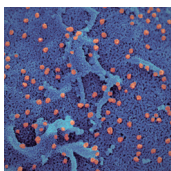


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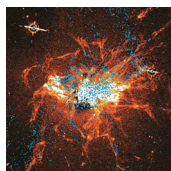


MAKING SOCIETY FIT FOR AGEING



IN THE MIDST OF THE PANDEMIC

HKU experts' leading role in
the fight to contain COVID-19



A BREAKTHROUGH IN ASTRONOMY

Discovering the origin of globular
clusters around giant galaxies



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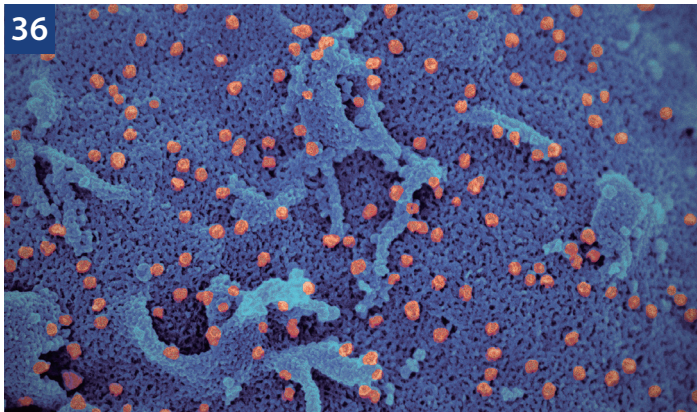
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MAKING SOCIETY FIT FOR AGEING

Hong Kong society is ageing rapidly. In 2018 the city had 1.27 million people over 65, representing 17.9 per cent of the population; by 2038 the number will soar to 2.44 million, or 31.9 per cent of the population. HKU scholars in social sciences, architecture, engineering and medicine have been testing physical and social improvements that would allow the elderly to be more mobile, receive better support for problems like dementia, and have a healthy, meaningful old age.



EMBRACING AN ACTIVE OLD AGE

People can have active, productive and meaningful lives in their senior years, especially with the right systems and support in place.



Hong Kong is getting old. By 2024, the city will officially be a 'super-aged society', meaning more than 21 per cent of people are aged over 65. By 2034, we will be ultra-aged, like Japan, with more than 28 per cent over 65.

"These numbers mean both challenges and opportunities," said Dr Vivian Lou Weiqun, Director of HKU's Sau Po Centre on Ageing, "particularly as they imply a significant change in demographics that challenge our existing infrastructure."

Dr Lou has been investigating active ageing and how to empower people to better enjoy their senior years, and recently received more than HK\$12 million from The Hong Kong Jockey Club Charities Trust to bring her strands of research under one umbrella, The Jockey Club Golden Age Journey Project.

"Our aim is to promote active ageing and make the process better, healthier and more meaningful. We want to empower older adults through a focus on balancing employment and caregiving, volunteering, and learning. If older adults can become more engaged, this will have positive impacts on individuals, families, communities and society as a whole," she said.

This empowerment is happening at a time when the traditional Chinese model of families looking after their elderly parents has become unsustainable because the nuclear family now dominates and adult children have work and other obligations. As a result, caregiving is a growing concern.

"We also don't have enough professionals to deliver care to the rapidly growing number

of elderly," she said. "Instead, we need to think about a model in which families, community services, volunteers and the healthcare system collaborate and share caregiving for the elderly."

Filling in the blanks

The first step is to understand how many people are engaged in caregiving and who they are, including age, gender, relationship with the elder person, labour force participation and other information. The government has not collected this data but following a 2018 study of the problem led by Dr Lou, it is changing tack: a subset of questions about caregivers will be included in the 2021 census. "Without data, evidence-based policy and planning is impossible," she said.

The costs of caregiving must also be understood. A study she conducted jointly with HSBC and The Women's Foundation in 2019 estimated the direct and indirect costs of caregiving (such as reduced labour force participation by unpaid caregivers) will more than triple by 2040 to HK\$126 billion (against HK\$38.8 billion in 2018).

Moreover, there is a need to understand the emotional cost on caregivers who have paid work and fear revealing their caregiving obligation will cause employers or work colleagues to look at them in a negative way. "We need to pool multiple stakeholders, including the commercial sector to look at this very serious challenge," Dr Lou said.

One solution is to train volunteers to share the caregiving load. Dr Lou has developed capacity-building programmes for the 'young-old' – retired people in their 60s or early 70s who are healthy and resourceful and who are sent to visit socially-isolated people with mild cognitive impairment. She and her team have also produced guidebooks, websites, apps and videos for both trained volunteers and those families who are taking care of stroke patients recently discharged from hospital or engaged in end-of-life care for loved ones.

"We have standardised evidence-based volunteer empowerment by studying who are the most vulnerable groups and training volunteers to help them. My dream is to have specialised volunteers providing partnered care and support for community-dwelling older adults in every neighbourhood in Hong Kong," she said.

Breaking down barriers

An added benefit is that volunteering can help the young-old lead more meaningful lives, especially as Hong Kong employers are still reluctant to recruit, retain and retrain them. "Fewer than 10 per cent of those aged over 65 do paid work. Internationally, this figure is not desirable. If we want older adults to have healthier, more meaningful lives, work should be an option," Dr Lou said.

To break down some of the boundaries for the aged, the Sau Po Centre on Ageing launched the Campus Ageing Mix Project for University Students (CAMPUS) last year with support from the ZeShan (HK) Foundation to bring together groups of senior citizens and students in the Faculties of Law, Engineering, Medicine, and Architecture to discuss topics of shared interest and increase the students'

ageing literacy. For example, law students met with seniors to discuss wills and power of attorney, while medical students learned about the daily challenges and experiences of ageing. Dr Lou has also worked with HKU Libraries and the Common Core Team on an inter-generational participatory co-design project supported by a Teaching Development Grant.

All these efforts are working towards one goal. "Through our innovative inter-sector, interdisciplinary and international collaborations, we strive to continue our leadership in promoting quality of life in the face of new demographic realities and technological advancements," she said.



DR VIVIAN LOU WEIQUN
We need to think about a model in which families, community services, volunteers and the healthcare system collaborate and share caregiving for the elderly.



The Campus Ageing Mix Project for University Students (CAMPUS) brings together groups of senior citizens and students in different faculties to discuss topics of shared interest.



HKU students and community members collaborate in inter-generational projects to design innovations for an ageing society.

NO PLACE LIKE HOME

Elderly residents can feel lost and depressed when redevelopment or changing needs force them from the homes they have lived in for decades. HKU scholars are searching for ways to ease the blow.

Many elderly people in Hong Kong and rural China have lived in their homes most of their lives. They know the neighbours, shops, sitting areas and transport links. But instead of enjoying the familiarity and security of their surroundings, some are being uprooted in their twilight years to make way for new developments or because their homes lack facilities they now need, such as wheelchair access and lifts.

The situation has attracted interest from HKU researchers, who are looking at how to improve the built environment for the elderly in both new and existing neighbourhoods.

“Our goal is to find architectural and planning solutions to some of the challenges that the growing population of elderly might face, whether it be mobility, access to services

such as health centres, or opportunities for social connections. We also want to look at the impact that the built environment has on health and other indicators,” said the Dean of Architecture, Professor Chris Webster.

Several recent projects are addressing the problem by combining data about the elderly with assessments of the built environment, both in Mainland China and Hong Kong.

Banishing the relocation blues

Using a natural experiment in Suzhou, China, Professor Webster, Dr Ying Chang and Dr Sun Guibo are studying the physical and mental effects on farmers forced to move due to development that is changing rural environs into new towns, and measuring the health impact of alternative designs.

A baseline survey has been administered to more than 2,600 elders, including a control group still living in their village, and health information collected. The first part of the study was completed in November 2019 and yielded rather depressing preliminary results: those who were relocated had statistically higher levels of hypertension and were more likely to be overweight. The researchers hope they can improve such outcomes through more consultative planning as well as better design.

“We want to make things better for these residents by looking at the environmental features that are best for their mental, physical and social outcomes. For example, what are the effects of planting greenery outside their buildings, or installing facilities for them to exercise or sit and socialise, or placing roads

away from these public places? China has invested a lot of money in greening, but is it being spent in ways that the elderly need?” Dr Sun said.

The team is also conducting natural experiments in Hong Kong. One project measures impact of the new Tuen Ma Mass Transit Railway (MTR) development on a group of elderly living near a station; another, the impact of relocating elderly residents from sub-divided units (earmarked for development) in To Kwa Wan to high-rise commercial housing. Results are pending but, as with the China study, Dr Sun said they hope to show how changes to the built environment causally affect the mobility and well-being of elderly people.

Optimal thresholds

Professor Rebecca Chiu Lai-har has also studied the changing living circumstances of Hong Kong’s elderly and her work has had policy impact. The Hong Kong Housing Society (HKHS) adopted her recommendations to include wheelchair access and other support and services to make it easier for the elderly to ‘age in place’ in its estates (see Vol. 19 No.2 of the *Bulletin*), and to design new housing estates with buildings and services targeted at seniors. The HKHS and government also both recently adopted her

recommendation to let elderly homeowners essentially swap flats with other eligible homeowners so they can move into a smaller place, while staying independent.

Professors Webster and Chiu also work with Dr Derrick Ho Hung-chak, who is measuring the associations between estate layout, density, air pollution and other environmental features and the health and behaviour of elderly residents. Dr Ho’s early findings show there can be too much of a good thing – too many open spaces put facilities beyond easy walking distance for the elderly, while too many health clinics stigmatise a place for them.

“There should be a balance of these things. We’re trying to determine the optimal threshold for different environmental factors around public housing estates that will give older adults high mobility and comfort,” Dr Ho said.

Dr Ho and Professor Terry Lum Yat-sang of the Department of Social Work and Social Administration are also looking at how the physical environment of HKHS estates affects the mental health of the elderly. “We want to see if a more stimulating environment can promote more social interaction and physical activity and help slow the deterioration of mental health,” Professor Lum said. The

numbers are still being crunched but so far it seems that a sense of community and social support make people more willing to stay in their estate.

Professor Lum also works on a Jockey Club-funded project to help districts develop initiatives that will qualify them for the WHO Global Network for Age-friendly Cities and Communities. An example of his recommendations was to install fold-down chairs at tram stations and seats in MTR stations so the elderly can take a short rest while they wait for transport.



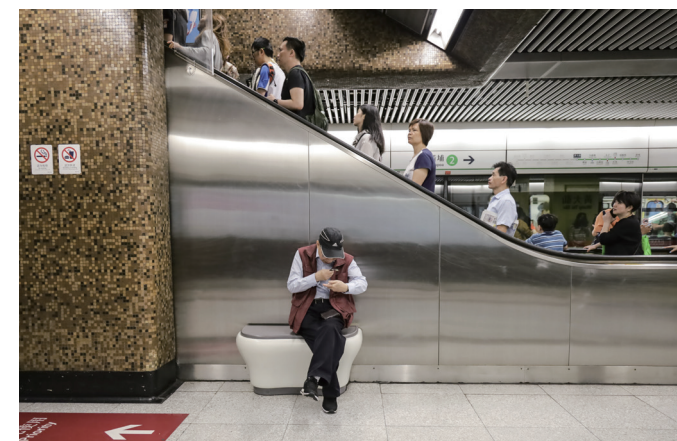
PROFESSOR CHRIS WEBSTER

“Our goal is to find architectural and planning solutions to some of the challenges that the growing population of elderly might face, whether it be mobility, access to services such as health centres, or opportunities for social connections.”

An interview with an elderly person in the sub-divided flat about their concerns on the coming urban renewal and relocation.



Elderly residents doing exercise in the open space of the Choi Hung Estate, a public housing estate built in the 1960s.



Installing fold-down chairs at tram stations and seats in metro stations for elderly to take a short rest when waiting for transport are one of the many ways to make the city more age-friendly.

TECHNO-AGEING

HKU scholars are using robotics and artificial intelligence to develop smart devices and better services for the elderly.



Professor Terry Lum Yat-sang of the Department of Social Work and Social Administration has been a champion of Hong Kong's elderly, overseeing multiple funded projects to make the city more age-friendly and improve elderly care. But as a social scientist, he is keenly aware that the best solutions require interdisciplinary approaches – particularly when it comes to technology.

Professor Lum has therefore teamed up with the Department of Computer Science on several projects that bring new approaches to improving the lives of the elderly. "When we come together and brainstorm, we can combine both the clinical and data sides and make more exciting solutions for enhancing the well-being of older people," he said.

One example of that is the Time Bank, which Professor Lum has advocated for in Hong Kong, to encourage able senior volunteers to help their more frail counterparts with such things as doctor visits and shopping. The volunteered hours are 'banked' for redemption later, when the volunteers themselves may need help.

However, the system is not digitised, which makes management of the Time Bank more burdensome for participating non-governmental organisations (NGOs) and means that useful data for improving the service is not computed. A collaboration between Professor Lum and computer scientist Professor Reynold CK Cheng will change that.

Professor Cheng and his team are applying artificial intelligence (AI) to create a heterogeneous information network (HIN)

The Time Bank app provides intelligent recommendation services and matches volunteers and the elderly in need. After providing services, volunteers can save their time credits in their 'bank accounts' for redemption later when they need help.

database for the Time Bank that not only matches the elderly and volunteers, but provides a deep well of information about who is using the service, what they use it for, their health conditions and other data that will help NGOs and the government plan services.

Like Uber

For instance, an app under development will let volunteers input special skills, such as languages spoken and driving license, and allow the elderly to directly 'book' volunteers for the time and service that they need. Currently, they need to make arrangements through participating elderly centres.

"The system will operate similar to Uber. So if the elderly person uses a wheelchair and needs two people to accompany them next Wednesday to outpatient services, the system will use AI to suggest several names available at the time for the older person to choose," Professor Cheng said.

"The data will also be able to track the elderly over time and see what types of activities may help in the ageing process."

The project, which is funded by the Innovation and Technology Fund under the umbrella title HINCare, is timely given that society is rapidly ageing and there are fewer people to look after the elderly. By 2038, Hong Kong will have only about two working adults for every elderly person, nearly half the rate of 2018.

In addition to the Time Bank collaboration, Professor Lum has also joined up with Dr Chuan Wu in Computer Science (see box) to develop a smart sensor system that monitors the trajectory of elderly residents around their home to detect emergency situations, such as a fall, and alert caregivers. The system may also detect longer-term changes, such as changes in gait or patterns of wandering.

"Each person has their own gait velocity which indicates how healthy they are. If they develop dementia, this changes," Professor Lum said. "In working with the computer scientists, we can develop devices like this to help older people in their everyday lives."



PROFESSOR REYNOLD CK CHENG

“The data will also be able to track the elderly over time and see what types of activities may help in the ageing process.”



A user requirements meeting for HINCare application.

A WALKER WITH SMARTS

When computer scientist Dr Chuan Wu watched her elderly father struggle to stay mobile with Parkinson's disease, she felt she had to do something. The disease affects balance and makes it difficult for patients to grasp and push walkers. Dr Wu teamed up with Dr Zheng Wang from Mechanical Engineering to devise a prototype smart walker – a device that can move independently with patients, detect if they are falling, and give them something to hold onto if they fall.

"Parkinson's disease patients tend to lean forward when they walk and they often trip. This device is stable and strong enough to support them so they don't fall to the ground," she said.

The walker is like a robot with sensors that allow it to move autonomously. It can be controlled by voice or claps, so if people are in their bedroom they can signal the walker to come to them from another room. "The user can even give it a name and call it by that name," she said.

Dr Wu recently received an Innovation and Technology Fund grant to develop the prototype further over the next two years. Her teammate Dr Wang is exploring 'soft skin' technology to detect pressure on handrails and perform corresponding actions, a wheel that can go over small curbs, and an adjustable handrail that could lower to chair level to help people stand up.

Dr Wu is also working on a mobile app for Parkinson's patients that would recommend suitable exercises for managing their disease, keep records and send out reminders when it was time to do them.



The prototype smart walker can move independently with patients, detect if they are falling, and give them something to hold onto if they fall.

RAISING THE ALARM ON DEMENTIA

About 100,000 people in Hong Kong suffer from dementia, a number that is expected to triple by 2040. Scholars in the Department of Social Work and Social Administration are trying to jumpstart the city's dementia policy and improve the lives of patients and caregivers.

Dr Gloria Wong Hoi-yan has worked for years to develop interventions and care management for sufferers of dementia. And while she has had some successes (see box), one stumbling block has loomed in her path. Unlike Taiwan, Macau and other developed societies, Hong Kong does not yet have a specific policy for dealing with dementia, creating a dilemma for her.

"If the system is not ready, it is difficult to do effective intervention work. But to help people, you have to work within the system," she said.

Her response has been to try to improve that system. Dr Wong is spearheading a Research Impact Fund-supported project to develop short-, medium- and long-term goals for dementia care in Hong Kong, called the TIP-CARD – for Tool to Inform Policy: Chinese Communities' Action in Response to Dementia.

The three-year project started in April 2019 and Dr Wong and her team have been working with stakeholders to assess the current needs,

expectations, priorities and resources for dementia care, the cost to society (including caregivers, who not only need support but may have stepped back from income-generating work to look after loved ones), and the policy options.

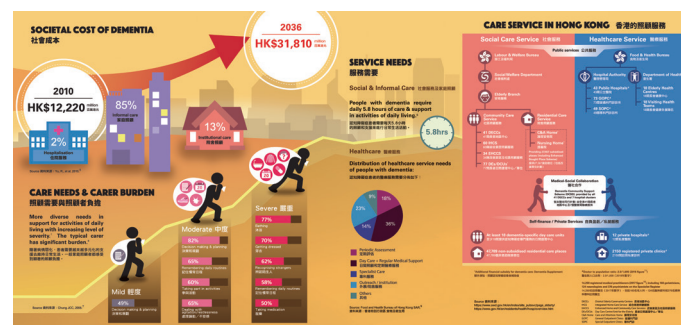
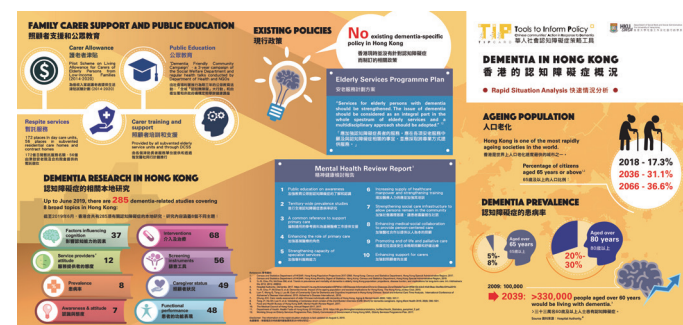
They will develop new tools for policymakers, and not a moment too soon. Within 20 years, nearly one-third of Hong Kong residents will be over 65 years old and about 330,000 people will have dementia. Hong Kong is not alone in facing this problem. "The World Health Organization has declared that dementia is a public health priority," Dr Wong said. She is thus also collaborating with a London School of Economics project to help lower- and middle-income countries develop dementia policy.

Improving services

Apart from policy development, HKU scholars are also advising the government on how to improve services for dementia patients. In

one project, Dr Wong and a multidisciplinary team from the Social Sciences and Medical Faculties evaluated the pilot Dementia Community Support Scheme, a government-funded initiative in which medical and associated professionals provide community-based support for patients with mild to moderate dementia and their caregivers. The scholars showed this maintained daily living function in patients and reduced the burden on caregivers. With that evidence, the government made the scheme permanent.

Team member Professor Terry Lum Yat-sang has also devised a tool to improve the allocation of government-funded long-term care for cognitively impaired individuals. Currently, the system is crude – 86 per cent of those assessed are deemed to have severe impairment, qualifying them for long-term care; the rest are diagnosed with low or mild impairment. "That is a very high proportion getting long-term care. We joke that it might be cheaper for the government not to do the assessment rather than put in this effort," he said.



The leaflet of the TIP-CARD project includes figures showing the expected growth in the number of people with dementia in Hong Kong, as well as the increasing burden.



TIP-CARD researchers participating in a Theory of Change workshop led by the London School of Economics and Political Science to develop a roadmap for dementia policy.

The tool developed by Professor Lum and his team provides a finer, more precise assessment that he likens to "an MRI machine instead of the low-resolution x-ray they have now". Older adults are classified into six to eight categories and each level has a protocol for planning the patient's care. The Legislative Council is expected to endorse this approach this year. In the meantime, 3,000 social workers are being taught how to use it.

"This will change the whole landscape of long-term care in Hong Kong," Professor Lum said, although ultimately the outcome will depend on government support. "The government will need to provide resources for long-term care services. Otherwise, the higher-resolution image will not help clients at all."



DR GLORIA WONG HOI-YAN

"If the system is not ready, it is difficult to do effective intervention work. But to help people, you have to work within the system."

BRAIN ACTIVITY

Dr Gloria Wong Hoi-yan has been at the forefront in bringing cognitive stimulation therapy (CST) to Hong Kong, a non-pharmacological treatment for dementia patients that has been endorsed in the United Kingdom. She has adapted materials for Cantonese speakers and overseen the training of more than 400 CST facilitators.

The therapy brings together patients with mild to moderate dementia in small groups to chat and play games as they would normally do in an elderly centre. However, a trained leader prompts them with questions or tasks to stimulate their brainwaves. For example, as patients reminisce, they may be asked to compare the price of a bowl of wonton noodles in the past versus today, which involves executive functioning. Or play a game where they plan a dinner.

"Often people with dementia are treated as having no ability. The family takes care of everything so the person has nothing to do but sit at home, which isn't great for cognitive functioning or quality of life. CST provides a platform for them to be engaged in a social setting in activities they enjoy," she said.

Dr Wong has also received funding to develop new non-pharmacological interventions, including for people with more severe dementia in collaboration with University College London and Peking University. "These people have long been neglected but we think we can at least do something to improve their mood. Improved mood can also improve a person's cognition," she said.



Training of local healthcare and social care professionals in cognitive stimulation therapy led by Dr Gloria Wong from HKU and Professor Aimee Spector from the University College London.

MOOD ENHANCERS

Elderly people and the caregivers of elderly with dementia all have a high risk of depression. Programmes developed at HKU are helping to lift their mood.

About 10 per cent of Hong Kong people aged over 65 show signs of depression, the result of stress, poor health and lack of social engagement. Similar factors can also darken the mood of the family members who look after elderly relatives suffering from dementia. The problem has motivated Professor Terry Lum Yat-sang, Henry G Leong Professor in Social Work and Social Administration, of the Department of Social Work and Social Administration and Dr Chan Wai-chi of the Department of Psychiatry to find ways to improve the mental health of both groups.

"Depression is a common mental health challenge for older people, but the current system is not effective in helping them," said Professor Lum. Moreover, because Hong Kong is an ageing society with fewer working adults available to look after each elderly person, the burden of care falls on families, especially for the elderly with dementia. Dr Chan said a study in the United States found nearly one-third of caregivers met the diagnostic criteria of depression, and caregivers also

suffered from more physical problems, such as hypertension.

Given that Hong Kong's over-65 population already numbers more than 1.27 million and is rapidly growing, time is of the essence to get solutions in place that will help the elderly and their caregivers enjoy better mental health.

Joy in old age

Professor Lum is spearheading the Jockey Club JoyAge project, launched in 2016 to promote collaboration between medical and social services on elderly depression and train social workers and other frontline staff to identify and help at-risk individuals. The project also provides 100 hours of training for 'peer supporters' – seniors who visit the elderly who live alone or are at risk, and encourage them to come out into the community, and who provide peer support to older people with depression under the supervision of a professional social worker.

The first stage of the project involved about 4,000 elderly in four districts and was supported by six non-governmental organisations and about HK\$82 million from the Jockey Club. The results so far have been highly encouraging.

"There are two major outcome indicators that we are focussed on. One is preventing older people from falling into depression. The other one is treating people who already have symptoms that we can try to reverse," he said.

Over three years, those who received the JoyAge intervention were two times less likely to become depressed or six times more likely to show significant improvement than the control group that did not participate in the project.

That success has convinced the Jockey Club to inject another HK\$279 million into JoyAge so it can be implemented in all 18 districts in Hong Kong starting this year. "We are helping to reduce the stigma of getting help for

mental health issues and we hope to reach many more people," Professor Lum said.

Helping the helpers

Stigma is also a concern for caregivers because dementia is often seen as a mental illness in the Hong Kong community. "Caregivers don't want other people to know they have relatives with dementia because they worry it will be degrading to their family name and their status in society," Dr Chan said, so they tend to 'hide' their caregiving role.

Focus groups assessing the concerns of caregivers have highlighted their unhappiness. "It's not surprising that most caregivers see caregiving as a negative, associated with guilt, embarrassment and shame," he said, especially given the 24-hour nature of caregiving and the challenge of dealing with people who are aggressive, irritable and difficult. "Some did share positive aspects with us, such as the opportunity to return the favour to

their parents who looked after them when they were young by now providing them with companionship. Some find caregiving adds meaning to their lives. But most tell of negative emotions."

To help them cope, Dr Chan developed workshops for caregivers at the David Trench Rehabilitation Centre that is part of Queen Mary Hospital, led by himself and nursing and occupational therapy colleagues. They educate the caregivers about what to expect with dementia and how to deal with the behaviours, such as identifying patterns. For instance, expressions of anger may arise when the patient is hungry but cannot express themselves properly. "We formulate steps that caregivers can take when facing these problems," he said.

He also organises an annual workshop for formal paid caregivers to reinforce their skills in handling such problems as shouting and inappropriate sexual behaviours by patients.

Dr Chan also piloted a programme to provide exercise intervention for family caregivers that involved 12 weeks of guided tai chi. The mood of the group was elevated compared to the control group that did not receive the intervention, but after 24 weeks both groups were back to the same levels.

"When we were not there to guide them, they didn't keep it up. Exercise improves endorphins, especially when people do it together," he said, underscoring the need to help both caregivers and the elderly feel less isolated. This may go a long way to improving their mood.



PROFESSOR TERRY LUM YAT-SANG

"We are helping to reduce the stigma of getting help for mental health issues and we hope to reach many more people."



An appreciation gathering was held in December 2019 for peer supporters of the Jockey Club JoyAge project.



Participants in the Wellness Recovery Action Plan facilitator training.



A workshop for old age home staff to learn about the symptoms of dementia and ways to handle them.

FILLING THE VACUUM

Recent research by HKU's President and Vice-Chancellor, Professor Xiang Zhang, has caused a stir in the scientific world by demonstrating that vacuums are not empty spaces and by manipulating activity within them.

When Professor Xiang Zhang undertook his qualifying PhD examination at the University of Berkeley, California, in 1994, he was asked to explain how his examiner's voice could be heard across the table. "I answered, 'it is because your sound travels by vibrating molecules in the air.' He further asked me, 'what if we suck all air molecules out of this room? Can you still hear me?'" I replied no, because there would be no medium to vibrate."

But times – and human knowledge – have changed. Two new studies guided by Professor Zhang and involving colleagues from Berkeley have shown that there is indeed much going on in vacuums.

The focus of their research is a recent theory based on quantum mechanics, which argues empty space cannot be truly empty because it still contains fluctuating electromagnetic waves that cannot be completely eliminated. These waves produce a force, called the Casimir effect, that connects two objects such that if one object starts shaking or oscillating, the nearby object will be set into motion even in a vacuum.

The scientists demonstrated for the first time that the Casimir effect can enable heat transfer, which has implications for high-speed computation and data storage. Furthermore, they proposed and demonstrated that the Casimir effect could also cause objects to

repel from each other, which has implications for frictionless mechanics that are important for medical robots and quantum sensors.

Hot discovery

In the heat transfer study, Professor Zhang and his team overcame the significant hurdle of transmitting heat in a vacuum.

They engineered extremely thin, gold-plated silicon nitride membranes in a dust-free clean room, then placed two of these membranes a few hundred nanometres apart inside a vacuum chamber. The temperature of the membranes was precisely controlled and monitored using optic and electronic

components. As predicted, when one membrane was heated up, the other warmed up, too – in other words, heat leapt from a hot membrane to a colder one inside the vacuum.

The size and design of the membranes were important in enabling this thermal transfer, as was the distance between them in order to rule out thermal radiation as the cause. The findings were published in *Nature*.

"Although this interaction is only significant at very short lengths – a few hundred nanometres – the implications could be profound for the design of computer chips and other nanoscale electronic components that are affected by heating issues that could limit their performance," Professor Zhang said.

No friction

In the study on frictionless mechanics, Professor Zhang and a separate team pushed scientific understanding even further. They proposed creating a 'Casimir quantum trap' without energy input by exploiting both attractive and repulsive forces – the attraction

between two objects of the same material would be reversed at short distances and preserved at long ones without them ever touching each other.

The repulsion effect was confirmed in experiments similar to those for heat transfer, except in this case the objects were coated with Teflon. At short electromagnetic wavelengths Teflon's low reactivity gave a repulsive force, while at longer waves gold's higher-refractive index caused an attraction, thus creating the Casimir trap without using additional energy.

The finding is important for mechanical systems, which typically experience friction between objects such as gears and wheels that require costly maintenance and replacement. It also has implications for magnetic systems, such as Maglev trains, which have high energy demands.

"This quantum trap is totally passive and the trapping distance can be controlled by adjusting the thickness of the coating layer. The same principle can be applied to many

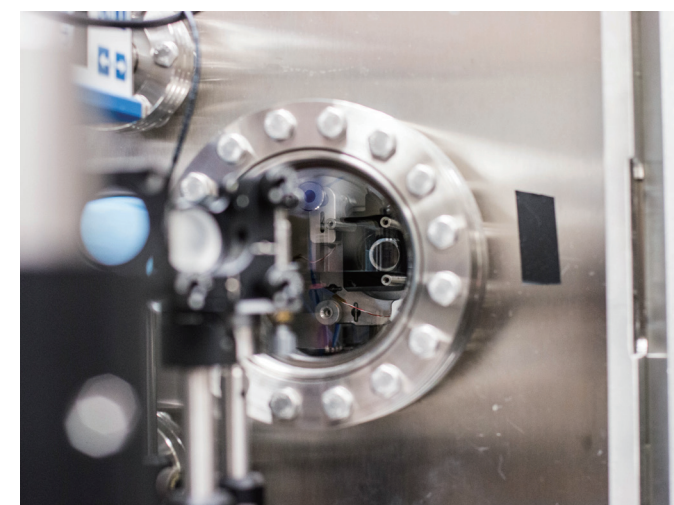
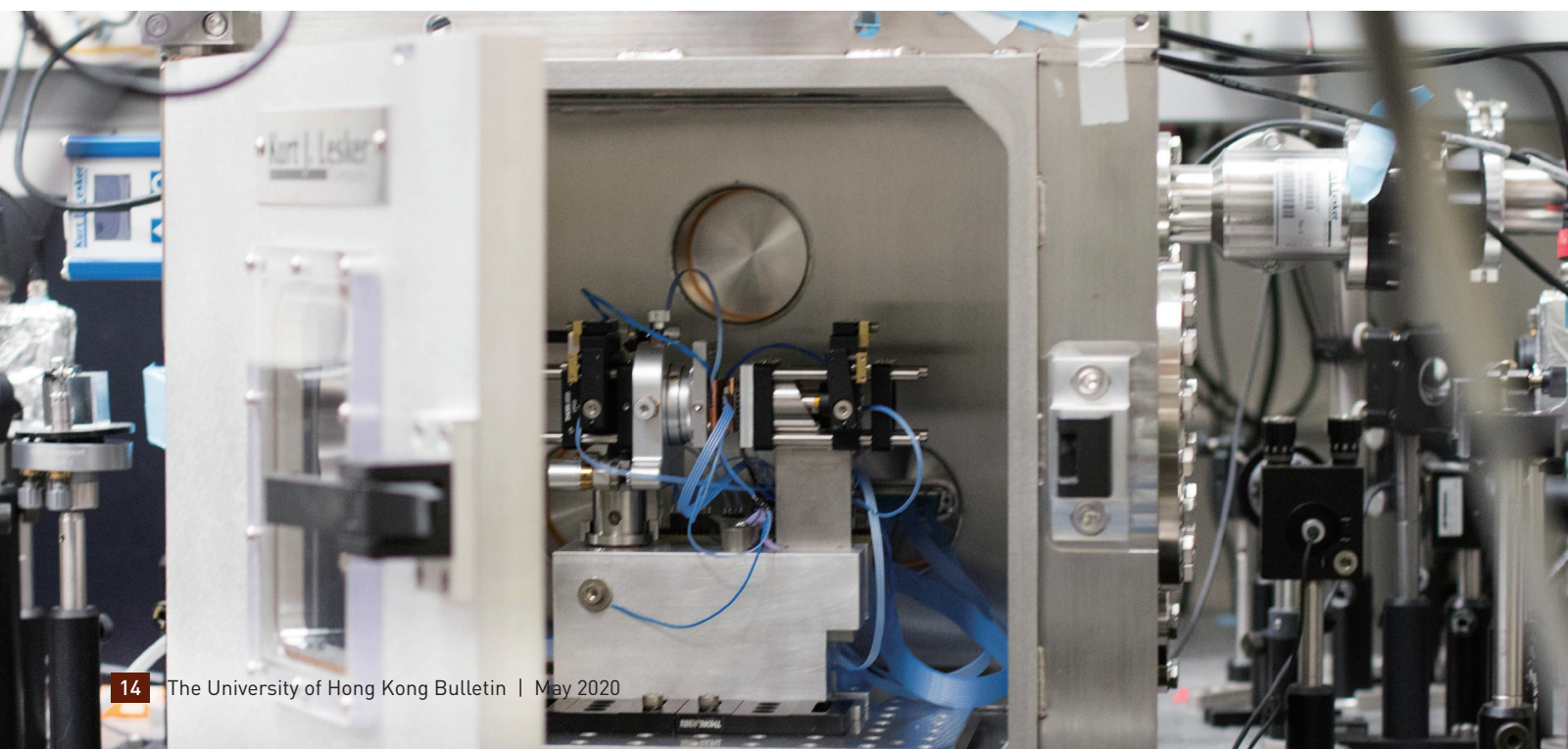
other materials," he said. The discovery was published in *Science* and selected as a top 10 Breakthrough of the Year 2019 by *Physics World*, a membership publication of the Institute of Physics in the United Kingdom.

Professor Zhang noted that these discoveries were just the beginning. The heat transfer effect is particularly resonant with his PhD examination experience. "Because molecular vibrations are also the basis of the sounds we hear, the discovery opens up the possibility that sounds could also travel through a vacuum. So I was wrong in my 1994 examination. Now, you can shout through a vacuum," he said.

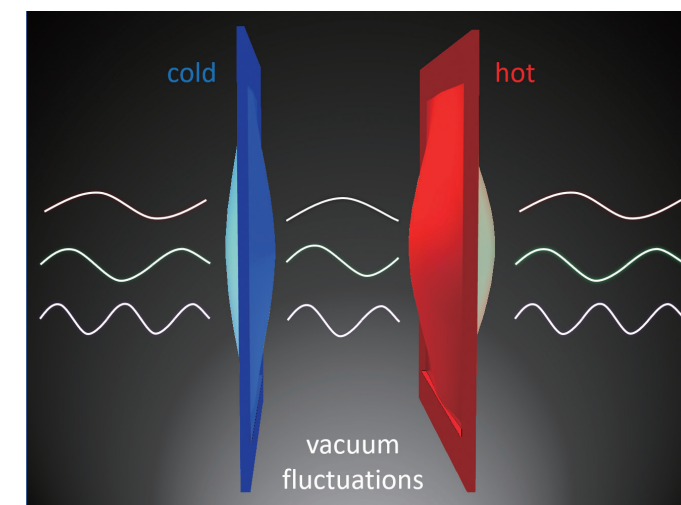


PROFESSOR XIANG ZHANG *"Because molecular vibrations are also the basis of the sounds we hear, the discovery opens up the possibility that sounds could also travel through a vacuum."*

Researchers from the University of California, Berkeley showed that heat energy can travel through a complete vacuum thanks to invisible quantum fluctuations. To conduct the challenging experiment, the team engineered extremely thin silicon nitride membranes, which they fabricated in a dust-free clean room, and then used optic and electronic components to precisely control and monitor the temperature of the membranes when they were locked inside a vacuum chamber. (Courtesy of Violet Carter, UC Berkeley)



The team used highly sensitive optics to monitor the temperature of the silicon nitride membranes during the experiment. (Courtesy of Violet Carter, UC Berkeley)



In the experiment, the team showed that heat energy, in the form of molecular vibrations, can flow from a hot membrane to a cold membrane even in a complete vacuum. This is possible because everything in the universe is connected by invisible quantum fluctuations. (Courtesy of Zhang Lab, UC Berkeley)

GUT REACTION

The discovery that an individual's gut microbes may determine how much benefit they get from exercise, has significant implications for preventing diabetes and for improving exercise efficacy in general.



Exercise is generally recognised as highly beneficial for your health, but it works better on some people than others. New research suggests that people possessing certain gut microbes may in fact gain better metabolic outcomes from exercise than others.

"The prevalence of diabetes (particularly type 2 diabetes) has been reaching epidemic proportions globally," said Professor Xu Aimin, Chair Professor of Metabolic Medicine in the Department of Medicine. "Although there is no cure for diabetes, it can be prevented by early lifestyle interventions, with exercise being the most cost-effective strategy. However, until now, the molecular transducers mediating the metabolic benefits of exercise have remained largely unclear."

To address this issue, his team – including co-corresponding authors Dr Michael Tse, Director of HKU's Centre for Sports and Exercise, and Dr Gianni Panagiotou, Head of Systems Biology and Bioinformatics, Hans Knoell Institute – decided to identify exercise-responsive factors comprehensively using an unbiased multiomics approach.

Asked why they concentrated on the gut, Professor Xu said: "Our gut harbours a complex community of over 100 trillion microbial cells which influence human metabolism, nutrition and immune function, while disruption to the gut microbiota has been linked with obesity and diabetes. Therefore, we wanted to investigate whether exercise mediates the metabolic benefits by reshaping gut microbiota, and for those people who do not respond well to exercise, whether their 'exercise resistance' is due to maladaptation of gut microbiota."

The research team conducted a 12-week randomised controlled trial (RCT) in the form of a high-intensity exercise training intervention on 39 Chinese men with pre-diabetes. The participants, who had never taken medication for their condition, were randomly assigned to either a sedentary control group, or to a group that underwent the supervised exercise training. All participants were instructed to maintain their usual diet.

The results showed that while all the participants exhibited a similar degree of weight and fat mass reduction, only 70 per cent of them showed significant improvements in glucose metabolism and insulin sensitivity, whereas the remaining 30 per cent were not responsive to exercise.

"Analysis revealed obvious differences in exercise-induced compositional and functional alterations in gut microbiota and its metabolites between responders and non-responders," said Professor Xu. "The microbiome of responders exhibited enhanced capacity for biosynthesis of short-chain fatty acids and catabolism of branched-chain amino acids, whereas that of non-responders was characterised by increased production of metabolically-detrimental compounds.

"The results suggest that gut microbiota and its metabolites serve as important contributors to the metabolic benefits of exercise intervention. They also identify maladaptation of gut microbiota as being responsible for those individuals who do not respond to exercise."

Maximising the benefits

This is one of the first interventional RCT studies providing clear evidence of the role of gut microbiota on metabolic health. The findings raise the possibility of maximising

the benefits of exercise by targeting gut microbiota; and also offer new insight for clinicians and exercise specialists to target the microbiome of exercise non-responders as another means of better enhancing therapeutic interventions.

While acknowledging that this discovery has big implications for diabetes sufferers, Professor Xu emphasised that despite the existence of exercise resistance, physical exercise remains the most cost-effective strategy for the prevention and treatment of diabetes. "We observed a quick improvement in insulin sensitivity within only four-week period after commencing the high-intensity training, in the absence of any dietary changes. This finding suggests that glucose metabolism can be improved in a portion of individuals with pre-diabetes by even short-term modifications to their exercise habits.

"For non-responders, exercise alone may not be enough but this doesn't mean exercise is useless. For these subjects, more intensive interventions, a combination of exercise training and targeted dietary intervention to modulate gut microbiota, are required to achieve a better therapeutic effect," he said.

In addition, the team is looking at the implications for improving the efficacy of exercise for people not suffering from diabetes. "We tried to establish a model from our study, which could first predict the

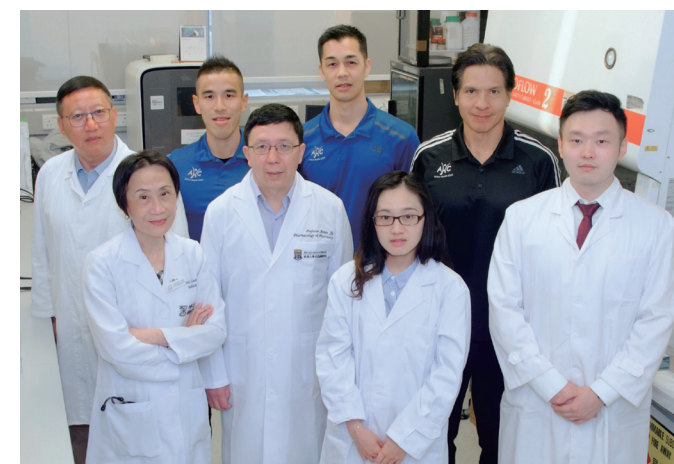
probability of whether an individual could benefit from exercise," Professor Xu said. "If they did not show to benefit from exercise, we could further analyse the unique metabolic characteristics of the gut microbiota and use probiotics, prebiotics or targeted dietary intervention to fine-tune the gut microbiota, thus restoring responsiveness to the metabolic benefits of exercise training.

"Interventions could be modified based on our prediction model to classify if one is a responder or a non-responder. By doing so, we are seeking the possibility of people taking some types of supplements to enhance the microbiome to make the gut more responsive to exercise. It also helps exercise practitioners 'prescribe' exercise plans and strategies based on an individual's responsiveness."



PROFESSOR XU AIMIN

The results suggest that gut microbiota and its metabolites serve as important contributors to the metabolic benefits of exercise intervention.



Professor Xu Aimin (second from left, front row) and his research team, including Professor Karen Lam Siu-ling (first from left, front row) and Dr Michael Tse (first from right, second row).



Volunteers participating in a 12-week supervised exercise training intervention.

THE PARADOX OF INFORMATION CONTROL IN CHINA

Chinese law allows access to information on the one hand but restricts it on the other, which has a troubling impact on everything from virus outbreak controls to the country’s new social credit system.



The COVID-19 coronavirus outbreak that started in Wuhan this past winter triggered deep questions about the flow of information in Mainland China, as officials played down the threat until it became too big to ignore. To those who experienced SARS in 2003, the situation was depressingly familiar.

Dr Clement Chen Yongxi of the Faculty of Law was an MPhil student during SARS. In 2002, he had witnessed the drafting of a new freedom of information regulation for Guangzhou – the first of its kind in China – and he was dismayed that it failed to make the municipal government more transparent about the SARS outbreak.

The situation prompted his research interest in the gap between law on paper and law in action, and to observe: “What happened with SARS is closely related to what is happening now.”

As in Guangzhou, the central government had ostensibly improved freedom of information with the 2007 introduction of the Regulation on Open Government Information (ROGI) which, ironically, was partly motivated by SARS

and other cover-ups. But this failed to ensure prompt reporting about COVID-19. Whistle-blowing doctors in Wuhan felt compelled to go to social media about the threat rather than official channels such as news agencies, and they were summoned and disciplined by the police for their efforts.

So why haven’t the lessons been learned? Dr Chen’s research over the past 12 years sheds light on the flaws – and progress – of information control on the Mainland.

No right to monitor government

Dr Chen said the ROGI was initially considered a positive step because for the first time in Chinese history, citizens had the right to demand information from their government. But two critical defects have limited its impact. One is that it conflicts with other laws which restrict disclosure of information and prevail over ROGI. The other is that it contains a wide scope of exemptions, including disallowing the disclosure of information that ‘endangers social stability’, which is not defined. This gives government agencies wide discretion to interpret things as they see fit.

The judicial response to the government’s denial of access to information has been cautious. Courts examine closely the motive of the applicant, but subject agency claims to various degrees of scrutiny. As a result, they support information requests relating to the applicant’s personal interests, such as their property rights, but refrain from enforcing ‘watchdog requests’ concerning government accountability or the common good.

“Some judges have even claimed that the right to information under ROGI does not amount to the right of monitoring the government. This is a bit ironic because the nature of freedom of information laws almost around the world is as an instrument to support democracy and allow citizens to monitor government operations,” he said. “This partly explains why, after 17 years, ROGI doesn’t prevent a public emergency similar to SARS from being covered up.”

Dr Chen also finds connections between freedom of information and privacy and the new social credit system. Similar to ROGI requests, court rulings on privacy tend to support individuals seeking to protect

themselves from other private entities, such as individuals and corporations, but act differently on privacy claims against agencies holding public power, such as the government.

“In the absence of a general law that regulates government collection and use of personal data, citizens find it difficult to sue the government for privacy violation. Nor is there an effective legal mechanism to guard oneself against government surveillance,” including the new social credit system, which is being rolled out across the country, he said.

‘Trustworthiness’ and double punishment

The social credit system rates each citizen’s ‘trustworthiness’, but its operation deviates

from legal principles such as proportionality and no double punishment. For instance, if a person is deemed ‘untrustworthy’ for failing to pay an administrative fine, that assessment will remain attached to their rating long after they face the legal consequences. As a result, they may encounter bans or difficulty in purchasing airline tickets, unfavourable rates on loans and other punishments.

Moreover, the person will usually not be notified about their untrustworthy rating nor why it has been applied – they discover the rating only when they try to use a service, such as book a flight. “In classical administrative law, there should be no double punishment. If I rush a red light, I should be fined, but after I fulfil my legal liability, that is it. I would not be punished twice or three times for a single misbehaviour,” he said.

“This is entirely a new, strange way of decision-making. It overly focusses on the deterrent effect but without looking carefully into the rationale or severity of punishment.”

Dr Chen is concerned about the challenges facing administrative law in China, given the slow response of the legal system to the datafication of society as demonstrated by the social credit system, and restrictions on freedom of information and privacy. “When ROGI came in, I hoped it could be a game changer for government transparency and accountability. The subsequent developments show otherwise,” he said.



DR CLEMENT CHEN YONGXI

“What happened with SARS is closely related to what is happening now.”



Credit China is the official portal for promulgating policies of the social credit system and sharing data concerning the trustworthiness of individuals and entities.

LESSONS FROM THE PAST

A new major archaeological research programme enables students to study the past of Armenia and the Ancient Near East and to excavate an ancient fortress and other settlements. The project also engages the public directly in field archaeology through an interdisciplinary knowledge exchange initiative.

The five-year programme marks the beginning of a collaborative research partnership between HKU and the Institute of Archaeology and Ethnography of the Republic of Armenia's National Academy of Sciences, as well as multiple cross-faculty collaborations within HKU.

"Our international project seeks to apply interdisciplinary approaches to the study of the ancient world," said Dr Peter J Cobb, Assistant Professor in the Faculties of Education and Arts, who is leading the project in collaboration with Artur Petrosyan and Boris Gasparyan of the Armenian Institute. The trio developed the Ararat Plain Southeast Archaeological Project (APSAP) to advance knowledge about human life and mobility in the Vedi river valley, a tributary valley to the Ararat Plain located south of Yerevan,

Armenia's capital. The Institute's Hayk Azizbekyan coordinates all on-the-ground activities for the project.

Shared heritage

"The Ancient Near East is central to our shared human heritage as the region of the world that saw many firsts in societal complexity – from agriculture to writing and cities," said Dr Cobb. "The Vedi river valley connects the plain and the mountains as an important sub-route within larger historical networks like the Silk Road. Our main site, the Vedi Fortress, controlled local traffic from its central position in the valley. Protected on most sides by cliff faces, the site's gentle northwestern approach is defended by two lines of massive fortification walls, likely dating to the Late Bronze Age (circa 1500–1150 BCE)."

Despite this rich history, the Vedi river valley and its environs have seen comparatively less archaeological attention than other surrounding regions, which means the project presents a unique opportunity to explore new chronological and theoretical questions. The programme collects and analyses data using the latest accurate and efficient digital tools and methods – one more important focus of innovative cross-disciplinary cooperation.

"We are collaborating with Professor Wenping Wang from the Faculty of Engineering to explore the latest technologies for rapidly 3D scanning and precisely analysing the shapes of ancient objects, especially ceramics," said Dr Cobb.

In addition, the project has sparked an interdisciplinary knowledge exchange

initiative called 'Digging the Past Together: International Public Engagement in Near Eastern Archaeological Research'. This initiative brings together faculty members from Engineering, Architecture and Social Sciences, in addition to Education and Arts, and also activates multiple international partnerships.

"I am working with Dr Tom McDonald of Social Sciences to supervise a student social media specialist who will help engage the public in conversations about archaeology," said Dr Cobb. "We are particularly interested in introducing Near Eastern archaeology to East Asian audiences. To create content for our outreach efforts, we have partnered with Dr Serkan Şavk of the Izmir University of Economics' Department of Cinema and Digital Media. His team is currently developing short films from the first season to introduce our fieldwork and invite the public to participate in our research.

"We are also working with Dr Zhu Xu of Architecture to bring an architecture student on to our project to create 3D reconstructions of our site. These models will help the public visualise the past. In addition, we are developing educational activities for schoolchildren in Armenia. This outreach will take place through partnerships with Ms Ani Avagyan and the National Gallery of

Armenia and Dr Caitlin Curtis of the University of Wisconsin-Parkside. As part of the Gallery's summer cultural heritage programme, groups of Armenian children will visit our fieldwork site during the summer, where HKU students will help them learn about archaeology. Through all these knowledge exchange efforts, we hope to increase the impact of our archaeological research on contemporary society."

Initial foray

APSAP's first season took place last summer when a team – which included HKU students from Arts, Architecture and Social Sciences, as well as undergraduates from universities in the United States, Turkey and Armenia – made their initial foray to the Vedi Fortress, a site which had not previously been subject to scientific archaeological excavation. The main discoveries included fragments of ceramic vessels and the remains of stone architecture, which will be analysed to develop a clearer picture of how people lived in this landscape in the past.

"Pottery styles inform us about the time periods when sites were occupied, and how sites in the landscape communicated with each other," said Dr Cobb. "We map the architectural remains to better understand the

urban configuration of the site, thus revealing where people lived, what they did in each space, and how they moved from place to place."

The Armenia field project has now become an official credit-bearing undergraduate course 'Cultural Heritage and Information in the Field'. The class will enable students to gain experience with field archaeology, to learn about the Ancient Near East, and to develop new skills in digital humanities technologies and information management during a complex data collection project.



DR PETER J COBB

“Groups of Armenian children will visit our fieldwork site during the summer, where HKU students will help them learn about archaeology. Through all these knowledge exchange efforts, we hope to increase the impact of our archaeological research on contemporary society.”

The team of students (and a young aspiring archaeologist) excavating Mediaeval remains at the Vedi Fortress. The Ararat Plain stretches out in the distance.



The outer massive fortification wall of the Vedi Fortress is likely to be over 3,000 years old.



A team from the Izmir University of Economics filming the archaeological fieldwork to share with a public audience. (Courtesy of Yadian Wang)

CAPITAL GRAINS

The discovery by HKU plant biotechnology scientists of a protein that can not only increase rice yield but also enhance the grain’s composition and nutritional content marks an important step forward in food security on our crowded planet.



Professor Mee-Len Chye, Wilson and Amelia Wong Professor in Plant Biotechnology from the School of Biological Sciences, who led the research team, said: “Increasing grain size and yield, besides rice bran and seed lipid content, in crops such as rice is an important research area because one can grow a better (higher yielding) crop on the same area of land. That in turn means we do not need to clear more land for farming as the all-important forests will be in lower competition with farmland.”

The breakthrough came when the team identified that when the protein, ACYL-COA-BINDING PROTEIN2 (OsACBP2) from rice (*Oryza sativa*), is overexpressed in transgenic rice, it will enhance grain size and weight by 10 per cent and increase grain yield.

“Before this discovery, ACBPs [acyl-CoA-binding proteins] were not known to affect grain size and weight,” said Professor Chye. “Further, as OsACBP2 is a lipid-binding protein that binds lipids such as acyl-CoA esters, the major precursors in seed oil production, it was not surprising that oil was observed to

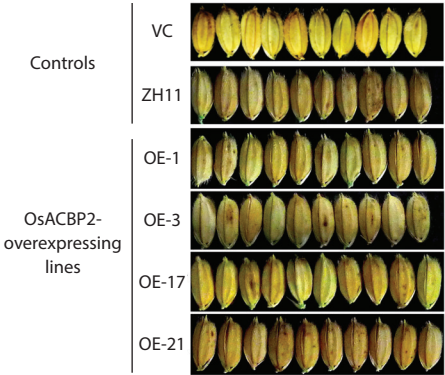
accumulate in the transgenic rice grains. Thus OsACBP2 could also enhance nutritional value with a 10 per cent increase in lipid content of rice bran and whole seeds.

“Given that OsACBP2 contributes to boosting oil content as well as size and weight in transgenic rice grains, an application of this technology in rice is expected to benefit agriculture by increasing grain yield and composition to satisfy the need for more food.”

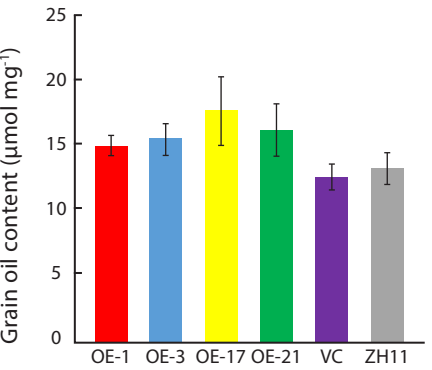
Bioactive components

And it is the right kind of food: rice bran oil has been shown to contain bioactive components that have been reported to help lower cholesterol, and it possesses anti-oxidation, anti-carcinogenic and anti-allergic inflammation activities. “This technology, if applied to other food crops, would not only help address food security but also elevate nutritional properties in grains,” she said.

The findings have been published in *The Plant Journal* and an international patent has been filed. Asked how soon the



The research group led by Professor Chye identified a protein, ACYL-COA-BINDING PROTEIN2 (OsACBP2) from rice (*Oryza sativa*), that when overexpressed in transgenic rice, will enhance grain size and weight by 10 per cent and elevate grain yield.



OsACBP2-overexpressing rice grains possess higher oil content.

technology could be put to widespread use, Professor Chye replied: “The bottleneck is at the planting and use of genetically-engineered crops/food. While these crops/food are widely consumed in North America their status in Hong Kong appears less optimistic. Local granting bodies should support animal testing on these crops, as such experiments must be carried out next following our initial discoveries.”

The findings are the result of many years’ research. Professor Chye started working on plant ACBPs when she set up her laboratory at HKU around 25 years ago. Prior to that she was in Professor Nam-Hai Chua’s Laboratory at the Institute of Molecular and Cell Biology, Singapore.

“While there, I had prepared a cDNA library from Arabidopsis embryos for the laboratory and Professor Chua very generously allowed me to bring a few of the potentially interesting cDNA clones that I had identified to work on when I left to set up my own laboratory at HKU,” she said. “Of the six clones I brought, one encoded an ACBP, and thus the story began.

Nothing much was known on plant ACBPs then so I was very fortunate to stumble upon this niche.

“In fact, only one form – that is, the smallest ACBP member – was well characterised in mammals and yeast then. We discovered there was an ACBP protein family of six members from the model plant, Arabidopsis, and later from rice, a crop we selected to work on. We first published on rice ACBPs in 2011.”

Her partners on the research are postdoctoral fellows Dr Guo Zehua and Dr Shiu-Cheung Lung, as well as her long-term colleagues and collaborators Professor Edward Yeung from the University of Calgary, with whom she has been publishing since 2001, and Dr Richard Haslam, from Rothamsted Research (a well-established agricultural research institution in the United Kingdom) who provided expertise in lipid profiling, particularly using minute amounts of material.

The research was funded by both the Research Grants Council of Hong Kong and the Wilson and Amelia Wong Endowment

Fund, which supports Professor Chye’s Endowed Professorship in the School of Biological Sciences. Professor Chye concluded: “Increasing grain size and yield in crops such as rice is an important research area that aligns with the aspirations of Dr Wilson and Mrs Amelia Wong on the use of plant biotechnology for a sustainable future.”



PROFESSOR MEE-LEN CHYE

“Given that OsACBP2 contributes to boosting oil content as well as size and weight in transgenic rice grains, an application of this technology in rice is expected to benefit agriculture by increasing grain yield and composition to satisfy the need for more food.”

FINDING ANSWERS TO AN AGE-OLD QUESTION

Astronomers shed new light on the origin of globular clusters surrounding giant galaxies.

Contrary to previous belief, globular clusters around the giant galaxy at the centre of the Perseus galaxy cluster are not all ancient objects. Instead, several thousand have been forming at a roughly steady rate out of a cool gas in the centre of the Perseus galaxy cluster, and they have been doing so over at least the past 1 billion years, and perhaps many more over the course of cosmic history.

This discovery was made by a group of astrophysicists led by Dr Jeremy Lim and his research assistant, Miss Emily Wong, from the Department of Physics, using data from the NASA/ESA Hubble Space Telescope.

Working in collaboration with Professor Thomas Broadhurst from the University of the Basque Country in Spain and a Visiting Research Professor at HKU's Department of

Physics, Dr Youichi Ohyama at the Academia Sinica Institute of Astronomy and Astrophysics in Taiwan, and Dr Elinor Medezinski at Princeton University in the United States, the team's journal paper 'Sustained Formation of Progenitor Globular Clusters in a Giant Elliptical Galaxy' was published recently in *Nature Astronomy*.

The oldest visible objects in the Universe, globular clusters were thought to be all relics from the first epoch of galaxy formations. These spherical groups each contain hundreds of thousands to occasionally over 10 million stars gravitationally bound into a single structure about 100 to 200 light years across.

"They are most numerous around massive elliptical galaxies and typically reside in galaxies' outer, less-crowded areas," said Dr Lim.

"Our Galaxy is surrounded by about 150 such globular clusters, some of which are visible to the naked eye from a sufficiently dark site."

Scientists have long thought that globular clusters were formed soon after the Universe began nearly 13.8 billion years ago, at the same time as – or possibly even before – the first galaxies formed. They have since remained largely unchanged, apart from the ageing and death of their constituent stars.

Dr Lim explained: "Globular clusters have always been regarded as important as ancient witnesses to the formation of galaxies, and therefore a possible source of vital clues to how infant galaxies form and then grow over time. But until now we have had scant information about how globular clusters themselves form and accumulate around galaxies."

The team's analysis of the Hubble Space Telescope data revealed that the younger globular clusters are closely associated with, and therefore formed from, a complex network of cool gas that extends to the outer reaches of the giant galaxy. Professor Broadhurst said: "This network of cool gas precipitated from the hot gas that infuses the entire Perseus galaxy cluster. In fact, the gas concentrates in the centre of the cluster, where the giant elliptical galaxy resides, allowing it to cool faster and that leads to the creation of globular clusters."

Raining inwards

"Once formed, these infant globular clusters do not remain in the network of cool gas but rain inwards on to the giant galaxy like raindrops falling from the clouds," added Dr Lim. "Those not disrupted will end up orbiting the galaxy, reaching distances as far away from the centre as the locations where they were born."

The team's analysis explains several other aspects that have previously had scientists

puzzled. "First is their sheer numbers – evidently, some fraction of globular clusters around giant galaxies formed over cosmic history from the gas that infuses galaxy clusters," said Dr Lim.

"Second is the especially broad range of colours exhibited by globular clusters around giant galaxies. The colours of globular clusters change progressively from blue to red as they age – because more massive and bluer stars die first, leaving less massive and redder stars. Hence, their broad range of ages results in a broad range of colours."

The globular clusters that formed from the network of cool gas at the centre of the Perseus galaxy cluster span a broad range of masses, but with a diminishing number at higher masses. "Their number dependence with mass follows the same trend as the truly ancient globular clusters, as well as less massive star clusters in our Galaxy and other spiral galaxies," said Miss Wong.

"This affirms a common formation mechanism for star clusters over all mass scales – from

those weighing just over 10 Suns to those weighing about 10 million Suns – irrespective of the environment in which they formed, whether it be from gas compressed in the spiral arms of galaxies or dense gas at the centres of galaxy clusters; or in ways yet to be discovered as is the case for truly ancient globular clusters."

Finally, the sustained formation of globular clusters at the centres of galaxy clusters also helped explain the enormous size of giant galaxies – up to 10 times or more that of our Galaxy.

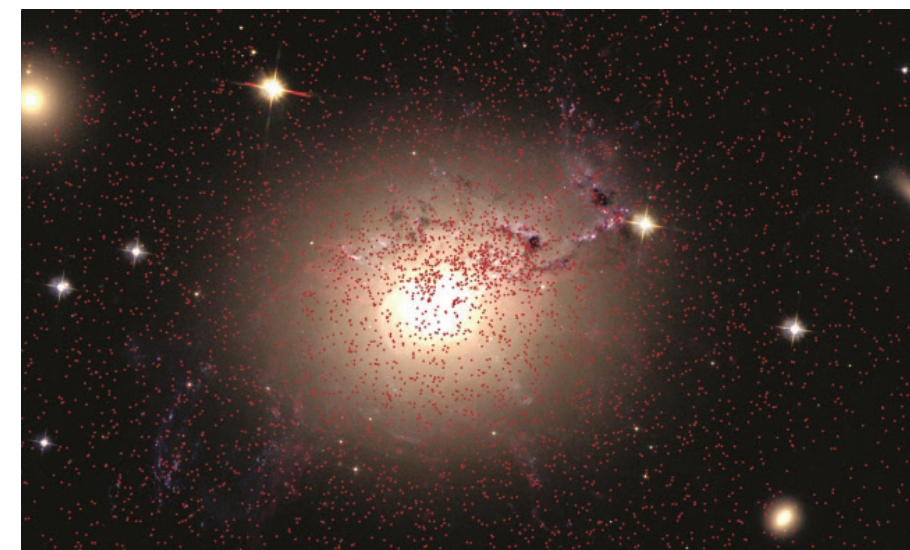
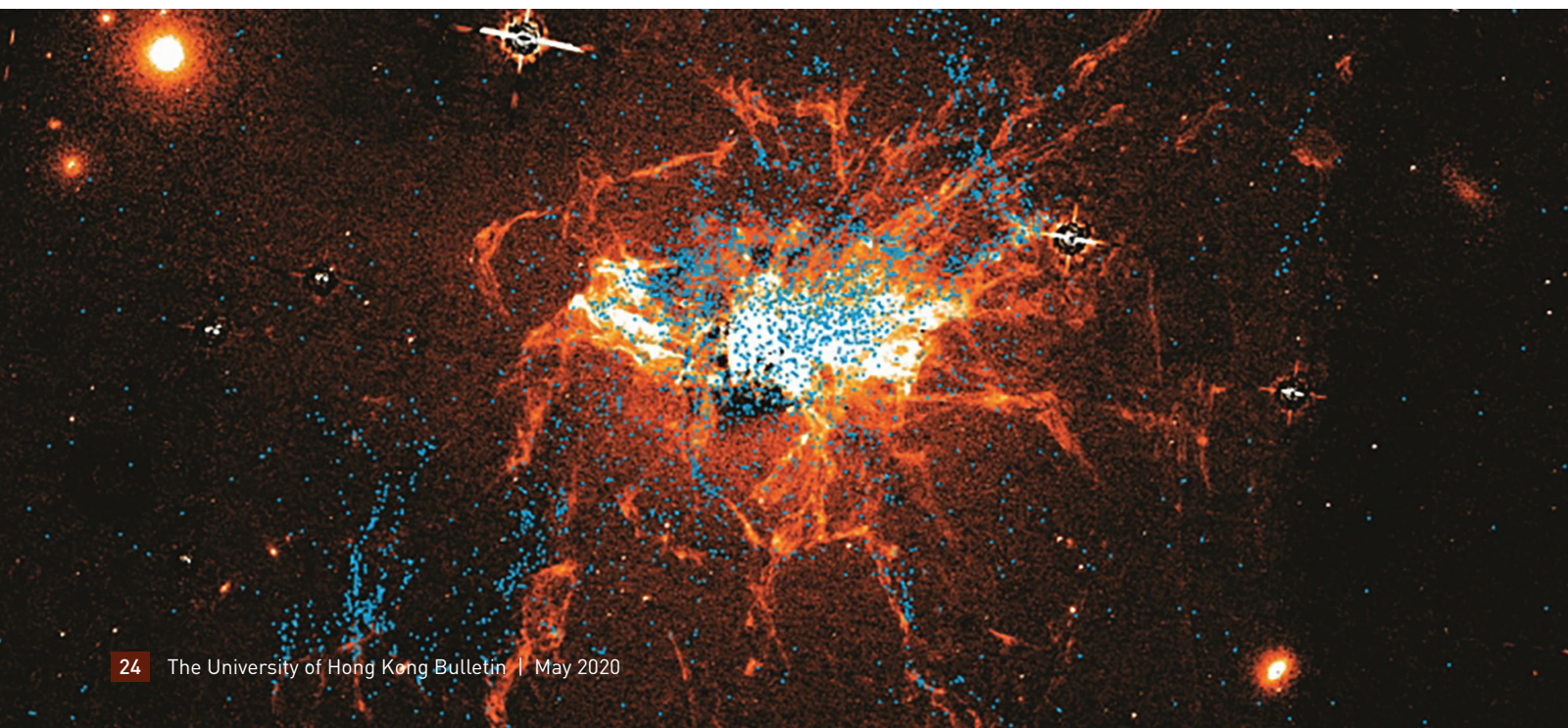
"Whereas the more massive globular clusters will long endure, the less massive globular clusters are expected to be ripped apart as they orbit the galaxy," said Dr Lim. "Their constituent stars, spread throughout the galaxy at the centre of the galaxy cluster, contribute to the growth in size of giant galaxies over time."



DR JEREMY LIM

“Globular clusters have always been regarded as important as ancient witnesses to the formation of galaxies, and therefore a possible source of vital clues to how infant galaxies form and then grow over time.”

Young globular clusters (ages up to 1 billion years) are indicated by the blue dots.



Old globular clusters (ages up to 10 billion years or more) are indicated by the red dots.

DEMOCRACY AND JUDICIAL BEHAVIOUR IN ASIA

Judiciaries can shape – and are shaped by – the political systems they operate within, for better or worse. Professor Yap Po-jen of the Faculty of Law has been investigating this interplay between law and politics in Asia.



Democracies come in different forms. Some are effectively ruled by a dominant party that has muted most opposition. Some are dynamic, with two or more parties that have taken turns in power. Others are more fragile, with a strong military that may seize power if there is a vacuum. Each system shapes judicial behaviour in different ways, according to Professor Yap Po-jen.

Professor Yap has studied the political factors that strengthen or constrain judiciaries in Asia. He has also been looking at how some of

these judicial systems are converging by intentionally adopting constitutional practices from the West.

“Judges today no longer simply interpret the law, they also make law that binds their governments and citizens. The level of democratisation in a political system can impact judicial behaviour, and judicial behaviour can also facilitate the democratisation of a system,” he said.

His first major study on the topic, the monograph *Courts and Democracies in Asia* published in 2017, examined nine Asian democracies – three dominant-party (Hong Kong, Singapore and Malaysia), three dynamic (Taiwan, South Korea and India) and three fragile (Pakistan, Thailand and Bangladesh).

Protecting independence

The dominant democracies are practically ruled by one coalition or its proxies (in Hong Kong, the pro-Beijing forces) and their judiciaries can be easily overruled by the political branches of government.

Nevertheless, the courts in these places can still assert some autonomy within bounds – for instance, Hong Kong courts have ruled against the government on multiple occasions on issues relating to social welfare and gay rights. Where the courts cross the tolerance threshold of the government, they will be punished or overridden, as seen in Singapore and Malaysia.

“All dominant parties will eventually fade away with time, even if this may take a long while. In the meantime, the role of their courts is to do what they can, while protecting their institutional independence. If they rule too aggressively, the dominant party will clip their wings,” Professor Yap said.

In the dynamic democracies, because power changes hands between political parties, the courts are not beholden to any single party and can act more independently. This means judges can make systemic changes to the electoral system, such as correcting gerrymandering in South Korea and overturning constitutional amendments that suspended elections in Taiwan. “Unlike courts

in dominant party democracies that have a minor role in making systemic changes, those courts in two-party systems can actually facilitate systemic political change,” he said.

In fragile democracies, the military is not under the control of the government and can veto or overthrow the government if they are displeased with its decisions. Judges must walk a very careful line. “My prescriptive argument for these courts is that they should impose limits on the government but not in a way that triggers or facilitates martial law” – something that has happened in Pakistan and Thailand when court rulings went against the government of the day.

The most liberal systems

Despite their differences, courts in some of these systems have been converging in their approaches, namely Hong Kong, Taiwan and South Korea. They have all applied the doctrine of proportionality to strike down legislation. The latest example is the Hong Kong Court of First Instance’s recent decision to give same-sex couples who are legally

married overseas access to public housing. And these three courts have all used Suspension Orders to give their governments time to fix a law before a court order comes into effect, as they did with transsexual marriage in Hong Kong, same-sex marriage in Taiwan, and anti-abortion legislation in South Korea.

“With proportionality, courts often say that the government is pursuing a legitimate aim but has gone too far. It’s about determining whether the government’s actions are balanced,” he said.

Professor Yap notes that these three jurisdictions are not intentionally converging with each other, but are converging with practices in the West, from where they actively seek guidance – Hong Kong from the United Kingdom and Canada, and Korea and Taiwan from Germany. Insofar as Western Europe and Canada are in sync, the Asian jurisdictions indirectly converge.

He also thinks it is significant that in these three Asian systems, the judiciaries enjoy

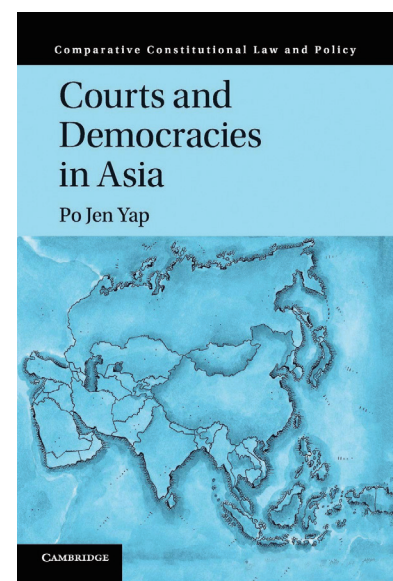
judicial independence (even Hong Kong, where an independent commission selects judges for appointment) and the legislatures are fragmented – Taiwan and South Korea because they are two-party systems and Hong Kong because the Pro-Beijing legislators do not vote as a monolithic block on issues not core to Beijing.

“If we are talking about human rights in general, Hong Kong, Taiwan and South Korea appear to be the most liberal systems in Asia precisely because of these variables. The fragmented political spaces don’t allow one party all the power to decide all legislative decisions. Judges are not accountable to just one political party. And there is intentionality on the part of the bench to converge with Western human rights laws,” he said.



PROFESSOR YAP PO-JEN

Judges today no longer simply interpret the law, they also make law that binds their governments and citizens.



Professor Yap's monograph *Courts and Democracies in Asia* was published in 2017.



GREEN BONDS ARE ON THE MONEY

A new approach to financing is found to benefit both shareholders and society.

When banks and other institutions lend money, their chief aim has long been to get paid back in full, with interest. But over the past decade or so, a new kind of financing has emerged – the green bond – to support companies that are trying to have a positive impact on the environment. The green bond market is worth more than US\$700 billion globally and research by Professor Dragon Tang Yongjun shows it is rewarding shareholders.

Green bonds require companies to take extra steps when seeking a loan. They must lay out specifically how the project will be environmentally friendly and produce an assessment verified by independent parties. In most cases, they are required to keep a separate account for the project so the funds will not be used as working capital (Mainland China is an exception to this), and issue separate progress and final reports on the project's impact.

Professor Tang and his PhD student, Yupu Zhang, collected data from 132 publicly-listed corporations in 28 countries that issued their first green bonds between 2007 – when green bond issuance started – and 2017, to see how share prices were affected. The results were very good news for investors: share prices for these firms rose by 1.4 per cent to 1.7 per cent on average within three weeks around the announcement of green bond issuance.

"The green bond is a signal that the way the company is doing business may actually make it more valuable. To be environmentally friendly is more difficult than business as usual. Managers have to put in more effort and work harder. So there will be a fundamental change to the company," Professor Tang said.

The effect only applies the first time a company issues a green bond because by the second green bond, their environmental credentials have already been factored in by the market. But the findings have wider implications beyond these firms.

China on board

Governments have started to promote green bonds and other forms of green financing through policies and regulations and the research lends support to that approach. Hong Kong and Singapore, for instance, provide subsidies to companies that issue green bonds. "Our findings suggest such government-led policies can work and should be encouraged," he said.

The evidence that green investment is profitable is also timely for markets. Mainland China only just squeezed into the study, having issued its first green bond in 2016. But it is now among the top two issuers in the world. Although China allows firms to mix green bond accounts with other company accounts, it also has the most companies in the world that adhere to the international standard of separate accounting.

The Chinese government is also using other financial instruments to promote better environmental performance – and in separate research, Professor Tang has shown that this approach is having the desired effect.

In 2017 Beijing announced five pilot 'green finance zones' that earmarked incentives and special funds for environmentally friendly industries. Professor Tang looked at the spill-over effects in nearby cities and found they worked even harder to improve their environment than the green finance zones, as measured by available data on pollution and greenhouse gas emissions.

"The reason is that they want to be named a green finance zone in future. This has real benefits because they will get money faster through the green channel, and local government officials may believe it could help in getting promoted," he said.

Failure of traditional finance

Professor Tang sees the success of green finance zones and green bonds as a response to the failure of traditional finance. "When banks or bond markets give loans in the

traditional way, they only care about getting their money back. This makes companies more short-term oriented because they have to pay back the interest and the principle. I have done other research that shows when companies get loans in this way, they pollute more. So that form of financing increases pollution.

"With green finance, the lender cares about more how the money is used. They might lend \$100 and instead of getting \$110 back, they will ask for \$107 and require the company to put the extra \$3 towards reducing their pollution," he said.

Professor Tang himself is committing to green finance by making it a major focus of his research going forward. He is particularly keen to apply academic rigour in a way that keeps this fast-growing field on the straight and narrow. "It's important to do it right. I want to be critical about 'greenwashing' by those who try to get a free ride by saying they will make changes but don't follow through," he said.



**PROFESSOR
DRAGON TANG
YONGJUN**

“With green finance, the lender cares about more how the money is used. They might lend \$100 and instead of getting \$110 back, they will ask for \$107 and require the company to put the extra \$3 towards reducing their pollution.”



HKU's Faculty of Business and Economics signed a memorandum of understanding with Climate Bonds Initiative to jointly provide training on green finance for students in Asia.

THE SUSTAINABLE PRACTICE OF BACKPACKING

Backpackers typically try to do things on the cheap in ways that turn out to be good for the planet, as Dr Benjamin Iaquinto of the Department of Geography discovered.

Tourists can be a negative for environmental sustainability because they often travel by plane and indulge in extras that they may do more sparingly at home, such as taking long, hot showers every day. But one group of tourists may provide a model for sustainable living, and that is backpackers.

Dr Benjamin Iaquinto studied the practices of international backpackers in Australia over several years to see how they use resources over the long term. His methods included interviews, direct observations and questionnaires.

“The findings were more novel than I expected – that tourists, these leisure seekers, could fall into sustainability effortlessly without really thinking about it,” he said.

“Normally, sustainability is seen as a burden on people, something they have to be mindful of and educated about. But the backpackers I studied performed sustainability in their everyday activities and routines inadvertently.”

The infrastructure around them was a big factor. Hostels usually have only one or two stoves for dozens of guests, so backpackers tend to eat communally. The hostels also have few showers and tend to offer only cold-water washes for clothes and no dryers. For cost reasons, backpackers also tend to share rooms and, most importantly, travel by land – usually by bus or shared car.

“Backpackers are unusual because they voluntarily reduce their consumption for long periods of time. They come from rich

societies, like Germany or Hong Kong, they eat instant noodles or plain pasta, and they travel 19 hours on buses when they could fly if they wanted to. Because they want to keep spending down, they are engaging in these unspoken sustainable practices,” he said.

Social and economic sustainability, too

Dr Iaquinto found they also engaged in social and economic sustainability. On the social side, because they stay longer in places (six to 12 months in Australia because they can get working holiday visas), they interact more with the local community and over time spend more money than tourists visiting for just a week or two. They also interact with fellow backpackers who in his research came from

Europe, particularly Germany and the United Kingdom, Hong Kong, Taiwan, Canada, Korea and Japan.

“Backpacking is how many people from affluent societies come to learn about the world. They encounter these societies that are foreign to them and different cultural practices and ways of living that are quite different to what they are used to,” he said.

The working holiday visa itself means they also contribute to economic sustainability because the Australian agricultural industry depends heavily on backpackers to help harvest crops. About one-quarter of the agricultural labour force is backpackers and for some highly seasonal crops, such as cherries, it can climb to 85 per cent. Much of the Australian fruits and vegetables available in Hong Kong shops will have been picked by backpackers, including backpackers from Hong Kong.

Despite their essential contributions, backpackers also face threats and Dr Iaquinto has studied these, too. They often pay for their trip through farm work but climate change and the associated higher temperatures

are making that work even more difficult than usual, as are exploitative practices by employers, such as sexual harassment and withholding wages. A new 15 per cent tax on backpacker income does not help, either.

“Who is going to want to be harvesting in these difficult conditions? Farm work is already tough at the best of times. I’m worried whether the workforce can sustain itself to harvest enough fruits and vegetables for the industry in future,” he said.

Tourism’s future?

The sustainability of backpacking, though, is in no doubt. Dr Iaquinto thinks countries might consider encouraging more backpacking to sustain their tourism industries, given the lower impact and longer-term financial contributions. He would also like to follow up with the subjects of his fieldwork to see if they carried any of their sustainability practices back to their home country.

“These practices may be harder to replicate at home where people have a bit more money to spend and less time. Still, there is

something you can learn from backpacking about how to create the conditions under which sustainability becomes possible in your everyday life, without making it a burden on people. That would be very useful for the environment,” he said.

Dr Iaquinto is about to publish the last of six papers related to his backpacker research and is planning future projects that will look at a different kind of sustainability in tourism: how Hong Kong and China can maintain their tourism industries in light of the 2019 protests in Hong Kong and the COVID-19 virus outbreak.



DR BENJAMIN IAQUINTO *There is something you can learn from backpacking about how to create the conditions under which sustainability becomes possible in your everyday life, without making it a burden on people.*



Many backpackers choose to earn extra cash with fruit-picking jobs during their working holiday in Australia.

RESEARCH LESSONS FROM THE EMERGENCY ROOM

Pharmacy students were recruited to a clinical research team and dispatched to accident and emergency (A&E) wards across Hong Kong to gather information on the effectiveness of different drugs in treating behavioural emergencies.

Research is critical to the pharmacy profession and drug dispensation, but most pharmacy students do not get a deep, first-hand insight into that process. Dr Esther WY Chan of the Department of Pharmacology and Pharmacy set out to change that by incorporating undergraduate learning into a randomised clinical trial (RCT).

The RCT compared two different treatments – sedative agents and anti-psychotic drugs – in managing acute agitation or behavioural emergencies in Hong Kong hospitals. These emergencies may be due to mental illness and/or alcohol or drug intoxication and occur fairly frequently in A&E.

“RCTs are necessary to ensure that drugs are safe and effective for drug registration.

Following registration, RCTs also provide information on how well drugs are working and to what extent they cause side effects in real-world practice. I wanted the students to understand the importance of this research and its role in pushing the profession forward,” she said.

Dr Chan invited final-year Bachelor of Pharmacy students and students on summer programmes to join her RCT. They were assigned to one of six sites where suitable patients were administered with either a sedative, midazolam, or one of two anti-psychotic drugs, haloperidol or olanzapine. She said: “The objective was to provide some answers on what type of dosing and administration would be suitable and how the different options compared.”

Moreover, there was a broader learning opportunity. “I told the students at the beginning that we cannot predict how many patients will be recruited and it may not be many, but they will also learn about everything else that is part of the clinical setting in a hospital,” she said.

Eye-opening

Students first did a literature review and background preparation to gain awareness of the many procedures and considerations involved in recruiting patients, including documentation and approvals from the Department of Health, ethics committees of Hospital Authority and patients. The students then did shifts waiting in A&E rooms for potential cases.

Not every patient with a behavioural emergency could be included, for example pregnant women or patients with a previous reaction to drugs were excluded. The students observed discussions between nurses and doctors on whether to include a patient and noted down important points, the obtaining of patient consent, the administration of the drug, and the patient’s response during their stay in the A&E. They were also tasked with

reminding nurses and doctors when it was time to reassess the patient and determine the need for further drug dosing if necessary.

Hinson Lin Hin-sang, who graduated with a Bachelor of Pharmacy degree last year, participated in the RCT programme in 2017 because he wanted to learn more about research outside the laboratory. He was based in the A&E department of Queen Mary Hospital and said the experience was eye-opening.

“The patients were sometimes very agitated and required physical restraint. It was the first time I had seen patients like this and it was quite shocking when they kept shaking and shouting even after being restrained. This made me realise the importance of chemical sedation for protecting both the patients and healthcare professionals,” he said.

Miriam Leung, who graduated in 2018, joined the RCT in her final year. She was surprised by the lengthy process involved in recruiting eligible patients, but grateful for the opportunity to be in a hospital setting. “I gained valuable insight into how doctors and nurses work in the A&E department, which helped me later when I practised as a hospital

pharmacist,” she said. She currently works as a pharmacist with a non-governmental organisation.

Study results

For Dr Chan, outcomes like these confirm the teaching value of involving students in RCTs. “This was an opportunity for them to appreciate that behavioural emergencies are emergencies just as much as heart attacks or strokes, which is important because mental health tends to be somewhat neglected in Asia,” she said.

A total of 20 students, including 12 on summer programmes and a PhD student, participated in the RCT. Apart from observing patients selected for the trial, they also recorded those who were excluded, which is an important requirement in the final report of the study and journal publication.

The RCT ended in September 2019 after five and a half years and Dr Chan is now circulating the manuscript for publication. The drug allocation was not revealed to students, patients and hospital staff at the time of patient recruitment but unveiled when the study ended. Midazolam was shown to be a

little more effective for managing behavioural emergencies. Both anti-psychotics were effective and safe but olanzapine, a newer drug, performed somewhat better than haloperidol. This supported a key goal of the study, which was to show that olanzapine was a viable alternative for Chinese patients.

“The students involved in this project now have a basis for understanding not only how drugs are tested prior to drug registration but importantly, how registered drugs can be further assessed for safety and effectiveness. This is important first-hand experience,” Dr Chan said.

DR ESTHER WY CHAN
This was an opportunity for the students to appreciate that behavioural emergencies are emergencies just as much as heart attacks or strokes.



Preparation of study drugs for use in clinical trials.



An information and training session about randomised clinical trials for the research team and students.

EQUAL OPPORTUNITY

Born out of the work on gender and diversity that began in April 2015, when HKU signed on to the United Nations HeForShe initiative for gender equality, the Faculty of Arts has launched the first and only Gender Studies major in Hong Kong.

As the new 'I' of 'inclusivity' was unofficially added to the University's mission statement in 2015, the question of instituting gender studies as an academic programme became central to the pursuit of establishing that inclusivity within the curriculum. In December 2015 Arts Dean Professor Derek Collins established a Gender Task Force which became the Committee on Gender Equality and Diversity (CGED), chaired by Professor Gina Marchetti. The CGED hired Dr Elizabeth LaCouture who, alongside Professor Julia Kuehn, then Associate Dean of Teaching and Learning in the Arts Faculty, proposed the programme.

Launched in the first semester of 2018, the major is based on three questions: Who am I?

The programme helps participants understand their identity. What is my relationship with larger communities and structures? This involves exploring the relationship of individuals and groups to larger cultural, social, economic, and political spheres, and examining how gender and sexuality intersect with other categories of social difference, such as, race, ethnicity, social class, and ability. And, how can I change the world? Gender Studies emphasises transforming theory from the classroom into real-life social action.

Uniquely Hong Kong elements

Dr LaCouture is keen to emphasise the uniquely Hong Kong elements of the programme. "For me at HKU the three

questions developed organically from teaching students, responding to their questions and interests as well as to the local situation in Hong Kong. From the beginning, I have wanted our programme to be firmly grounded in a local context. HKU is a global university, but we are in Hong Kong and in Asia. I want our programme to reflect that."

Inclusivity is a key term within the programme. "We practise inclusive pedagogies because that is core to our discipline," said Dr LaCouture. "We highlight inclusivity from day one in every class. We write it into our course syllabi. We are also aware that inclusion at HKU has unique elements. Language, for example, is a major issue of inclusion in Hong Kong, so when students do group work I tell them to first pick

a language for their group that is inclusive to all members and that the process through which they choose the language must be inclusive.

"When doing final projects in 'Introduction to Gender Studies' we spend time in class developing best practices for inclusive group work as a class. The time we spend talking about inclusion pays off. In their reflection essays for group work, students talk about how inclusive their groups were; some of them say it was the most inclusive group they have ever joined at HKU; others who don't normally participate in groups say that now they participate more. And when students who have taken our classes go on to organise student groups and activities, they take these lessons of inclusion with them."

Oversubscribed

The programme has proven popular with students across the faculties. Due to overwhelming demand in year one – the first semester was oversubscribed by 77 per cent and the second semester by 68 per cent.

It has also been busy, staging 13 events in the first year, covering topics as diverse as 'Race

and Asia', 'The Compass to Navigating Your Career and Finding Purpose' and 'Too Many Americans? Debates on the Population Crisis and the Politics of Reproduction in Post-World War II America'.

Dr LaCouture's own interest in Gender Studies comes from her background as a historian of China with focus on women's history. "My interest on gender issues in China was sparked by my junior year abroad, which I spent in Beijing from 1993 to 1994. Beijing was preparing for the UN conference on women and it was a really important moment in the development of women's studies in China. It was a very exciting time to study gender in China!"

She aims to pass that excitement on now through the Gender Studies programme. In terms of what she hopes the students will get out of it, she commented: "Our majors are going to be uniquely positioned to work in the growing field of diversity and inclusion in Hong Kong, but they can also apply the lessons from the Gender Studies classroom into all fields. One of our goals is to put theory into practice and we are constantly challenging students to think about how the lessons relate to the 'real world'. We also have a

new course on leadership: we are training the next generation of female leaders and the next generation of male and female leaders who care about issues of diversity and inclusion.

"Our students are already bringing the Gender Studies classroom to the world! A group of our majors started an organisation on gender issues that ran a summer project in Nepal. Another pair of students started a talk show on YouTube that touches on issues of inclusion. I am really looking forward to seeing what our amazing students do when they graduate."



DR ELIZABETH LACOUTURE
Our majors are going to be uniquely positioned to work in the growing field of diversity and inclusion in Hong Kong, but they can also apply the lessons from the Gender Studies classroom into all fields.



'Spots of Light: Women in the Holocaust Exhibition', co-hosted by European Studies, Gender Studies, Committee on Gender Equality and Diversity and Hong Kong Holocaust and Tolerance Centre, was held in 2019.



Students having a group discussion in the 'Introduction to Gender Studies' class.

HKU'S VIRUS EXPERTS CALLED TO ACTION

The pandemic caused by COVID-19 (for coronavirus-2019) has upended all areas of life around the world. HKU's Medical Faculty, one of the world's foremost research centres for emerging infectious diseases, has played a central role in the effort to contain it.

HKU's LKS Faculty of Medicine (HKUMed) has been at the forefront of research into emerging infectious diseases for decades, producing groundbreaking work on H5N1 and H9N1 bird flus, H1N1 swine flu, SARS (severe acute respiratory syndrome) and MERS (Middle East respiratory syndrome). Now, with COVID-19, that expertise is being applied to the most critical task yet: helping the world understand and contain this new coronavirus that has spread rapidly around the globe.

Scholars in the Faculty were the first in the world to produce a detailed cluster report, epidemiology report, electron microscope images and mathematical model of the potential spread of the virus – all within a few weeks of COVID-19 taking hold in Wuhan

city in Mainland China. Their research has continued apace ever since.

In addition, two HKUMed experts – Professor Gabriel Leung, the Dean and Helen and Francis Zimmern Professor in Population Health, and Professor Yuen Kwok-yung, Henry Fok Professor in Infectious Diseases and Co-Director of the State Key Laboratory for Emerging Infectious Diseases in the Department of Microbiology – were part of the 25-member World Health Organization (WHO)-China Joint Mission that visited the Mainland in February to study the state of the epidemic and the effectiveness of China's response. Professor Leung also co-convenes the WHO's research group on the epidemiology of COVID-19 and testified to

the British parliament via video link on HKU's measures to contain the outbreak.

HKUMed experts have also been advising the Hong Kong government on its response to the disease and speaking almost daily to top local and international media outlets, such as 60 Minutes Australia, Al Jazeera, BBC, CBS News, CNN, CCTV, *Der Spiegel*, *Financial Times*, *The Guardian*, NBC News, *The New York Times*, *The New Yorker*, NHK, Politico, Phoenix TV and *The Wall Street Journal*, to provide current scientific and epidemiological information that has helped communities and individuals develop their response to COVID-19.

"Over the past two decades, HKUMed has been advancing our capabilities in response

to threats from emerging infections. We have world-leading experts and excellent research facilities that we were able to deploy immediately when COVID-19 emerged. We have the capabilities to help not just Hong Kong and the region but also the whole world in coping with this threat," Professor Leung said.

Influencing policy, raising alarms

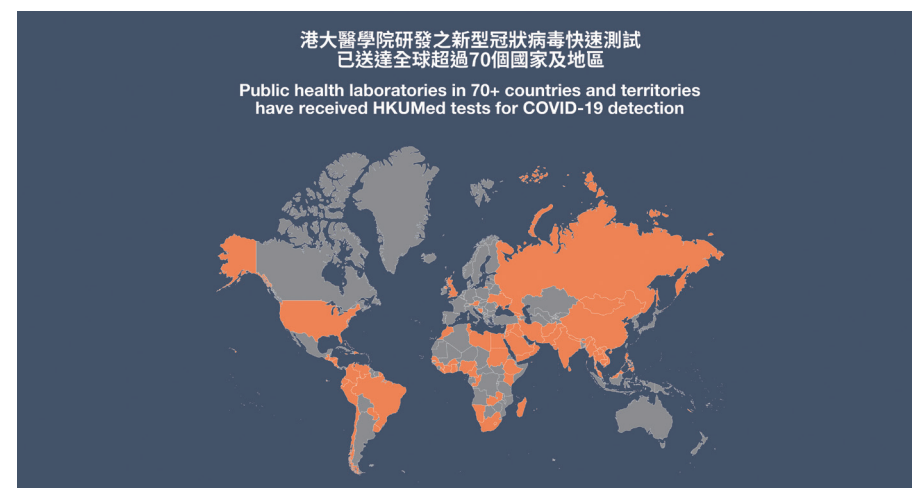
Those capabilities include physical infrastructure, such as two P3 (biosafety) laboratories, research programmes such as the State Key Laboratory for Emerging Infectious Diseases, the WHO Collaborating Centre for Infectious Disease Epidemiology and Control and a WHO H5 reference laboratory that are both based in the Faculty, and more than 55

researchers listed among the top one per cent in their fields based on the number of citations, according to Clarivate Analytics.

Virologist Professor Malik Peiris, Tam Wah-Ching Professor in Medical Science, who earlier published landmark research on SARS and MERS, was one of the first to isolate the virus outside of Mainland China and, together with Professor John Nicholls of the Department of Pathology, produced the first images of the COVID-19 virus' replication in cells (the virus is officially known as SARS-CoV-2). He also worked with Professor Leo Poon to rapidly establish assays for detection of SARS-CoV-2, a test that has been requested by and shared with more than 70 countries and territories. This team also assessed the viral load and

dynamics, showing that asymptomatic patients could transmit the virus.

Clinical microbiologist Professor Yuen, who has been widely cited for his discovery of over 30 novel human and animal coronaviruses since 2003, including the first bat SARS-related coronavirus, led colleagues in providing the first proof of human-to-human transmission of SARS-CoV-2, which is also a bat SARS-related coronavirus. The finding was based on a family cluster from the HKU-Shenzhen Hospital. "This research changed policy control in Mainland China and then the world," he said. "It was because of the accumulation of virus genomic information from our years of work on emerging infectious diseases that we were able to produce a very good diagnostic test for this family cluster of COVID-19."



Rapid nucleic acid amplification tests that were developed by HKUMed to detect COVID-19 in patients are being used by public health laboratories in more than 70 countries and territories.



Professor Gabriel Leung (left) and Professor Ben Cowling (right) releasing a real-time situation report based on the instantaneous effective reproductive number of COVID-19.

PROFESSOR GABRIEL LEUNG

"We have the capabilities to help not just Hong Kong and the region but also the whole world in coping with this threat."

Professor Leung's portrait by Pan Shiyi Photography

Public health experts, such as Professor Leung, Professor Ben Cowling and Professor Joseph Wu Tsz-kei, who all have stellar track records in infectious diseases, were the first to define the epidemiological characteristics of COVID-19 in Wuhan. Working with the Chinese Center for Disease Control and Prevention, they provided the first analysis of transmission dynamics. “We also published a paper at the end of January that was a modelling analysis of how the outbreak could spread across China and the rest of the world in the coming weeks and months. That projection has now in many ways materialised,” Professor Cowling said.

The public health team also produced research on the severity of infections in terms of hospitalisations and deaths; the effectiveness of face masks based on pre-COVID-19 infections, which became the fifth highest ranked article on Altmetric, a system tracking social and news media coverage of more than 14 million research papers from around the world; and the likely risk of a second wave of infections as controls on people’s movements and interactions are lifted.

Far from over

A vaccine would of course be a game changer by bringing this pandemic under control. “A vaccine for coronavirus will be a challenge,”

Professor Peiris said, “but if an effective vaccine is developed, it is likely to remain effective long-term, unlike vaccines for influenza, because the mutation rate is lower than that for flu and also because the protective antibody binds exactly at the site where the virus binds to the cell. This means the virus cannot afford to mutate at that site.”

Research on a vaccine as well as the pathogenesis and treatment for COVID-19 will be facilitated by other new discoveries in the Faculty, including the pioneering use of an *ex vivo* human lung explant model to study SARS-CoV-2 and other viruses, and the development of a hamster model that responds in a similar way as humans to the virus. Further work on the latter has already shown that blood plasma from recovered hamsters could be injected into sick hamsters to lower their viral load.

Apart from continuing to make new discoveries about the virus, HKUMed scholars are also providing expertise in other ways to help society cope with the outbreak. They deliver weekly briefings to the Hong Kong government on the latest local situation; a real-time dashboard of COVID-19 cases in Hong Kong, including a breakdown of sources of cases and outcomes; and regular information and advice to the WHO.

“The threat from this outbreak is far from over,” said Professor Leung, who has predicted it could last at least 18 months. Like everyone, he is on his guard – masking up, wiping down and diligently washing his hands, while sustaining energy for the work ahead. “Usually people in my line of work might count themselves lucky or unlucky to have one big global epidemic in their career, depending on which perspective you take. To have four in the space of 17 years – SARS, influenza A(H1N1) and A(H7N9) and now COVID-19 – it’s rather too much,” he said.



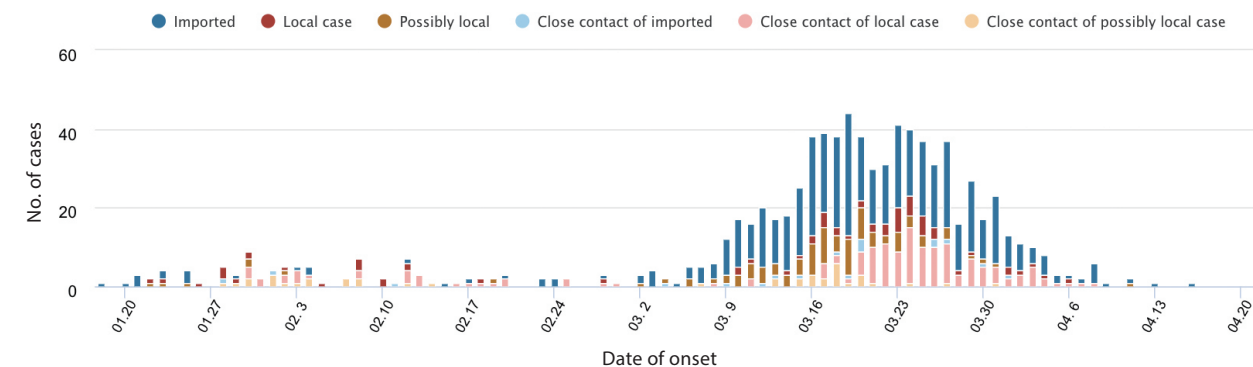
PROFESSOR
YUEN
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“It was because of the accumulation of virus genomic information from our years of work on emerging infectious diseases that we were able to produce a very good diagnostic test for this family cluster of COVID-19.”



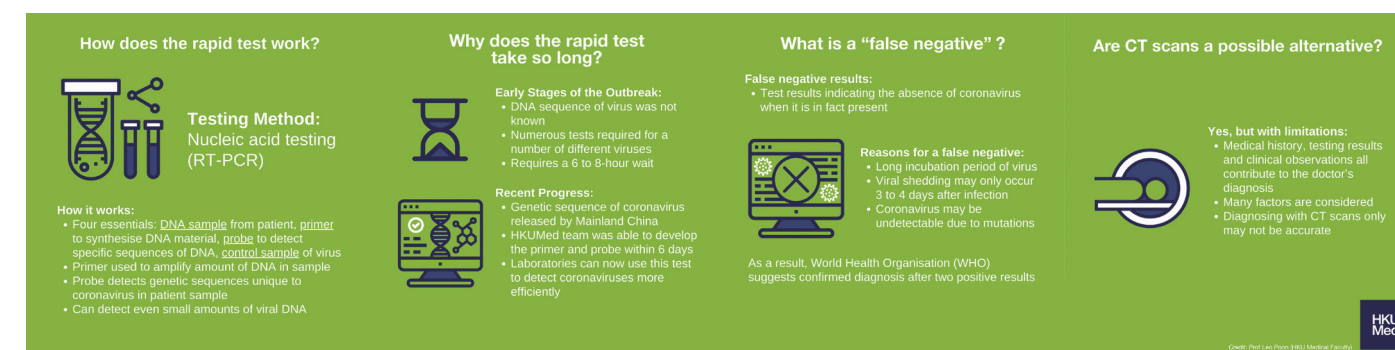
The HKU State Key Laboratory for Emerging Infectious Diseases has partnered with the global Coalition for Epidemic Preparedness Innovations to rapidly develop a vaccine candidate against COVID-19.

Epidemic curve by onset date and stratified by case classifications



The School of Public Health shares the visualised statistics of COVID-19 in Hong Kong on a real-time dashboard.

Get up-to-date figures from the real-time dashboard

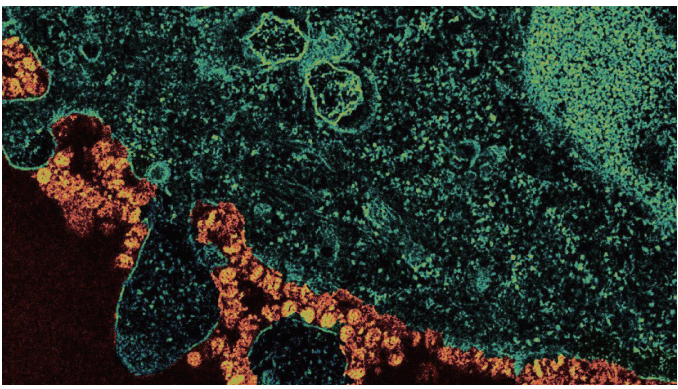


HKUMed has produced a series of ‘Healthographics’ with expert advice and health tips for sharing on different social media platforms.

RESEARCH HIGHLIGHTS ON COVID-19*

- HKUMed's microbiologists and public health scholars have been working with collaborators in Hong Kong and around the world to improve the understanding of the disease, identify treatments, assess effective ways to manage the outbreak, and search for a vaccine. The findings have been published in such high-impact journals as *The Lancet*, *The New England Journal of Medicine* and *Nature*. During the first three months of the outbreak, their achievements included:
- **Firsts:** Produced the first family cluster evidence of person-to-person transmission based on patients at the HKU-Shenzhen Hospital; the first epidemiology report on COVID-19; the first electron microscope images of the COVID-19 virus; and the first mathematical dispersion model of the potential spread of COVID-19.
 - **Tests:** Developed rapid nucleic acid amplification tests that have been requested by public health laboratories in more than 70 countries and territories. The tests are freely available through HKUMed and the WHO. Also developed a hamster model for research on the SARS-CoV-2 virus that is more physiological than the transgenic mice model and is more accessible than macaque models, and used an *ex vivo* human lung explant model to demonstrate why SARS-CoV-2 produces relatively milder symptoms and has higher transmissibility than the 2003 SARS-CoV.
 - **Diagnosis:** Produced more than a dozen published reports on diagnosing COVID-19, such as the viral dynamics in mild and severe cases, detecting the disease in children, and estimating clinical severity. Also showed that a deep throat saliva sample taken in early morning is effective for diagnosing and monitoring COVID-19 infection.
 - **Transmission:** Produced multiple reports on the spread of the disease, such as transmission dynamics, the effectiveness of measures such as social distancing in previous influenza pandemics, and the effectiveness of surgical face masks in preventing transmission of human coronaviruses and influenza viruses.
 - **WHO Team and National Team:** Two HKUMed staff (Professor Leung and Professor Yuen) were appointed to the 25-member WHO-China Joint Mission, and with experts from around the world visited five cities over two weeks in February to assess the state of the epidemic in China and the effectiveness of its response. These same two HKU experts are also part of the Chinese National Experts Group.
 - **Analysis and more:** Contributed analyses of the international governance structures needed to address the pandemic threat. Also produced studies on other aspects of COVID-19, such as identifying the Malaysian pangolin as a possible source.
 - **Trials:** Announced plans for a clinical trial on a possible target drug (through the HKU Clinical Trials Centre) and vaccine (through the State Key Laboratory for Emerging Infectious Diseases).

*As at April 12, 2020



Pseudo-colour thin-section electron micrograph of the 2019 novel coronavirus grown in cells at the University of Hong Kong. The image shows part of a virus infected cell grown in culture with multiple virus particles being released from the cell surface. Each infected cell produces thousands of new infectious virus particles which can go on to infect new cells.



'Live from Hong Kong' broadcasts an interview with Professor Yuen Kwok-yung on 'masks and other lessons from Asia'.

Learn more about the most recent HKUMed COVID-19 research



HKU RESPONDS TO THE OUTBREAK

The University has sought to provide the Hong Kong and global communities with accurate information and advice, while maintaining teaching and learning activities online. Details of the following highlights are available on the Fight COVID-19 website, which is regularly updated and received more than 5,000 views per day during its first two months (up to early April).

- **Fact-checking:** The student-led Annie Lab of the Journalism and Media Studies Centre (JMSc) is part of the International Fact-Checking Network and its #CoronaVirusFactsAlliance, which is working to combat misinformation about COVID-19. Alliance members also include Agence France-Presse, Politico and news agencies from around the world.
- **Health advice:** HKUMed and its experts have provided advice and answered questions from the community on how to wear a mask correctly, wash hands properly, maintain good health, help children stay healthy and other issues of concern. The real-time dashboard also provides the latest information on cases in Hong Kong, such as age, source, onset and outcome.
- **Relief Fund:** The University has set up a Relief Fund to support students and community members in need, with a target of HK\$10 million; HKU President Xiang Zhang and his senior management team have pledged 10 per cent of their salaries over 12 months and are encouraging HKU staff and other members to contribute as well.
- **Supporting the community:** The LoveHK LoveU campaign was launched by HKU's Admissions and Academic Liaison Section to provide tangible support and advice to the Hong Kong community on COVID-19. One platform, ShareWithU, collects anti-epidemic materials such as face masks from HKU members, alumni and partner organisations, which are distributed by students to people in need. Another platform, StandByU, offers health tips and live sessions, including professional medical advice, chatrooms for student support, well-being and counselling, and live chats by HKU top-scorers offering studying tips to HKDSE and IB candidates.
- **Free mindfulness practice guides:** The Jockey Club 'Peace and Awareness' Mindfulness Culture in Schools Initiative at HKU has provided a mindfulness resources package with practice guides for the public.
- **Free home-based exercise videos:** The 'Exercise is Medicine on Campus' initiative of HKU's Centre for Sports and Exercise has produced a series of videos on home-based stretching, relaxation, mobility and circuit training exercises.
- **E-learning tools and tips:** The Faculty of Education and HKU's Technology-Enriched Learning Initiative have been providing support to colleagues and the wider community, such as guidance on how to apply technologies in effective and interactive ways for online teaching and student collaboration, how to convert a blended learning design course into a fully online course, links to arts and culture learning sites, and free online videos on documentary filmmaking and appreciation (through the JMSc).
- **Learn more:** HKU has 17 MOOCs (massive open online courses), which are designed and taught by HKU academics and available for free on the Coursera and edX platforms. Two MOOCs are particularly timely – Epidemics I and Epidemics II – led by the Dean of Medicine, Professor Gabriel Leung. The latter is a new addition and focusses on COVID-19. In addition, the online 'Live from Hong Kong' broadcasts interviews with HKU experts on issues related to the pandemic to countries around the world. The first three programmes featured Professor Richard YC Wong, Philip Wong Kennedy Wong Professor in Political Economy from the Faculty of Business and Economics, and Professor Gabriel Leung and Professor Yuen Kwok-yung from the Faculty of Medicine, and attracted about 280,000 views. The 'Podcast COVID19 with HKU' also reports on the University's latest research related to the pandemic.



The University has launched the LoveHK LoveU campaign in which the ShareWithU platform helps those in need by matching up resources from those who are willing to share. The collected materials were distributed to charitable institutions by HKU student volunteer teams.



Epidemic II looks at the fundamental scientific principles underlying epidemics and the public health actions behind their prevention and control in the 21st century, with follow-up discussions and supplementary content on how these concepts may be helpful in better understanding the COVID-19 outbreak.

Visit the Fight COVID-19 website



SINK OR SWIM?

A newly designed shellfish culture raft could help Hong Kong's beleaguered oyster industry stay afloat.

A course on aquaculture was the inspiration for HKU students to design a new kind of raft for cultivating oysters and then launch a start-up company, Soonlution, to develop and market it. Called the Modern Shellfish Home (MSH), it is specifically designed to withstand typhoons, to allow automatic rotation of the oysters for optimum feeding and to have a remote control function.

The Soonlution founders are: Chief Technical Officer Abigail Zhao Ziwei, who was responsible for the design, production and testing of the rafts during the research and development (R&D) phase; Chief Executive Officer Meko Law Ho-ka, Chief Financial Officer Calvin Ma Hui; Chief Communications Officer Zachary Mok King-him, and recent addition Tsun Shueman as Product Director.

The course that inspired them, 'Oyster Aquaculture: Business and Technology', is taught by Dr Thiyagarajan Vengatesen (Dr Rajan) from the School of Biological Sciences, and looks at how Hong Kong's 700-year-old oyster industry is transforming to meet the challenges of the modern world and achieve sustainable aquaculture.

Ms Zhao said: "Most of our members have a background in ecology and biodiversity, which is amazing but we wanted to explore the interdisciplinary knowledge that goes beyond pure science, and Dr Rajan's course led us into the aquaculture industry."

Problems and answers

According to oyster growers in Lau Fau Shan, they lost up to 80 per cent of their rafts during

Typhoon Mangkhut in September 2018. Having inspected the different types of oyster rafts in Hong Kong, Zhanjiang and Qingdao, the Soonlution team found that, ironically, the most commonly used type of floating bamboo raft was also the most vulnerable to typhoons.

They also researched 'thinning' of oysters caused by overcrowding when farming. In pursuit of higher income, oyster growers would try to grow as many oysters as possible to increase yield, but this compromised quality. The final problem was that very few young people are joining the industry, which traditionally is very labour intensive.

Soonlution's answer, the MSH, is an innovative shellfish raft design, which comprises three innovative protective systems. "The first is a

typhoon resistance system," said Ms Zhao. "During typhoons, the MSH will sink into the sea, avoiding direct contact with the wind and waves at the surface."

The second is a transportation system, which rotates the oysters on the raft automatically and regularly, so that all oysters are filter-fed adequately to maintain consistent quality. "The transportation system also assists partially with convenience and safety," said Ms Zhao, "since oyster growers can now load and unload the oysters from a single standing point."

Finally, there is an off-field monitor and control system. "Through a combination of sensors, satellite and remote control, oyster growers can access environmental data and operate the MSH through an app," explained Ms Tsun. "The system will also connect to the official weather platform for information on typhoons and natural hazards, and suggest corresponding actions to be taken."

Soonlution will start product testing next year with their industry partners in Hong Kong and Zhanjiang, who have agreed to let them carry out tests in their waters. And the industry is certainly interested. "Since we devised our design after listening to the needs

and challenges that oyster farmers are facing, we are basically providing a solution that they have longed for," said Mr Law.

"In fact, we received far more support and praise than we expected, including from the world-renowned oyster sauce brand Lee Kum Kee who have told us they would be interested in following our development and perhaps even buying our product in the future."

In the meantime, they are finalising the prototypes this year, and conducting field tests to collect feedback from oyster growers. After gaining the patent, they intend to launch MSH to the market officially from 2022.

"Through HKU, we have received both advisory and financial support," said Mr Ma. "Dr Rajan has been Soonlution's consultant and inspiration from the start, and has shared with us his personal network in the oyster industry. We have also been selected to join the iDendron seed programme, which provides invaluable tips on running a start-up, getting funding, applying for patents, etc. In addition, we have received TSSSU@HKU [Technology Startup Support Scheme for Universities at HKU] funding which is vital for our R&D of the oyster raft."

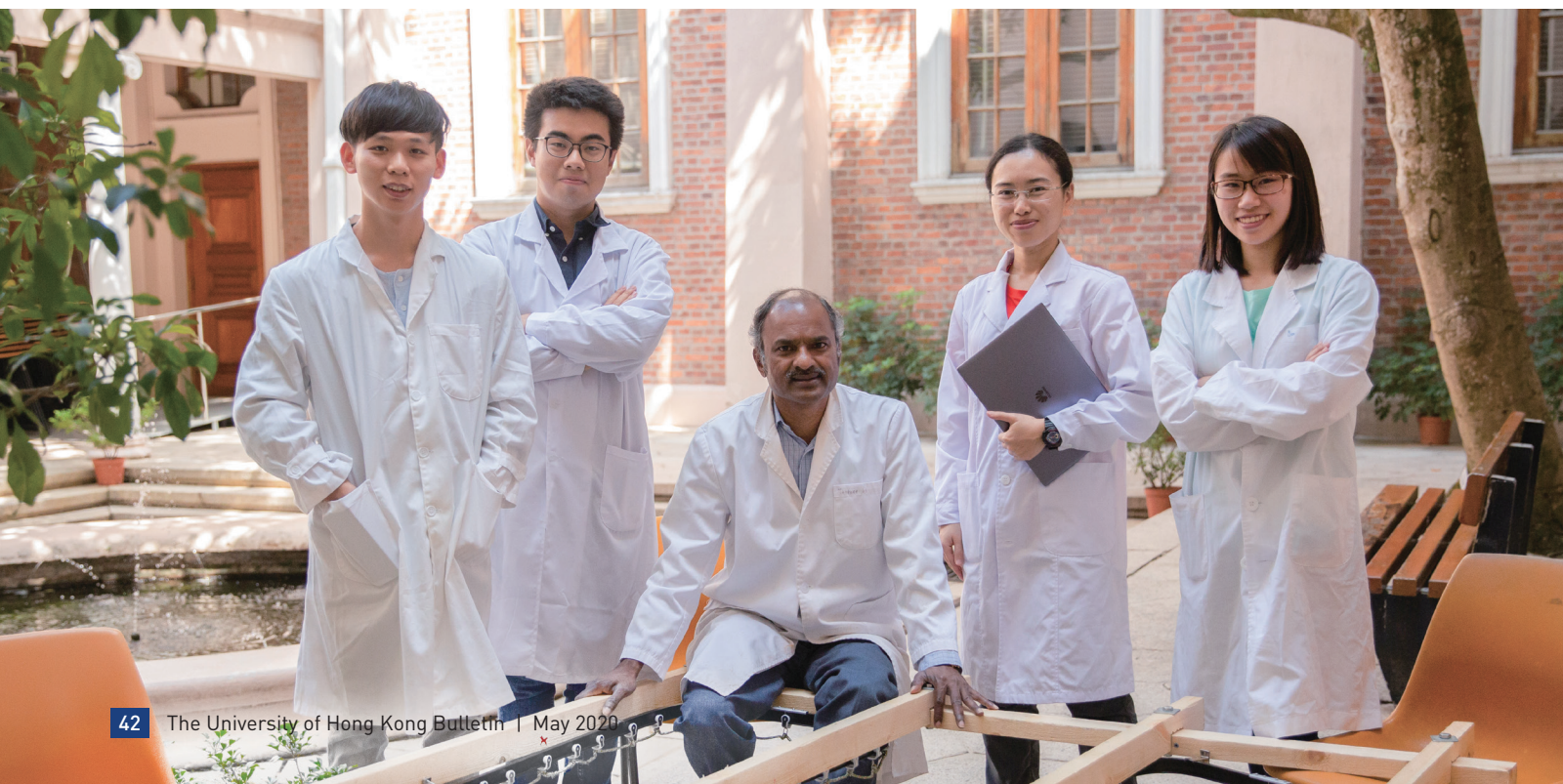
"While we initially set up Soonlution because of the innovative raft design, we went above and beyond soon after and are looking across the different stages of aquaculture production," added Mr Mok. "There are many more problems – or should we say opportunities – when it comes to boosting aquaculture production, workers' safety, and environmental sustainability. Once the raft production line is up and running, we are planning to venture into other types of shellfish aquaculture."



MS ABIGAIL ZHAO ZIWEI

“Most of our members have a background in ecology and biodiversity... but we wanted to explore the interdisciplinary knowledge that goes beyond pure science, and Dr Rajan's course led us into the aquaculture industry.”

Members of the Soonlution team – (from left) Calvin Ma Hui, Meko Law Ho-ka, Dr Thiyagarajan Vengatesen, Abigail Zhao Ziwei, Tsun Shueman, with a prototype of the raft.



MAKING IT WORK

Exposure to a children's cancer centre convinced Dr Yiwu He that researchers should make it a priority to get their findings out of the laboratory and into the world. He will be championing that process as HKU's first Chief Innovation Officer.



Dr Yiwu He's resume includes an impressive range of high-end academic, industry and philanthropic exposure: postdoctoral fellowship at Harvard University, 11 years with GlaxoSmithKline (GSK) where he served as Global Head and Senior Director, nine years at the Bill and Melinda Gates Foundation where he was Deputy Director for global health discovery and translational science, and three years as Senior Vice-President and Global Head of R&D at BGI, one of the world's largest genome sequencing companies.

But he has another quality, not easily enumerated, that he can offer in his new position as HKU's Chief Innovation Officer: passion.

The spark came during his postdoc at Harvard, where he focussed on cancer drug development in a hospital specialising in paediatric cancer.

"We saw these kids facing life and death at such a young age. That's very hard and it changed me completely to feeling that unless a research result can be developed to benefit a patient, it won't excite me. This experience has guided my whole career," he said.

Dr He joined GSK to focus on drug development, then went to the Gates Foundation for the opportunity to use technology to bring vaccines and treatments for common infectious diseases to less developed regions.

"Working at the Gates Foundation was very inspiring, with very frequent interaction with Bill Gates, travelling to different parts of the world to see children and people who were suffering from infectious diseases,

and knowing that what we bring to those countries could save their lives and make them better," he said.

Branching out

Rapid advances in technology, however, were appealing to the scientist in him, so in 2016 Dr He moved to BGI, which develops genomic technology for more precise treatments across a range of diseases.

Last year he had a meeting with HKU's President Professor Xiang Zhang and saw a different opportunity as HKU's first Chief Innovation Officer – to branch out from medicine and bring his mission of translating research to all 10 HKU faculties. He was also intrigued by the high quality of research and the opportunities to develop that further – both Dr He and Professor Zhang have a deep appreciation of how American universities successfully commercialise their research.

"In the past, HKU hasn't paid enough attention to commercialisation, which is bad and good. Bad that it hasn't been done, but in a way good because there is a larger reservoir of technologies and findings that haven't been explored extensively for commercialisation," he said.

Dr He's job is to dig out those opportunities and foster a culture of innovation and entrepreneurship on campus among both academics and students. "I want people to think not only in terms of pursuing a new idea

or concept for discovery, but to understand that really good research that results in products impacts the world," he said.

To inculcate that thinking, he will first focus on systemic changes that will make it easier for innovations to be commercialised and widely shared.

Be with the best

He envisions, on the one hand, a vertical ecosystem that provides practical assistance, such as a network of marketers, investors, intellectual property lawyers, and industrial experts who can be accessed easily for help in getting products and start-ups off the ground. On the other hand, he wants to set up a horizontal ecosystem that will be characterised by close contact with the technology transfer offices of the world's top universities, such as Harvard, Stanford, MIT, Imperial and Oxford.

"How do we push ourselves to become better and eventually the best? One way is to be with the best. So we want to establish an alliance with universities that are doing very well in innovation," he said.

Dr He is also head of HKU's Technology Transfer Office and Knowledge Exchange Office, which have been providing support to scholars for many years and will implement these wider visions. He also leads iDendron, which provides space, training and networking for students and others in the

University community to develop start-ups and commercialise their ideas. The iDendron space currently lacks core equipment and wet labs to dream big and he hopes to change that, too, in collaboration with partners such as Hong Kong Science Park.

"There is opportunity here because HKU has world-class researchers and our leadership wants to help them develop their innovations into products that will benefit society. Commercialisation will not only create a financial return that will provide more resources to do better research, it will also support the development of career opportunities for young people and new high-tech industries, which will increase the diversity of Hong Kong's economy," he said.



DR YIWU HE

“ I want people to think not only in terms of pursuing a new idea or concept for discovery, but to understand that really good research that results in products impacts the world. ”



Dr He (second from right) meeting the iDendron team.



At the Bill and Melinda Gates Foundation, Dr He (right) worked with Bill Gates (left) and he found the experience very inspiring.



HOT OFF THE PRESS

Peter Daniell brings long experience in Oxford University Press and journalism and a lifelong connection with Hong Kong to his new role as Publisher of Hong Kong University Press (HKUP), the University's publishing arm.

Peter Daniell was comfortably ensconced as a senior commissioning editor at Oxford University Press (OUP) in England, where he had been for 14 years, when an advertisement last year caught his eye. HKUP was looking for a new publisher. For Mr Daniell, this was more than a curiosity. It was a calling from his boyhood home.

"I grew up in Hong Kong and later returned for two years in my 30s to work for Thomson Reuters," he said. "OUP was an absolutely lovely place to work, but I know and love Hong Kong and that draw never goes away. So when I saw the advertisement, it seemed like a really good idea to apply."

The job itself held great appeal, too – a chance to work in a smaller publishing house that has fewer boundaries in terms of titles and division of work than a large bureaucratic operation. "HKUP also has a great international reputation," he said.

Mr Daniell brings a worldly outlook himself to the job. He qualified as a barrister in the United Kingdom, then went into television as a broadcast journalist and producer of current affairs programmes at the BBC and ITV. Later, he entered legal publishing, first with Thomson Reuters then OUP, where he was responsible for both practitioner and scholarly output on criminal law, police law and criminology.

At HKUP, he will be overseeing publications on a much broader range of subjects and he is keen to embrace the potential of that. "I am excited about the commissioning opportunities open to us based on our

unique position in Asia and by drawing on the outputs of a strongly research-oriented university."

Crossing disciplines

Mr Daniell wants to deepen the content pool, starting with HKUP's strengths – including Asian studies, Asian history, cultural and gender studies, anthropology, film and media, law, religion, fine arts and languages – but also expanding into interdisciplinary areas.

A key focus for that expansion is HKUP's specialist series, which embrace topics not covered well elsewhere: the 'Crossing Seas' series focusses on Chinese migration from the migrants' perspective; 'Crossings' on Asian cinema and media; and 'Queer Asia' on non-normative sexuality and gender cultures, identities and practices across the region.

"Queer Asia has been particularly successful and it has enhanced our reputation internationally as having this area of expertise, which is helping to build our profile," he said.

To capitalise on that momentum, he hopes to launch a new social science series for the Asia Pacific region that would be broad-based and interdisciplinary and guided by a board of experts from around the world. "The idea is

to look widely but take a restrictive approach for inclusion, only accepting those research monographs that truly move the debate forward or break new ground," he said.

Mr Daniell also wants to reach out to scholars doing interdisciplinary research in all areas at HKU including contemporary China, the law, education, megacities, and urban planning and well-being. "The broad message is that we are keen to find out what they are doing," he said.

Here to help

He is starting to pitch directly to the faculties, departments and individual academics on campus, and has offered to help departments that publish their own publications with such things as distribution and marketing.

All HKUP titles undergo a peer review system by readers from top universities around the world. "We take our peer review process very seriously. Everything that we publish is read in its entirety by at least two experts in the field and manuscripts must be revised according to their feedback before they are accepted into production. If you set the bar high for quality, you should be open to all kinds of formats and topics that meet the needs of specific audiences," he said.

HKUP books are distributed globally to libraries, individual academics and professionals, students, and general readers too. Many sell well in local bookshops, particularly local history, law and language books, and quite a few titles on Chinese history, film and fine art have been picked up by publishers in Mainland China.

"Overall, we want to make HKUP the go-to place for all research emanating from the Greater China area and to translate the research to an international audience," he said. "A lot of people say a small press can't compete with the big players out there, but there's no reason you can't be a small press with an international reputation for quality."



MR PETER DANIELL

“Overall, we want to make the Hong Kong University Press the go-to place for all research emanating from the Greater China area and to translate the research to an international audience.”



Building on its unique position in Asia, the Hong Kong University Press releases up to 50 new titles a year from leading scholars around the world.

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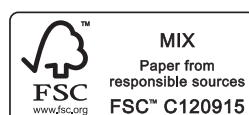
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