intervals. Gateways installed in rooms received the signals and forwarded them to a cloud server through the MQTT protocol. A minimum of three gateways per room enabled more precise indoor positioning through trilateration. Because the system relied on Bluetooth-received signal strength indication rather than GPS, it was better suited to indoor care environments and consumed far less power. The beacons were lightweight, waterproof and had an estimated battery life of up to three years, making them practical for everyday use.

Once the raw signal data reached the cloud server, localisation algorithms were used to estimate beacon coordinates and timestamps. To improve data quality, the system incorporated calibration, validation and noise reduction. When several gateways received the same beacon

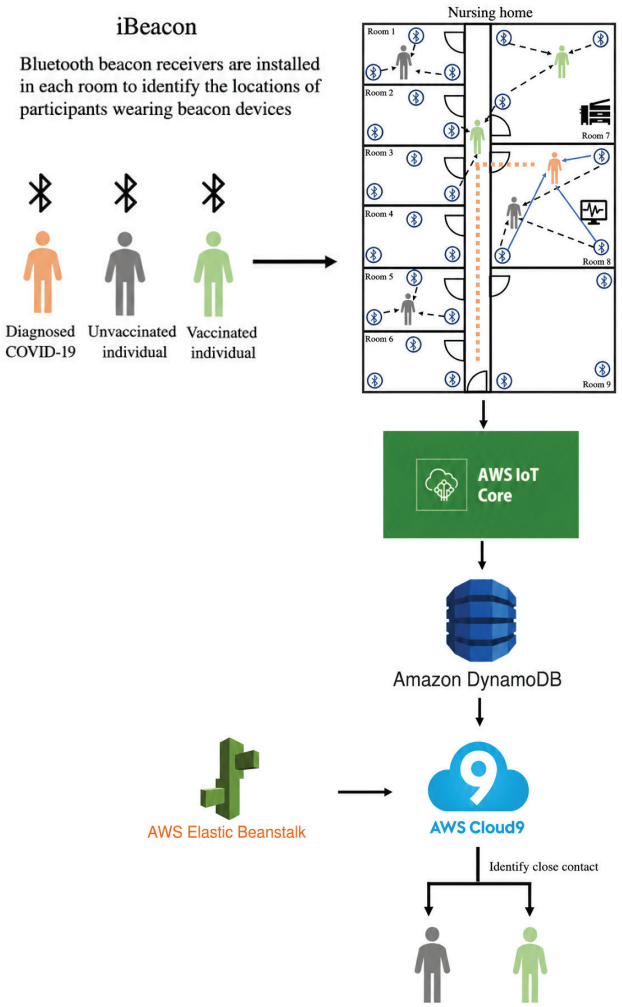


Figure 1. Architecture of the tracing system

signal at the same time, the system identified the most likely room location by selecting the room with the highest number of records. It then converted timestamps into time intervals. If two adjacent timestamps from the same beacon were more than 30 seconds apart, they were not merged into a single interval, reducing the risk of false continuity. Contact duration was determined by searching for overlapping time intervals between different beacons detected by the same gateways. In other words, the system inferred who had shared the same room and for how long.

This processing pipeline matters because outbreak control in care homes is not simply about knowing where people are. It is about understanding patterns of interaction that are otherwise difficult to capture reliably: who spends prolonged time together, how routines differ on weekdays and weekends, and which contact thresholds are most meaningful when identifying close contacts. The web portal translated these data into actionable outputs, including movement paths, lists of high-risk zones and close contacts linked to a confirmed case. For care home managers, such a dashboard could support much faster and evidence-based decisions during an outbreak.

Privacy was a central design principle. The beacon devices did not carry personally identifiable information in the transmitted packets, and the data analysts did not know the identity of beacon users. At the care home level, only designated personnel handling the beacon distribution records could link devices to individuals, while access to contact data was restricted to outbreak situations. This separation between identity management and movement analytics is especially important in ageing services, where trust, dignity and data governance are critical.

The system was tested in two residential care homes in Hong Kong. One was an elderly home with staff, residents and day-care users; the other accommodated both older adults and people with disabilities. Across the two sites, the study collected two weeks of contact data and examined both routine interaction patterns and interactions during an actual COVID-19 outbreak.

The contact analysis showed that indoor interaction patterns varied by user group and by day type. In one care home, residents had longer contact durations with one another than staff did, and some weekday-weekend differences were statistically significant. This suggests that care environments have distinct social rhythms that can shape transmission risk. This is an important reminder that outbreak systems should not merely record contacts. They should also help services understand when and where contact intensity changes over time.

The most compelling findings came from the second care home, where a COVID-19 outbreak occurred during the study period. The index case was identified on one floor, and under the regulations in force at the time, all staff and residents on that floor were transferred to quarantine centres two days later. Within six days, five additional cases were confirmed. In total, six of the 14 residents on that floor tested positive during the outbreak.

The study compared contact durations involving the index case on the day of diagnosis and up to three days prior (*Figure 2*). Some pairing patterns stood out, such as residents who shared rooms having longer contact durations. However, there was no significant difference between infected and uninfected contacts in terms of demographic characteristics or measured contact duration with the index case. This is a useful caution against assuming that transmission can always be predicted from simple descriptors alone. In real-world care settings, infection risk is shaped by a complex mix of contact time, environmental conditions, host factors and timing within the infectious period.

To explore how the contact data could improve outbreak response, the team built an agent-based simulation model using data from the above outbreak. They compared the real-life strategy of quarantining everyone on the same floor with more targeted strategies based on direct contact with the index case. Thresholds for cumulative contact time were set at 0, 15, 30, 60 and 120 minutes, using either contact on the previous day only or contact over the previous two days.

The simulation results (*Figure 3*) are especially relevant for future infectious disease management in care homes. They

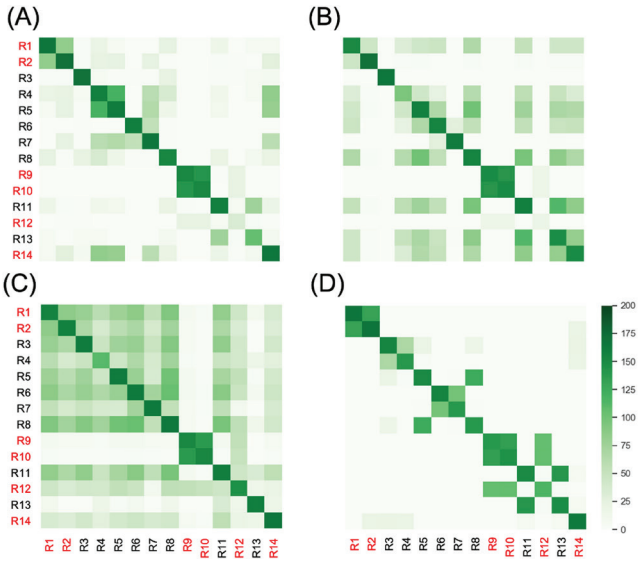


Figure 2. Heat map of daily contact duration (in minutes) between participants (R1 to R14), on **(A)** the day of the index case diagnosis, **(B)** one day, **(C)** two days and **(D)** three days prior to (A). R14 is the index case. Other numbers highlighted in red are secondary cases. The diagonal line shows the total duration of stay in the residential care home during the exposure period.

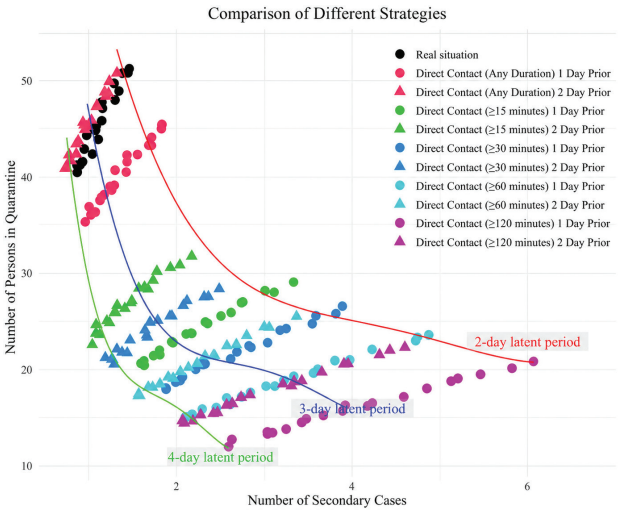


Figure 3. Simulation under different outbreak containment strategies. A multinomial regression line is fitted to the data points under different assumptions of latent period.

showed that targeted quarantine based on cumulative contact thresholds one or two days before diagnosis could contain outbreaks much more efficiently than blanket isolation. In particular, thresholds of at least 15 minutes one day before diagnosis and at least 30 minutes one day before diagnosis appeared to mark a turning point: outbreak size could be reduced substantially without quarantining as many people as in a whole-floor approach. In practical terms, this means a better balance between infection control and quality of life. Instead of removing an entire unit from normal activity, services may be able to isolate a smaller group of genuinely high-risk contacts.

This insight has wide implications beyond COVID-19. In care homes, quarantine is never a neutral intervention. It can interrupt routines, increase confusion and distress, reduce social engagement and place an additional burden on staff. A system that enables more selective and evidence-based isolation could therefore support both infection prevention and person-centred care.

The study also highlights several design lessons for future outbreak tracing systems. First, indoor-specific solutions are essential. GPS and mobile apps have limitations in enclosed care environments, whereas room-level Bluetooth systems can capture the kinds of interactions that matter most. Secondly, passive and wearable infrastructure improves feasibility in populations who may not always carry a personal device. Thirdly, privacy-preserving architecture should not be a secondary feature but a prerequisite for implementation in care settings. Finally, tracing systems become more useful when paired with analytics that can translate raw proximity data into actionable thresholds for intervention.

The future of outbreak readiness in care homes will depend on intelligent systems that are practical, privacy-conscious and tailored to indoor living environments. AI-enabled contact tracing can certainly achieve more than document exposure after the fact.

Prof. Shum was recognised by Stanford University as one of the top 2% most-cited scientists worldwide (career-long) in the field of rehabilitation for two years, in 2023 and 2025, and one of the top 2% most-cited scientists worldwide (single-year) for four years, in 2021, 2022, 2023 and 2025. He is a neuropsychologist with 30 years of experience in the assessment and rehabilitation of higher-level cognitive functions in normal and brain-injured children and adults. He has been awarded more than 25 national and international competitive grants from major funding bodies, including the Australian Research Council, the National Health and Medical Research Council in Australia, the Hong Kong Research Grants Council and the Health and Medical Research Fund in Hong Kong. In addition to his university appointments, Prof. Shum currently serves as a member of the Hospital Authority Board, the Chairman of the Hospital Governing Committee of the Pamela Youde Nethersole Eastern Hospital, the Chairman of the Regional Advisory Committee of the Hospital Authority, and a member of the Allied Health Professions Council.

Prof. Yang was recognised by Stanford University as one of the top 2% most-cited scientists worldwide (single-year) in the field of microbiology in 2022. Her research interests include infectious disease epidemiology and infection control and pandemic preparedness, and AI applications in healthcare.

This study, in which Prof. Shum serves as the Principal Investigator and Prof. Yang as the Co-PI, was supported by the Health Medical Research Fund, the Health Bureau, the Government of the Hong Kong Special Administrative Region.

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Sound Solution: A Breakthrough Approach to Parkinson's Disease

Harnessing Hollow Silica Nanostructures for Precise, Durable and Clinically Relevant Ultrasound Brain Stimulation

Parkinson's disease has long been regarded as an irreversible condition among older adults. Although existing treatments may manage symptoms, they are often invasive or limited in precision and effectiveness. Prof. Sun introduced a cutting-edge approach combining ultrasound brain stimulation with hollow silica nanostructures, offering a more precise, safer and durable solution that brings new hope to patients with limited treatment options.



Prof. Lei SUN

Professor, Department of Biomedical Engineering
Director, Research Centre for Non-invasive Brain Computer Interface
Associate Director, Centralised Animal Facility

Parkinson's disease (PD) is one of the most common neurological disorders associated with later life, and its prevalence rises sharply with age. It affects the brain systems that control movement, often causing tremor, stiffness, slowness and problems with balance, all of which can reduce independence and quality of life in older adults. The condition is mainly linked to the gradual loss of dopamine-producing nerve cells. Current treatment usually relies on medicines such as levodopa, which can improve symptoms, especially in the earlier stages, but their benefit may become less consistent over time. For some patients, deep brain stimulation (DBS) offers another option, yet this involves surgery to place electrodes deep inside the brain.

These limitations continue to motivate the search for neuromodulation approaches that are both precise and less invasive. In a recent study published in *Nature Communications* [1], Prof. Lei SUN, Professor of the Department of Biomedical Engineering at The Hong Kong Polytechnic University, and his research team address the need for such approaches by combining low-intensity ultrasound with engineered hollow silica nanostructures (HSN) to achieve chronic, localised brain stimulation in mice, as well as therapeutic benefit in PD models.

The principal advancement of this work is the demonstration that ultrasound neuromodulation can be made both spatially precise and durable through the use of stable, sonoresponsive nanostructures. Conventional transcranial ultrasound is attractive because it penetrates deeply and can be delivered non-invasively, but its spatial resolution is typically limited to millimetre or centimetre scales, making selective activation of small neuronal populations difficult. Earlier nanoparticle- or nanobubble-assisted approaches improved localisation, but their in vivo instability limited usefulness for chronic applications. In contrast, the HSN developed by Prof. Sun and his team persisted in the mouse brain for more than nine weeks while remaining functionally responsive to ultrasound. This enabled repeated stimulation of targeted regions, including the motor cortex, striatum, ventral

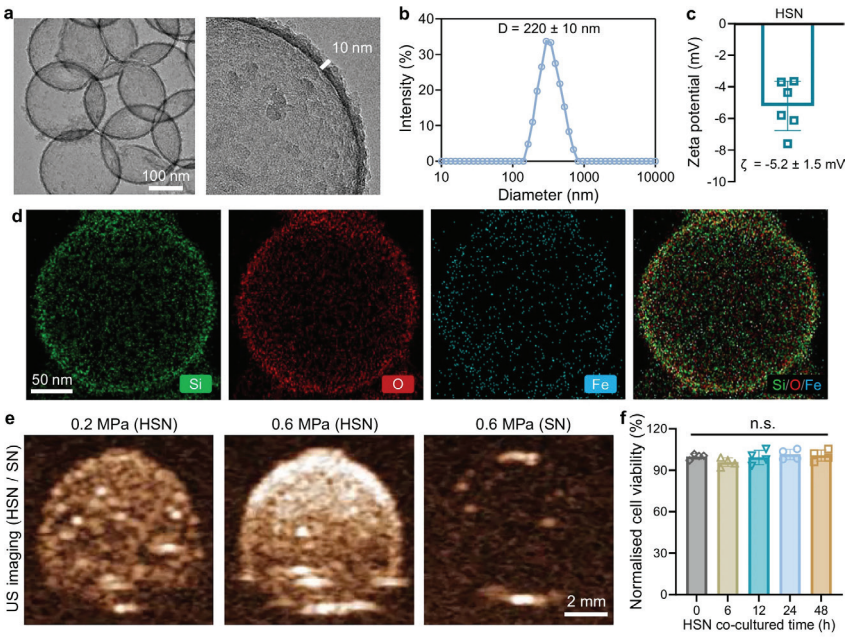


Figure 1. Characterisation of the fabricated HSN
(a) Transmission electron microscopy image of HSN
(b) Size distribution plot of HSN
(c) Zeta potential measurement of HSN
(d) EDS elemental mappings of HSN
(e) Ultrasound imaging of HSN and SN under varying acoustic energy levels
(f) Cytotoxicity assessment of HSN

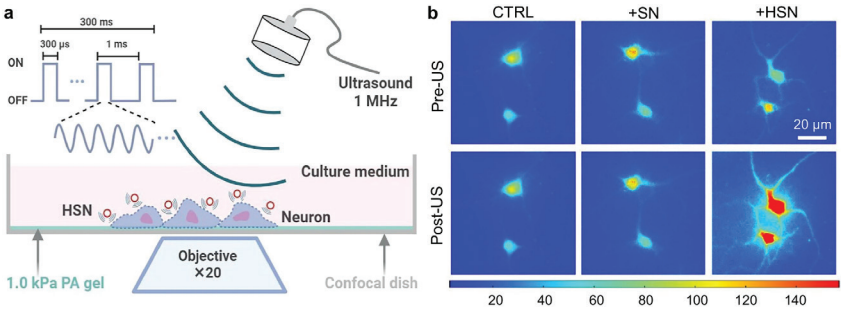


Figure 2. HSN-enabled low-intensity ultrasound modulation of primary neurons **(a)** Schematic illustration depicting HSN-medicated ultrasound stimulation of primary cultured neurons **(b)** Representative images showing calcium fluorescence in primary neurons without nanoparticles (CTRL) or with HSN/SN, before and after ultrasound stimulations

tegmental area (VTA) and subthalamic nucleus (STN), without genetic modification and without repeated intracranial administration.

The HSN were designed as hollow, gas-containing silica particles with an approximately 10 nm shell and an overall diameter of around 220 nm. The characterisation of the HSN is illustrated in *Figure 1*. The hollow architecture is central to their function, as it allows them to amplify local acoustic effects under ultrasound exposure. Iron was incorporated into the shell to improve robustness and to provide magnetic responsiveness, creating the possibility of MRI visibility. To improve colloidal stability and biocompatibility, the surface was modified with polyethylene glycol (PEG).

Characterisation confirmed a spherical morphology, uniform elemental distribution of silicon, oxygen and iron (*Figure 1d*), and successful PEG functionalisation. The particles produced strong ultrasound contrast signals, unlike solid silica nanoparticles (SN) used as controls (*Figure 1e*), confirming that the gas-filled hollow structure was responsible for their acoustic responsiveness. They also retained contrast under repeated ultrasound bursts, indicating substantial mechanical stability. Importantly, the particles showed no detectable cytotoxicity in primary neuronal cultures (*Figure 1f*).

The study then examined whether HSN could enhance neuronal responsiveness to low-intensity ultrasound. Primary cortical neurons were grown on an acoustically transparent polyacrylamide (PA) gel and then exposed to ultrasound sonication (*Figure 2a*). Calcium responses were visually recorded. In cultured primary cortical neurons, ultrasound in the presence of HSN produced marked calcium influx, whereas ultrasound alone (CTRL) or ultrasound with SN did not (*Figure 2b*).

Responses were repeatable, rapidly reversible and dependent on acoustic intensity. The team further tested the mechanism using gadolinium, a broad inhibitor of mechanosensitive ion channels. This substantially suppressed the calcium signal, with recovery after washout, supporting the conclusion that HSN-mediated ultrasound acts primarily through activation of mechanosensitive ion channels. This interpretation was reinforced by increased c-Fos expression, indicating downstream neuronal activation. Together, these data show that HSN sensitise nearby neurons to mechanical stimulation by ultrasound, allowing effective activation at relatively low acoustic intensities.

In vivo findings were consistent with the in vitro data and demonstrated a high degree of localisation. After HSN injection into the motor cortex of a mouse, low-intensity ultrasound elicited forelimb electromyographic responses, while saline controls showed little or no response at lower pressures. Response magnitude and success rate increased with HSN dose, indicating a controllable effect. In the striatum, c-Fos activation following ultrasound was confined to the HSN-containing region, with little increase in adjacent tissue lacking particles (*Figure 3*). Notably, the activated zone was substantially smaller than the ultrasound wavelength itself. This is an important conceptual point: spatial selectivity was determined not by focusing ultrasound more tightly, but by restricting where the sonosensitive nanostructures were located. The study therefore shifts precision from the acoustic field alone to the combined acoustic–material interface.

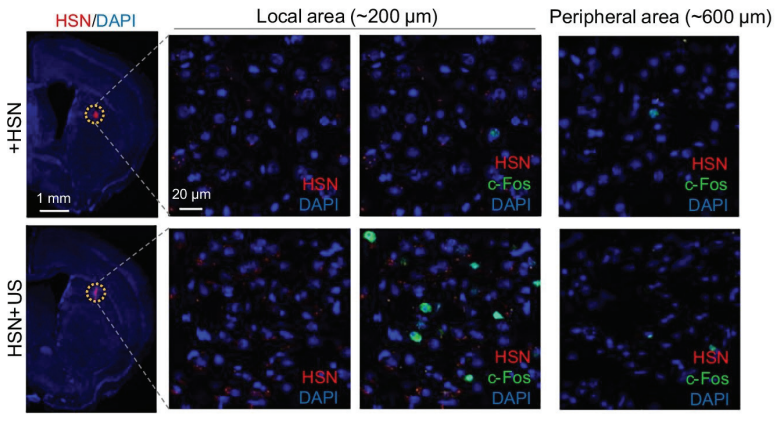


Figure 3. Immunofluorescence staining of c-Fos expression (green) in the area surrounding the HSN (red) injection site in the mouse stratum stimulated with or without US

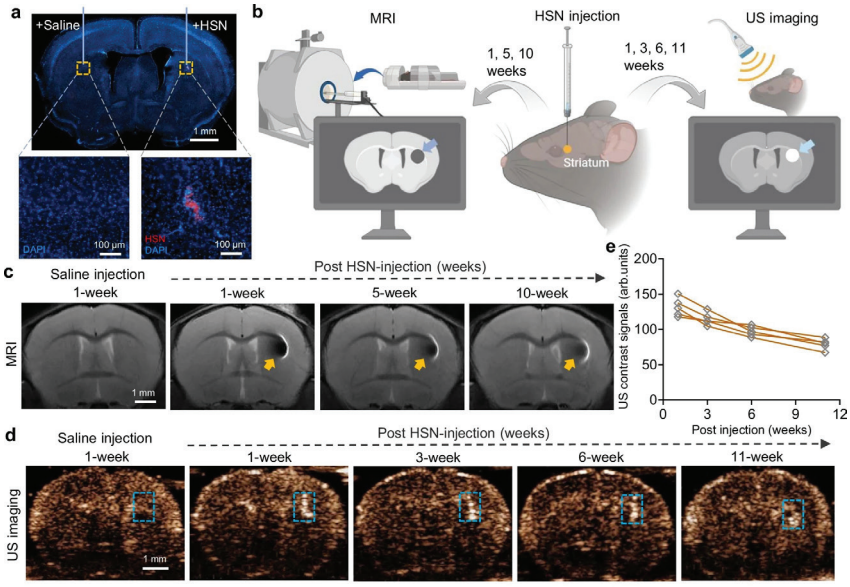


Figure 4. In vivo HSN lifetime test using fluorescence, MRI and ultrasound imaging. **(a)** Representative fluorescence images of mouse brain slices following HSN and Saline injection at week 9 **(b)** Schematic illustration of the experimental process **(c)** MRI images of mice brains at different time points after HSN/Saline injection **(d)** Ultrasound contrast-mode images of mice brains at different time points after HSN/Saline injection

A major strength of the work is its demonstration of chronic utility. Fluorescence imaging, MRI and ultrasound imaging all showed persistence of HSN in the brain for over two months (*Figure 4*), with gradual signal decline consistent with biodegradation and clearance. In the VTA, fibre photometry using GCaMP6s showed that ultrasound continued to evoke rapid and reversible calcium responses up to nine weeks after HSN injection. Although response amplitude declined modestly over time, latency remained stable, indicating durable functional performance. Histological analysis suggested that extracellular persistence was accompanied by uptake into astrocytes, neurons and especially microglia, implicating microglia-mediated clearance as a likely pathway. For chronic neurological disorders, this balance between persistence and eventual biodegradation is highly relevant.

The most translationally important aspect of the study is its application to PD models. In an MPTP-induced mouse model, the team injected HSN into the STN, a clinically established DBS target, and delivered repeated ultrasound over nine weeks. Mice receiving HSN plus ultrasound showed progressive improvement in rotarod performance, indicating better motor coordination, while saline-treated controls did not. Open-field testing similarly showed increased locomotor activity and mobile time in the treated group. Importantly, these gains persisted for at least two weeks after the treatment period ended, suggesting more than an immediate stimulation effect.

To understand how the treatment worked, the team examined dopamine activity in brain circuits linked to movement. Ultrasound stimulation of the HSN-targeted STN increased dopamine signalling, suggesting that the approach activated pathways affected in Parkinson's disease. Treated mice also showed better preservation of dopamine-related neurons. Similar benefits were seen in a second Parkinson's model, indicating that this ultrasound-based method may achieve some DBS-like effects without implanted electrodes.

The safety results were encouraging. Over two months, mice given HSN maintained normal weight and no deaths were recorded. Tests of movement, memory and cognition did not show clear differences from control animals. Brain tissue analysis also found no obvious signs of cell death, inflammation or damage. Because the study used low-intensity ultrasound, the risk of overheating or physical injury was also reduced. Even so, longer-term safety studies will still be needed before clinical use.

In summary, this study provides a compelling proof of concept for chronic, localised and minimally invasive neuromodulation using ultrasound and hollow silica nanostructures. The work is particularly relevant to age-related neurological disease because it addresses a central translational challenge: how to stimulate deep brain circuits precisely, repeatedly and safely without implanted hardware or genetic manipulation. For PD and, potentially, other chronic neurological disorders, it suggests a future in which engineered nanomaterials and focused acoustic energy may complement or in some cases reduce reliance on, conventional invasive neuromodulation strategies.

Prof. Sun has 25 years of research and development experience in medical ultrasound technology, including in system development, signal/image processing and biomedical applications. He holds more than ten US and Chinese patents, either granted or filed. As a Principal Investigator, he has led research projects in Hong Kong and Chinese mainland with total funding of over HKD76 million. In recognition of Prof. Sun's outstanding research achievements in the field of biomedical engineering, he was awarded a fellowship under the Research Grants Council's (RGC) Senior Research Fellow Scheme (SRFS) 2025/26.

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Stepping into Safety: How Immersive VR Can Help Prevent Falls in Older Adults

VR Training Improves Cognitive-Motor Performance and Gains Strong User Acceptance Among Older Adults



Prof. Kenneth Nai Kuen FONG
Associate Head (Research, Innovation and Knowledge Transfer) and Professor, Department of Rehabilitation Sciences
Director, Research Centre for Assistive Technology
Associate Dean (Community and Global Engagement), Graduate School

As the use of VR in healthcare continues to grow, it offers not only an engaging approach to promoting healthy ageing but also valuable clinical applications. Prof. Fong has actively explored this cutting-edge technology for older adults' fall prevention, developing a fully immersive VR training programme that has delivered significant and promising results in both research and practice.

Virtual reality is moving steadily beyond entertainment and into the mainstream, including in healthcare. Over the past decade, clinicians and researchers have explored how immersive digital environments can support rehabilitation, pain management, mental health interventions and physical training. In ageing care, VR is attracting particular interest because it can create safe, controllable and engaging environments in which older adults can practise everyday tasks without facing the real-world consequences of a mistake. That matters especially in fall prevention, where both physical and cognitive factors play a role.

This is highly relevant for older adults with mild cognitive impairment (MCI), a group known to face elevated fall risk. Changes in attention, executive function and judgement can make walking in complex environments more hazardous, while fear of falling can further reduce confidence and mobility.

Against this backdrop, Prof. Kenneth Nai Kuen FONG, Associate Head (Research, Innovation and Knowledge Transfer) and Professor of the Department of Rehabilitation Sciences at The Hong Kong Polytechnic University (PolyU), and his research team, in collaboration with the University of Southern Queensland, have explored whether a fully immersive VR training programme could provide a meaningful new approach to fall prevention. The first study is published in *Sensors* [1]. Their work not only examines whether VR could improve fall-related outcomes, but also whether older adults would actually accept and engage with the technology, which is an essential consideration for real-world adoption in smart ageing services.



Figure 1.
3D stereoscopic glasses for the VirCube VR application

At the centre of the project was a full-immersive Cave Automatic Virtual Environment, or VR CAVE, using the VirCube VR for Rehab programme. Unlike conventional head-mounted VR systems, the CAVE setup is designed as a room-scale immersive environment in which users wear 3D stereoscopic glasses rather than a headset (*Figure 1*). This age-friendly design is vital for older users, as it may reduce discomfort, dizziness and simulator sickness often associated with head-mounted displays. Motion sensing and interactive game modules allow participants to move through simulated scenarios while receiving close supervision from trained staff.

The PolyU fall prevention programme was developed as a cognitive-motor intervention for older adults at risk of falls, particularly those with MCI. The VR modules included outdoor walking, balance activities, fire emergency handling and daily community practice (*Figure 2*). These were not simple games for entertainment; they were designed to require dual-task performance, combining movement with attention, judgement and executive functioning. Participants in the intervention group attended two sessions per week, completing 16 sessions over eight weeks. Each session lasted around 45 minutes and included three to four modules, with breaks between activities to avoid fatigue.

The first study examined whether this training could reduce risk factors for falls among older adults with MCI in Hong Kong. Fifty-five eligible participants were assigned either to the VR group or to a control group receiving non-VR falls prevention support in community aged care settings. Outcomes were measured at baseline, post-intervention and three-month follow-up. The primary outcome was the number of falls post-programme, while secondary outcomes included cognition, executive function, balance, walking performance, functional mobility and fear of falling.

The findings are encouraging (*Table 1*). Most notably, the VR group showed significantly greater improvement than the control group in several cognitive-motor measures across time. Cognitive performance, measured

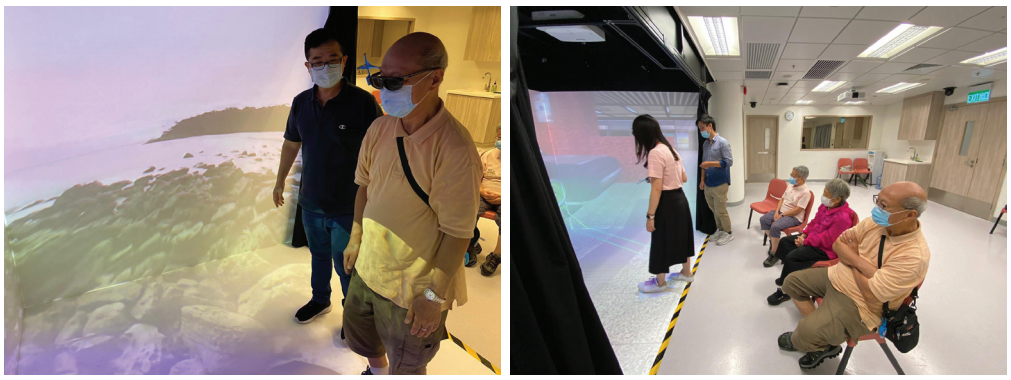


Figure 2. Participants in a supervised training session

Table 1. Comparison of outcome measures between and within groups

Outcome Measures	Group	Outcomes(M ± SD)			Comparison		
		Pre=Test	Post-Test	Follow-Up	Multivariate Comparison	Within Group	Between Group
Cognition (HK-MoCA)	VR	22.68 (0.69)	25.72 (0.79)	25.96 (0.81)	0.008**	0.000**	0.000**
Cognition (HK-MoCA)	Control	20.00 (0.63)	20.97 (0.72)	21.2 (0.74)			
Executive Function (TMT-A)	VR	65.85 (8.45)	47.29 (6.93)	42.94 (6.24)	0.038*	0.000**	0.038*
Executive Function (TMT-A)	Control	69.63 (7.14)	61.68 (6.32)	64.52 (6.07)			
Executive Function (TMT-B)	VR	104.28 (13.96)	83.16 (14.49)	72.88 (15.41)	0.006**	0.172	0.041*
Executive Function (TMT-B)	Control	119.61 (12.74)	109.83 (13.22)	140.01 (14.66)			
Balance (BBS)	VR	50.72 (0.98)	52.84 (1.65)	53.21 (1.16)	0.032*	0.311	0.047*
Balance (BBS)	Control	50.70 (0.90)	47.33 (1.15)	50.13 (1.05)			
Walking Speed (6MWT)	VR	318.51 (13.18)	365.10 (12.82)	373.68 (13.02)	0.001**	0.002**	0.002**
Walking Speed (6MWT)	Control	303.84 (12.03)	298.42 (11.07)	305.19 (11.89)			
Functional Mobility (TUG)	VR	11.48 (0.93)	9.27 (0.56)	8.46 (0.71)	0.938	0.000**	0.000**
Functional Mobility (TUG)	Control	15.01 (0.85)	12.61 (0.51)	12.07 (0.66)			
Fear of Fall (FES-I)	VR	43.64 (2.31)	39.00 (2.35)	33.48 (2.01)	0.148	0.001**	0.299
Fear of Fall (FES-I)	Control	37.16 (2.10)	38.80 (2.15)	33.53 (1.84)			

M = mean; SD = standard deviation; *p ≤ 0.05; **p ≤ 0.01

VR = Virtual reality; HK-MoCA = Montreal Cognitive Assessment Hong Kong version; BBS = Berg Balance Scale; 6MWT = 6 Minute Walk Test; TMT-A = Trail Making Test - A; TMT-B = Trail Making Test - B; TUG = Time Up and Go Test; FES-I

by the Hong Kong Montreal Cognitive Assessment (HK-MoCA), improved more strongly in the VR group. Executive function, assessed by Trail Making Tests A and B (TMT-A & B), also showed favourable changes, suggesting that immersive dual-task training may help stimulate the kinds of higher-order functions linked to safer navigation and movement in daily life. This is a crucial point for smart ageing professionals, because it reinforces the idea that fall prevention is not only about muscle strength or balance drills, but also cognition matters.

Physical performance measures also pointed in a positive direction. Participants in the VR group showed significantly greater gains in balance, as measured on the Berg Balance Scale (BBS), and in walking endurance and speed, measured by a six-minute walk test (6 MWT). These improvements suggest that immersive VR can support meaningful functional training rather than only serving as a motivational add-on. In practical terms, the programme appears to have helped participants practise safer movement in a stimulating environment that integrates both physical and cognitive demands. The primary outcome adds another layer of promise. Post-study, the VR group recorded two fall incidents, compared with five in the control group.

The second study, published in *Virtual Reality* [2], compared the effects of full-immersive VR training with group-based exercise (Baduanjin) training on falls prevention for 18 older adults with MCI and a history of falls in the past two years. Both groups participated in 16 falls prevention training sessions over eight weeks. The VR group showed significantly greater improvement than the non-VR group on measures of cognitive-motor performance, such as global cognition, functional mobility, balance and walk speed over time. However, no significant differences were observed between the two groups in executive functions and fall efficacy.

Although these two feasibility studies were not powered to make definitive claims about fall reduction itself, the direction of the results is clinically relevant. For professionals working in rehabilitation, community care and age-tech innovation, even a suggestion of a reduction in the number of falls is worthy of attention, given the enormous health, social and economic consequences of falls in later life.

Fall efficacy showed less consistent differences between groups, and fear of falling remained relatively high despite some improvement. This may reflect the complexity of fear-related outcomes, which are shaped not only by physical capability but also by past experiences, confidence, social restrictions and living environments. Even so, the overall pattern is noteworthy: immersive VR training appears to have delivered stronger gains in the areas most closely tied to cognitive-motor performance.



Figure 3. Participants engaging in the VR game activities

This study is significant not simply because it reports positive outcomes, but also because it illustrates how an emerging technology can be translated into a practical programme for older adults. The intervention protocol was structured, supervised and feasible, with participants attending repeated sessions and engaging with a demanding but manageable format. This matters for industry and service providers considering implementation. A smart ageing technology is only useful if it can be integrated into workflows, adapted for older users and sustained over time.

There is also a broader strategic implication. Falls prevention services were heavily disrupted during the pandemic, exposing the fragility of traditional face-to-face delivery models. In this context, technologies such as VR offer not just novelty, but resilience. Immersive platforms can diversify intervention options, enrich therapist-led programmes and potentially support more personalised and engaging rehabilitation pathways. This work therefore contributes to a larger conversation about how digital and sensing technologies can strengthen aged care systems.

The team's third study, published in *Human Behaviour and Emerging Technologies* [3], addressed the adoption question directly by examining usability and acceptance of the same VR CAVE programme among older adults in Hong Kong. Thirty-one participants completed 16 training sessions (*Figure 3*) and were assessed using a VR usability questionnaire based on the Technology Acceptance Model.

The results showed significant positive changes over time in perceived usefulness, perceived enjoyment, user experience and intention to use. In other words, participants not only completed the programme but also increasingly viewed it as worthwhile, engaging and something they would consider using in future. Perceived ease of use and social norms were less consistent, which is unsurprising for a relatively unfamiliar and technically supported system introduced during the socially restrictive conditions of COVID-19. Even so, the overall trend was positive. Participants also showed significant improvements in balance, walking speed, functional mobility and fear of falling within the single-arm study. For smart ageing stakeholders, this is a crucial message: acceptance cannot be assumed, but when the design is age-friendly and support is built in, older users may be far more open to immersive technology than commonly believed.

The study makes a compelling case for the role of immersive VR in future smart ageing practice. First, the team suggests that full-immersive VR CAVE training can function as more than an attention-grabbing interface. It may support measurable improvements in cognition, executive function, balance and walking performance among older adults with MCI. Second, they show that older participants can find the technology useful, enjoyable and worth continuing. This combination of clinical promise and user acceptance is exactly what the field needs if innovation is to move beyond pilots and into service models.

VR will not replace human care, nor should it, but as populations age and demand for preventive, engaging and scalable interventions continues to rise, immersive technologies may become a major part of the ageing care toolkit. The study offers an early but persuasive glimpse of that future. One in which older adults can step into a virtual world not to escape reality but to move through it more safely.

Prof. Fong was recognised by Stanford University as one of the top 2% most-cited scientists worldwide (single-year) in the field of rehabilitation for two consecutive years, from 2024 to 2025. He was also ranked world no. 1 in upper limb (prior five years) by ScholarGPS in 2025 and received the Hong Kong ICT Award's Smart People (Smart Ageing) Certificate of Merit in 2023. Prof. Fong has led his teams to win numerous awards for the design of assistive technology products, including a prestigious Innovation Award at the Consumer Electronics Show 2026 in Las Vegas, a Bronze Medal at the 3rd Asia Exhibition of Innovations and Inventions Hong Kong in 2023, a Silver Prize in Social & Community Engagement and the Social Capital Builder Logo Award at the 2nd Smart Ageing Award 2022 as a team member, and the Best Dementia Care Programme award at the 10th Asia Pacific Eldercare Innovation Award 2022.

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When Digital Painting Meets Dementia Care Support

PolyU EPPS Platform Offers Caregivers a Flexible Creative Outlet



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Associate Director, Research Institute for Smart Ageing

Dementia is increasingly prevalent among older adults in Hong Kong, impairing cognitive function and daily self-care while placing substantial stress on caregivers. Led by Prof. Leung, Hong Kong's first electronic painting and peer supportive platform of its kind offers meaningful relief to caregivers and demonstrates how technology can help address the challenges of an ageing society.

Dementia affects not only the individual diagnosed, but also the family members who provide daily care. For family caregivers of persons with dementia, the demands are often intense, prolonged and unpredictable. They may need to manage wandering, mood changes, sleep disruption, communication difficulties and increasing dependence in everyday activities.

Compared with many other caregiving roles, dementia care can place a particularly heavy emotional burden on caregivers because symptoms evolve over time and often affect behaviour as much as physical function. Many caregivers experience anxiety, depression, exhaustion and social isolation, yet may struggle to attend face-to-face support programmes because they cannot easily leave the person they care for unattended.

Digital art therapy offers one possible response. Painting has long been used as a means of emotional expression and stress relief, while mobile technology makes creative activity practicable at home and on demand. For caregivers with little uninterrupted time, a digital platform can provide a simple, self-paced way to relax, reflect and reconnect.

This was the rationale behind the electronic painting and peer supportive (EPPS) platform (*Figure 1*), developed by Prof. Angela Man Yee LEUNG, Associate Head (Research) and Professor of the School of Nursing at The Hong Kong Polytechnic University (PolyU), and her research team.

Designed for family caregivers of persons with dementia, the app combines electronic painting with peer communication and basic self-monitoring. Users can create paintings on a smartphone or tablet using different brushes and colours, share their work with others, interact through a chatroom, view announcements and complete self-assessments. Background music was also added to make the experience more soothing. A study published in *Healthcare* [1] illustrated the design of the app and examined whether caregivers would use such a platform at home, whether they found it acceptable and whether it showed preliminary benefits for their well-being.

The research used a two-phase mixed-methods design. Phase 1 focused on app development. Before the platform was finalised, 22 caregivers took part in focus group interviews to discuss their preferences and training needs. This co-design stage was central to the project. Rather than developing the platform in isolation, the team built it with input from intended users. Participants suggested features such as background music, a wider range of colours, mood-related functions and demonstrations to guide painting. They also said hands-on practice would be helpful before using the app independently, particularly for downloading the app, navigating functions, and uploading or sharing images.

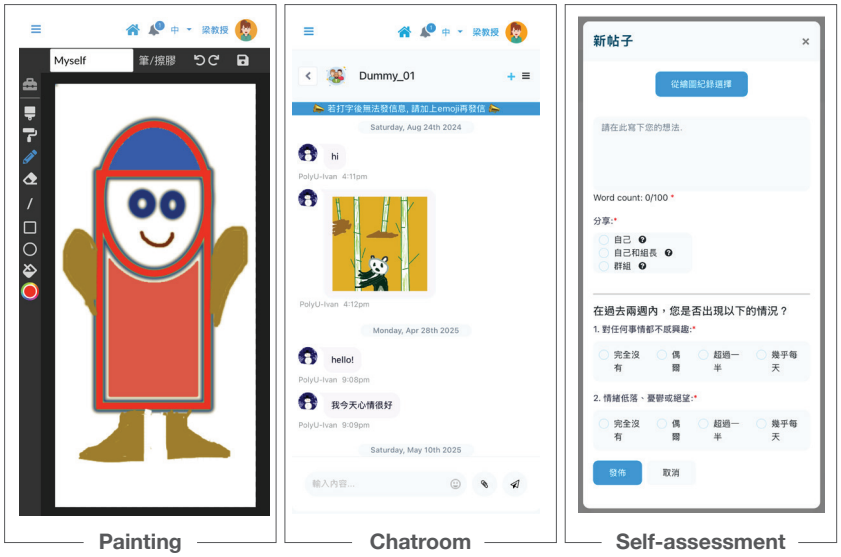


Figure 1. Layout and selected functions of EPPS app

Their feedback shaped the revised version of the platform used in Phase 2 of the research. In this second stage, 28 family caregivers were invited to use the EPPS platform over eight weeks. Participants were encouraged to create at least two paintings per week, though they were free to paint more. They could also share their paintings with friends or

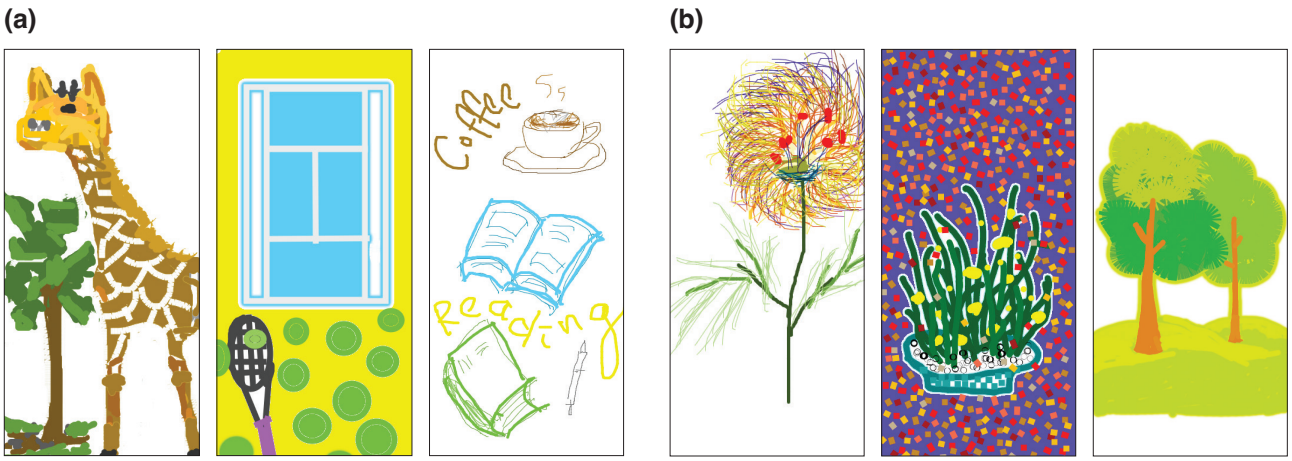


Figure 2. Paintings by participants
(a) On the topic "A place I want to go when I am free" **(b)** On the topic "A plant I like"

relatives, use the chatroom, and complete self-assessments at the start and end of the intervention. To encourage engagement, the app administrator posted weekly themes through the announcement function (*Figure 2*).

To evaluate the platform, the team collected both quantitative and qualitative data. Caregiver burden, depressive symptoms, self-rated health and social support were measured before and after the intervention. Post-intervention interviews explored how participants experienced the app and what role it played in their daily lives. This mixed-methods approach was well suited to an early-stage digital health study, allowing the team to look beyond metrics alone and capture the lived meaning of use.

Usage data help to show how the EPPS platform fitted into caregivers' routines. Across the intervention, participants produced a total of 116 pictures. The average number of logins was 6.89, though usage varied considerably. Most participants logged in between one and eight times, while two high-frequency users logged in 20 and 23 times respectively. Sharing behaviour was also notable. Most participants shared their paintings with friends or relatives, and login frequency was strongly correlated with the sharing of paintings ($r = 0.72$, $p < 0.001$). This indicates that more active use of the platform was closely linked to its social dimension.

Patterns of use over time were also revealing. App usage and picture sharing peaked in Week 1, when 45 login sessions and 54 shared pictures were recorded. Activity then declined after Week 2, reached a low point in Week 6, rose sharply again in Week 7, and tapered towards Week 8. This trajectory reflects a common pattern in digital interventions: strong initial engagement, followed by fluctuation as use competes with daily responsibilities. Even so, some participants continued using the platform after the formal eight-week period, suggesting that the app retained personal value beyond the study timetable.

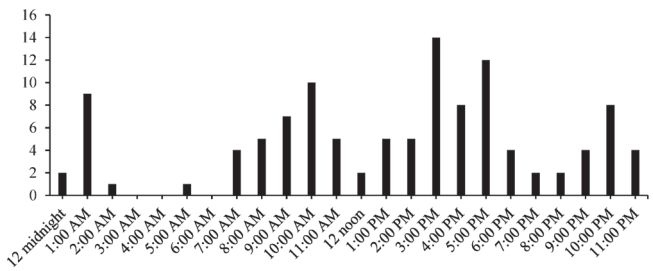


Figure 3. Participants' usage and timing of using the EPPS platform

Particularly interesting was the timing of app use. Five peak hours emerged: 1 am, 10 am, 3 pm, 5 pm and 10 pm (*Figure 3*). These are not conventional service hours. They are the leftover hours of caregiving life. The late evening and early morning peaks suggest that some caregivers used the app after the person with dementia had settled for the night or during periods of wakefulness and stress. Daytime peaks may reflect brief windows of respite.

The qualitative findings provide a fuller picture of what the EPPS platform meant to users. Four themes were identified: satisfaction and enjoyment in using the app; the app as a channel to ventilate emotions; the app making users feel connected; and caregivers' efforts to cope with the challenges of dementia care.

Participants generally found the app easy to use, convenient and enjoyable. They appreciated the simplicity of digital painting. If they were unhappy with a drawing, they could erase it and start again, which reduced the pressure that some may associate with traditional painting. This low-barrier format appears to have made creative participation more approachable, even for users without prior artistic experience.

Perhaps more important was the app's emotional function. Caregivers described painting as a way to release frustration, stabilise their mood and briefly step away from the pressures of care. One participant said, "*Whenever I paint, I feel like I'm brushing away all the negative events.*" Another explained, "*Painting can soothe my bad mood … I see it as a way to let go of bad feelings.*" Such comments suggest that the platform supported emotional regulation by offering a quiet and private means of self-expression.

The peer-support element also emerged as a meaningful

Table 1. Psychosocial Assessment before and after the use of EPPS

Psychosocial Well-Being	Pre		Post		Mean Difference	*t*	*p*	Cohen's D
	Mean	SD	Mean	SD	(SD)			
CZBI-Short	30.71	7.15	33.57	6.89	2.86 (4.87)	3.10	0.004	0.41
SRH	3.14	0.93	3.18	0.77	0.04 (0.92)	0.21	0.839	0.05
PHQ-9	15.25	4.95	15.61	5.03	0.36 (3.20)	0.59	0.560	0.07
mMOS-SS	20.14	6.00	21.32	5.48	1.18 (5.31)	1.17	0.251	0.21

feature. Several participants described limited support from family members and a lack of understanding from others. Some also referred to stigma around dementia and caregiving stress, which made it difficult to speak openly in everyday life. Within the app, however, they could see others' paintings, exchange messages and feel that someone else understood similar experiences. The chatroom and shared artwork therefore helped to create a sense of connection among users who might otherwise feel alone.

These findings are particularly relevant for the nursing sector because they show that value in digital caregiving tools does not come only from efficiency or monitoring. Emotional resonance, simplicity and social recognition also matter. In the case of EPPS, the combination of painting and peer contact appears to have made the platform more than a digital pastime. It became a small supportive space within an otherwise demanding caregiving environment.

The quantitative findings on psychosocial well-being were more measured (*Table 1*). There were no significant changes in depressive symptoms, self-rated health or perceived social support after the eight-week intervention. Caregiver burden increased significantly, with a mean difference of 2.86 ($t = 3.10$, $p = 0.004$). Yet these outcome measures sit alongside qualitative evidence showing that participants valued the app as enjoyable, emotionally expressive and socially connecting. It suggests that the platform's contribution may lie less in generating rapid changes in broad psychosocial indicators and more in providing an accessible, user-centred form of support that caregivers can turn to in stressful moments.

This study offers several important lessons. First, family caregivers of persons with dementia are willing to engage with digital psychosocial interventions when these are designed around their real circumstances. Second, co-design matters: features such as music, colour variety and guided support emerged from user input, not from technical assumption. Third, engagement is closely linked to flexibility. The irregular hours of use underscore the importance of digital tools that are available whenever caregivers have time, not only when services are scheduled.

The EPPS platform demonstrates how digital health innovation can support caregivers in a more humane and responsive way. By combining creative expression, peer interaction and mobile accessibility, it provided family caregivers of persons with dementia with a practical outlet for emotion and connection. In a field often dominated by conversations about efficiency, surveillance and clinical outcomes, EPPS points to another dimension of smart ageing: technologies that support the inner lives of caregivers as well as in the practical demands they face.

Following the trial, the platform received support under the Mental Health Initiatives Funding Scheme (Round 2), with funding of HK$2 million. The scope of the programme was subsequently extended to include caregivers of people with dementia, frail older adults and individuals with disabilities, benefiting approximately 800 users between 2023 and 2025. The outcomes of this extended implementation further support the findings reported in this article. In 2026, PolyU was granted the intellectual property rights by the HKSAR Government, enabling patent application and commercialisation of the system. These developments indicate the platform's potential for sustained translation into community-based digital mental health support.

Prof. Leung was recognised by Stanford University as one of the top 2% most-cited scientists worldwide (single-year) in the field of nursing for three consecutive years, from 2023 to 2025. She is a leading scholar in health literacy, dementia caregiving and healthy ageing, internationally recognised for developing technology-enabled solutions to improve the lives of older adults and caregivers. Her major honours include the Excellent Health Promotion Project Award (HKSAR Government, 2021), the Hartford Geriatric Scholars Program Award (Johns Hopkins University, 2014), the Distinguished Gerontological Nursing Educator Award (2018) and the Trailblazer Award in Medical & Health at the Smart Ageing Award 2025. She currently oversees more than HK$37 million in active research funding, supporting major projects in COVID-19 interventions, health literacy, dementia care and home-based robotic assistance. Beyond academia, she served as President of the Asia Health Literacy Association (2024–2025) and currently serves as a consultant to the Labour and Welfare Bureau and Department of Health of the HKSAR Government. She also contributes to public service through appointments to major grant review panels and elderly care-related committees in Hong Kong and international health networks.

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Beyond the Hype: Older Adults' Perspectives on Smart Healthcare in Hong Kong

What Interview Findings Reveal about Design, Adoption and Support

As smart ageing receives growing attention and related technologies become increasingly prevalent, how readily do users adopt smart healthcare technologies? Prof. Luximon conducted a detailed survey to examine older adults' acceptance of these technologies and the barriers they encounter, offering valuable insights to support the future development of useful, user-centred products for the healthcare industry and its evolving needs.



Prof. Yan Tina LUXIMON
Associate Dean (Research) and Professor,
School of Design

As Hong Kong's population ages, smart healthcare technologies (SHCTs) are increasingly seen as part of the answer to rising health and care needs. Wearables, health monitoring stations and mobile health apps are already being promoted to help older adults manage chronic conditions, stay active and access services more efficiently. However, market availability does not necessarily mean meaningful adoption. Real-life use depends on whether these tools are understandable, affordable and relevant in everyday life.

In an exploratory interview study published in *Gerontology* [1], Prof. Yan Tina LUXIMON, Associate Dean and Professor of the School of Design at The Hong Kong Polytechnic University, and her research team examined how older adults in Hong Kong actually experience SHCTs in practice. Rather than focusing on intention to use, it explored what they are already using, what needs these technologies meet, what barriers remain and what kinds of support make adoption easier.

The study found that older adults in Hong Kong are already using SHCTs, especially to support physical health. Three types were featured most often: smart wearable devices (SWDs), smart health monitors (SHMs) and healthcare applications (HCAs). Five main needs emerged: health monitoring, fall risk management, health information management, convenient access to medical services and maintaining social engagement.

In practice, current technologies were used mainly for physical rather than mental health. The study also identified four main barriers to adoption: technological, personal, financial and informational. At the same time, community-based support, especially from elderly centres, played a major role in reducing those barriers and helping older adults use technologies with more confidence.

The research was based on face-to-face semi-structured interviews with 22 older adults in Hong Kong, with an average age of around 73. Most were living independently, although the majority were managing at least one chronic condition. All had used at least one form of SHCT. This is important in itself: the issue is not whether older adults are using smart healthcare at all, but how well current technologies fit into their lives.

Physical health is where SHCTs currently work best

The clearest finding in the study is that SHCTs are mainly supporting physical health management. Participants used health monitoring stations, wearables and apps to track indicators such as blood pressure, weight, step count and general activity levels (Purple bars in *Figure 1*). For many, this offered practical support for self-management. Monitoring was not simply about collecting data; it helped users notice changes, adjust routines and stay more aware of their health.

For some, the value also came from follow-up by community staff (Green bars in *Figure 1*). Where an elderly centre was involved, readings could trigger a check-in or enquiry to seek further care. This made the technology connected to in-person support rather than it operating in isolation—the benefit came not only from the device itself, but from the surrounding service and social context.

Activity tracking was another valued feature (Deep blue bars in *Figure 1*). Step counts, exercise goals and simple forms of comparison with peers helped some participants stay motivated. This suggests that older adults do not only value SHCTs for clinical monitoring; they also appreciate tools that encourage healthier everyday habits.

Fall risk and emergency support matter, but are often adopted late

Fall risk management emerged as an important need, particularly through emergency alert functions in wearable devices. However, the study suggests that adoption in this area is often reactive (orange bar in *Figure 1*). Many older adults only began using such technology after a fall or health incident, rather than beforehand as a preventive measure.

This points to a mismatch between recognised value and real uptake. Emergency functions are clearly meaningful,

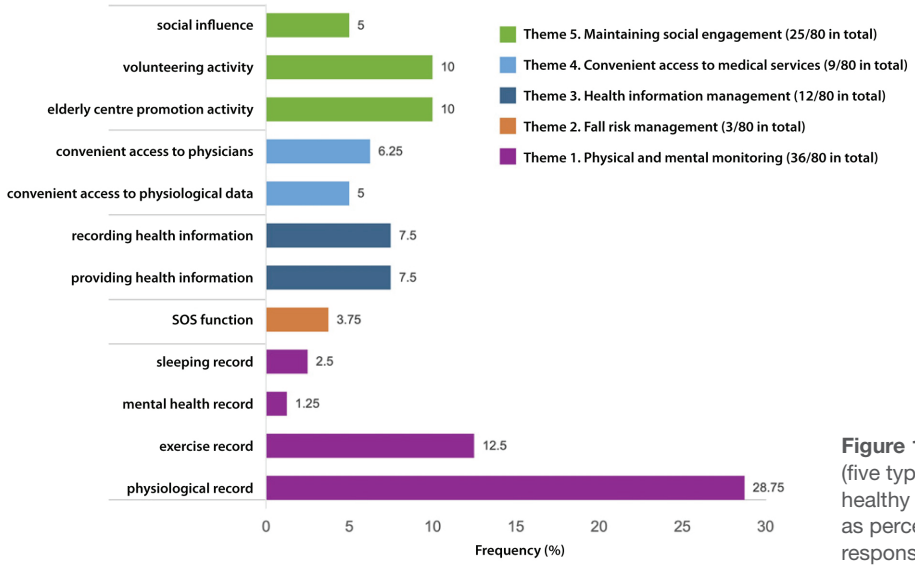


Figure 1. Frequency of themes (five types of real-life needs for healthy ageing) and 12 sub-themes as percentages of the number of responses (80 in total)

especially for those living alone or seen as physically vulnerable. However, concerns about cost, comfort or device design can delay adoption until after a crisis has already occurred.

Healthcare apps are most useful when they solve everyday problems

Healthcare applications were mainly used for managing practical information: appointment records, medical account details, medication records and allergy histories. These are not dramatic uses of technology, but they are highly relevant. They help older adults navigate the healthcare system more smoothly and communicate more effectively with clinicians.

This matters for the smart ageing sector because it shows that usefulness does not always depend on advanced functions. In many cases, technologies become valuable when they remove small but recurring frictions in daily care management.

Interest in convenient medical access is growing

Participants also expressed interest in more convenient access to healthcare, particularly online consultations or rapid digital contact with professionals. Although face-to-face care remained the preferred mode for many, the appeal of immediate reassurance was clear, especially in situations involving uncertainty about medication or symptoms.

Yet the study found that such services were still not common or well-tailored to older adults in Hong Kong. This suggests an area of opportunity for service providers and designers: not to replace in-person care, but to supplement it with age-friendly digital access where appropriate.

Mental health remains a clear gap

One of the most significant findings is what current SHCTs are not doing. While participants used technology for physical health in multiple ways, there was far less evidence of technology supporting mental health. This is striking given that some participants reported anxiety or low mood. The study argues that current SHCTs in Hong Kong still do not adequately address mental health needs in later life. This is a crucial message for both researchers and industry. Healthy ageing is not only about monitoring blood pressure or counting steps. Emotional wellbeing, loneliness and social connection are equally important, yet current solutions appear limited in these areas.

The study identified four categories of barrier, showing that adoption problems are not just technical. The responses are illustrated in *Figure 2*.

Technological barriers

Participants often struggled with small buttons on wearables, small icons and font sizes in apps, and interfaces that were difficult to learn. By contrast, fewer barriers were reported for the smart health monitors placed in elderly centres, likely because these were designed to be more user-friendly for older adults, with simple navigation and clear displays.

This comparison reinforces an important point: age-inclusive design makes a decisive difference. Where design more closely addresses users' cognitive and physical needs, barriers fall noticeably.

Personal barriers

Many participants reported technology anxiety, even when they had already gained some digital experience. They worried about making mistakes, damaging a device or not being able to learn how to use it properly. A brief training session was often not enough to build the level of confidence needed for continued independent use.

One participant captured this clearly: "*I didn't know how to use (SWDs). I was afraid that I would damage it, which is a waste of money.*" This reflects a wider issue of confidence, not simply competence.

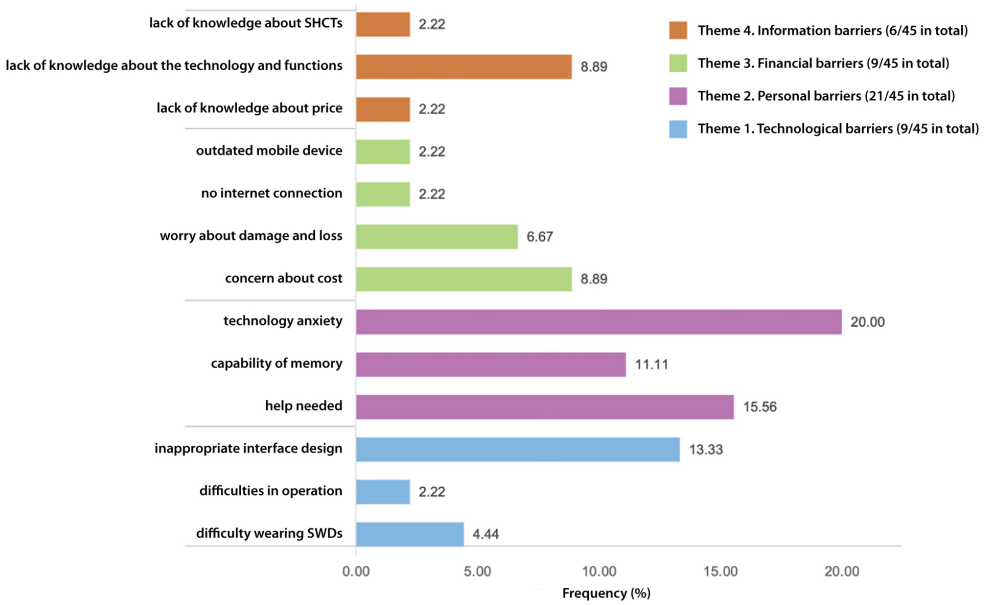


Figure 2. Frequency of themes (four types of barriers) and sub-themes as percentages of the number of responses (54 in total)

Financial barriers

Cost concerns were also common. Some older adults assumed SHCTs would be expensive before even trying them. Others faced indirect access problems: old smartphones, limited internet access or reliance on free Wi-Fi in community settings. Thus, affordability is not just about device price, but about access to the wider digital infrastructure needed to use these tools reliably.

Information barriers

A further obstacle was lack of awareness. Some participants did not know what technologies existed, what they could do or how much they actually cost. In some cases, they described needs that existing technologies might already address, but they had never been introduced to those options. This highlights the importance of outreach, demonstration and trusted information channels.

One of the strongest messages from the study is that successful adoption depends heavily on social support. Elderly centres in Hong Kong were especially important in providing training, encouragement and opportunities for peer learning. In some cases, older adults became volunteers helping others use the technologies, which strengthened both their own confidence and their social engagement. This helps explain why smart health monitors in community settings were experienced more positively than wearables or apps used more independently. Good design mattered, but so did having ongoing support nearby.

Family support also played a role, though often in a more limited way, such as helping with setup. The findings suggest that smart ageing initiatives work best when technology is embedded in a supportive local ecosystem rather than left to individuals alone.

The study provides a valuable reality check for the smart ageing field. Older adults in Hong Kong are using SHCTs in meaningful ways, especially for physical health monitoring, activity tracking and practical healthcare management. At the same time, current technologies still fall short of effectively addressing older adults' wider needs, particularly in relation to mental health.

The findings show that adoption is shaped by a combination of design, confidence, cost, information and social context. Effective smart healthcare must be usable, affordable and clearly relevant, but it must also be supported by community structures that help older adults learn, trust and continue using it. If smart healthcare is to contribute fully to healthy ageing, it must be fit for real life, not just technological ambition.

Prof. Luximon is Leader of the Asian Ergonomics Design Lab and Chair of the School of Design Research Committee. She has published over 150 peer-reviewed journal papers, books, book chapters, patents and international conference papers. Her research interests include ergonomics in design, anthropometry and its application in design, 3D digital human modelling and CAD, AI design tool and visualisation, head and face related products, human computer interaction, cultural difference, and statistical and mathematical models. Her ergonomic designs have earned her several international awards, including a gold medal with congratulations of the Jury in the 49th International Exhibition of Inventions of Geneva in 2024 and a silver award in the International Design Excellence Awards 2023.

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Caring for the Carers: A Nature-Based Mindfulness Programme for Caregivers

A Study on the Use of Mindfulness in Natural Settings to Alleviate Caregiver Stress

When discussing smart ageing, older adults are often seen as the primary focus, yet the well-being of their caregivers also merits attention. Amid today's growing interest in mindfulness as a contemporary approach to health and well-being, Prof. Lo, an expert in mindfulness programme design, presented and evaluated his nature-based mindfulness programme, drawing wider attention to those caring for older adults.



Prof. Herman Hay Ming LO
Associate Professor,
Department of Applied Social Sciences

Discussions of population ageing often centre on older adults themselves: how to promote their health, independence and social connectedness. Yet in Hong Kong, as in many ageing societies, a substantial proportion of care is provided not by formal institutions but by family members. Adult children, spouses and other relatives frequently support older people living with frailty, chronic illness and dementia, often while simultaneously managing employment, family responsibilities and financial pressures of their own.

This reality represents a significant gap in prevailing discussions of smart ageing. Considerable attention is devoted to eldercare services, age-friendly design and technological innovation, but far less attention is directed towards the well-being of the individuals who sustain caregiving on a daily basis. When caregivers experience exhaustion, anxiety or physical strain, the resilience of the broader care system is undermined.

A recent Hong Kong study conducted by Prof. Herman Hay Ming LO, Associate Professor of the Department of Applied Social Sciences at The Hong Kong Polytechnic University, provides an important perspective on this issue. The study examined whether a nature-based mindfulness programme could enhance the mental health of family caregivers, including caregivers of older adults. Its findings are encouraging, particularly for scholars, practitioners and policymakers seeking more humane and sustainable models of ageing support. The study report was published by the Hong Kong Family Welfare Society [1].

Why Mindfulness, and Why at This Time?

Mindfulness is commonly defined as the practice of attending to present-moment experience with openness and non-judgement. Over the past two decades, mindfulness has extended well beyond specialist clinical settings. Mindfulness-based programmes are now widely employed to support stress reduction, emotional regulation and psychological well-being across healthcare, educational and occupational contexts.

For caregivers of older adults, such approaches are particularly relevant. Many caregivers are confronted not only with short-term problems that can be readily resolved, but also with chronic and cumulative stressors. Caring for a person with dementia, for example, may involve emotional burden, role conflict, sleep disruption and sustained vigilance. In Hong Kong, these challenges may be intensified by cultural expectations surrounding filial responsibility, the practical constraints of co-residence and limited opportunities for self-care.

However, conventional mindfulness programmes are not always accessible to caregivers. Standard interventions often span eight weeks and require regular home practice. For individuals already burdened by caregiving duties, consistent attendance and sustained engagement may be difficult. This underscores the importance of developing shorter, lower-intensity and more feasible interventions.

The Programme

The study formed part of the three-year "Sunny Nature" Family Wellness Project (from April 2021 to June 2024), funded by The Hong Kong Jockey Club Charities Trust and implemented by the Hong Kong Family Welfare Society (*Figure 1*).



Figure 1. Press Conference to Release the Evaluation Study

Themes	Mindfulness practice	Possible nature-based activities
Session 1 Stepping out of automatic mode	Mindful eating Body scan	Mindfulness of five senses
Session 2 Reacting vs responding	Three-minute breathing Mindfulness of breathing	Mindful stretching
Session 3 Creating an inner space	Mindfulness of body and breath	Mindful walking Mountain meditation
Session 4 Bringing compassion to life (self-care and taking care of family members)	Body scan; Mindful sitting; Befriending exercise	

Table 1. Session plans of the nature-based mindfulness programme

Designed by Prof. Lo, the intervention was a low-intensity nature-based mindfulness programme comprising four weekly sessions, with a total duration of eight hours (*Table 1*). It was developed for two participant groups: caregivers of older adults with dementia or frailty and parents under stress.

The programme integrated core mindfulness practices, including a body scan, breathing exercises, mindful sitting and mindful movement, with activities explicitly engaging the natural environment. The activities included sensory awareness exercises, mindful walking and mountain meditation. Sessions were conducted mainly at the Zonta White House Family Retreat Centre in Tai Po, in a tranquil setting with gardens and green surroundings, and at community service units when necessary (*Figure 2*).

A total of 95 participants enrolled in the programme, including 40 caregivers of older adults. The study adopted a mixed-methods design. Participants completed validated questionnaires at four time points: one month before the programme (T0), immediately before the intervention (T1), immediately after the intervention (T2) and three months post-intervention (T3). The measures assessed depression, anxiety, stress, physical distress, daily functioning, well-being, family functioning, family conflict and connectedness with nature. Focus group interviews were also conducted to explore participants' subjective experiences of the programme.

For caregivers of older adults, the findings were notably positive.



Figure 2. Participants joining the programme at the White House

Comparisons between pre-intervention and post-intervention scores indicated significant improvements in levels of depression, anxiety, stress and physical distress, as well as in daily functioning and well-being. Improvements were also observed between the pre-intervention assessment and the three-month follow-up in family functioning and connectedness with nature (*Figures 3 and 4*).

Caregivers reported improvements in emotional well-being, a reduction in physical strain and an improved capacity to manage daily life following the intervention. Some benefits also appeared to be sustained beyond the end of the four-session programme.

The effect on depression was of moderate magnitude, while effects on the remaining measures ranged from small to moderate. Given the brevity of the intervention and the chronic stress experienced by this population, these findings may be regarded as meaningful.

The Role of Nature

One of the most noteworthy aspects of the study is its attempt to examine not only whether mindfulness was beneficial, but also whether the natural setting contributed meaningfully to the observed outcomes. Natural environments have long been recognised as potentially restorative, particularly in relation to stress and attentional fatigue. For caregivers, this is especially pertinent. Caregiving often entails continuous monitoring, anticipation and response. Exposure to nature may offer an alternative form of attentional engagement—less effortful, more expansive and potentially restorative.

The qualitative findings provide useful insights into this process. Participants described the White House as a setting in which they could momentarily disengage from the demands of everyday caregiving and experience a sense of relief.

One caregiver remarked: "*Arriving in that environment indeed helps people relax. When you enter a peaceful place like the White House it changes the mood… Especially when I take a leisurely walk in the garden, taking small steps and enjoying the surroundings.*"

Another participant reflected: "*When we walk slowly and mindfully, our hearts become calm… It teaches us not to rush and to take our time.*"

These reflections, while simple in expression, highlight an important dimension of caregiving support. The value of the programme lay not only in the acquisition of mindfulness techniques, but also in being situated within an environment conducive to slowing down, reconnecting with bodily awareness and shifting away from reactivity.

The quantitative findings were consistent with this interpretation. Connectedness with nature significantly predicted improvements in levels of depression among caregivers, both immediately after the programme and at

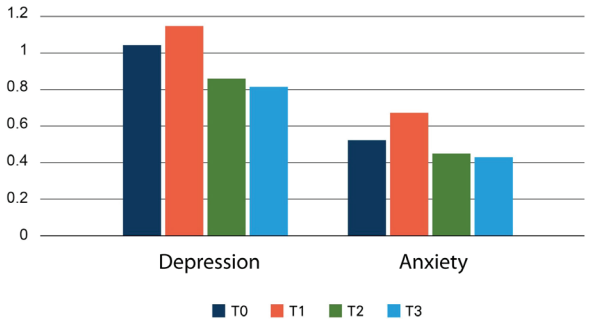


Figure 3. Results for caregivers of older adults (1)

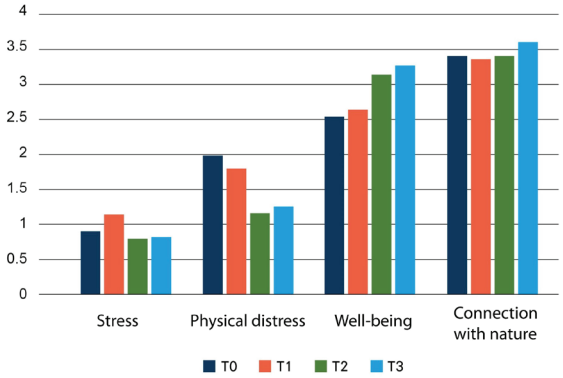


Figure 4. Results for caregivers of older adults (2)

follow-up. It also significantly predicted improved levels of family functioning at follow-up. Notably, the number of hours spent at the White House was not itself a significant predictor. This suggests that the therapeutic value of the intervention may depend less on the amount of time spent outdoors than on an individual's subjective sense of connection with the natural environment.

For practitioners, this distinction is important. A nature-based approach is not simply a conventional mindfulness class delivered outdoors. Rather, it requires intentional design such that the natural environment becomes an active component of the therapeutic process.

Implications

This study has several implications for professionals engaged in ageing-related services, programme design and policy development.

First, it strengthens the case for recognising caregiver support as a central element of eldercare. The mental health of caregivers is not peripheral to the well-being of older adults; rather, it has direct implications for care quality, family dynamics and the sustainability of ageing in place.

Second, it highlights the value of low-intensity and practicable interventions. Many caregiver support programmes struggle to achieve sustained engagement because they require commitments that are difficult for caregivers to maintain. A four-session model is unlikely to address all dimensions of caregiver burden, but it offers a practical and potentially scalable form of support.

Third, the findings broaden current understandings of smart ageing environments. Innovation in ageing is often framed primarily in technological terms. However, restorative physical environments also warrant attention. Quiet, green and accessible settings may play a meaningful role in community-based caregiver support.

Finally, the study underscores the importance of integrating emotional regulation and self-care into service design. For caregivers supporting individuals with chronic conditions such as dementia and frailty, support must extend beyond information provision or care skills. It should also include interventions that help caregivers maintain psychological stability in situations where there are no simple solutions.

This Hong Kong study of a nature-based mindfulness programme does not claim to fully address the broader structural pressures faced by family caregivers. Nevertheless, it offers a promising model of support: brief, accessible and attentive to both psychological needs and physical environment. Among caregivers of older adults, participation in the programme was associated with improvements in levels of depression, anxiety, stress and physical distress, as well as daily functioning and well-being, with additional gains in family functioning over time.

More broadly, the study highlights an important principle for smart ageing: if societies wish to promote the well-being of older adults, they must also create better conditions for those who care for them. Caregiver support should not be regarded as an optional supplement, but as an essential component of ageing infrastructure. In some cases, an effective response may begin not with greater complexity, but with something more fundamental: space to pause, breathe and recover.

Prof. Lo is a registered social worker of the Social Workers Registration Board, as well as an Associate Fellow and Approved Supervisor of the Hong Kong Professional Counselling Association. He is an expert in teaching and designing mindfulness-based programmes. His research interests include mindfulness-based interventions and the application of mindfulness in parenting and caregiving. Prof. Lo has secured several competitive external grants, including from the Hong Kong Research Grants Committee Early Career Scheme, the General Research Fund and the Public Policy Research Scheme, for randomised controlled trials on mindfulness-based intervention for parents and caregivers. He is currently an editorial board member of *Mindfulness and Scientific Reports*.

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PolyU and University of Toronto Partner to Explore Establishing Joint Research Centre, Driving Gerontechnology Innovation in Response to Ageing Population



PolyU and the University of Toronto signed a Memorandum of Understanding (MoU) on 4 February 2026 to explore the establishment of a Joint Research Centre on Healthy Ageing and AgeTech. In response to the challenges brought about by global ageing, this initiative aims to promote the development and application of gerontechnology, and enhance the quality of life and care for older adults. The partnership will foster in-depth cooperation and exchanges between Hong Kong and Toronto in research innovation, knowledge transfer and talent cultivation in the field of gerontechnology, benefitting the elderly populations of both cities and beyond.

Held on the PolyU campus, the MoU signing ceremony was attended by distinguished guests including Prof. Christopher CHAO, PolyU Senior Vice President (Research and Innovation); Prof. H.C. MAN, Dean of the PolyU Faculty of Engineering; Prof. David SHUM, Dean of the PolyU Faculty of Health and Social Sciences; and Prof. ZHANG Ming, Head of the PolyU Department of Biomedical Engineering. The MoU was signed by Prof. ZHENG Yongping, Director of the Research Institute for Smart Ageing, Henry G. Leong Professor in Biomedical Engineering and Chair Professor of Biomedical Engineering of PolyU and Prof. Alex MIHAILIDIS, Associate Vice-President, International Partnerships of the University of Toronto.

Under the MoU, the PolyU's Research Institute for Smart Ageing (RISA) and the Department of Biomedical Engineering will work closely with the University of Toronto Institute of Biomedical Engineering and its institutional strategic initiative, AGE-WELL National Network (AGE-WELL), to explore setting up the joint research centre. They will also jointly develop application-oriented gerontechnologies, and co-organise staff and student exchange programmes as well as international conferences to strengthen research and education. The two universities aspire to build a bridge between elderly care support in Hong Kong and Toronto through technology, with particular attention to the needs of Cantonese-speaking older adults and their families.

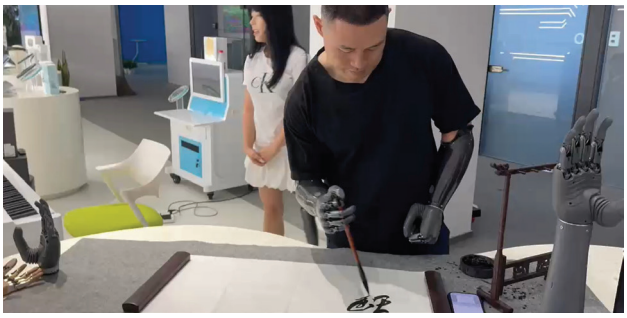
The collaboration of the two universities will enable development of a robust international platform for gerontechnology that will advance translation of research outcomes and nurture a new generation of talent in relevant fields.

In addition, the two universities will seek support from the communities in both cities, and, through the joint research centre, continuously innovate and promote the use of gerontechnology in community, with the vision of bringing older adults a "HAPPI" life: Healthy, Active, Positive, Prepared, and Independent.

PolyU and BrainCo Collaborate to Scale Deployment and Application of Smart Prosthetics for Amputees







Prof. ZHENG Yongping, Director of Research Institute for Smart Ageing (RISA) and Chair Professor of Biomedical Engineering, has recently entered into a deep collaboration with BrainCo to promote the deployment and application of advanced smart prosthetics.

According to the latest Chief Executive's Policy Address, the government will support the initiative via the funding from the Innovation and Technology Fund, and the initiative aims to provide amputee subjects in Hong Kong with free smart prosthetic fitting services. The PolyU team will oversee the entire process in collaboration with BrainCo, from initial assessment and installation to precise calibration, while providing two years of complementary maintenance and repair. To make the service more sustainable and accessible, the team also aims to train professional prosthetists and orthotists, with plans to extend this training to the serving clinicians in department of prosthetics and orthotics in hospitals of the Hospital Authority. This will help enhance the industry's capacity in delivering high-end prosthetics.

Prof. Zheng explained that the core technological breakthrough lies in the sophisticated interpretation of electromyography (EMG) signals. When a user intends to move, brain signals are transmitted to the muscles of the residual limb, inducing subtle EMG activity. While lower-limb prosthetics are already relatively technologically mature, the innovation of this smart hand prosthetic is its ability to achieve "individual finger control". Equipped with eight sets of built-in electrodes, it precisely captures micro-currents generated by muscles during contraction on the skin's surface and processes them in real time, enabling the prosthesis to perform delicate tasks, such as drawing, playing the piano or gripping objects of various shapes. Prof. Zheng added that despite the impressive technology, its optimal performance still relies on long-term professional calibration and consistent user training, and results may vary among individuals.

Prof. Zheng's team at PolyU has been researching to convert the muscle architectural changes during contraction, captured by wearable ultrasound imaging module, into a new control signal, named as sonomyography (SMG), to control prosthesis more intuitively. Their prototype prosthesis, ProRuka, fitting into an amputee subjects' arm won Gold Medal in the International Exhibition of Inventions Geneva in 2024. (Details of ProRuka are available here: <https://polyu.hk/eDnLI>.)

PolyU Department of Rehabilitation Sciences Launches "Better Ageing in Community Campaign" with Community Groups, Leveraging AI to Assess Fall Risk in Nearly 900 Elderly in First Phase



PolyU Department of Rehabilitation Sciences has, since January last year, partnered with multiple community groups to launch the "Better Ageing in Community Campaign", using the Department's artificial intelligence (AI) technology to conduct fall risk screening for the elderly. During the first phase, nearly 900 elderly residents on Hong Kong Island were assessed, with 26% identified as high-risk individuals. By January 2026, over 100 attendants have received 12-week fall prevention training from the University. The PolyU team plans to establish a large-scale elderly health database, benefitting more people with the aid of an enhanced AI model.

A sharing session was held on 24 January 2026, attended by Mr Chris SUN, Secretary for Labour and Welfare of the Government of the Hong Kong Special Administrative Region (HKSAR) of the People's Republic of China; The Hon. Tommy CHEUNG, Executive Council Member of the Government of the HKSAR; The Hon. SHIU Ka-fai, Member of the HKSAR Legislative Council; Dr Roy CHUNG, Honorary Chairman of the PolyU Court; Prof. Christopher CHAO, Senior Vice President (Research and Innovation) of PolyU; Prof. Marco PANG, Head of the Department of Rehabilitation Sciences of PolyU; and Prof. Amy FU, Associate Head of the Department of PolyU. The session also included various district officers, district councillors, partner organisation representatives, students and elderly participants, to review the first-phase achievements and look ahead to future developments.

Since January 2025, the faculty of the PolyU Department of Rehabilitation Sciences has led physiotherapy and occupational therapy students to conduct fall risk screening for 891 eligible elderly residents on Hong Kong Island, including the "walking speed test" and the "sit-to-stand test". The team successfully identified 235 elderly individuals with higher fall risk, representing approximately 26% of participants and arranged for them to attend 12-week fall prevention exercise training classes provided by the Department. The elderly participants responded enthusiastically, and generally agreed that appropriate exercise helps strengthen muscles and better enables them to cope with the demands of daily life.

The project team previously conducted telephone interviews with elderly participants of the fall risk screening and found that approximately 20% had fallen in the past year, with half of them requiring medical attention. Analysis also revealed that the "walking speed test" and the "sit-to-stand test" can effectively predict fall risk in elderly men, while fall risk in elderly women is not only related to the walking speed test results but also their weight-to-height ratio.

PolyU School of Nursing Co-hosts Sigma Asia Regional Conference 2025, Bringing Together Experts from 19 Countries and Regions to Advance Digital Health and AI in Nursing



The Pi Iota At-Large Chapter of Sigma Theta Tau International Honor Society of Nursing (Sigma), led by the School of Nursing at PolyU and including the nursing schools of five other higher education institutions in Hong Kong, has joined forces with Sigma Asia to host the Sigma Asia Regional Conference 2025 on 5 and 6 December 2025. Themed "Digital Health and AI in Nursing: Transforming Care Through Innovation", the Conference brings together more than 550 nursing practitioners, researchers and scholars from 19 countries and regions.

The Conference features multiple keynote speakers whose sessions highlight key trends and issues related to emerging technologies and explore their impacts on nursing practice and workforce, healthcare education and research.

Sigma is dedicated to cultivating professional nursing communities worldwide and advancing nursing knowledge, teaching and service through education, research and practice. The Pi Iota Chapter was founded by the PolyU School of Nursing in 2000. It evolved into an At-large Chapter in 2021, which comprises the six nursing schools from higher education institutions in Hong Kong: PolyU School of Nursing; the School of Nursing and Health Sciences at Hong Kong Metropolitan University; The Nethersole School of Nursing, Faculty of Medicine at The Chinese University of Hong Kong; the School of Nursing, LKS Faculty of Medicine at The University of Hong Kong; the School of Nursing at Tung Wah College; and the Division of Nursing Education at the School of Continuing Education of Hong Kong Baptist University.

PolyU RISA and BME Host 1st International Symposium on Smart • HAPPI Ageing, Fostering Global Smart and Healthy Ageing Initiatives

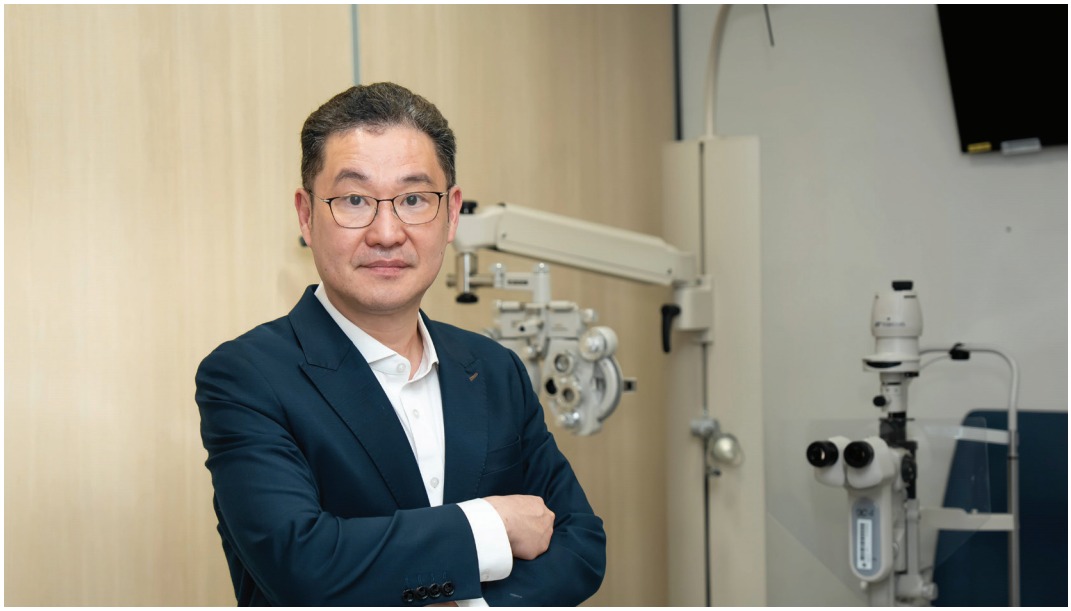


The Research Institute for Smart Ageing (RISA) and the Department of Biomedical Engineering at PolyU jointly hosted The 1st International Symposium on Smart • HAPPI Ageing: Healthy, Active, Positive, Prepared, and Independent on 28 November 2025 to advance the field of smart and healthy ageing. The event drew enthusiastic participation from leading academics, industry professionals and experts worldwide, highlighting the growing global interest and commitment to smart ageing initiatives.

The Symposium offered a diverse agenda, addressing a broad spectrum of topics central to healthy ageing. Proceedings began with opening remarks from Prof. ZHENG Yongping, Director of RISA, Henry G. Leong Professor in Biomedical Engineering and Chair Professor of Biomedical Engineering, Director of Jockey Club Smart Ageing Hub. The programme featured presentations by renowned international and local experts on topics such as elderly well-being, intergenerational support, cancer care, dementia, autonomy in later life and gerontechnology. Prof. Alex MIHAILIDIS from the University of Toronto shared how collaborative networks and co-design with older adults have advanced Canada's AgeTech ecosystem as a keynote speaker.

In addition to the main sessions, the Symposium included poster presentations and a guided tour of the Jockey Club Smart Ageing Hub, encouraging knowledge sharing and collaboration among attendees. Throughout the day, participants engaged in meaningful discussions and exchanged perspectives on the latest developments in ageing technology, ensuring a rewarding experience for all involved.

PolyU Develops EyeAgent 2.0: Next-Generation Ophthalmic AI for Clinical-Grade Decision Support



A research team at PolyU led by Prof. HE Minguang, Chair Professor of Experimental Ophthalmology and Henry G. Leong Professor in Elderly Vision Health of the School of Optometry, and Director of Research Centre for SHARP Vision, has launched the development of a next-generation clinical-grade ophthalmic artificial intelligence (AI) co-pilot system "EyeAgent 2.0", aiming to construct an intelligent decision support platform with advanced clinical reasoning capabilities to assist doctors in disease diagnostic analysis, treatment planning and follow-up management, thereby improving the quality and efficiency of clinical judgments.

The PolyU team previously developed the "EyeAgent 1.0" prototype system, capable of integrating multimodal medical data including clinical text and images, to provide diagnostic assistance. Pilot testing in hospitals across Hong Kong and Chinese mainland yielded positive clinical feedback. Leveraging this, the team is now developing "EyeAgent 2.0".

The new system is being developed around a domain-specific foundation model trained on large-scale, real-world multimodal electronic medical data from leading ophthalmic centres across different regions. It will integrate fundus imaging, optical coherence tomography, angiography and clinical text data. The system will also simulate actual clinical workflows, including data integration, differential diagnosis, treatment planning and disease progression prediction through a multi-agent collaborative framework, realising the goal of upgrading from one-time image analysis towards continuous decision support throughout the course of disease.

Based on current model validation and prototype testing results, the team anticipates that when fully developed the system, will significantly enhance diagnostic consistency and efficiency, while reducing the time doctors spend on case organisation and documentation. This will help alleviate work pressure in high-load clinical environments. The system's design emphasises human-AI collaboration, with AI serving as an auxiliary tool for enhancing data integration and analytical capabilities while all final clinical decisions remain doctor-led.

The system is intended to adopt a hybrid business model combining annual subscriptions with usage-based charges and will enable flexible deployment tailored to diverse hospital information system architectures. The team aims to foster a trustworthy, standardised and sustainable medical AI ecosystem through continuous technological refinement and clinical collaboration, thereby enhancing regional and global ophthalmic healthcare standards.

Award

PolyU PhD Candidate Secures Gold Medal at 5th Asia Exhibition of Innovations and Inventions Hong Kong



Ms Sisi TANG, a PhD candidate from the School of Fashion and Textiles at PolyU, clinched a Gold Medal at the 5th Asia Exhibition of Innovations and Inventions Hong Kong (AEII) in 2025 for her smart health-monitoring vest project.

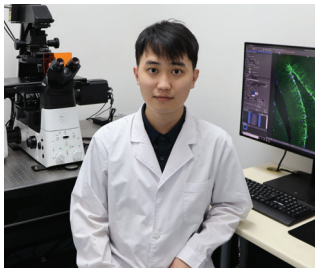
Developed by Ms TANG, the founder of PolyU startup Leopitorca Global Limited, BodyMate is an innovative functional vest designed for long-term, all-day use by older adults that integrates washable, textile-based sensors into comfortable daily wear. Unlike traditional wearables that require manual operation or frequent charging, it passively monitors vital signs such as heart rate, respiration, body temperature, posture and fall risk—all without disrupting daily routines.

The system supports real-time data transmission to caregivers or healthcare platforms. Ideal for ageing-in-place, chronic disease management and remote care, BodyMate addresses the growing demand for non-intrusive, elder-friendly health solutions. It combines smart textiles, AI algorithms and adaptive design to offer a seamless, scalable and human-centred approach to elderly care. The vest has been developed with support from leading Hong Kong innovation programmes and is ready for pilot deployment in smart communities and eldercare settings.

AEII is a prestigious annual exhibition-cum-competition devoted to innovations and inventions in Asia, organised by The Hong Kong Exporters' Association in partnership with Palexpo, the organiser of the International Exhibition of Inventions of Geneva. The event in 2025 attracted about 140 projects from around Asia. Project details are available here: <https://polyu.hk/bXPTf >.

Grant

PolyU Graduate and Postdoctoral Fellow Receives International Travel Grant for Summer Programme to Present Research in Tokyo



Dr YU Jiasui, a graduate and Postdoctoral Fellow from PolyU's Department of Rehabilitation Sciences, was awarded a travel grant for the RIKEN CBS Summer Program 2026 to present his research in Tokyo, Japan.

Dr YU was supervised by Prof. Sonata YAU Suk-yu, Associate Professor in the Department of Rehabilitation Sciences. The project directly contributes to the field of smart ageing by addressing the interplay among sarcopenia, physical activity and mental health, three critical components for ageing populations.

Dr YU's findings identify apelin as a key molecular link connecting age-related muscle decline to impaired hippocampal function and depression. By demonstrating that enhancing apelin signalling can mimic the beneficial effects of exercise on mood and neurogenesis, this research opens up avenues for developing targeted interventions for individuals with limited mobility.

The research was accepted for publication in *Molecular Psychiatry*, a leading journal in psychiatry that is one of the Nature Portfolio journals.

The RIKEN CBS Summer Program is offered by the RIKEN Center for Brain Science to train advanced students with broad interests in neuroscience. The programme is sponsored by the International Brain Research Organization (IBRO). This year's programme will explore the fundamental principles underlying children's brain development and neuropsychiatric disorders. It will cover diverse yet essential topics, including genetic and synaptic mechanisms, network dynamics and developmental psychology, and will highlight translational studies that demonstrate how basic research can improve clinical practice.

Dr YU won the Best Poster Presentation Professor Roongtam Ladpli Award for his presentation, "Muscle-derived Apelin Mediates Exercise-Induced Antidepressant Effects and Hippocampal Neuroplasticity", under Prof. YAU's supervision, at the 28th Thai Neuroscience Society Annual Conference held in Chiang Mai, Thailand, in late October 2025. The study also earned him full funding support from IBRO in the form of a travel grant to attend the IBRO-APRC Associate School on "Neuroplasticity Across the Lifespan" in Chiang Mai, Thailand, from late October to early November 2025.

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Yu, J. (29–31 October 2025). *Muscle-derived Apelin Mediates Exercise-Induced Antidepressant Effects and Hippocampal Neuroplasticity* [Poster presentation]. *28th Thai Neuroscience Society Annual Conference*, Chiang Mai, Thailand.

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