PEDALLING FOR PURPOSE
Keeping seniors fit and connected

NUTRIENT GOLDMINE
Urine-based fertilisers

HIGH POTENTIAL
Balloons bring space within reach

FUTURE-MAKERS

CULTIVATING THE FUTURE

Smart methods for ensuring Australia's food security

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ABOUT THIS MAGAZINE

Future-Makers is published for Western Sydney University by

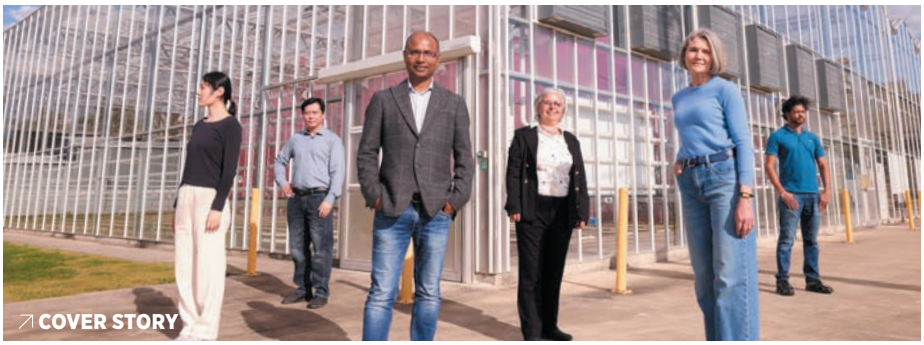
nature custom media

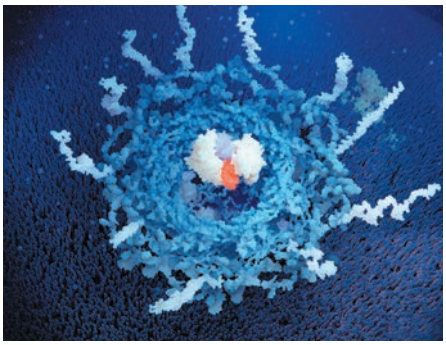
part of Springer Nature.
Level 8, 227 Elizabeth Street, Sydney, NSW 2000 Australia

Some of the research contained in this publication was supported by the Australian Government through the Australian Research Council (ARC) or the National Health and Medical Research Council (NHMRC). The views expressed herein are those of the authors and are not necessarily those of Western Sydney University, the Australian Government, the ARC or the NHMRC. Aboriginal and Torres Strait Islander peoples should be aware that this publication may contain the images and names of people who have passed away.

WESTERN 2030

Western Sydney University is transforming communities in western Sydney and the world through student success and impactful research. Established in 1989, the University proudly traces its history back to 1891 through the Hawkesbury Agricultural College. Today, the University has more than 240,000 alumni, 49,000 students and 2,700 staff. Western is ranked in all major global university ranking systems, and is in the top 2% of universities worldwide. It has consistently achieved number one in the world for its social, ecological and economic impact in the 2022-2025 Times Higher Education (THE) University Impact Rankings. Through a bold new strategic plan, WESTERN 2030, the University will take Western Sydney to the world and the world to western Sydney.





#1 IN THE WORLD

2022–2025

TIMES HIGHER EDUCATION IMPACT RANKINGS

Western scored the world number one ranking for the fourth year in a row.

We also ranked highly in the following categories:

- → **4th** in the world for SDG 15 *Life on Land*
- → **7th** in the world for SDG 5 *Gender Equality*
- → **8th** in the world for SDG 13 *Climate Action* and SDG 12 *Responsible Consumption and Production*
- → **9th** in the world for SDG 17 *Partnerships for the Goals*, SDG 6 *Clean Water and Sanitation* and SDG 11 *Sustainable Cities and Communities*
- → **10th** in the world for SDG 14 *Life Below Water* and SDG 7 *Affordable and Clean Energy*

WESTERN SYDNEY UNIVERSITY

WESTERN SYDNEY UNIVERSITY. SHOWING THE WORLD THE WAY.

ON THE COVER

Researchers from the new Australian Research Council Training Centre for Smart and Sustainable Horticulture.

page 25

Cover image:
© Cybele Malinowski

LOOKING FORWARD

Welcome to the ninth issue of *Future-Makers*, which highlights our impactful research and efforts towards building a more sustainable future.

Crucial to that future is WESTERN 2030, our new strategic plan. WESTERN 2030 is built around 7 priorities including: strengthening student success, putting our people first, leading Indigenous acceleration, unlocking global impact, driving research and innovation, unleashing Western Sydney, and securing sustainability. We believe this plan will help us realise our ambition to be the university that Western Sydney needs and deserves.

We are also celebrating being ranked first overall in the Times Higher Education (THE) Impact rankings for the fourth year in a row. These rankings identify and celebrate universities that excel across multiple United Nations Sustainable Development Goals (SDGs).

In this issue of *Future-Makers*, read about the steps taken by Western to become both climate and nature positive, including joining the global Nature Positive Universities network.

Our cover story introduces the new ARC Training Centre for Smart and Sustainable Horticulture led by Western's Professor Oula Ghannoum. We also present stories about co-operative housing, the future of space colonisation, and the intersection of bats and climate change.

This is just a taste of the stories in this issue. We hope you enjoy the rest of the magazine. For past issues and more stories of impactful research, please visit: westernsydney.edu.au/future-makers.

Professor Ian Anderson
Pro Vice-Chancellor (Research & Innovation)

SUSTAINABLE DEVELOPMENT GOALS

The UN Sustainable Development Goals (SDGs) are a blueprint towards a better, more sustainable future (see: sustainabledevelopment.un.org). Western Sydney University has many research projects aligned with these goals. We have indicated the most relevant SDG above each article in this issue of Future-Makers where applicable.

CHARTING A PATH TO A GREENER FUTURE

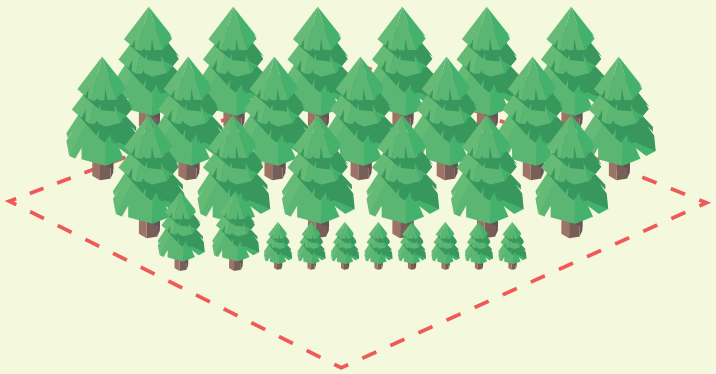
As part of its commitment to the United Nations Sustainable Development Goals, Western Sydney University has launched a number of research and on-campus initiatives focused on environmental sustainability, with a particular focus on 'Clean Water and Sanitation' (Goal 6), 'Affordable and Clean Energy' (7), 'Sustainable Cities and Communities' (11), 'Responsible Consumption and Production' (12), 'Climate Action' (13), and 'Life on Land' (15).

Learn more about some of these initiatives on these pages and also at westernsydney.edu.au/future-makers

NATURE POSITIVE PLEDGE

In late 2024, Western Sydney University pledged to become 'Nature Positive' by 2029, joining the global Nature Positive Universities network, an initiative led by the United Nations and the University of Oxford. This pledge builds on the University's Race to Zero commitment to restore ecosystems we all rely on.

As part of our Nature Positive Pledge, we developed baseline metrics and strategies that include citizen science engagement and mapping of the ecological communities across our campus network.



365
flora and fauna species identified

by our community in our university-wide campus BioBlitz.

1,899
hours invested

into invasive species management on our campuses.

19,208
trees identified

and mapped within the built environment of our campuses.

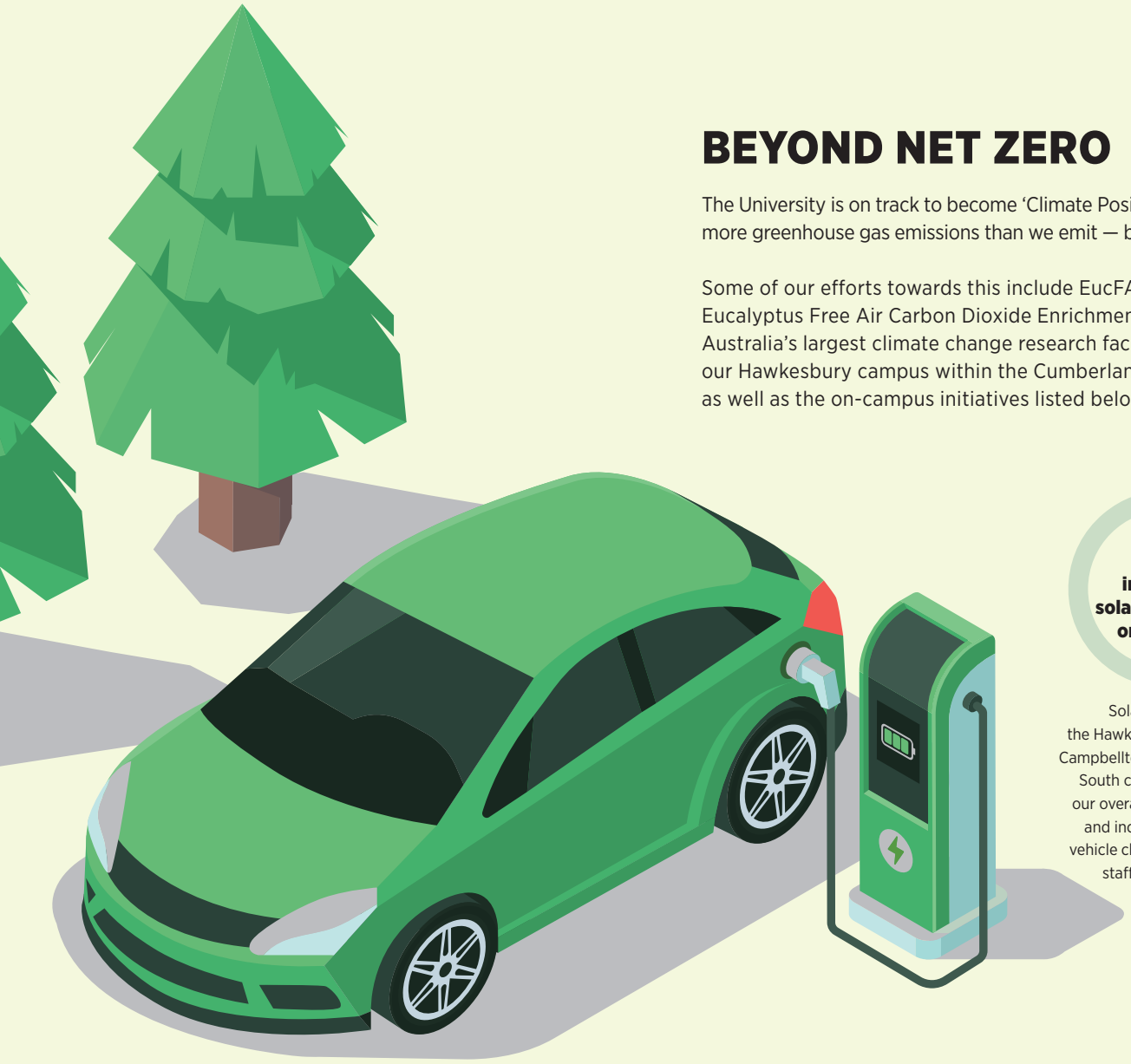
413
hectares of habitat protected

across our campuses, including endangered and critically endangered ecological communities.

BEYOND NET ZERO

The University is on track to become 'Climate Positive' — removing more greenhouse gas emissions than we emit — by 2030.

Some of our efforts towards this include EucFACE, the Eucalyptus Free Air Carbon Dioxide Enrichment Experiment — Australia's largest climate change research facility, located at our Hawkesbury campus within the Cumberland Plain Forest — as well as the on-campus initiatives listed below:



39%
increase in solar generation on campus.

Solar carparks at the Hawkesbury, Kingswood, Campbelltown, and Parramatta South campuses increase our overall solar generation and incorporate electric vehicle charging stations for staff and students.

100% of our electricity was purchased from renewable sources.

Our carbon electricity footprint reached zero this year.

6-star rating
for four campus buildings.

We are a sector leader for the number of green-star building projects and campus precincts.

89%
of campus waste

is diverted away from landfill.

60%
of water use

will come from non-potable sources on all campuses by 2026. This will be a 20-year commitment to water reuse and research under the Hawkesbury Recycling Scheme.

COMMUNICATION IN HUMANITARIAN WORK

Understanding how young people exchange information in refugee camps could help humanitarian agencies improve communication with affected populations.

A young person looking through a fence at the Kakuma refugee camp in Turkana county, Kenya.

© Chine Nouvelle/SIPA/Shutterstock

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

In a long-term refugee setting, where displacement of people spans years or even decades, the lines between humanitarian aid and development can blur. **Dr Valentina Baú**, a senior research fellow at Western Sydney University's Humanitarian and Development Research Initiative (HADRI), is leading research to understand how young people in long-term refugee camps communicate, and how humanitarian organisations can engage with them more ethically and effectively.

Her Australian Research Council Discovery Early Career Researcher Award project — Development Communication, Media and Peace in Protracted Displacement — focuses on two major camps: Kakuma in Kenya and Za'atari in Jordan. Kakuma is one of the largest refugee camps in the world, with a population of more than 200,000 people from different parts of Africa. It is also one of the longest running, having been established in 1992. Za'atari was founded in 2012 and has housed up to 120,000 people.

"I wanted to understand how communication is used in those camps, and how humanitarian agencies can use a more informed communication approach in reaching young people — particularly in ways that also promote social cohesion and community development in the camps," says Baú.

Her work is grounded in the idea of 'communicative ecologies', which structures the communication environment into three layers: technological, social and thematic.

"The technological layer refers to the media that young people use in their everyday lives to communicate; it doesn't necessarily need to be digital but it is the means through which information can be received and exchanged," Baú explains. "The social layer is all the interactions that young people have, such as gatherings, while the thematic layer is what they usually talk about. Essentially, these layers address the three questions of 'how', 'where' and 'what' communication takes place."

Although both Kakuma and Za'atari are long-term refugee camps, there are important differences in their communicative ecologies. For example, in the technological layer, Za'atari camp has more resources and young people there have access to mobile phones and computers.

While mobile phones are also accessible in Kakuma, they are usually shared on a rotational basis by several people. "Obviously, that influences how digital technology is experienced," Baú says.

On the other hand, Kakuma has a richer social layer and more opportunities for young people to meet, Baú continues. "There are interest groups, from poetry to acting and dancing; the humanitarian organisations operating there hold many activities for young people to participate in. In Za'atari, the social interactions tend to be more limited, with activities for different genders depending on the time of day."

MESSAGES THAT 'FIT'

One of Baú's key findings is that understanding these differences can help humanitarian and development organisations develop more tailored communication strategies. While the content of the messages remains important, beginning with the context can help agencies break through linguistic and cultural barriers.

These findings, published in the journal *Communication Studies*, were added by the United Nations Refugee Agency (UNHCR) as a resource in their Assessment, Analysis and Learning Hub to encourage others to take an ecology-informed approach to youth communications.

As a next step, Baú returned to Kakuma to conduct a follow up study on the use of radio and also plans to return to Za'atari to study how other technologies like geographic information systems are used. "Radio and other technologies can be an important platform through which communication takes place, playing an important role in the ecology of young people."

NEED TO KNOW

- Dr Valentina Baú is studying how young people communicate in refugee camps.
- She is using an approach called communicative ecologies to break up the environment into technological, social and thematic layers.
- This could help humanitarian organisations develop more effective communication strategies.

COUNTING THE COST OF PERIOD PAIN

Researchers are building a picture of the true economic toll of problematic menstruation.

3 GOOD HEALTH AND WELL-BEING

Cramps so bad you're throwing up from the pain. Bleeding so heavily that you flood through period products in an hour. Periods so unpredictable you never know when they're going to start — at work, on the train, or in a traffic jam.

Around three-quarters of women, girls and those who menstruate have experienced a problematic period in the past five years. For some, it renders them incapable of going to work, while others do their best to soldier on in pain, discomfort and anxiety.

Now a study from researchers at Western Sydney University and the not-for-profit organisation Jean Hailes for Women's Health has put a dollar figure on how much problematic periods cost the Australian economy: an incredible A$14.2 billion dollars every year, and even that is probably an underestimate.

"This just accounted for absenteeism — so days taken away from work — and presenteeism, which is feeling affected whilst at work," says **Dr Millie Mardon**, first author of the study and a postdoctoral research fellow in reproductive health at Western's National Institute of Complementary Medicine (NICM). "So, we're not accounting for healthcare costs, we're not accounting for payment to use period products, and we're not accounting for loss of superannuation because of time away from work."

It's the first time the economic burden of menstrual disorders has been quantified in Australia. The study, which is part of a bigger series of work exploring how menstruation contributes to gender inequity, used data from the Jean Hailes National Women's Health Survey, an annual survey of around 3,500 Australian women aged between 18 and 50 years.

The analysis, published in December 2024 in the *Australian and New Zealand Journal of Obstetrics and Gynaecology*, revealed that the economic burden of menstruation weighs more heavily on some groups than others. Just over 40% of women aged 18–24 years reported missing work or study due to menstrual symptoms, compared to just 30% of women aged 35–44 years.

"Younger women tend to have more problematic periods, and these young women are the ones that do not have a voice in the workplace," says Dr Sarah White, CEO of Jean Hailes for Women's Health. "If you're earning less because you're working less at 18 — or you're unable to perform some roles — by the time you get to midlife, the impact is compounded."

NEED TO KNOW

- Problematic periods can lead to absenteeism and presenteeism at work.
- Researchers at Western have estimated the cost associated with this as A$14.2 billion per year.
- To avoid this, conversations about menstruation need to be normalised.

ANTIQUATED WORKPLACES

At the heart of the issue is the fact that workplaces and work schedules were originally designed for men, says **Associate Professor Mike Armour**, a reproductive health expert at NICM, who led the study and brought the interdisciplinary research team together.

"When you think about the modern workplace, many of the policies have their roots in an era when women were not a large part of the full-time workforce and so were designed around the needs of men," he says. "Often we try and make women fit into the modern work schedule and workplace, rather than making the workplace fit around them."

So, what would a working environment which better supports the challenges of menstruation look like?

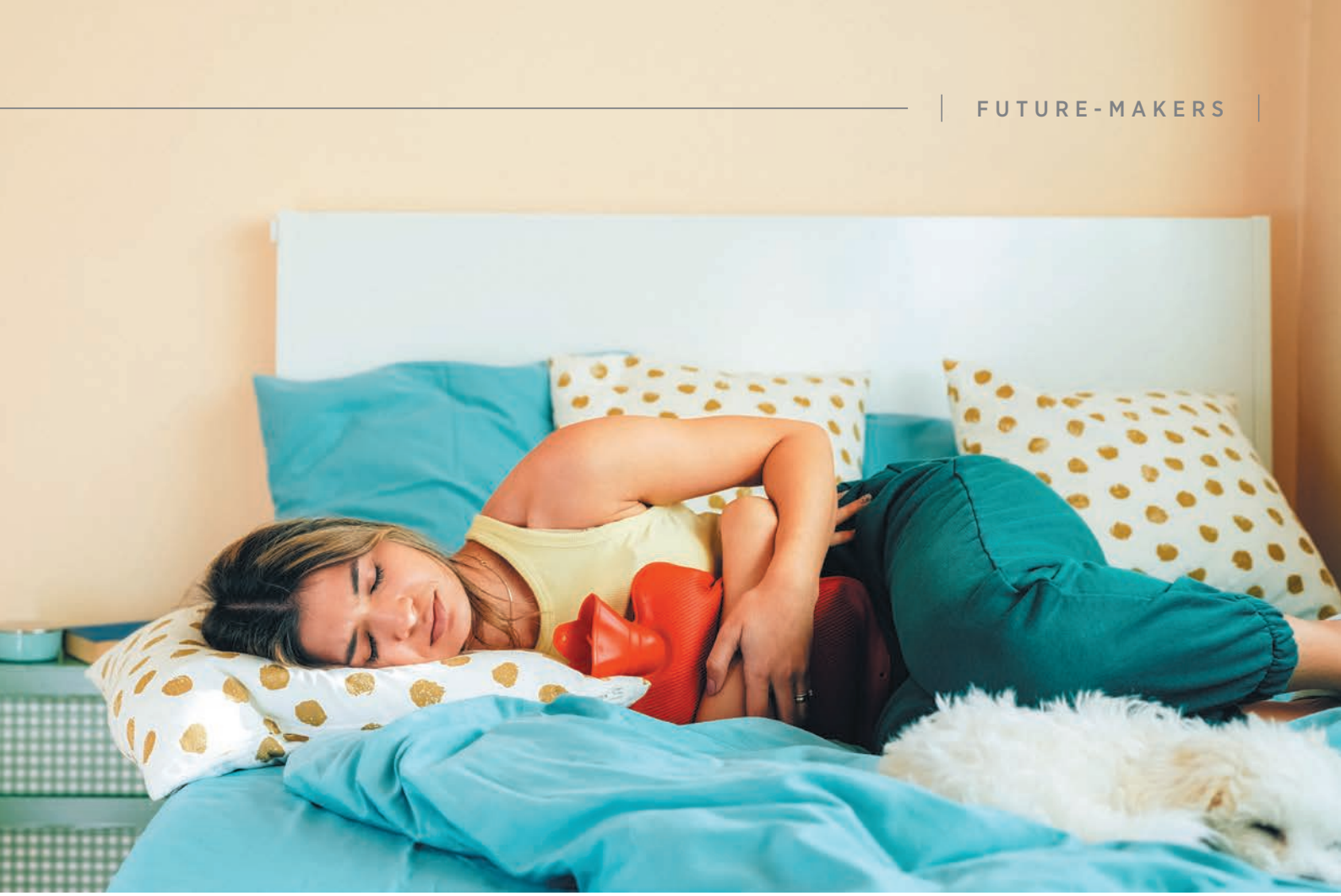
"It can be as simple as having a quiet space where people who are on day one or two of their period, and things aren't super-fun, can go," Mardon says. It could also be standing desks, so people can keep moving, or access to a microwave to warm a heat pack.

But the biggest influence is workplace flexibility — something that, since the

A$14.2 BILLION

The yearly cost to the Australian economy associated with problematic periods.

© Treety/iStock/Getty



The flexibility of working from home can help people with problematic periods to manage their day more effectively.

COVID-19 pandemic, has become more normal for many people. But even with the flexibility to work from home, mornings might be worse for some sufferers of problematic periods, meaning they would benefit from being able to start a few hours later than usual, while others might get worse in the afternoon and need to leave earlier.

Another issue is addressing menstrual stigma, which would also make it easier for people to ask for support in the workplace. "The shame and the stigma are so ingrained in all of us that we hide our period products up our sleeves; we don't talk about it for fear of being diminished, being insulted," says **Dr Sarah Duffy**, senior lecturer at Western's School of Business.

The researchers also found that male and female bosses can be equally unsympathetic to staff needing flexibility. "If you have a female boss who hasn't experienced difficult periods, they can often be very unsympathetic because they're worried that it's going to make women look weak, and they just can't understand that somebody else's experience is different to theirs," Duffy says.

Antiquated attitudes to menstruation are changing, albeit slowly. "Workplaces really do need to act, because many of their future employees are coming from schools where they've had access to free period products and are used to having more open conversations," Duffy says. "I think they will demand more from their employers on this front." Supporting reproductive needs and choices isn't just good for individual health – it's also a productivity imperative.

CRITICAL CONVERSATIONS

Mardon says conversations about menstruation need to be normalised. "If you work in an office with women and people assigned female at birth, there's going to be someone on their period, and they shouldn't feel ashamed."

Legislative and policy reform has been identified as one approach to redress menstrual inequities. But it's not straightforward, as the case of Spain's paid menstrual leave entitlement shows.

"The legislation's there, and the entitlement is available but it's not being taken up; women aren't making use of it," says **Dr Michelle O'Shea**, senior lecturer and interdisciplinary gender equity scholar at Western. "It speaks to the unintended consequences or the fear of, 'how will I be perceived if I use that entitlement?'" In response, O'Shea and colleagues are researching other workplace interventions, including the utility of both paid reproductive leave and flexibility to manage reproductive health more broadly.

This example highlights the many dimensions of menstrual inequity, and why it requires a multidisciplinary approach, O'Shea says. "My colleague Mike is the conduit and has brought people together with different and complementary knowledge and skills," she adds.

A GOLD MINE OF NUTRIENTS

Australian scientists and waste utility providers are reimagining human urine as a rich, affordable and sustainable fertiliser.

11 SUSTAINABLE CITIES AND COMMUNITIES

The waste flushed down the toilet is of no consequence to most of us as we leave the bathroom. But for **Professor Jeff Powell** and **Dr Jason Reynolds**, researchers at Western Sydney University, that rush of water in the toilet bowl hints at the possibility of a fertile supply chain — one that passes through wastewater treatment plants and into fields, gardens, and greenhouses.

The pair are laser focused on urine-based fertilisers as part of the Australian Research Council Research Hub for Nutrients in a Circular Economy (NiCE Hub), an ambitious A$2-million effort to recover useful nutrients from the wastewater stream. The Hub is a collaboration between universities and utility providers, and includes engineers, soil scientists, microbiologists and policy thinkers, all working to transform urine into a safe, effective fertiliser.

The idea isn't new — civilisations have recycled human waste for millennia. "But now we're trying to make it safe, scalable and acceptable," explains Reynolds, a soil scientist at Western's School of Science.

At the core of the project are two products: UrVAL and UGold. Developed by teams at the University of Technology Sydney (UTS) and the University of Melbourne, these are different urine-derived fertiliser systems. Both begin with source-separated urine, but UrVAL relies on membrane bioreactors to sanitise and concentrate nutrients, while UGold uses electrochemical processes with ion-exchange membranes to recover and concentrate nutrients. The result is a stable fertiliser product with minimal odour and low pathogen levels — typically yielding one litre of liquid fertiliser from every ten litres of urine.

The liquid is rich in nitrogen, phosphorus and trace elements, exactly what plants need to grow. However, "just because you can extract nutrients doesn't mean you know how they'll behave in soil," says Powell, an expert on soil microbiomes at Western's Hawkesbury Institute for the Environment.

That's where Western Sydney University comes in. While engineers focus on extraction, Powell and Reynolds are testing how these products interact with ecosystems. In greenhouses on the Hawkesbury campus, one of their PhD candidates, Niraj Yadav, runs trials with model grasses, adjusting dosage rates and pH levels. Too much, and the salts or pH in the fertiliser could damage the soil, explains Reynolds.

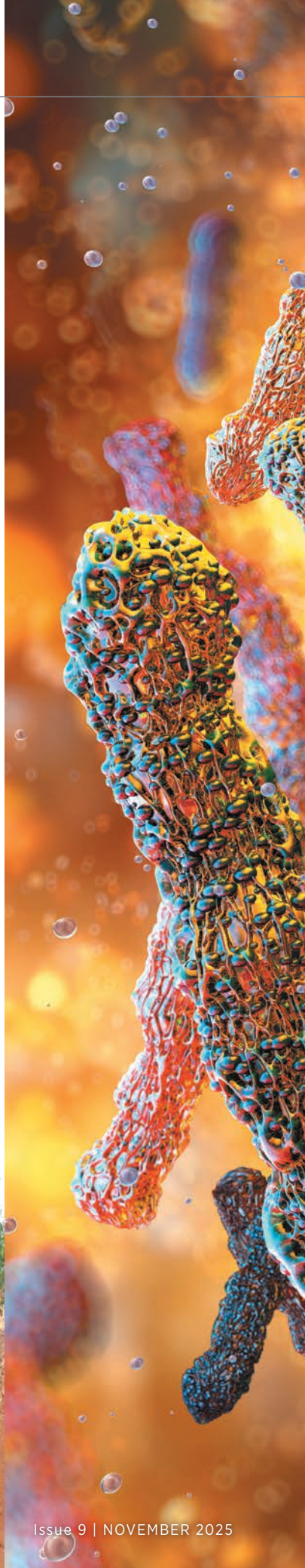
SECURING SOILS

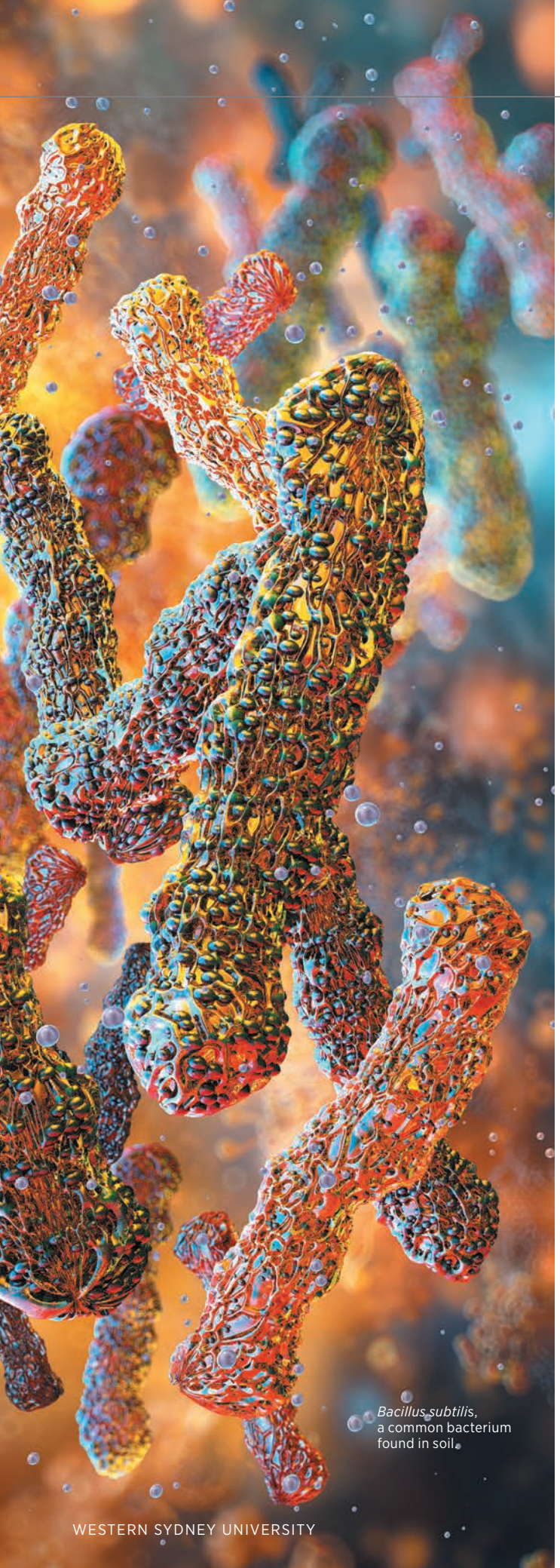
The early results are promising. In some trials, plants fertilised at Western with UrVAL have outperformed those given conventional nitrogen fertilisers. But the team is cautious. They're still learning how these products affect long-term soil health, says Powell. That includes monitoring changes in microbial communities and carbon retention.

UrVAL, for example, is acidic, which can suppress certain microbial processes (such as nitrification) and select for acidophiles, microorganisms that thrive in acidic conditions. It also contains dissolved salts, which at high levels may cause salinity stress or nutrient imbalances, particularly in sandy soils with low nutrient-holding capacity, like those common in Sydney's west. There is a further risk of sodicity, which can damage soil structure and reduce long-term fertility due to excess sodium levels.

That's why the researchers are now mixing

(left) Professor Jeff Powell and (right) Dr Jason Reynolds.





Bacillus subtilis, a common bacterium found in soil.

© Quantic69/iStock/Getty

WESTERN SYDNEY UNIVERSITY

NEED TO KNOW

- Human urine has potential use as a fertiliser.
- It needs to be treated in a safe and sustainable manner.
- Scientists at Western are investigating how urine-based fertilisers interact with the ecosystem.

UrVAL with 'biosolids', another product of wastewater treatment. These compost-like materials are derived from heat treating the sludge remains after wastewater has been separated, treated, and discharged to the environment.

"In testing, we're seeing signs that this combination is raising soil pH," explains Reynolds. "It appears the biosolid is acting as a buffer, helping to neutralise the acidity of the UrVAL. The biosolid substrate may contribute to this effect, reducing the net acid load delivered to the soil.

Biosolids are rich in organic matter, and when they are applied to land they help restore the soil's ability to hold water and provide nutrients, says Lyndall Pickering, a program manager at Sydney Water, a key industry partner of NiCE Hub. Sydney Water treats wastewater from nearly 5 million people in Greater Sydney and recovers biosolids during the treatment process. Rather than send biosolids to landfill, Sydney Water has been delivering all of its biosolids — roughly 40,000 dry tonnes a year — to farmers, compost producers and forestry since the 1990s.

The UrVAL-biosolid mix is now being tested on wheat- and legume-like model plants at Western, while a team at the University of Southern Queensland, in Toowoomba, is testing a mix of UGold and biochar (a charcoal product also derived from biosolids) on crops. The two teams work closely together, testing their different plants and soils in parallel.

STEADY SUPPLY

The nitrogen-rich system makes sense from a resource perspective. "Australian farms have a huge demand for nitrogen-based fertilisers," notes Reynolds. "And the standard Haber-Bosch approach is expensive and energy-intensive to produce."

Unsurprisingly, Australia is not the only country testing this idea. Swiss researchers are pioneering urine purification technologies and American research teams are trialling direct urine application.

But Australia, Reynolds argues, is ahead of the curve when it comes to integration of products and rolling these new products out to broadscale agricultural trials. "The ARC NiCE Hub has developed a membrane system that's not only effective but scalable," he says. "That's the hurdle most others haven't cleared." Pilot plants in Sydney are already producing UrVAL at scale, and the team is now presenting the technology to international industry partners.

Still, the project's success depends on more than just science. "It requires regulatory approval and public trust," says Powell. But the very real hope is that wastewater treatment plants will evolve into complex, responsive hubs "not just for sanitation, but for significant resource recovery," adds Reynolds.

SPACE COLONIALISM: RETHINKING FRONTIERS

A research project has been exploring narratives that reimagine humanity's future in space.

Victoria Hunt plays Māori astrobiologist Xue Noon in Juan Francisco Salazar's feature film, *Cosmographies* (2025).

When humans set out to establish new homes on the Moon, Mars and beyond, who will get to go? Which groups will be left behind — and who decides?

As humanity considers its future as a space-faring species, big questions loom. But in the hype about the potential to leave the planet, one researcher says we may have settled for a narrow prevailing narrative of how the colonisation of space will unfold.

"Philosophically and ethically, we need different ways of approaching the idea of moving into outer space," says **Professor Juan Francisco Salazar**, an interdisciplinary researcher and filmmaker from Western Sydney University's Institute for Culture and Society. "We cannot go to space with only the story of conquest — of colonising space, hunting for life, or exploiting resources," he says.

"WE CANNOT GO TO SPACE WITH ONLY THE STORY OF CONQUEST."

Salazar recently completed an Australian Research Council Future Fellowship project titled 'Australia a Space-faring Nation: Imaginaries and Practices of Space Futures' — which started shortly after the 2018 establishment of the Australian Space Agency (ASA). The project set out to broaden the nation's narratives around future space habitation.

The first part of the project explored the challenges, opportunities and implications of exploring space for Australia, from a broad range of views through an industry report featuring a range of political, environmental, cultural, economic and scientific perspectives.

"We designed the report to reach as many different audiences as possible and invited these audiences to enter into a dialogue," Salazar explains.

The 2020–2024 project also included the production of what Salazar refers to as a "hybrid speculative fiction documentary film", titled *Cosmographies*, which has been shown at major international film festivals in more than a dozen countries.

ALTERNATE PERSPECTIVES

The first goal of the report was to capture a snapshot of Australia's space sector during the ASA's first few years. Salazar and colleague Dr Paola Castaño, a research fellow at the University of Exeter, in the United Kingdom, interviewed 41 stakeholders across Australia, from a diverse range of fields such as private industry, defence, government, history, science, art and law.

"We wanted to paint a picture of the sector as something broader than conventionally described — beyond defence, astronomy and science," Salazar says.

Their report, *Framing the Futures of Australia in Space*, published in 2022, challenged the prevailing narrative in Australia that space is foremost an industry. It proposed expanded frameworks of the sector's public value to incorporate cultural inclusion, including Indigenous perspectives, education and sustainability.

One striking insight of the interview process, says Salazar,

The high altitude salt lake of Quisquiro, Lickan Antay community of Toconao, Atacama Desert, Chile, where part of the film *Cosmographies* was filmed.

was that despite the diversity of views canvased, most participants ascribed to what he describes as a United States-centric, Hollywood- and NASA-based narrative of humanity's space futures.

"This informed the second half of the project, which explored space future 'imaginaries' from alternate perspectives," he says.

An imaginary is a collection of ideas, thoughts and images that a society creates to think about a possible or a probable future, Salazar explains.

"When space entrepreneurs say that humanity should become a multiplanetary species, that's an imaginary," he says. "They're creating a set of values and ideas that, as a species, we need to leave this planet and launch ourselves into conquering other planets."

A key output of the second part of the project was Salazar's feature length film, which explored space future imaginaries from Indigenous, feminist and decolonial perspectives.

"I have worked for more than 25 years with Indigenous organisations, particularly with Lickan Antay communities in Chile's Atacama Desert, where I shot the film," he says. *Cosmographies* combined documentary and science fiction to draw parallels between the impact of mining in Atacama and plans for the future colonisation of the Moon and Mars. The film was a collaboration with Australian-Māori artist, Victoria Hunt, and the Lickan Antay community of Toconao in the Salar de Atacama, Chile.

The film explores the complexities of sustainable development, when the extraction of lithium in the Atacama required by the global north to power the global energy transition destroys Indigenous ways of living, lands and waterways. "It's a metaphor suggesting the ways in which we are thinking about space are not the right ones," Salazar says.

The project's output also included a book co-edited by Salazar and Australian space archaeologist Alice Gorman — *The Routledge Handbook of Social Studies of Outer Space* — and public events hosted by Sydney's Powerhouse Museum as part of the Sydney Science Festival in 2022 and 2023.

These events brought together people from the creative, science and technology sectors, as well as First Nations communities, says Dr Deborah Lawler-Dormer, Research Manager at Powerhouse, who collaborated with Salazar.

"From the enthusiastic conversations that took place afterwards, the audience was clearly engaged and inspired," she says.

To continue broadening the public conversation over Australia's spacefaring future, Salazar is collaborating with Powerhouse as an advisor on a major new exhibition, to open at the Powerhouse Parramatta in 2026.

NEED TO KNOW

- Professor Juan Salazar led a report that considered the public value of the Australian space sector.
- He directed a major feature length film titled *Cosmographies* that was exhibited internationally.

STABLE HOMES, STRONGER FUTURES

For years Australia has struggled with a growing housing crisis, but housing co-operatives may offer a third approach beyond renting or ownership.

11 SUSTAINABLE CITIES AND COMMUNITIES

Since the 21st century began, housing availability and affordability has become one of Australia's largest social problems. Secure accommodation has always been a challenge for Australians in crisis, but today the issue affects people in many walks of life.

"We are now seeing a situation where some people on very good working wages, with incomes above the median, simply cannot get access to stable, quality housing," says **Professor Louise Crabtree-Hayes**, a human geographer at Western Sydney University's Institute for Culture and Society.

Despite the scale of the problem, there are signs of hope. For years, the residents of Australian housing co-operatives have reported a range of positive experiences. Co-operatives are unique because their occupants — whether they rent or own — participate in management and maintenance activities that can include co-operative governance, finance, membership, property care and community life.

Housing co-operative sectors for rent or ownership have been successful at scale in other countries. In fact, the United Nations declared both 2012 and 2025 the International Year of Co-operatives. However, if Australian housing providers and policymakers are to treat co-operatives as a viable option, their benefits must be captured through robust research methods.

Now, in an unprecedented study, Crabtree-Hayes and her colleagues have created a report, *The Value of Housing Co-operatives in Australia*, documenting the benefits of Australia's affordable rental housing co-operatives. The report provides grounds to expand housing co-operatives in Australia through both rental and ownership models, to improve the benefits of social housing and have a significant impact on the overall housing market and the lives of many.

NEED TO KNOW

- In Australia, housing is usually attained through renting or owning.
- Housing collectives offer a third alternative.
- Researchers at Western have investigated the benefits of housing collectives in the Australian context.

BEYOND THE BINARY

"In Australia we have an incredibly simplistic binary," says Crabtree-Hayes. "We have private, market-rate homeownership, which is seen as the only way to achieve stability, equity and dignity — and we have rental models that are either privatised and precarious, or public and marginalised."

Although renting has traditionally been viewed as a step on the path to ownership, going from renting to owning has become an "impossible leap" for many, she says, with diverse negative consequences for communities, as well as individuals. Housing co-operatives, however, are an exception to the binary, as their members have a say in their housing, regardless of whether they rent or own.

Having previously served on the boards of housing co-operative peak bodies in NSW, Crabtree-Hayes — who had to move her young family six times while completing her PhD — has seen the benefits of co-operatives. But

Vacant land sectioned off for housing projects in Sydney's western suburbs.

it hasn't been clear which benefits were due to the co-operative model, and which were due to other factors such as housing quality or location, or basic social housing support.

When approached by the affordable rental housing cooperative sector to find an answer, she worked with Western Sydney University colleagues, including **Associate Professor Emma Power**, a geographer from the School of Social Sciences, and **Professor Neil Perry**, chief economist at the Centre for Western Sydney and School of Business, along with colleagues from Griffith University and Swinburne University of Technology.

The team collaborated with five state-based community housing providers that develop, manage, and represent Australia's affordable rental housing co-operatives, which occupy rent-controlled properties built by government-funded bodies. The team also worked directly with rental housing co-operative tenant-members and an international panel of housing co-operative researchers. They developed seven high-quality research tools, including a co-operative time use survey, a tenant-member survey, and an in-depth tenant-member interview, that enabled them to produce a detailed picture of the cost and consequences of Australia's rental housing co-operatives.

A SENSE OF SECURITY

One of the most striking findings was the co-operative tenant-members' overall sense of security in their homes. Making regular moves impacts the mental, physical, and financial wellbeing of individuals and families. This is exacerbated for those already at risk from other factors. One woman quoted in the report spoke about fleeing domestic violence only to spend four winter months in a tent at the town showgrounds because local emergency services were full.

86%
OF TENANT-MEMBERS SURVEYED
feel very much or somewhat at home in their co-operative.

The team found that the benefits of living in housing co-operatives as opposed to renting were extraordinarily positive. They went much further than simply the benefits of stable, affordable housing, and ranged from relief from crisis to significant associated effects on employment, identity, and family wellbeing.

Tenant-members in co-operatives were found to be more satisfied with their lives and had an enhanced sense of belonging. They reported stronger social ties and a sense of community, and their experience in contributing to the management of their co-operative had given them a 'voice' and sense of purpose in their lives they didn't previously enjoy.

Living and participating in their co-operative encouraged some to pursue higher education, supported skill development, and sometimes led to better jobs. A respondent to the survey reported finally being able to budget because she knew what her costs would be. She used her budget to support her daughter's ambition to train as a dancer, and at the time of the survey, her daughter had just signed her first professional dance contract.

The woman who had to camp at her local showground said that being part of a housing co-operative had given her confidence and security. "Now that I am secure," she wrote, "I can give back to not only my co-operative but the community in general."

In fact, Crabtree-Hayes and her colleagues found that the higher the commitment to the activities and principles of being in a co-operative — a quality they dubbed "co-operativism" — the greater the benefits were to tenant-members. Tenant-members were especially satisfied in co-operatives where incoming tenant-members were given training in how the co-operative worked, and where they might be able to contribute and learn.

The fit between housing layout and the co-operative's identity was also a factor in the model's overall success. Some co-operatives occupied a single building, for example, where others were more spread out. The researchers found that, in the first case, the tenant-members typically loved their co-located dwellings, while in the second, the tenant-members felt that their dispersed way of living was better. What mattered, said Crabtree-Hayes, was the match between the co-operative's identity and the way they used their space.

BUILDING THE FUTURE

The affordable rental housing co-operatives in the study form only a small part of social housing in Australia, which is itself a small and marginalised part of the housing market, yet the findings of Crabtree-Hayes and her colleagues may contain lessons for the nation.

The team says the evidence base in their report lays the groundwork for robust engagement with policy makers, a renewed public discussion about co-operative benefits, and expansion of both rental and ownership co-operatives. Likewise, the project's research tools can be used to further build the evidence base and create meaningful national and international comparisons.

Crabtree-Hayes attributes the success of the project to its collaborative and co-operative nature: "It was only possible, and only as effective as it was, because of the comprehensive and complimentary expertise of the team, including the research partners and the co-operative tenant-members."

THE INFLUENCE OF SOCIAL MEDIA ON PARENTS OF LATE TALKERS

A research project will look into the reach of paediatric speech pathology services across NSW, and the power of social media to influence parents to seek help for their toddlers.

3 GOOD HEALTH AND WELL-BEING

What prompts parents with late-talking toddlers to seek therapy from speech pathology services? And what role does social media play in guiding their decision to enlist help? These are questions doctoral candidate and speech pathologist, **Lori-Ann Boxsell,** is exploring at the MARCS Institute for Brain, Behaviour and Development, Western Sydney University.

Boxsell's quest goes back to her childhood. "My sister required speech-therapy services as a child, and so I'd often go along with my mum to her sessions," she recalls. "I found them so engaging, and I could see the difference that speech therapy made within my family."

Boxsell's parents found out about speech-therapy services through a paediatrician, with support from the special-education unit at her sister's primary school. But two decades on, she says that the path to getting help has become much more convoluted due to the proliferation of both information and misinformation online.

Speech pathologist and doctoral candidate, Lori-Ann Boxsell, conducting a session.

"It's such a challenge for parents to know whom and what they can trust," says **Dr Elise Baker**, one of Boxsell's doctoral supervisors and the Associate Dean (Research) at the University's School of Health Sciences. "We're concerned that misinformation could be doing harm and preventing families from contacting services. It could also be worrying families who don't need to be concerned."

TRACING PATHS

Boxsell's PhD will look at the paths parents took to access speech-therapy services at Liverpool Hospital in western Sydney. "I will interview parents about the factors that influenced their decision to seek speech-therapy services," says Boxsell. "That's where the social media aspect comes into play — looking at what parents are accessing online, how it influenced their decisions, and whether it was positive or negative."

Boxsell is going in with an open mind. "We're adopting an 'inductive' approach in this study, so we're not going in with particular themes to test," she says. "We want those themes to arise from our data." She notes that while similar studies have been conducted in other areas of public health, she isn't aware of any similar research looking specifically at paediatric speech-therapy services.

The findings from Boxsell's research will have practical outcomes, helping to inform how public speech-therapy services can best engage with parents via social media. The ultimate goal is to ensure that every child receives the assistance they need.

"In New South Wales, every child has access to free health speech pathology services or NDIS prior to starting school," explains **Kate Short**, a clinical specialist speech pathologist at Liverpool Hospital, who is another of Boxsell's thesis supervisors. "We want to find out how we can make it easy for parents to find out about these services."

THE SHOULDERS OF GIANTS

Western encourages its undergraduate students to continue into higher degrees at the University. Boxsell had never considered doing a PhD until she did a research project as part of the final year of her undergraduate degree. "I really loved the experience," she says. "It sparked my interest in research."

Boxsell is also the inaugural recipient of a PhD scholarship in language sciences, set up in memory of the late Distinguished Professor Anne Cutler (1945–2022). A leading scientist in spoken-language processing, Cutler had an international research career spanning five decades, the last of which was spent at Western.

"Anne Cutler revolutionised the field of spoken-language processing by accumulating evidence in support of principles that are true across diverse languages," says **Professor Caroline Jones**, who is also supervising Boxsell and is based at the MARCS Institute at Western. "She also championed the cause of women in academia, advocating for quotas, and training and inspiring younger generations."

"I was extremely honoured to receive the scholarship," says Boxsell. "I hope I can really make a difference, not only with my research, but using it to optimise the outcomes for toddlers who are late to talk."

NEED TO KNOW

- Speech pathology can significantly help late-talking toddlers.
- Many factors influence a parent's decision to send their child to speech therapy.
- A recipient of a PhD scholarship set up in memory of the late Distinguished Professor Anne Cutler is investigating the role social media plays in this decision.

MAKING LGBTIQ+ CANCER CARE INCLUSIVE

A cancer diagnosis is traumatic for anyone. But for LGBTIQ+ Australians, there is often additional anxiety involved in navigating the healthcare system.

When Natalie Halse had a mastectomy to treat her breast cancer, she went through the pain and trauma any woman does: grief, fear that the cancer would return, and questioning whether breast reconstruction surgery was right for her.

But — as she told the Breast Cancer Network of Australia (BCNA) — in addition to what every woman feels, Halse had an extra source of stress: discrimination. Halse identifies as gay, and at times her medical team seemed uninformed about how her care needs might differ from other patients.

"A breast-care nurse said to me that I may not want to have a reconstruction because I didn't have a husband. So that presumption that a breast isn't important to a lesbian woman — I was quite shocked," she said.

Halse is not alone. *Out with Cancer: LGBTIQ+ experiences of cancer survivorship and care*, a three-year study led by Western Sydney University and funded by an Australian Research Council Linkage grant, has found that 31% of lesbian, bisexual, gay and other queer people experienced discrimination while receiving care for a cancer diagnosis.

The report notes that number jumps to 50% for trans-people (people whose gender is different from the one they were assigned at birth) and 52.4% for intersex people (people whose sex characteristics differ from the expected female or male characteristics).

Professor Jane Ussher, from the School of Medicine and the Translational Health Research Institute (THRI) at Western Sydney University, who led the study, says that after a lifetime of discrimination and trauma, some LGBTIQ+ people have genuine fears for their safety at the hands of their doctors. "For me, the most shocking finding was that so many people said, 'I don't want them to know I'm gay because I don't want them to treat me differently. If they're religious, are they going to have less motivation to treat me, cure me?'"

BURDEN OF DISCLOSURE

The reality is that LGBTIQ+ people live with discrimination. Between 82 and 95% of participants in the study, or their LGBTIQ+ carers, had experienced serious forms of discrimination in their life, including family rejection, work harassment, criminalisation of homosexual sex, or being forced into therapy to 'cure' them. Such experiences leave lasting effects, and many people protect themselves by keeping their sexuality, trans identity, or intersex status a secret, even from their doctors.

In addition, LGBTIQ+ people are at higher risk of cancer due to lifestyle factors, such as higher rates of smoking and drinking, which is often a response to life stress. They are also less likely than the general population to seek out cancer screening from healthcare professionals, because of fear of discrimination.

While the study found that most cancer clinicians were comfortable treating LGBTIQ+ people, levels of confidence and knowledge were low. Less than half of clinicians in the study could pass a 10-question quiz on cancer in the LGBTIQ+ community. Ussher says that many well-intentioned doctors don't ask about a person's sexuality, thinking that treating everyone the same is good practice. However, "it's not good practice and it's not a neutral position," says Ussher.

This 'don't ask, don't tell' approach can create anxiety

NEED TO KNOW

- LGBTIQ+ people face additional stresses when navigating healthcare.
- More than 30% have faced discrimination when receiving a cancer diagnosis.
- The *Out with Cancer study* suggests ways to make cancer care more inclusive.

Photographs taken by study participants. Left: A queer woman being supported through breast cancer by her cherished "queer family"; Right: A trans participant before loss of their facial hair following treatment.

Being inclusive can start with something as simple as a rainbow sticker in a clinic.

in the patient, who is unaware of whether the doctor is an ally. It also puts the burden of disclosure on to the patient. Even though LGBTIQ+ people regularly come out to new people across their whole lives, the process is never easy and raises memories of occasions when the disclosure was poorly received. "We need to ask about sexual orientation, diverse gender identities, and intersex status, on intake forms" says Ussher. Understanding that a person is LGBTIQ+ is essential to providing inclusive care, ensuring that language and information are relevant to their sexuality, gender, and relationships.

INCLUSIVENESS IS CRITICAL

Being more inclusive can start with something as simple as a rainbow sticker in a clinic, flagging that it's safe to come out. But Ussher says more LGBTIQ+ resources are needed, with the study finding only 13% of cancer information websites mention the LGBTIQ+ community. Cancer clinicians also need training in recognising the specific needs of LGBTIQ+ patients and their carers. For example, the study interviewed the partner of a trans man who watched as women were offered support to help them reconcile with hair-loss following chemotherapy, where his partner was offered nothing over the loss of his beard. Being a trans man, having "facial hair matters so much," he said. In another case, a lesbian woman was pressured by doctors to use vaginal dilators after treatment, with no-one asking her "if I use my body that way".

Knowing there's potential to encounter a homophobic or uninformed healthcare professional while dealing with cancer adds to an already stressful situation. Not having the confidence to bring a partner or friend to doctor's meetings or to be by their bedside can exacerbate that stress. Support from queer family is essential to coping with cancer. Some 41% of LGBTIQ+ cancer patients reported high or very high levels of distress in the study, compared with just 7–12% of the general cancer-affected population.

For Halse, it was stress she didn't need. What she did need during her treatment was support and acceptance from her medical team, carers, family, friends and community. "You are very vulnerable during that time, and I think it's just important to make sure that you wrap around yourself a bit of a security blanket to help you get through that tough time and not be alone," she told the BCNA. Having strong social support from LGBTIQ+ communities, partners, and chosen family provides that security blanket for many people.

Findings from the *Out with Cancer* study have informed the creation of LGBTIQ+ patient resources, developed by Ussher and her team in partnership with BCNA, Cancer Council, and Canteen. In collaboration with the McGrath Foundation, online training modules for healthcare professionals have also been launched to improve clinicians' understanding of the unique needs of the LGBTIQ+ community and help patients feel safe and supported.

NEW WAYS TO HELP IMMIGRANT COMMUNITIES NAVIGATE DEMENTIA

Multilingual workshops are educating and empowering people in immigrant communities to cope with dementia.

3 GOOD HEALTH AND WELL-BEING

10 REDUCED INEQUALITIES

More than 430,000 Australians, or about one in every 67 people, have dementia. They must cope with memory loss, confusion, behavioural and mood changes, communication problems, and other distressing symptoms.

Another 1.7 million Australians are involved in caring for someone with dementia — caused by a number of conditions, the most common of which is Alzheimer's disease.

For **Dr Diana Karamacoska**, a cognitive neuroscientist at Western's National Institute of Complementary Medicine, her first real brush with dementia came during her PhD, when two of her grandparents were diagnosed.

It was an incredibly stressful time for her family, she recalls: "We didn't anticipate the number of hurdles we were going to encounter whilst navigating the healthcare system."

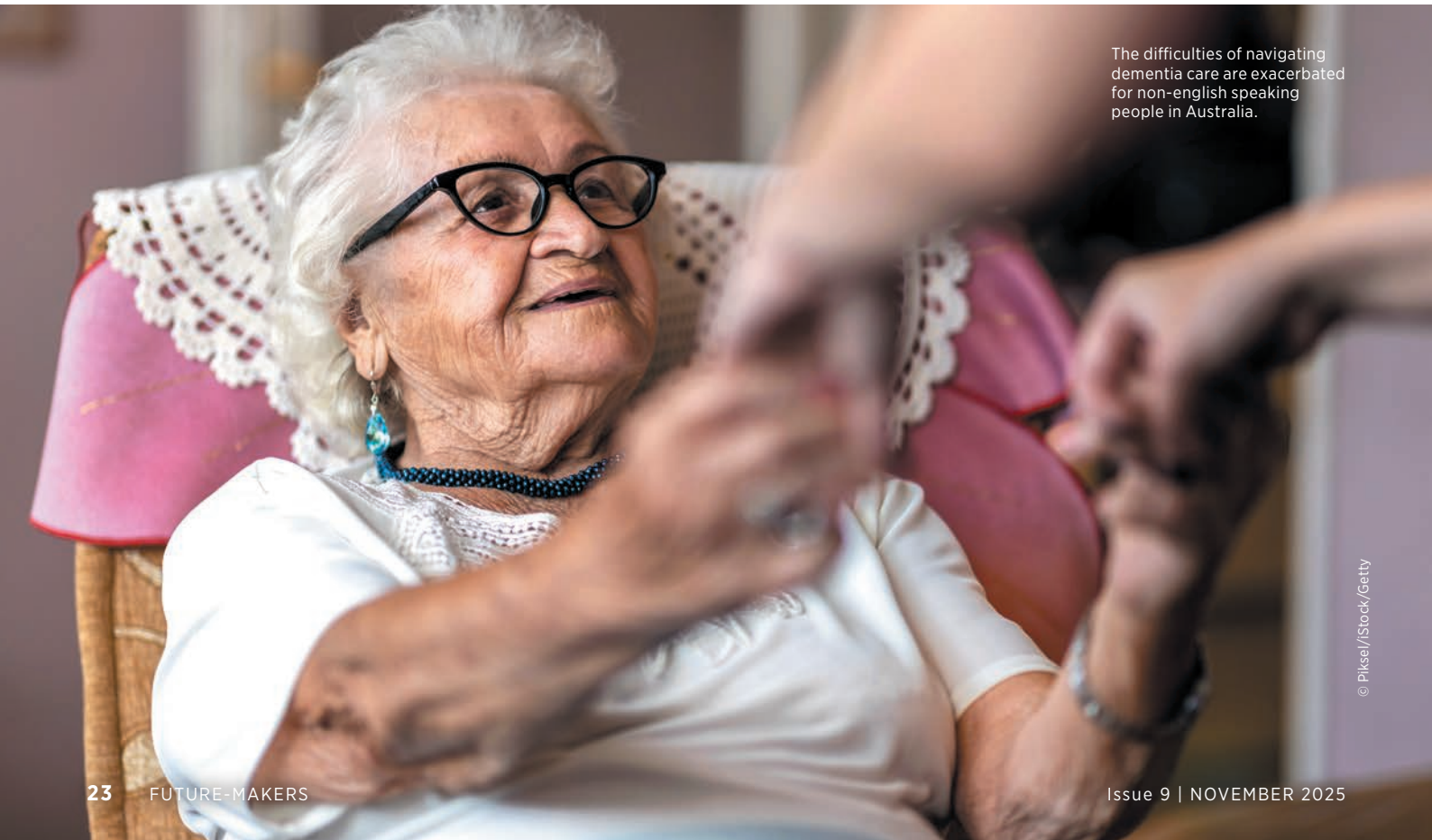
To make the situation more difficult, Karamacoska's grandparents were Macedonian immigrants who spoke little English.

"A lot of diagnostic tools that we use here are in English," she says. "Also, they're not culturally appropriate. For instance, they include questions such as 'who is the Prime Minister of Australia?', which don't necessarily relate to these individuals and aren't good indicators of their cognitive capacities."

Initially, Karamacoska thought her family's struggles were unique. But as she met others in a similar situation, she realised there was a larger, more systemic problem. She wanted to discover how people with dementia and carers from non-English speaking communities could be better supported on their dementia journey.

Chatting with colleagues and collaborators led to an idea — a series of education workshops, conducted in multiple languages, that were tailored to the needs of immigrant communities to help them learn more about dementia.

"The aim was to raise awareness and reduce stigma through culturally relevant education, particularly in western Sydney communities that are often overlooked in mainstream programmes," says urban planning expert **Professor**



The difficulties of navigating dementia care are exacerbated for non-english speaking people in Australia.

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Nicky Morrison, co-director of Western's Urban Transformations Research Centre and one of Karamacoska's collaborators.

PLUGGING GAPS

The research team — which also included **Professor Ann Dadich**, a psychologist at the School of Business, and **Associate Professor Joyce Siette**, who studies brain health at the MARCS Institute for Brain, Behaviour and Development — partnered with a local dementia support group, service providers, and other experts to co-design a workshop programme called 'Dementia Friends Unite'. Their insights were key to identifying the specific challenges that people from culturally and linguistically diverse backgrounds face, says Karamacoska, and helped shape the workshop's content.

"We learnt, for instance, that a lot of people were struggling with understanding what dementia is, how to recognise it, and where to get help," says Dadich.

Fellow collaborator Donna Lee, a 61-year-old person living with dementia and mother of four, explains: "When I was diagnosed more than a decade ago, no one told me where to go or what to do. I found it hard, even though I speak English. I can only imagine how much harder it would be for someone who doesn't speak the language."

As a result, the team made it a focus to cover a lot of foundational material in their programme, "so really explaining how the brain functions and changes with age, what the key signs and symptoms of Alzheimer's disease and dementia are, and then unpacking the causes and risk factors," says Karamacoska.

The programme also included tips on how to cope emotionally, how to continue living a full life, and potential ways to help slow the progress of dementia, such as eating healthily, exercising regularly and keeping socially active.

The sharing sessions revealed another major barrier faced by immigrant communities — that dementia is frequently associated with "fear, stigma, and a belief that little can be done," says Morrison, making it harder for people to talk about it or seek support. "It's sometimes deemed to be shameful," adds Dadich. "In some communities, mental health and cognitive decline are not openly discussed."

Others wrongly equate dementia with mental illness or as only starting in old age. "When I was diagnosed, everyone said I was too young and that I was lying," recalls Lee. "My boyfriend at that time even said to me: 'Go and get your head examined.'"

NEED TO KNOW

- In Australia, about one in 67 people today are living with dementia.
- Immigrant communities with diverse linguistic and cultural backgrounds face additional challenges when navigating dementia diagnosis, treatment and care.
- Dr Diana Karamacoska led a team that designed a series of interactive dementia education workshops in six languages.

A 'Dementia Friends Unite' workshop being conducted in south-western Sydney.

The team added segments to the workshop that were targeted at teaching carers how to engage with people with dementia and how to create a safe, easy-to-navigate living environment.

CHANGING LIVES

Dementia Friends Unite was launched in 2022 in south-western Sydney — home to a large migrant population, and where more than 12,500 people live with dementia. Each workshop was run by trained bilingual facilitators in English, Arabic, Vietnamese, Mandarin, Cantonese and Greek. More than 220 people attended the workshops, mostly older adults.

The results were really encouraging, says Karamacoska. Participants surveyed after the programme showed significant improvements in their knowledge about dementia, especially about the causes and how to manage it, as well as improvements in attitudes toward the diagnosis and comfort in accessing services.

"We also heard stories of how families were implementing some of the strategies we had shared for making small adjustments to help their loved ones," she says, adding that a follow-up survey conducted 12 months later revealed similar findings.

Community and aged-care industry stakeholders also benefitted from the programme, "they really appreciated the whole-community approach that it takes to support someone with dementia. And they got to leverage resources amongst themselves," Karamacoska says.

In further proof of its success, Dementia Friends Unite has since expanded beyond the Canterbury-Bankstown region into other suburbs. "Once people found out what we were doing, they all jumped on board," she says. "Everyone wanted a piece of the action."

Her team is now adding more languages into the mix, including Spanish, Hindi, Punjabi and — her grandparents' native tongue — Macedonian.

If Dementia Friends Unite had existed during her PhD, Karamacoska says it would have saved her family years of figuring things out on their own. "I think we would have helped my grandma especially cope much better, and we would have more quickly tackled the stigma of having dementia."

FARMING

Left to right: Min Gao, Associate Professor Yi Guo, Distinguished Professor Brajesh Singh, Professor Oula Ghannoum, Professor Graciela Metternicht, Shahasad Salam.

THE FUTURE

With climate change threatening food production, a new national training centre is cultivating sustainable solutions that will take root inside high-tech greenhouses.

2 ZERO HUNGER

Australia is grappling with increasingly extreme and unpredictable weather. In a country where one state can experience widespread flooding while neighbour states endure drought, maintaining sustainable food production is a challenge.

Interest is rising in a farming approach that enhances food security by moving production indoors. Protected cropping is a form of horticulture in which high-value fruits and vegetables, such as berries and capsicum, are produced under optimised growing conditions inside plastic tunnels or high-tech glasshouses.

"By shielding food production from environmental stressors such as drought, flooding, and disease, protected cropping reliably produces a year-round supply of high-quality produce," says **Professor Oula Ghannoum**, a crop physiologist at Western Sydney University's Hawkesbury Institute for the Environment.

"But that dependability brings additional energy and labour requirements," she adds.

Ghannoum is now leading a multidisciplinary research consortium which will boost the industry and upskill workers, to ultimately bolster national food security.

The Australian Research Council Training Centre for Smart and Sustainable Horticulture is a collaboration between Western, The Australian National University, The University of Western Australia, and eight other partners from industry, academia and government.

Between 2025 and 2030, the Centre will train a new generation of tech-savvy horticulturalists, who will undertake research projects co-designed with industry partners to directly address protected cropping's pain points.

"You can train people by sitting them down in a classroom — but I think that a much better, more holistic approach to training is to give students a hands-on research project," Ghannoum says. "By the end of their programme, they will have acquired skills, an understanding of the industry and its challenges, and also the capacity to think critically and problem solve."

The Centre will provide the crucial expertise and people required to drive the protected cropping industry in Australia, says Wayne Ford, CEO of partner Vertical Patch, an organic farm in Smithfield, New South Wales, which uses a form of protected cropping called vertical farming.

"Vertical farming is a high-tech industry and requires highly skilled labourers who are fluent in AI, imaging, and crop biology," Ford says. "We want to see the Centre provide our next research and technical personnel, and our sector's future leaders."

> "IT'S ABOUT OUR CHILDREN AND GRAND-CHILDREN HAVING NUTRITIOUS FOOD."

Growing Gina and Syngenta orange variety (*Capsicum annuum*) blocky sweet capsicums at the cutting edge Greenhouse Research Education Training Facility at the Hawkesbury Institute for the Environment.

DEEP-ROOTED SUSTAINABILITY

Baked into the Centre's operations is an overarching emphasis on net-zero solutions and sustainability, says **Professor Graciela Metternicht**, Dean of the School of Science at Western and a Centre chief investigator. "It's about our children and grandchildren having nutritious food, but still being able to enjoy nature, because the land hasn't been given over to food production", she says.

One branch of the Centre's work, led by **Professor Dilupa Nakandala** from Western's School of Business, will map protected cropping supply chains and conduct lifecycle analysis on its products, to identify environmental benefits from this mode of food production. "The beauty of enclosed cropping — compared to open field agriculture — is the diverse opportunities to optimise resource efficiency, integrate recycling, minimise waste, introduce circular economic practices and reduce land and water use," Nakandala says.

The Centre's training goals are to teach not only the essentials of protected cropping, but an understanding of the wider social and environmental picture, Metternicht adds. "By embedding this focus into our programmes,

Left: Professor Oula Ghannoum and Namal Jayasuriya. Right: Distinguished Professor Brajesh Singh and Min Gao.

we can foster future sector leaders who embrace corporate social responsibility and the principles of circularity and sustainability," she says.

A second key focus of the Centre is to develop applied solutions that can be readily adopted by industry, adds Metternicht, who is leading knowledge transfer efforts.

One of the industry's main needs is for research findings to be translated into "something growers can actually use," she says. "We're all about co-designing research projects with industry to make sure the results are relevant and easy for growers and stakeholders to adopt."

DIGGING IN

Research programmes at the Centre are designed in response to industry reports highlighting the sector's challenges and gaps. Ghannoum, for example, is a chief investigator on a project to expand a narrow crop base by integrating high-value crops such as saffron, vanilla, ginger and bush pepper into indoor cropping systems.

Students in this project will compare the health, growth, vigour and crop quality of selected plants. The team will then optimise parameters — including lighting, temperature and nutrient application — to get the best results.

In a parallel project, **Professor Zhonghua Chen**, plant physiologist and adjunct professor at Western's School of Science, will develop indoor cropping varieties that maintain high yields even under stress.

The focus of his work will be to enhance the tolerance of plants to the stress caused by climate change. By developing varieties that maintain high yields as the temperature climbs, growers can reduce their reliance on energy-intensive cooling in their greenhouses.

The direct impact of high temperatures on cropping is only part of the problem. "The biggest challenge that we face in a warming climate will be pest and disease outbreaks in the cropping facilities," Chen says. As temperatures rise, plants in the greenhouse lose more water into the air through transpiration. The combination of high temperature and high humidity create ideal conditions for many pests and diseases, particularly fungal infections, to spread.

One strategy will be to reestablish some of the stress tolerance and pest resistance lost in modern crop varieties, but still found in their ancestral wild-growing relatives. An alternative approach could be to directly combine the hardiest and the most productive varieties of a crop, by grafting the tough rootstock of the former to the fruitful upper parts of the latter, to create productive and stress-resistant hybrid plants.

Alongside his research, Chen leads the project's industrial engagement component. "Through connections such as internships, our students and postdocs will gain direct experience in applying their findings to benefit the industry," Chen says.

NEED TO KNOW

- Food security is a significant issue.
- Growing food indoors helps avoid environmental stress.
- A new ARC training centre, led by Western, is preparing the next generation of protected cropping scientists.

ROBOTS ON PATROL

A second project co-led by Ghannoum aims to reduce the risk of crops being exposed to pests or diseases. "To minimise infection risk in a protected cropping facility, you don't want people going in and out all the time," she says. As a solution they are developing cameras and sensor technology to monitor crops.

The team will test this technology in fixed locations and mounted on patrolling robots. Ghannoum has also teamed up with **Associate Professor Yi Guo**, a data scientist from Western's School of Computer, Data and Mathematical Sciences, to develop AI-powered analysis of image and sensor data.

"We want to develop crop-sensing technology to the point that we can monitor each individual plant within the protected cropping facility," Guo says.

Once plant monitoring is automated, the next step is to eliminate the need to send in workers for tedious tasks such as pruning and pest control. "Our ultimate goal is an autonomous robotic platform that not only carries sensors, but has arms equipped with, for example, a sprayer, to very precisely treat an area affected by pests."

Technology is advancing so fast that the team hopes to have a prototype within three years, Guo says.

Across all its work, the Centre is "a place where innovation meets real-world impact," says Metternicht, who highlights its focus on net-zero solutions and circular agronomy.

"These aren't just trendy terms — they're critical changes needed for how we produce food and manage resources," she adds. "It's fantastic to work with people with shared values and aspirations of doing research with purpose."

UNDERSTANDING MULTICULTURAL MENTAL HEALTH

Understanding multicultural communities' attitudes towards mental health is helping researchers make mental health services and engagement more effective.

Navigating mental health services can be difficult for anyone.

But the added barriers of language, different cultural views, and trauma from past experiences can make it especially challenging.

A psychologist and mental health researcher at Western Sydney University's School of Medicine, **Associate Professor Shameran Slewa-Younan** has focused on mental health issues in culturally and linguistically diverse (CALD) communities for more than 20 years.

Her work is shedding light on why many people don't seek help for mental health issues and aims to improve the delivery of mental health services to multicultural communities, including refugees and asylum seekers.

NEED TO KNOW

- Accessing mental health services can be difficult for members of cultural and linguistically diverse (CALD) groups.
- Associate Professor Shameran Slewa-Younan and colleagues are trying to better understand and improve the treatment of mental health in three CALD communities — Congolese, Arabic speaking, and Chinese Mandarin speaking.

(Image) © FilippoBacci/E+/Getty; (Infographic); © CreativaImages/iStock/Getty
Source: www.abs.gov.au/statistics/people/population/australias-population-country-birth/jun-2024

FIGHTING STIGMA

With colleagues from Western and two other Australian universities, Slewa-Younan undertook a project to better understand and improve the treatment of mental health in three CALD communities — Congolese, Arabic speaking, and Chinese Mandarin speaking. Funded by Mental Health Australia, the project aimed to find out what influences people in these communities to seek help with their mental health and to recommend how best to work with CALD communities to develop strategies to tackle mental illness related stigma.

In early 2020, the team conducted a series of online focus group discussions and 26 individual interviews with community members and leaders.

"All three communities reported that stigma was a significant barrier to seeking help and that the topic of mental illness is 'taboo,'" Slewa-Younan recalls. "There's a hesitation, for example, to disclose that you have a mentally ill family member, because it influences factors such as community acceptance and marriage prospects."

The project team reported in *BMC Public Health* that traditional beliefs and cultural frameworks affected how mental illness was perceived in all three communities. In the Congolese community, some participants described the belief that mental illness could have supernatural causes. The Chinese community thought that interpersonal and intergenerational conflict could lead to mental illness. A belief that mental state is related to the individual's physical and social environment emerged in Arabic focus-group discussions.

Mental health providers need to work with CALD communities for better outcomes.

31.5%
IN 2024
The proportion of Australia's population born outside Australia

All three communities preferred to access informal sources of help, including family, social, and community support networks.

The focus group discussions prompted frequent requests for educational initiatives. As well as tailored education to the communities, the project team recommended developing initiatives where people with lived experience of mental illness could share their stories, through live interactions or stories delivered using multimedia.

"The most important recommendation was about the need to work with the communities, because they're the experts," says Slewa-Younan.

"You need to work with the gatekeepers, like the spiritual leaders — the priests and Imams — to deliver these projects, and you need to employ a long-term approach," she says. "Stigma is not something you can shift really quickly, and it's not something that you can do once and forget."

COMMUNITY CONSULTATION

Slewa-Younan's combination of clinical work as a bilingual, bicultural psychologist and extensive research with refugees and multicultural groups gives her unique insights into the mental health needs of CALD communities.

Former director of the NSW Refugee Health Service, Mitchell Smith, says Slewa-Younan has raised awareness of mental health issues affecting resettled refugees in Australia for years (see 'Improving Mental Health Literacy'). "Shameran has a keen interest in mental health literacy of communities, and she has been a strong advocate for programmes and services that address gaps in mental health literacy and care," Smith says.

Slewa-Younan was recently selected to lead a major initiative funded by Mental Health Australia to document the state of multicultural mental health in Australia.

In this project, she and her team, which includes **Distinguished Professor Andre Renzaho** from Western's School of Medicine, **Professor Kingsley Agho** from the School of Health Sciences, and **Associate Professor Ilse Blignault** from the Translational Health Research Institute, are investigating models of best practice for multicultural communities.

Using linked big data sets such as the Australian Bureau of Statistics' database Person Level Integrated Data Asset (PLIDA), they will investigate the use of mental health services amongst CALD communities.

The project will include community consultation with service providers and their clients from a CALD community background.

IMPROVING MENTAL HEALTH LITERACY

Improving mental health literacy is an important focus of **Associate Professor Shameran Slewa-Younan**'s work. With her former PhD candidate, **Dr Gabriela Uribe Guajardo**, she has developed guidelines for providing mental health first aid to refugees from Iraq. They then used these guidelines to improve mental health first-aid training courses.

Together, they also developed a one-day workshop for community leaders to improve their mental health literacy. They then evaluated the improvement in post-traumatic stress disorder (PTSD) related knowledge, attitudes and help-seeking measures and published their results in the *International Journal of Mental Health Systems*.

Fifty-four adults were trained, and pre- and post-workshop questionnaires showed significant improvement in measures such as the ability to recognise mental health problems and an increased recognition of the role that medication can play in the treatment of PTSD.

By equipping community leaders with the knowledge to respond to mental health problems, the workshops helped improve mental health outcomes for Arabic-speaking refugee communities.

One of the participants, Carmen Lazar, programme director at the Assyrian Resource Centre, said the workshop helped deepen her understanding of mental health using a culturally sensitive framework.

"It provided clear, accessible tools and strategies to identify early signs of mental health issues, reduce stigma, and open conversations around mental wellbeing."

After the workshop, she felt confident responding to a situation involving a newly arrived refugee family that was experiencing distress and isolation.

Associate Professor Shameran Slewa-Younan.

"I used the techniques from the workshop to approach the conversation with sensitivity and helped connect them to culturally safe mental health services," she says. "I've also used what I've learned to initiate conversations about mental wellbeing in community gatherings, helping to break down stigma and encourage people to seek help when needed."

Father Ramen Youkhanis from the Assyrian Church of the East Archdiocese of Australia also attended the workshop. "It appealed to me because I recognised the growing mental health challenges in our community — especially issues like trauma, depression, and anxiety given many have arrived as migrants and refugees," he says. "As a religious leader, I felt it was important to be equipped to support our people both from a religious and emotional perspective."

He has been able to put what he learned from the workshop into practice. "Whenever I am faced with families or individuals struggling with mental illness or crises, I have been able to draw on what I learned and encourage them to seek suitable professional help. For me it is clear that faith and mental health care can go hand in hand."

TESTING THE BENEFITS OF TAI CHI FOR STRESSED STUDENTS

Tai Chi has long been practised by people in their later years. Researchers have now shown that this mind-body therapy can help reduce stress in university students.

3 GOOD HEALTH AND WELL-BEING

A team of researchers at Western Sydney University has co-designed a Tai Chi-based stress-reduction programme tailored to higher education students, to help address rising mental health concerns in young adults.

An eight-week programme was piloted in a randomised controlled trial, offering students a low-cost, flexible method to manage stress and anxiety. **Dr Guoyan (Emily) Yang**, a research fellow and Tai Chi Master at Western's National Institute of Complementary Medicine, who leads the project and has taught Tai Chi for nearly 20 years, says its accessibility is one of its most important advantages.

"The unique advantage of Tai Chi is that it doesn't require special facilities and yet is profound enough to sustain a long-term practice for stress management," she explains. "You can just take a five- or ten-minute break and do it anywhere — indoors or outdoors, such as in the classroom, on campus, or at home."

The team, including **Associate Professor Janet Conti**, from the School of Psychology, **Associate Professor Erin Mackenzie**, from the School of Education, and **Associate Professor Carolyn Ee**, from the National Institute of Complementary Medicine, conducted a pilot study with 44 students to investigate the feasibility of a Tai Chi-based stress reduction programme. They also worked alongside headspace, Australia's national youth mental health foundation, which provides early intervention services to 12–25 year olds.

NEED TO KNOW

- Tai Chi has been shown to have mental health benefits for older adults.
- Its impact is less studied in young people.
- A team from Western has shown that Tai Chi can help reduce risk factors related to stress in university students.

While a wealth of previous research supports Tai Chi's mental health benefits for older adults, few studies have examined its impact on younger people. Through the first phase of their research, the team found that the students had the misconception that Tai Chi is just for older people, but soon embraced the initiative.

"During the initial phase of this research, we found that students wanted to feel that they were part of a community. This sense of dislocation fits with our previous research looking at postgraduate student experiences during COVID-19, which showed that a lack of connection had an adverse effect on student wellbeing," Conti explains.

For the Tai Chi intervention, Yang notes that 75% of the students completed the programme, suggesting the program is feasible and well accepted. "Our preliminary analysis showed significant improvements in sleep quality, social support, quality of life, and physical activity levels before and after the programme in comparison to the control group who were not exposed to the programme. Important lifestyle behaviour and health changes like these can beneficially impact stress levels," she says.

Some students were so enthusiastic about their experience that they launched the University's first student-led Tai Chi Association for Wellbeing, creating a space for continued practice open to all students, staff, and alumni.

"The research has been valuable to equipping students with the practical tools to manage stress and improve their mental health," says Serena Nian, Service & Community Development Officer at headspace.

Next, the team hopes to secure funding for a larger trial across multiple universities, with the long-term vision of offering the programme across more Australian universities and beyond.

Dr Guoyan Yang, a research fellow at Western and a Tai Chi master.

THE TECH BOOSTING OUR UNDERSTANDING OF BATS

Heat-sensing drones and radar pulses promise to transform the study of bats in Australia.

"Bats are really hard to study," says **Associate Professor Christopher Turbill** from Western Sydney University's School of Science. They are active at night, they move around a lot, and they're often very small. All of which makes being a bat researcher a tough gig.

"You're peering into the dark. Bats are very difficult to even see, let alone get an understanding of what they're up to," he adds. Yet a better understanding of bats is key to resolving bat-human conflicts emerging all over Australia, and protecting them against growing threats, including a deadly fungus.

To fill knowledge gaps, Western's BatsLab — led by Turbill and **Professor Justin Welbergen**, of Western's Hawkesbury Institute for the Environment — is turning to new technology.

More than 80 species of bat are found in Australia. They range in size from a few grams up to a kilogram, and each has its own ecological niche. Bats pollinate crops, they control insects that are agricultural pests or carry disease, they disperse native seed, and energy from their faeces can support unique cave ecosystems.

But beyond bats having 'useful' roles in ecosystems, Welbergen adds that "we should also value them purely for their own sake, like we do more visible animals."

TURBINE TROUBLES

But not all Australians appreciate bats. Fruit- and nectar-eating flying foxes, which make a lot of noise and mess, can provoke the ire of some people.

For example, in 2016, around one quarter of Australia's population of grey-headed flying foxes — some 300,000 bats — descended on Batemans Bay, New South Wales, to feast on flowering gum trees.

"I can't open my window at all because the smell is so bad," one local complained to the Associated Press, prompting the local authorities to attempt to disperse the bats with loud noise and smoke, much to the consternation of researchers and other wildlife conservationists. Moreover, flying foxes are also in the firing line of farmers, who report fruit harvests being stripped.

And the latest concern for Welbergen and Turbill is the growth of wind power in Australia, with bats being increasingly hit by wind turbine blades. It's a complex problem though, says Welbergen, as "we need development of wind farms, to mitigate climate change, and one of the major threats to bats, especially flying foxes, is climate change."

Minimising the impact of bats on humans, and vice versa, requires better understanding of Australian bats more generally, so Turbill and Welbergen are deploying emerging technology to help them achieve this. Included in their toolkit are heat-sensing drones, ultrasonic bat detectors, temperature-sensitive radio transmitters and data from the Bureau of Meteorology's (BOM) rain radar.

Appropriately for studying bats, the BOM rain radar works a little like bat sonar, but instead of bat-squeaks, a ground-based transmitter sends out pulses of radio waves into the sky. This bounces off moisture in the atmosphere, giving a reading of rainfall levels.

Because bats are full of moisture, the BatsLab team can use the BOM data to extract information about numbers of flying foxes departing their roosts at sunset. They have coupled this with more fine-grained data from their own heat-sensing drones to improve the estimates. While radar has been used overseas to study smaller bats, Welbergen says they are the first to attempt this for flying foxes.

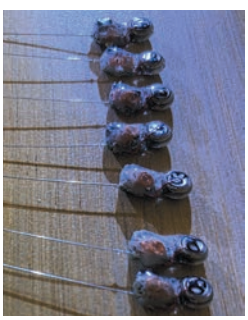
The team has shown that up to one fifth of the individuals in a flying fox colony turns over every night, with some bats moving on to greener pastures, and others arriving from elsewhere. This suggests that dispersal strategies like the ones used in Batemans Bay are likely to be only partially effective, as new bats arrive every day. The bats probably departed on their own because they are nomadic, Welbergen says.

TINY HEAT DETECTORS

Among other technology that BatsLab researchers are using are temperature-sensitive radio transmitters. Flying foxes are famously susceptible to heat waves, with a joint project between Western and the NSW Department of Climate Change, Energy, the Environment and Water reporting the largest loss of flying foxes to extreme heat in a single summer in 2019–2020.

NEED TO KNOW

- Researchers from Western are using heat-sensing drones, temperature-sensitive radio transmitters and rain radar data to study flying foxes.
- This will help us understand bats' response to climate change.



(top) Setting up infra-red and thermal cameras to record and count bats exiting from a cave shortly after dark. (left) Temperature-sensitive radio-transmitters, ready to be attached to a bat. (right) An eastern bent-winged bat — a cave-roosting bat of eastern Australia.

A winter cave survey to record temperature and humidity, and the presence of hibernating bats (normally using a red light to minimise disturbance). Pictured are PhD candidate Tomas Villada-Cadavid and postdoctoral research associate Dr Nicholas Wu.

Matthew Mo from the Department says the project "created broader awareness of extreme heat as an emerging threat," and was referenced by an international initiative to review the conservation status of the grey-headed flying fox in 2021.

But according to Welbergen, the heat-stressed fruit bats are perhaps just the most visible victims of climate change. Bats and indeed other mammals that live solitary lives in the forest may be just as susceptible, but don't so obviously die in dramatic numbers.

The team are trying out tiny, implanted heat detecting transmitters, so their temperatures can be monitored in the wild. These transmit data, which can be picked up by strategically placed data-loggers.

While this technology will be useful to understand bats' response to extreme heat, Welbergen and Turbill are also keen to understand what bats do when they are cold. This information is key to figuring out how vulnerable Australian bats are to a fungus that has almost wiped out many North American species.

DEATH BY FUNGUS

Pseudogymnoascus destructans causes 'white nose syndrome', where hibernating bats' skin becomes mouldy, leading to wing damage and emergance from hibernation too early. Mortality rates can be as high as 90 to 100%. Nine years ago scientists predicted this fungal pathogen was "almost certain" to arrive in Australia within the next ten years. So Turbill and Welbergen have spent much of the past few years scrambling to better understand Australian bats' sensitivity to the disease.

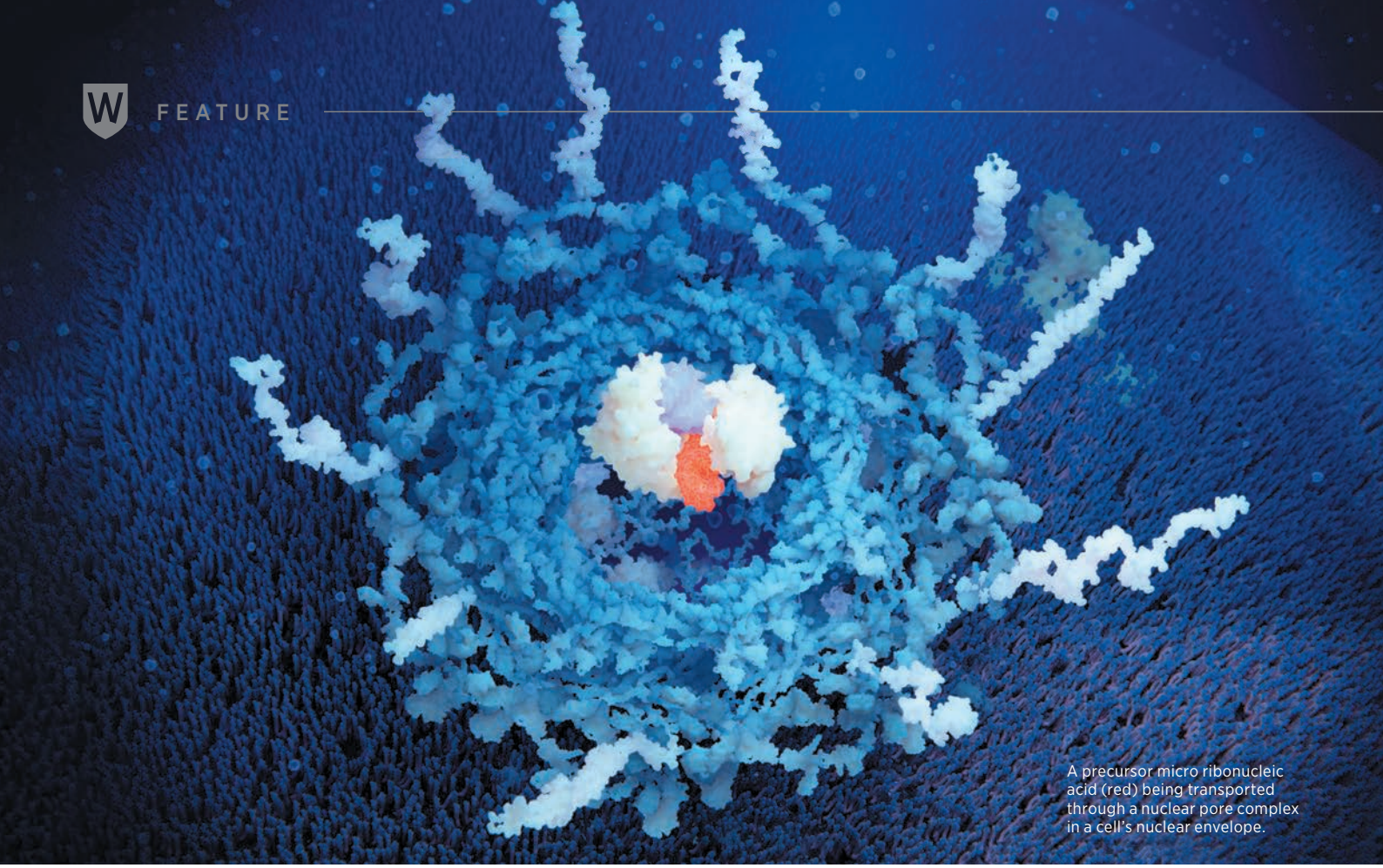
In North America, the bats had little immunity to the fungus, which likely came from Asia or Europe. American bats, which endure a harsher winter than Australian bats, hibernate, which involves dropping their body temperature. This creates more favourable conditions for the cold-loving fungus to thrive.

BatsLab's work with temperature-sensitive radio transmitters has shown that some southern Australian bats also hibernate in caves during winter, dropping their body temperature to the range preferred by the fungus.

"This research project, led by Western Sydney University, is so important," says Keren Cox-Witton, from Wildlife Health Australia, who works with BatsLab. She says white nose syndrome presents "a real risk to a number of our hibernating, cave-dwelling bats, including the critically endangered southern bent-wing bat."

BatsLab's work has helped to identify the species and caves most at risk from white nose syndrome so that protective and preventative measures can be put in place before the fungus, inevitably, arrives.

This is in line with the BatsLab team's wider mission: to employ cutting edge technology, combined with ecophysiology, behavioural ecology and conservation research, to better understand the drivers of bat declines in Australia and provide the robust scientific evidence needed to underpin appropriate management interventions.



A precursor micro ribonucleic acid (red) being transported through a nuclear pore complex in a cell's nuclear envelope.

A GAME CHANGER FOR DIABETES

An innovative tool that predicts whether a patient will benefit from a drug therapy called Imatinib could transform precision medicine for those with type 1 diabetes.

3 GOOD HEALTH AND WELL-BEING

Delayed flights don't typically breed innovation. But for **Professor Anand Hardikar**, a weather-related travel delay in 2009 gave him six hours for some unscheduled blue-sky thinking. This ultimately led to a dynamic risk score for both predicting the onset of type 1 diabetes and gauging an individual's response to cell therapy and drug therapy for the disease.

Hardikar, a biologist at Western Sydney University's School of Medicine and Translational Health Research Institute, was flying from Mumbai to Melbourne that day with the School of Medicine's **Associate Professor Mugdha Joglekar**, his partner in life and research. "We work much better together," he says. "Our children almost began to hate research careers, because it took up most of the dinner-table conversation."

One of the major challenges in diabetes research is that only 20% of individuals who develop type 1 diabetes have a family history of the disease. "And that's really mind-boggling, because it means that anyone from the general population can be at risk of the disease, not only those who have a genetic predisposition to the condition," Hardikar explains.

When someone without diabetes eats, carbohydrates in their food are converted into glucose, which enters the bloodstream and raises the blood sugar level. This triggers the release of insulin, which moves through the blood, helping cells to absorb the glucose and reducing blood sugar levels again.

In people with type 1 diabetes, the cells in the pancreas that produce insulin have been destroyed by the immune system, reducing and eventually halting insulin production. This immune destruction is easy to spot in mouse models, but in humans, the immune attack on insulin-producing cells is milder, occurs more slowly, and varies across ethnically diverse individuals.

In 2009, Hardikar and Joglekar had been researching diabetes for some time, but they had only just started working on microRNAs — tiny non-coding RNA molecules that regulate protein production. They had recently discovered how microRNAs regulate the genes involved in development of the pancreas, and they thought they might be able to map that knowledge to type 1 diabetes.

The back of a boarding pass became a blueprint for an idea that was 15 years in the making: a way of using microRNAs to diagnose type 1 diabetes. "We thought of the possibility to not just identify and validate these key microRNAs associated with type 1 diabetes, but to tie them into a single score that clinicians could use to stratify type 1 diabetes risk".

Left: Associate Professor Mugdha Joglekar (leftmost, standing), Professor Anand Hardikar (centre, seated) and their research team holding the chip on which the type 1 diabetes risk score was developed. Right: A patient with type 1 diabetes monitoring their blood glucose.

SHIFTING RISK

MicroRNAs turned out to be an excellent biomarker for type 1 diabetes risk prediction because they are remarkably robust; they do not degrade easily (like some other biomarkers) and can be reliably measured in human pancreas tissues or plasma samples.

In 2012, the Australian Research Council (ARC) funded a Future Fellowship proposal for the basic science part of the project, but Hardikar found it difficult to attract more funding because a test for type 1 diabetes was deemed to be of little value without a viable cure at that time.

Research in diabetes therapies quickly caught up. There are now several drugs that have progressed through clinical trials, and one already approved by the U.S. Food and Drug Administration that delays progression of the disease. For each of these drugs, there will be some people who respond well to the treatment, and others who do not respond at all. Hardikar and Joglekar's study found that their microRNA measure could predict how individuals would respond in the clinical trial of a drug called Imatinib.

The advent of effective type 1 diabetes drugs introduced another element: dynamic risk. Genetic risk was one of the first measures developed to test for diabetes, but it is highly variable; one of the best-known alleles, or gene variations, associated with type 1 diabetes is present in only 30% of people with the disease.

And as Hardikar explains, "Now you have drugs that can change the course of type 1 diabetes, does a high (genetic) risk mean that you would have very low (or no) chance of a cure? Current and emerging drugs are going to change diabetes progression." This realisation led Hardikar and Joglekar to incorporate dynamism into their risk score.

NEED TO KNOW

- Type 1 diabetes is a condition in which the body attacks its own insulin-producing cells.
- It is difficult to predict the changing risk of type 1 diabetes in humans, and a person's risk of developing the disease changes over time, based on their environment.
- A new dynamic risk measure can predict whether a person has type 1 diabetes, and how they will respond to cell therapy and drugs designed to treat it.

NEXT STEPS

The next plan is to further improve the accuracy of this risk score by adding other biomarker categories, such as proteins, lipids, metabolites, and cell-free DNA, in these populations of patients used to calculate the dynamic risk score. The microRNA-based model is based on patient data from seven different countries, which were largely contributed by Hardikar's network of collaborators. With industry support, Hardikar and Joglekar are now also setting up a platform to translate this research-based workflow into a system for patient diagnostics reporting that is compliant with U.S. Food and Drug Administration regulations.

Hardikar is keen to update the training set to include a wider range of patient data from different demographic groups. A second goal is to make it even more accurate by incorporating different machine learning and synthetic data-based analytical workflows.

Professor Flemming Pociot, at the Steno Diabetes Center Copenhagen in Denmark, agrees that the approach has tremendous potential. Pociot is one of Hardikar's many long-term collaborators.

"The dynamic risk score has clear applications in personalised care," he says. Integration with other signatures, such as circulating proteins and lipids, will further enhance the accuracy of this microRNA-based risk score.

Hardikar is particularly eager to move in the direction of personalised medicine. "We can now say that a given drug would not be very useful to a particular individual before they start the medication," says Hardikar, "and that opens up a lot of possibilities".

PEERING DOWN ON EARTH FROM THE 'DEATH ZONE'

High-altitude balloons equipped with brain-inspired cameras are a fast, cheap, and versatile way of getting eyes into near space.

We live in an era of satellites — an armada of 15,000 or so circle the Earth — and we rely on them for everything, from navigation and communication to weather forecasting. So it might feel a bit strange to turn to something based on the 18th-century technology of high-altitude balloons to carry out near-space sensing and imaging.

Dr Nic Ralph, a postdoctoral research fellow at the MARCS Institute for Brain, Behaviour and Development and the International Centre for Neuromorphic Systems at Western Sydney University, is incorporating bio-inspired sensors with specially designed high-altitude balloons as a short-term and vastly cheaper alternative to satellites for certain applications. While near-space systems are not a replacement for satellites, they offer an interesting approach to 'de-risking' new satellites in development with a short-term deployment to test functionality before going all the way to outer space.

MIMICKING NATURE

The high-altitude balloons are equipped with special sensors that mimic the way the human brain processes visual information. "For example, neuromorphic sensors don't continuously record the entire field of view, but only regions that change between frames." Thanks to this bio-mimicry approach, they are extremely lightweight and consume little power.

"Biology is incredibly efficient and really good at performing in resource-constrained conditions," Ralph explains. In contrast, modern computing and sensing is very precise and fast, but it uses a lot of power and equipment. High-speed cameras which record millions of frames per second require too much power and data to operate in space or at high altitudes. Neuromorphic cameras are much more efficient but still produce high-speed imaging.

Ralph's project marries these state-of-the-art neuromorphic sensors with the long-established technology of high-altitude balloons which bypass the previous limits on the type of science and engineering equipment that can be deployed to near space.

High-altitude balloons typically operate in near space at altitudes of between 20 and 100 kilometres. This region has been dubbed a 'death zone' because the conditions are so harsh to our technology.

"There's almost no atmosphere there, it is near vacuum," says Ralph. "It's very cold, sometimes getting down to –45 °C. There's a huge amount of radiation from cosmic rays as well — about 50 times the radiation levels on the ground."

High-altitude balloons need to be lighter than 4 kg, not a gram over, or due to regulations they can't be flown anywhere near people because of the safety hazard they pose. These tight engineering constraints have traditionally limited the application of high-altitude balloons, but using neuromorphic sensors instead of conventional imaging systems could achieve dramatic reductions in size, weight, and power.

"When we started looking at ballooning, we realised we

The Daedalus 3 neuromorphic sensing platform in the near-space domain at 33km altitude in 2024.

(Right) © NG Images/Alamy

A high-altitude balloon that was part of NASA's BARREL (Balloon Array for Radiation Belt Relativistic Electron).

WESTERN SYDNEY UNIVERSITY

NEED TO KNOW

- High altitude balloons offer an affordable way to directly research space.
- Incorporating neuromorphic sensors allows them to be lightweight and energy efficient.
- Engineering students at Western are able to access these balloons.

had a particular niche," says Ralph. "Since our cameras and sensors are lightweight and super low power, they can help us open up the near-space domain. We're the first people to deploy neuromorphic sensors in near space, and this breakthrough allows us to deploy agile, affordable platforms capable of high-speed, wide-area sensing."

When it comes to short-term imaging, high-altitude balloons offer many advantages over satellites. At about A$2,000 per balloon, they are a tiny fraction of the cost of satellites.

They don't orbit, but drift over the region of interest. "A low-Earth orbit satellite might only pass over your target area once every 90 minutes," says Ralph. A geostationary satellite, which remains in place over the same region of the Earth, requires "significant optics to be able to see close up, and then you're looking at a nearly hundred-million-dollar satellite." In contrast, high-altitude balloons can remain in the general area for hours or longer in the right conditions.

Furthermore, unlike satellites — which are prohibitively expensive to launch and manoeuvre — balloons can be launched at the drop of a hat. "We can respond rapidly to an evolving scenario like a bushfire, and we can have it in near space within 45 minutes of launching," says Ralph.

LOOKING UP AND DOWN

Ralph's team is looking at using their balloons for applications that require collecting data both in space and on the ground.

One application is using balloons to track satellites, which is important for ensuring air safety and for improving the success rate of satellite launches. "We can use balloons to track satellites from launch, to transfer into orbit, and to re-entry," says Ralph. "We have a very cheap way of doing that." They can also use balloons to track orbiting space debris, which is a growing problem as more satellites go into orbit.

Australia is launching more and more satellites, increasing the need to manage traffic in space, Ralph notes.

The team also intends to use balloons to monitor bushfires. "Fire and disaster agencies need something that can cover more area than drones and aircraft, but still image at a higher resolution, like a satellite," says Ralph. "They need to collect data before and after a disaster, but also rapidly during an ongoing fire and flood." That's exactly what high-altitude balloons can do.

Another big advantage of high-altitude balloons is that they enable students to directly research space. Several engineering students at Western are playing key roles in this project as their first space project, explains Ralph. "High-altitude balloons give them a near-space experience, which covers the whole lifecycle of the project."

CYCLING CONNECTIONS FOR SENIORS

An indoor equivalent of the Tour de France has aged care residents improving both their fitness and their social connections.

3 GOOD HEALTH AND WELL-BEING

"I want to win this!" exclaims Joy. It's not the kind of outburst typically expected from a senior citizen in an aged care facility. Joy is pedalling sedately on a modified exercise bike, blanket over her knees, with her hair done nicely and a dash of lipstick on. Despite her not-exactly-athletic attire, she's participating in a global competition to see who can pedal the farthest over a 26-day period.

She doesn't need to ride furiously; she just needs to keep clocking up the kilometres. She's chatting with her fellow residents, who are also riding, and watching a video on a big screen of a cyclist's point of view as they ascend the Swiss Alps.

The challenge is called Road Worlds for Seniors. Each year around October, the gauntlet is thrown down: which senior can individually clock the most kilometres, and which aged care facility, and which country, can collectively clock the greatest distance?

In 2018 an aged care provider managed by Harbison in the Southern Highlands of New South Wales introduced the programme and modified bikes to its residents. The staff and management quickly saw the positive effect it had on the residents' mood and fitness, but they didn't have hard data to confirm their hunch that the programme was beneficial.

To this end, they partnered with **Dr Ruth Brookman**, a research fellow from the MARCS Institute for Brain, Behaviour and Development at Western Sydney University, to study it.

APPROXIMATELY 185,000 PEOPLE AGED 65 AND OVER use residential aged care

NEED TO KNOW

- An international cycling programme was trialled at an aged care home.
- It was found to have physical, mental and social benefits for the residents.
- The effects of the programme were validated by Western's Dr Ruth Brookman.

PEDALLING FOR PURPOSE

Brookman found that the programme brought significant improvements physically, mentally and socially for residents. Cyclists' distance-counts ranged from 17 kilometres to an astonishing 1,035 kilometres over the 26 days. Two-minute tests also revealed that most participants had increased the speed with which they could stand from a seated position, and also increased the distance they could walk in that time period.

Psychologically, they enjoyed improvements too, with reduced depression scores, and increased scores on a measure of self-belief. "That sense of, 'I can do things'," explains Brookman. "Often that's lost when you're losing function and needing help from other people. It can feel like a downward spiral of discouragement."

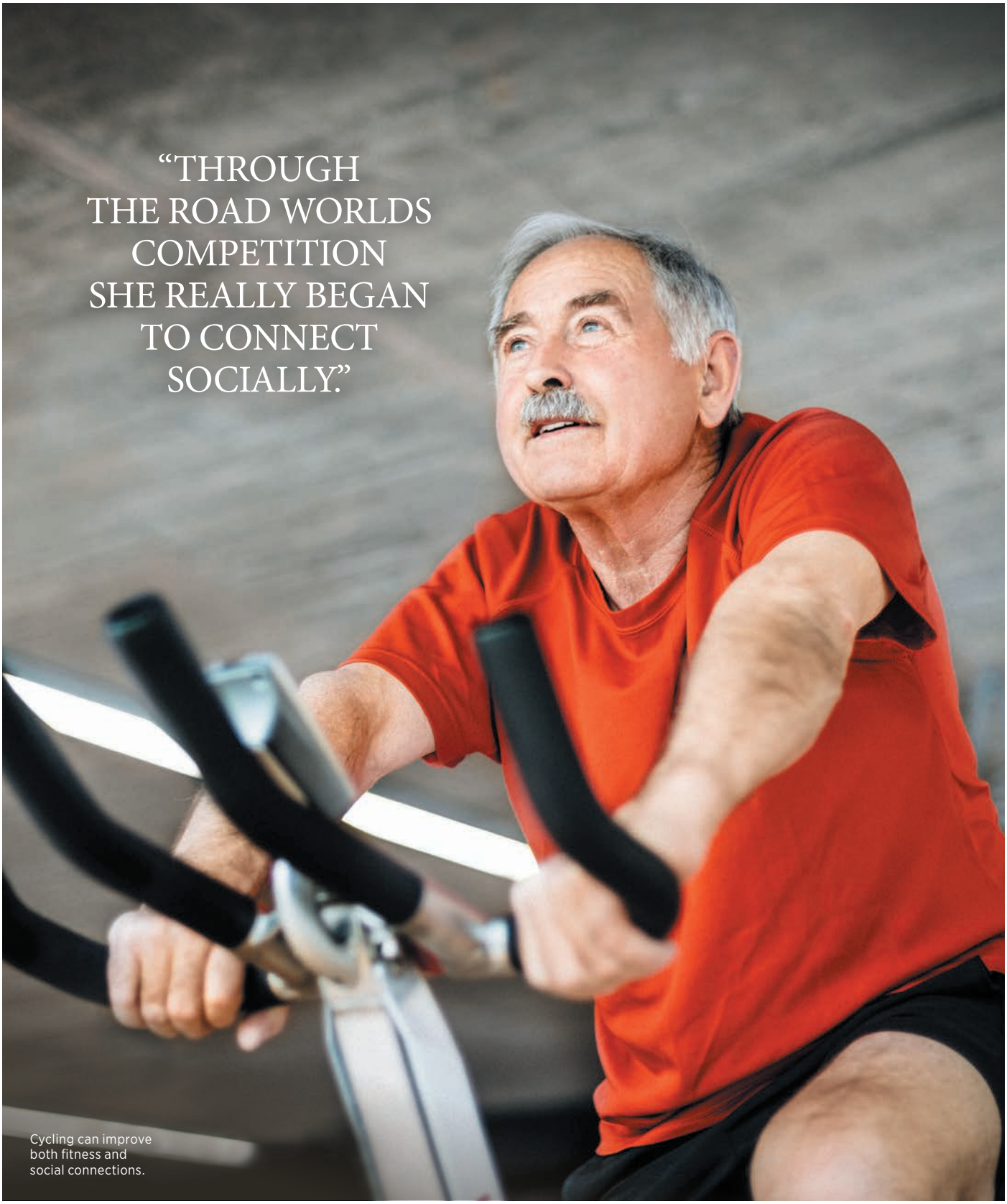
Significantly, the cyclists also increased their scores for the size of their social networks, with the cycling challenge presenting an opportunity for residents to come to communal spaces in the facility, meet other residents and participate in a shared goal of beating other aged care facilities around the world.

Brookman says one woman, named Dorothy, typically chose to stay in her room rather than socialise with residents, but "through the Road Worlds competition she really began to connect socially." Dorothy subsequently came second in the world for kilometres pedalled, and said it was the first time in her long life that she had ever done so well in anything. "She was really proud of that," says Brookman.

Reflecting on the programme, Brookman believes it's been effective because it engages people through different motivations. Some come for the competition, some for the socialisation, some for the fitness, and some for the ability to 'travel' through the videos. Many residents reminisced about their own travels to the places on the cycling videos or expressed excitement about being able to see such places for the first time.

Brookman's work in validating the effects of the programme, which was published in May 2024 in the journal *BMC Geriatrics*, has cemented Harbison's commitment to the Road Worlds competition. And the aged care provider was recently recognised with three international awards at the 2025 Asia Pacific Eldercare Innovation Awards, including 'Operator of the Year – Active Ageing' for the cycling programme.

David Cochran, chief executive of Harbison, says, "Our partnership with Western has played a critical role in taking the programme to the next level, given our residents a sense of purpose, and given us confidence to develop more initiatives."



Cycling can improve both fitness and social connections.

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