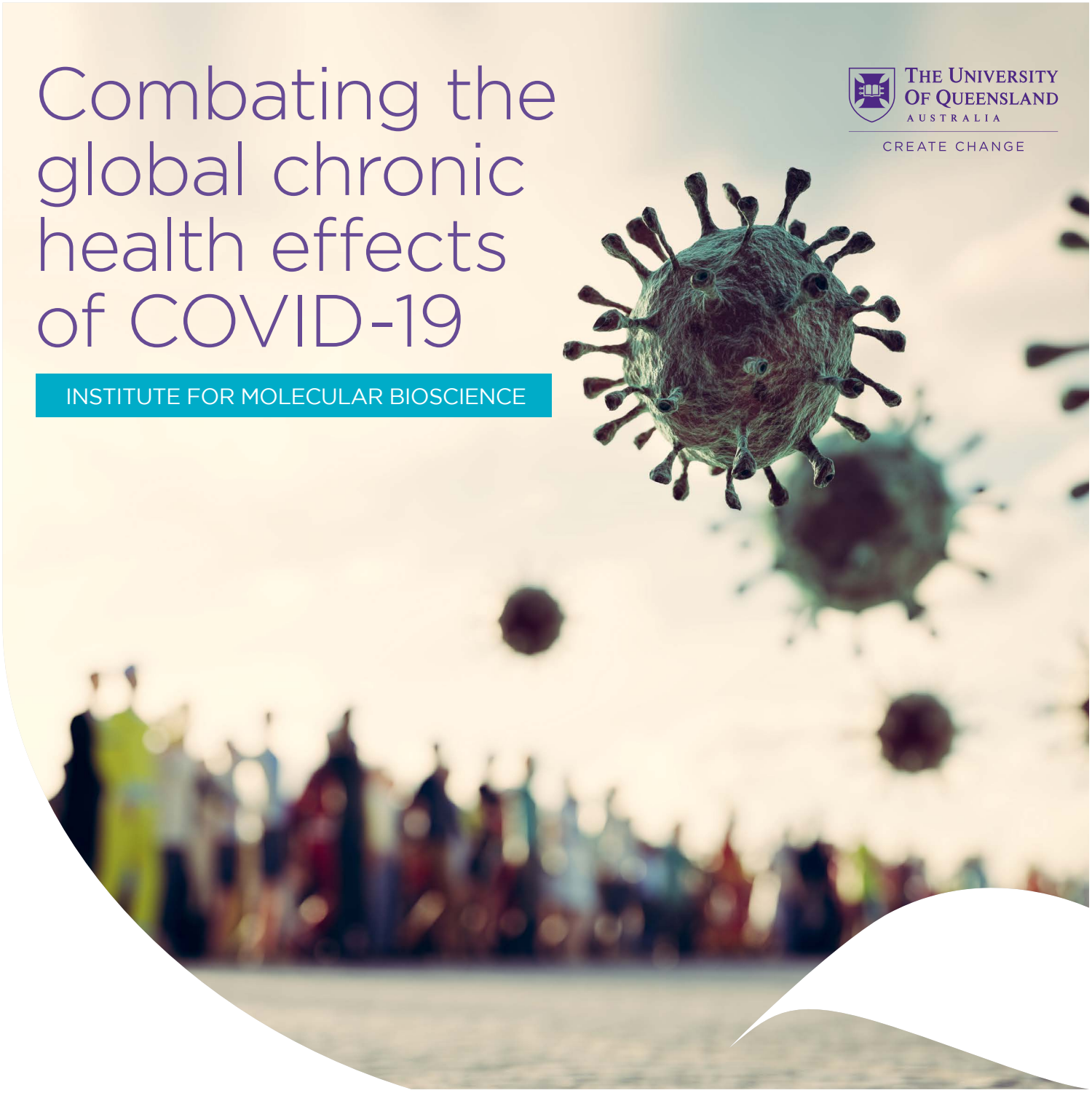
Combating the global chronic health effects of COVID-19

INSTITUTE FOR MOLECULAR BIOSCIENCE



THE UNIVERSITY OF QUEENSLAND
AUSTRALIA
CREATE CHANGE

HOME TO GAME-CHANGING HEALTH DISCOVERIES

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

CREATE CHANGE

Our race to defeat a global menace

Ever since the first cases of COVID-19 became public in late 2019, there has been a life-or-death race involving the global scientific community.

Yet this race is not against each other. Instead, it is a collaborative effort to learn as much as possible about the SARS-CoV-2 virus that causes COVID-19 and how, as a society, we can defeat it as quickly as possible.

The misery COVID-19 has wreaked upon society includes the loss of over a million lives, economic havoc, spiking unemployment, widespread social and mental health problems, and in some cases, the loss of our freedom to move and assemble as we once could, to see our loved ones face-to-face.

Much of the public's focus to date has been on the development of a vaccine, including the fantastic work pursued at UQ. Still, it is just one piece of the larger COVID-19 puzzle that must be solved.

Better ways to detect, test and diagnose the virus are needed now.

It is imperative to understand how the virus spreads in ways that cannot be traced so that we can control outbreaks much faster.

Why does the virus affect different people in different ways; why are some barely touched while others develop life-threatening complications.

We must find better treatments for those who are severely affected, while racing to discover a cure.

Sources:
www.worldometers.info/coronavirus
www.population.gov.au/docs/population_statement_2020.pdf

- <177 million cases identified from over 220 countries
- Australia's population projections 1.1 million less than expected
- Overseas migration will plummet >88%
- Australians are now ageing faster
- >3.7 million deaths globally as of June, 2021

UQ's Institute for Molecular Bioscience

IMB is Australia's #1 research institute*, with a track record of translating research discoveries into spinout drug discovery companies with molecules in clinical trials. We are committed to improving the health and sustainability of our local and global communities.

Our scientists have capitalised on one of the greatest periods of discovery in history – the unlocking of the genetic and molecular basis of life and its diversity – to become a global leader in multidisciplinary life sciences research.

Our success stems from our integrative research approach. IMB scientists work together in a unique collaboration of some of the world's best minds in varied disciplines including chemistry and structural biology, genomics of development and disease, and in cell biology and molecular medicine.

We sit at the edge of discovery, harnessing different types of expertise to tackle problems from various angles, fill the gaps in our knowledge and make discoveries that help solve some of the world's greatest health and environmental challenges.

Together, we can drive discovery and impact through the development of preventions, diagnostics and solutions. Partner with IMB to create change and improve the future.

SNAPSHOT

1454
INTERNATIONAL COLLABORATIONS

OVER
$1.3B
OF COMMERCIAL INVESTMENT ATTRACTED TO IMB RESERCH

OVER
$28M
IN RESEARCH FUNDING

OVER
20%
OF ALL PATENT FAMILIES AT UQ ARE DERIVED FROM IMB RESEARCH

** Nature Index, natureindex.com*

Faster detection: earlier warning tests for infections

The faster we can detect if COVID-19 is present in a community, ensures the restrictions that need to be implemented to keep it under control are less severe. This means fewer lockdowns that devastate the economy and restrict our ability to support family and friends.

Detecting clusters of COVID-19 in the community predominantly comes down to testing individuals for the virus followed by contact tracing. While this has proved to be effective when deployed at scale, it does require significant compliance and honesty about movement.

Also, the difference in the time between testing and the results means contact tracers are playing an almost never-ending game of catch-up to discover how far it has spread.

Developing a test that can detect infections in larger populations much earlier is the focus of IMB researcher, and Director of the Centre for Superbug Solutions, Dr Mark Blaskovich.

“The existing method test for fragments of the genetic component of the virus shed by individuals who are infected is very sensitive,” Dr Blaskovich said.

“But you can’t tell if the virus is live or whether it has mutated.”

That is vital information to have when determining what steps health officials need to take to protect that community.”

Dr Blaskovich is working on a technology that could capture any live virus present in wastewater, allowing for sequencing of the complete viral genetic code.

“We’re developing a rapid diagnostic for detecting the SARS-Cov-2 virus by using magnetic nanoparticles that bind specifically to the virus, based on work we’ve done capturing bacteria,” he explains.

“We can take a dilute solution containing a small number of virus particles, mix it with the nanoparticles, wash away the rest of the solution and are left with a concentrated amount of the captured virus.

“This may allow us to capture the intact virus with much greater sensitivity than is currently possible. If it was present, we might be able to do complete genome sequencing to get the full virus signature.

“From that, we would get greater detail about the strain of the virus and how much it has mutated than with current wastewater monitoring methods.”

Dr Blaskovich notes that even if the proof-of-concept is successful, it is not an ‘either-or’ situation that would replace individual testing.

“This would enhance what is in place to give us more information with earlier detection,” he said.

“We know from examples such as up in Townsville where they found the COVID virus in the wastewater tests, but no one in the community had tested positive.

“It may have been a passing traveller, or maybe an outbreak was imminent. Having much more information would help us determine what we need to do next and if there is a threat.”

Dr Blaskovich and team are increasing the investigation efforts to move the trials ahead, but philanthropy is the key to fast tracking the progress and discovery.

“This is not just important for COVID; it potentially can be scaled and applied to many other types of viral or bacterial outbreaks that are anticipated in the near future.”

IMB RESEARCHER

Dr Mark Blaskovich
WEB: imb.uq.edu.au/profile/929/mark-blaskovich

I genuinely didn't expect to have tested positive for it. I got tested for a runny nose on a cold winter's day. [Being] Admitted to the COVID ward, seeing the people coughing, people gasping for air was terrifying, because I knew that was what was ahead.

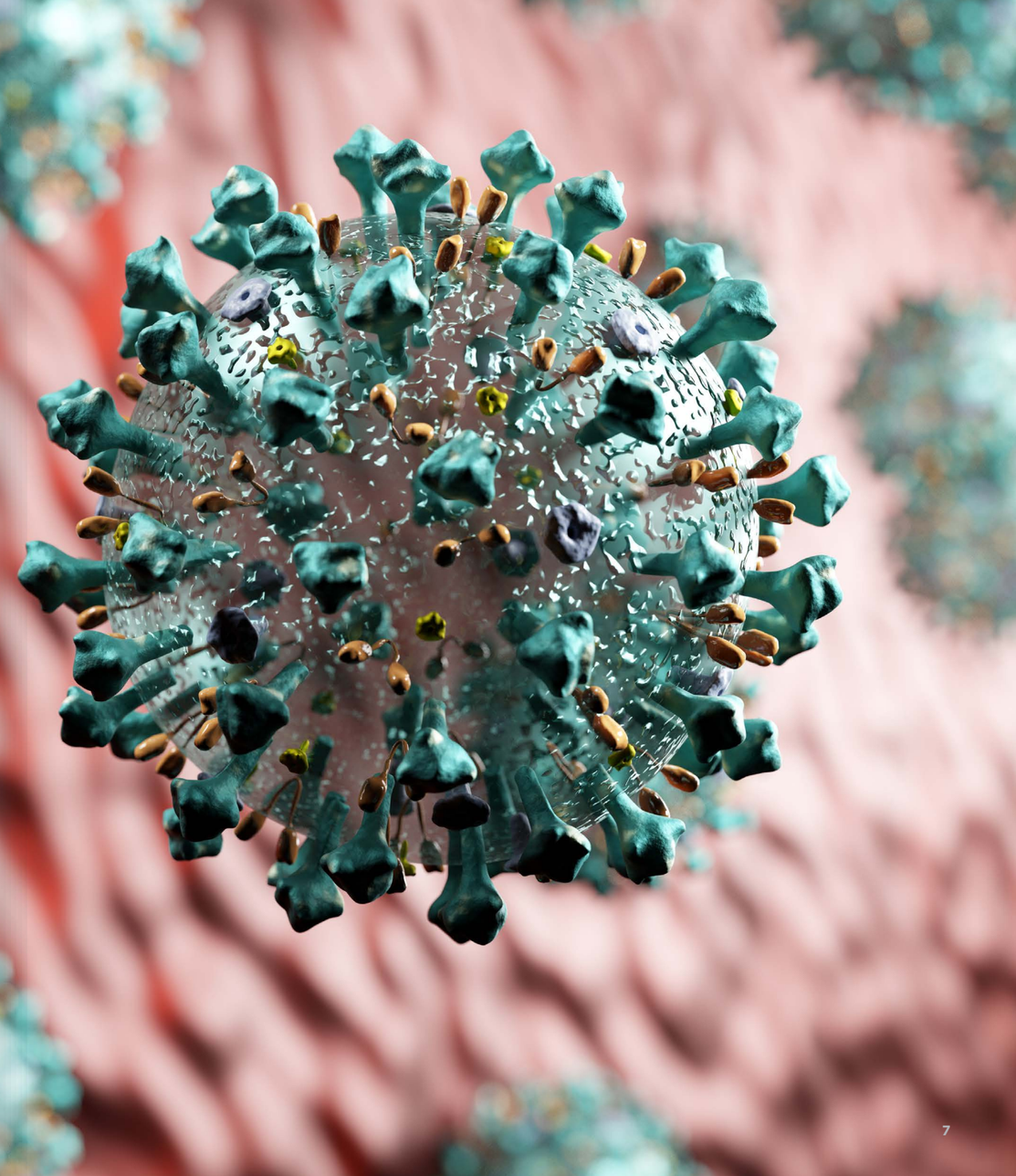
This weakness washes over your body and you just know, I'm not getting enough oxygen right now. I got up and basically just collapsed to the floor. It's so scary to know that your lungs aren't working the way that they should. You can feel your heart trying to compensate, trying to pump blood even harder and faster, but that it's just not working.

There is still some lingering kidney pain and body aches. I'm very short of breath, all of the time. And while I am testing negative for the virus, this is probably a chronic issue and the medical professionals don't know how long it will last. Being a novel virus, we simply don't know what the end point of this is. It could be months it could be years, we just simply don't know yet.

This can make you really, really, really sick. This can kill you. It doesn't matter how old you are, doesn't matter how fit you are, you're not necessarily immune.

SAM MARTIN

26 YEARS OLD
COVID 19 SURVIVOR, MELBOURNE, VIC
SOURCE: ABC NEWS AUSTRALIA, 10 AUG 2020



Containing risk: answering one of the biggest questions

Why are some people who contract COVID-19 barely affected while others develop life-threatening complications?

Some differences are due to age or the presence of comorbid disorders such as cardiovascular disease, chronic respiratory disease, diabetes and cancer. However, they don't explain all variations, with otherwise young and healthy people ending up in intensive care units or dying.

IMB researchers Professor Naomi Wray and Dr Edna Byrne believe the reason lies within each person's host genetics, with DNA variants in their genomes being a contributing factor.

To uncover this, they are in the early stages of a project that will ask each person in Queensland who has tested positive to COVID-19 to provide a biological sample.

The samples collected from consenting participants will help researchers conduct a detailed genome-wide association analysis linking variations in human DNA with the severity of their response to an infection.

"It will help to identify the people who will have the highest likelihood of severe reactions," Professor Wray said.

One of the key benefits this research will yield is to support decision-makers who inform policies around movement restrictions and future wave projections that in turn will minimise isolation and impacts to health systems and the economy.

"Just as important, it will provide key insights to antibody biomarker research to develop defences against the virus – including the prioritisation of participants entered onto vaccine trials."

Researchers have used this type of research to unlock significant virus breakthroughs in the past.

"One of the ways researchers made progress in the early days of HIV was to study sex workers in Kenya who did not get sick even though they had massive exposure to the virus," Professor Wray said.

"It was then that we realised their natural genetic variation gave them protection."

While the study will feed into a global project, Professor Wray believes Australia has a significant advantage when it comes to analysing COVID-19 patient data over their international counterparts.

"They don't have the same amount of data covering the wider breadth of symptoms," she explained.

"One of the things Australia's been very good at is testing so many people, so we have the full spectrum, including those with mild symptoms.

"If you want to get a proper understanding, then you need to study both the severe and the mild cases."

The research team has received some seed funding to progress through the preparatory stages of the project. Still, more financial support is needed to ensure the study advances as soon as possible.

IMB RESEARCHER

Professor Naomi Wray
WEB: imb.uq.edu.au/program-in-complex-trait-genomics

Vampire therapy: saving the lives of the most critical cases

One of the confronting realisations researchers and clinicians faced in the early days of the coronavirus pandemic was that the antibodies, produced to fight the infection, were making some patients much worse.

Known as antibody-dependent enhancement (ADE), the virus attaches itself to suboptimal antibodies incapable of helping with the defence. It is those antibodies that allow the virus to enter the host cells and to drive the inflammation that causes severe damage.

In the most severe COVID-19 cases, patients experience serious respiratory problems when the virus enters the lungs, creating many other types of life-threatening complications.

To combat this, Professor Ian Henderson and fellow UQ researcher Dr Tim Wells are investigating whether an innovative treatment called 'plasmapheresis' - also known as 'vampire therapy' - may be a life-saving option.

Plasmapheresis is a process whereby a patient's blood is removed from the body where it is 'washed' to remove the harmful antibodies, before being returned to the patient. This process has already successfully treated three patients across the world, including a Brisbane patient who underwent a lung transplant after having been born with cystic fibrosis.

Professor Henderson found some patients overproduce antibodies. This natural part of the immune system is designed to kill bacteria but in these patients the antibodies actually protect the bacterial cell from death, leading to severe infection. Removing the antibodies and then applying the drug therapy has worked for these patients when all other treatments failed.

"Even though we had lab evidence to show that the treatment would work, we didn't know if it would work on a human being," Professor Henderson shared.

"But, when the results came back and they showed the treatment was working – well, it was just absolutely fantastic."

Professor Henderson and his team now want to prove that there is a link between elevated levels of antibodies and severe cases of viral diseases, and how, the 'vampire therapy' can be an effective treatment to alleviate COVID-19.

It's not a course of action for every patient or every infection, but we predict that for the very severe responses, we could empower clinicians to discover if their patients would benefit.

"Given the arrival of COVID-19 and the global fight at hand, I have never been more inspired to accelerate this scientific discovery." Professor Henderson said.

IMB RESEARCHER

Professor Ian Henderson
WEB: imb.uq.edu.au/profile/9708/ian-henderson

I was at work when I developed some aching to my lower legs. I spoke to my manager immediately. I was taken off the floor, tested and then self-isolated until I got my result, which was around 24 hours later, which said that I was COVID positive.

I was absolutely devastated. I think that, as a health care worker, there is a little bit of shame and stigma around being diagnosed as COVID positive.

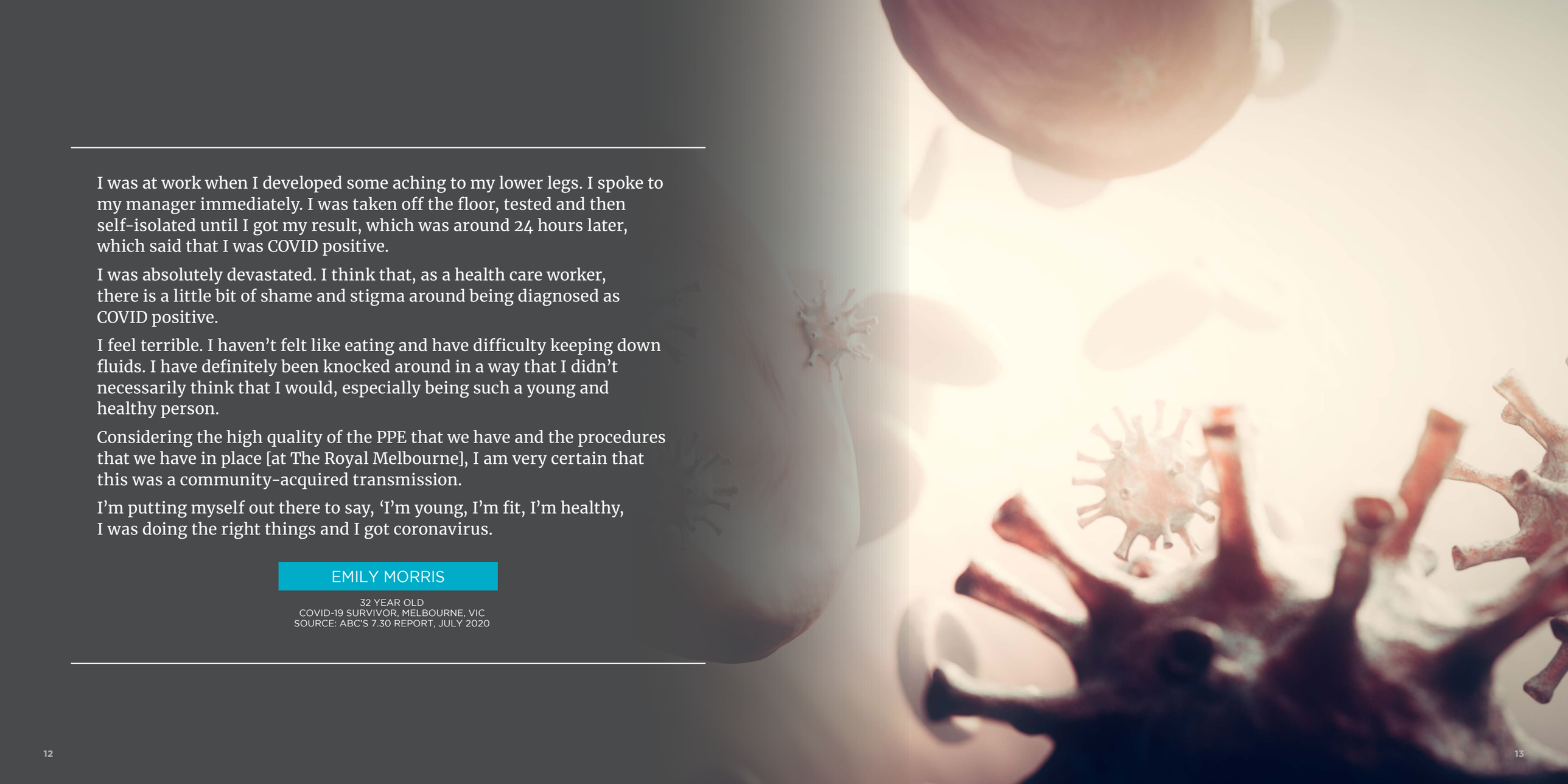
I feel terrible. I haven't felt like eating and have difficulty keeping down fluids. I have definitely been knocked around in a way that I didn't necessarily think that I would, especially being such a young and healthy person.

Considering the high quality of the PPE that we have and the procedures that we have in place [at The Royal Melbourne], I am very certain that this was a community-acquired transmission.

I'm putting myself out there to say, 'I'm young, I'm fit, I'm healthy, I was doing the right things and I got coronavirus.

EMILY MORRIS

32 YEAR OLD
COVID-19 SURVIVOR, MELBOURNE, VIC
SOURCE: ABC'S 7.30 REPORT, JULY 2020



Putting out the fire: tackling harmful inflammation triggered by COVID-19

One of the biggest unknowns with COVID-19 is how our immune response fights the infection. The paradox is that it's not the virus causing the most harmful damage, disease and eventually death, but the immune system's response.

When faced with an infection or injury, inflammation is our body's first response. Inflammation is the alarm system that alerts the rest of the immune system to the danger of an infecting virus. It is necessary to clear the infection and trigger immunity (and long-lasting vaccine responses) to eventually recover from disease. However, if this powerful inflammatory alarm system isn't controlled, it can lead to prolonged or chronic inflammation leading to serious problems such as cancer, arthritis, heart disease, diabetes, asthma and even Alzheimer's disease.

A common reaction by patients who have a severe reaction to COVID-19 is a cytokine storm - an overly rigorous response by the immune system. This response really becomes evident during the second week of infection when people's symptoms worsen, and they often need to be hospitalised. In severe cases this inflammation can drive the lung dysfunction and low oxygen, blood clotting, cardiovascular complications and ultimately, death.

Effectively treating severe COVID-19 extends beyond just the suppression of the virus itself – we must learn how to avoid the life-threatening complications brought on by inflammation. Dr Larisa Labzin, a virologist at the IMB, is investigating how inflammation is triggered during COVID-19.

"We are trying to stop it at the source. By studying how our inflammation to SARS-CoV-2 is initiated in healthy cells, we can learn how it is switched on and off. Our research will identify new drug targets and new treatments for stopping that dangerous inflammation, without compromising our protective immunity," Dr Lazbin shared.

Importantly, understanding inflammation in viral infection will provide important therapeutic options in case of the next pandemic, such as potentially with other viruses like influenza.

Dr Labzin is also working together with a team of multidisciplinary experts including Professor Kate Schroder, Dr Emma Gordon, Dr Anne Lagendijk and Dr Kirsty Short to identifying the specific inflammatory factors that drive vascular damage in COVID-19 patients.

The research team believes that anti-inflammatory drugs now in clinical use, or human clinical trials for other inflammatory conditions, offer exciting potential for the treatment of severe cases, and the prevention of COVID-19 associated cardiovascular disease.

This research offers the potential for rapid translation from bench to bedside, as available drugs that may be repurposed to prevent life-threatening COVID-19-associated blood clotting.

By identifying the specific inflammatory factors that drive COVID-19, the team hope to devise new strategies for the treatment of acute viral infections, as well as for treating other common inflammatory diseases.

IMB RESEARCHERS

Dr Larisa Labzin

WEB: mb.uq.edu.au/profile/6308/larisa-labzin

Tomorrow's health burden: mending COVID's broken heart's

COVID-19 not only puts people with existing heart conditions at a higher risk of death, but generates chronic cardiac issues in people who were otherwise healthy before contracting the virus.

It is an alarming finding by researchers, and one that could result in a crippling health burden for the future.

Tasked with discovering why the heart reacts this way to the virus and developing therapies to stop it from happening is Dr Nathan Palpant at IMB.

"Patients who are infected with coronavirus experience an inflammatory response that has serious adverse effects on their heart," Dr Palpant explains.

"Heart cells react to the stress of the infection in ways that lead to organ failure that prevent it from pumping properly.

"This is something usually seen in patients with heart attacks that go on to have heart failure.

"Unfortunately, this is now prevalent in people who have contracted COVID."

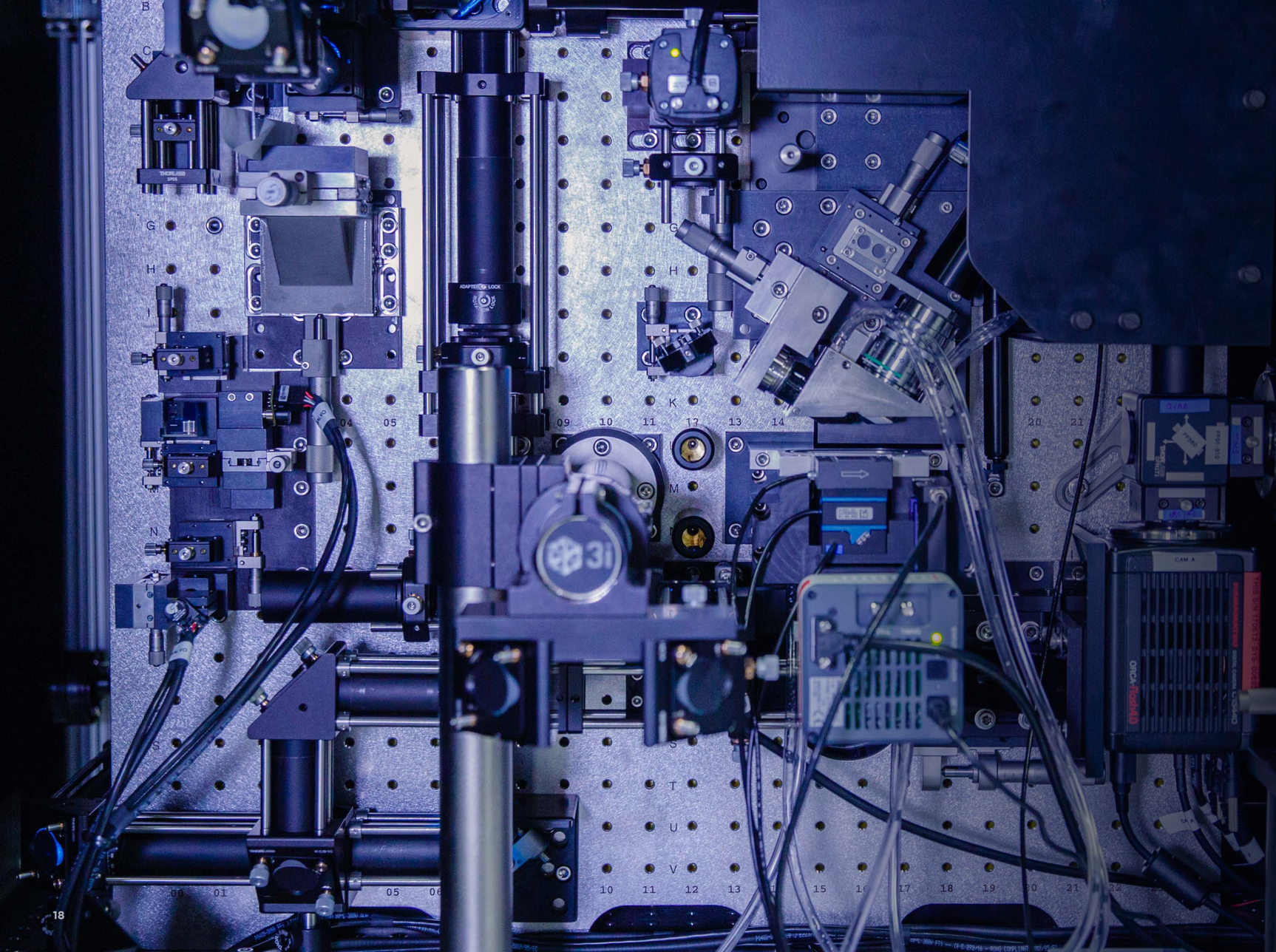
Dr Palpant is working with international groups of chemists, clinicians and scientists to find a solution by implementing a discovery program to accelerate the identification and testing of drugs that help fight COVID infection in the heart.

A successful outcome will have far more comprehensive benefits for the community than just protecting the heart from the effect of COVID.

"Our work aims to develop strategies to predict factors that cause the heart to fail in diverse contexts of acute stress like infection and heart attacks and developing new molecules that block those vulnerability points," Dr Palpant said.

IMB RESEARCHER

Dr Nathan Palpant
WEB: imb.uq.edu.au/profile/1142/nathan-palpant



IMB is quite marvelous in the sheer knowledge and capability in one building. Whatever the problem, there will be an expert in the building, so there is little that we can't achieve. The diversity of the researchers, the techniques used, and the facilities are second to none.

PROFESSOR IRINA VETTER

DIRECTOR OF THE IMB CENTRE FOR PAIN RESEARCH

Featured: IMB's Lattice Light Sheet Microscope is at the forefront of imaging capability

End global health devastation with us

Life-changing research requires significant funding. Your donation will power efforts to discover prevention, treatment, or a cure for the impact so for COVID-19 ravaging health worldwide.

Your investment could provide

$50,000

A named prize for IMB's Women in Science & Technology fund to provide researchers who are facing an unprecedented vulnerable position due to COVID's impact to the Australian funding landscape. With you, urgent research can continue by empowering driven scientists to make discoveries that benefit our local and global communities in the face of COVID-19.

$250,000

Launch a research program that capitalises on the unparalleled compound libraries of candidates at IMB to be screened against the live virus to develop new defences and treatments for the severe impacts of the disease.

$300,000

Critical capital investment to rapidly upgrade the facilities at UQ to deliver state of the art Physical Containment level 3 (PC3) laboratories, giving our brightest researchers the flexibility to handle a number of infective organisms and genetically modified organisms in total safety for them and the world around us.

$600,000

Establish and endowed Ignite Innovation Award to provide the financial capacity to pursue blue sky ideas through to commercialisation. Innovative science with translational outcomes will bring better preventions, diagnostics and cures to patients sooner. Our researchers are dedicated to translational ideas, to ensure we can defend against an inevitable next wave of corona virus or the onslaught of anti-microbial resistance.

$1,500,000

Make a capacity-building investment to IMB's Centre for Inflammation & Disease Research. Inflammation disease is a global problem and a major cause of death. It has been identified as the trigger for some of the more devastating reactions in patients who contact COVID-19.

Enhance the capability of world leading researchers to forge strategic partnerships with industry and clinicians internationally to sustain life saving research.

$10,000,000

Endow UQ's Chair in Vaccine & Infectious Disease Research. A philanthropic investment of this magnitude will support the substantial and vital body of work required to translate the discoveries of leading molecular medicine scientists, from the lab to clinical trials to make a lasting impact in ending infectious and chronic disease.

To discuss your investment in the minds of IMB for a healthier future, contact Kamyra Laurenson by email: k.laurenson@uq.edu.au or phone: +61 7 3346 2222.

We are leading the global fight to stop superbugs and infection

Help us discover the unknown in antibiotics

Donate today

For more information contact

Kamyra Laurenson
Director, Advancement
Institute for Molecular Bioscience
E: k.laurenson@uq.edu.au
M: +61 429 518 792
imb.uq.edu.au/get-involved

CREATE CHANGE