COVID-19

How Australia's health and medical research sector is responding

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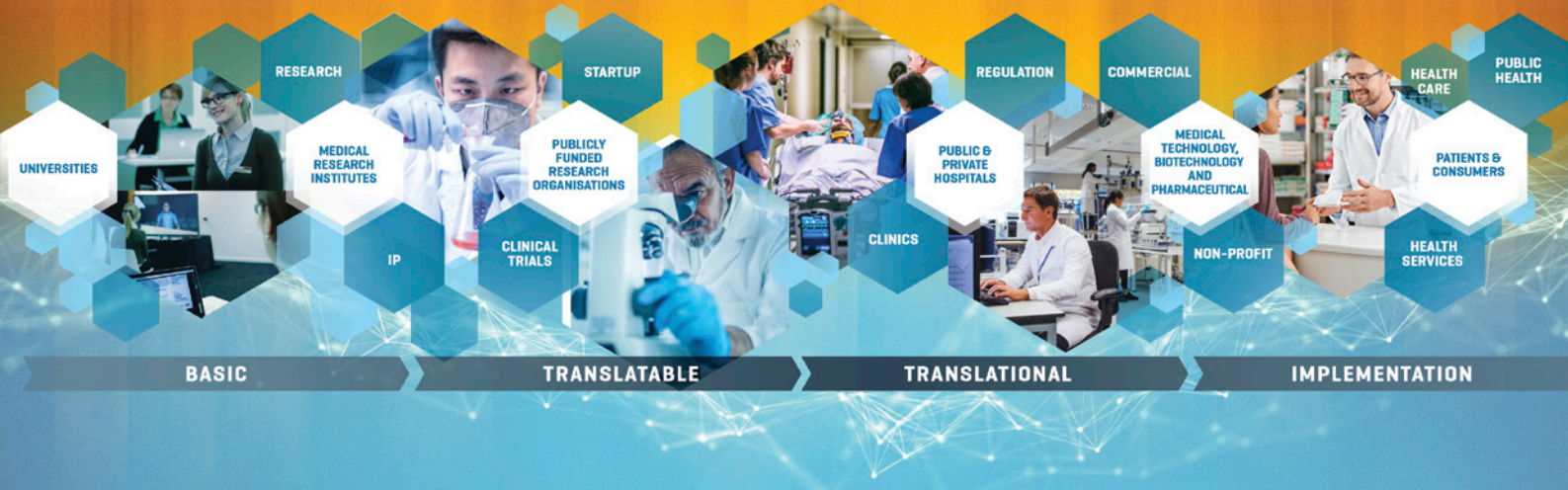
Research Australia is *the* national alliance representing the **entire health and medical research pipeline** from the laboratory through to the patient and the marketplace.



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Foreword

As the national peak body for Australian health and medical research, Research Australia has broad insight into the massive breadth and depth of the health and medical research and innovation sector's response to the COVID-19 pandemic. It is a response that has mobilised researchers and support staff from across universities, medical research institutes, pharmaceutical companies, public and private hospitals and not-for-profits.

Australia's response to COVID-19 has been so broad and deep because of previous investments in the nation's research and innovation capacity. This capacity, and the funding that underpins it, cannot be taken for granted. There is no guarantee that Australia's health and medical research and innovation community will be equally well placed to respond to a future pandemic.

There are a number of elements of Australia's research ecosystem that have slowed down researchers. Incredible progress has been made despite the challenges within the sector. These would include funding processes, research organisations' internal ethics and approval processes and constraints on the ability to implement evidence based research in our hospitals and clinics.

And while the whole health and medical research sector is better connected than it has been in the past, it is still hindered by a lack of information about what research is happening currently, and where.

The economic consequences of this pandemic – increased government debt, and an economic downturn – affect all the sources of income (government, philanthropy and private investment) that the sector relies on. It is these issues of financial and capacity constraint that Research Australia explores in our accompanying report, *The impact of COVID-19 on health and medical researchers*.

Australia, and the rest of the world, will not be free of COVID-19, or at least be able to live with it, without our health and medical researchers. This pandemic serves as a stark reminder of how much Australians need a standing capacity in health and medical research generally, but especially in times of crisis, and how responsive our researchers are when they were called upon.

We are highly appreciative of our esteemed researchers and the alacrity with which they contributed to the research discussed in this Report.

Chris Chapman
Chairman

Nadia Levin
CEO and Managing Director

Introduction

Since the COVID-19 pandemic hit Australia's shores, our health and medical researchers have been at the forefront of Australia's response, advising governments about how the virus behaves, how it can be contained and drawing on the experiences of other countries.

In unprecedented numbers, health and medical researchers have been rapidly redeployed to work on vaccines, treatments, diagnostics and the rapidly expanding body of knowledge on the short and long-term health impacts of COVID-19.

While we have all become aware of some of the research that is under way in Australia in response to COVID-19, Research Australia believes the true range and depth of the research being undertaken in response to this pandemic is not evident to the researchers themselves, organisations across the research pipeline, and within governments and the broader community. This report captures the responses from a call out to Research Australia's membership across the health and medical research and innovation pipeline in April 2020. We asked our members to give us examples of the types of COVID-19 research they are undertaking, demonstrating the depth and breadth of research underway.

As snapshot of the all these activities, it is not a complete catalogue of all COVID-19 related research underway in Australia currently. It does, however, provide a useful insight into the incredible response the Australian health and medical research and innovation sector is making to this pandemic.

The approach taken in this report is to describe the research on a state-by-state and territory basis. Much of the research is being undertaken in collaborations that are crossing state and international boundaries, so almost none of the research is limited to one state or territory.

The research and innovation has been grouped where applicable under the main themes of:

- Understanding the Coronavirus SARS-CoV-2;
- Vaccine development;
- Therapies,
- Testing and Diagnostics;
- Health System and Workforce; and
- Community.

What we have learned

It has been incredibly reassuring that our health and medical researchers have been able to respond so ably to this crisis, triggering their connections to activate and ramp up collaborations between researchers, across teams and over local and international borders. COVID-19 has required many researchers to find ways to shift gear quickly.

Some very positive key themes and characteristics of this research and innovation have emerged; and along with them, the possibility of permanently adopting a more agile approach to the way we conduct research and innovate.

COLLABORATION

Real collaboration is occurring across research organisations, between academia, government research agencies and departments, with healthcare services and the private sector. The urgency and scale of the COVID-19 pandemic has accelerated the creation of partnerships.

Competitors have put aside their own commercial interests, with pharmaceutical companies pooling resources and making information, samples and resources widely available. And while the pandemic has closed international borders it has not prevented international collaboration, which is currently occurring on a scale that is unprecedented.

One of the most high-profile examples of this is the collaboration between the Doherty Institute, Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the University of Queensland which are combining their diverse expertise to develop a vaccine.

GLOBAL, NATIONAL, LOCAL

Many Australian researchers are contributing to global solutions, not just in work on vaccine candidates, but also the development of therapeutics and diagnostics. Other research responses are at a national or state level, for example helping inform Australian governments' response to the pandemic. Further efforts are at a localised or specialised level, including addressing the needs of our nursing community, the wellbeing of students, or helping a local health service make the most effective use of its resources.

CSL, arguably one of Australia's most successful public-turned-private organisations, is standing ready to carry any successful vaccine through to manufacture. The CSIRO is simultaneously testing two other vaccine candidates developed in the United Kingdom and the United States at one of the few facilities in the world that can do this work and at time of writing, one of these vaccine candidates is moving into clinical testing at sites in Brisbane and Melbourne.

We know that most vaccines that enter testing won't work. For this reason, we need researchers all around the world developing vaccines using different methods and approaches. We are hopeful that one or more will work but we can't wait and do this in turn – we need to follow all leads simultaneously.

Global collaboration enables the best and most efficient use of worldwide expertise and facilities, and having the capacity to participate and contribute effectively goes far beyond just responding to this global crisis. It also provides standing and authority for Australia, ensuring a seat at the international table.

IMMEDIATE AND LONG TERM

Some of the research is aimed at predicting the course of COVID-19 in the next few days and weeks; other research is seeking to understand the long term health and social impacts on those who recover from COVID-19 and the broader societal impact on our health and wellbeing. In relation to the latter, this report describes a couple of long running population studies that are adapting to monitor the effects of recovery from COVID-19.

LABS, BEDS, WORKPLACES, SCHOOLS AND HOMES

Researchers from a wide array of disciplines are working across Australia. Biomedical research is being undertaken in our labs. Engineers and clinicians are collaborating on new medical devices and diagnostics, while other engineers are working on new filters for air conditioning systems that can remove the virus.

Mathematicians and epidemiologists are tracking COVID-19 and developing models to guide policymakers. Health services researchers are partnering with our health services to better understand the impact of COVID-19 and how to respond in innovative ways. Others are working with our communities to understand and respond to the impact of social isolation, remote learning and the additional stress and anxiety.

NEW AND REPURPOSED

Much of the research being undertaken is brand new, and we have seen new funding provided with unprecedented speed by both governments and philanthropy, and new expenditure by large companies.

Other research now directed at COVID-19 is drawing on existing research and expertise that is being re-purposed. It is great to see that this includes research in HIV, experimental drugs being trialled for their ability to eliminate the virus or minimise symptoms, and the innovative re-design and re-purposing of medical devices and materials.

THE FUTURE

Australia's researchers are also turning their minds to the future, exploring how Australia will be changed by COVID-19 and the lessons we can learn from this pandemic to better prepare us for the next one. It is important that we start thinking now about the kinds of data we need to collect and what we can do in advance that will mean we can respond in a more timely and effective matter to the next pandemic.

This includes evidence on how best to support a population at both a health and social level, as well as how we can use health and medical research to help sustain our economy.

Health and medical research and innovation in Australia

Australia invests approximately $7.9 billion per annum in health and medical research and innovation. More than half (52%) of all Australian health and medical research and innovation is undertaken in the higher education sector. Another 14% is undertaken by medical research institutes, and 25% by the private sector.[1] The remainder is direct expenditure by Commonwealth, State and Territory Governments and their agencies, for example the CSIRO.

While this sum is large, it pales into insignificance when compared to the health sector, which the research is largely designed to serve. In 2017-18, total health expenditure in Australia was $185.4 billion[2], while the investment in health and medical research is just 4% of this.

Funding for research and innovation in universities and medical research institutes comes from a range of different sources, including the universities themselves, Commonwealth and State Government funding, philanthropy, and commercial partnerships and activities.

In addition to funding from within Australia, there is also revenue generated from grants and contracts with international governments, international philanthropy and multinational companies. Many Australian universities have large numbers of international students and use some of the income from teaching international students to fund research. The research described in this report is funded variously from one or more of these sources.

If research is to benefit patients and society it needs to be translated into better health outcomes for our community and without compromising patient safety, it should be faster than the current 17 years on average.

Research can lead to new drugs and medicines to treat illness, new tests and diagnostics to detect disease and vaccines to prevent disease. It can also lead to new insights into how our behaviour affects our wellbeing, and the changes that can improve the health of our communities.

Health and medical research provides the information we need to make our health systems safer and more effective. All this requires our researchers and innovators to engage with others: hospitals, pharmaceutical and biotechnology companies, governments, local communities and international partners. This engagement is evident in the examples of research contained in this report.

1 https://researchaustralia.org/category/hmr-facts/
2 https://www.aihw.gov.au/reports/health-welfare-expenditure/health-expenditure-australia-2017-18/contents/data-visualisation

Australian Capital Territory

While geographically small, the nation's capital is home to two of Australia's leading universities.

The **Australian National University** is Australia's only university created under Commonwealth legislation, with a specific mandate serve the Commonwealth of Australia.

The **University of Canberra** is constituted under ACT legislation, and has its foundations in technical and teacher training colleges, with a current health and medical research focus on health sciences and allied health.

UNDERSTANDING THE CORONAVIRUS SARS-COV-2

Mapping the spread of COVID-19 in real time

A team at the **Australian National University** has been awarded funding from NHMRC (through the APPRISE Centre for Research Excellence) to produce an information and visualisation dashboard that maps the spread of COVID-19 in Australia over time and place.

The project aims for real-time information by linking data from multiple sources such as health departments, laboratories, and case investigations. The system will also include spatial data so users can easily identify transmission hotspots and aid our national response by streamlining data collection and analyses across all states and territories. Collaborators include members of the GRAPHC team at the ANU Research School of Population Health, other researchers from ANU, APPRISE Partners, the **Menzies School of Health Research**, and Health Departments.

The Australian Geospatial Health Lab at University of Canberra is mapping COVID-19 to help inform public health strategies.[3]

THERAPIES

Factors for survival of patients with Acute Respiratory Distress Syndrome

Australian National University researchers are undertaking a prospective observational study for 6 to 12 months in 25 Intensive Care Units (ICUs) in Australia and New Zealand to describe management practices, ventilator strategies, adjunctive therapies and outcomes in patients with and without COVID-19 who develop moderate to severe Acute Respiratory Distress Syndrome (ARDS) and determine factors associated with survival.

This data will give an accurate description of the characteristics of patients with moderate to severe ARDS with and without COVID-19, admitted to ICUs in Australia and New Zealand and help inform treatment.

TESTING AND DIAGNOSTICS

Monitoring sewage as an early warning system

Australian National University's National Centre for Epidemiology and Population Health has a team monitoring sewage for evidence of COVID-19 in the ACT. The project will identify virus transmission outside of standard testing and hospital reporting. The monitoring of wastewater has been effective in serving as an early warning system. Researchers in Holland detected COVID-19 in sewage samples before the first officially recorded case.

The study will provide critical information for preventative interventions and health service planning both in the ACT and nationally.[4] This research could inform our understanding of the level of undiagnosed cases and hep inform decisions about how and when to relax restrictions.

3 https://www.canberra.edu.au/uncover/news-archive/2020/april/covid-19-the-need-to-fill-the-spatio-temporal-data-vacuum

4 https://www.anu.edu.au/news/all-news/tracking-covid-19-transmission-through-our-sewage

Australian Capital Territory

Clinical diagnostic platform

University of Canberra biomedical science researchers are working with staff from the **Doherty Institute**, setting up a clinical diagnostic platform.

HEALTH SYSTEM AND WORKFORCE

Using telehealth effectively

University of Canberra staff working with the **Digital Health CRC** have set up a Telehealth Hub website which collates and indexes a wide range of resources that have been shared and recommended by members of Australia's health community, in order to support their colleagues, professionals, and consumers to use telehealth effectively during COVID-19.[5]

COMMUNITY

Driving optimal compliance to reduce the spread of COVID-19

Researchers in **Australian National University** schools of Psychology and Population Health are studying the unprecedented psychology and behaviour changes that are critical in Australia's response to reducing the spread of COVID-19. Drawing on the science of group processes, this project seeks to provide evidence to inform optimal ways of increasing the populations' compliance with health behaviour recommended by the Australian government – specifically hand washing, social distancing and self-isolating.

These results will be translated as a matter of urgency into information that can be used to slow the spread of COVID-19 and strengthen social cohesion.

The most effective way to get information to the public

The **Australian National University** Research School of Population Health is conducting an online survey to help researchers identify which media sources are most frequently used to access information on COVID-19, and what changes participants have made in their daily life.

This information will be accessible by the Australian Department of Health and other agencies to correct misinformation, target more effective public news information, develop risk communication messaging aimed at reducing the spread of COVID-19 within the population, and help alleviate anxiety associated with COVID-19 pandemic.

Minimising mental health risks

Australian National University researchers at the Research School of Psychology are leading a study aimed to improve the understanding of the mental health and behavioural impacts of COVID-19. The study also investigates how risk communication (e.g. in the media, or by politicians) impacts on people's emotions and decision-making.

This longitudinal study aim to discover what puts our community at risk during pandemics, what protects them, and what can be done to foster community mental health—including by improving communication by Governments and other organisations.

Supporting accurate information

Researchers at the **University of Canberra** are investigating COVID-19 news and misinformation consumption in Australia to support better and more accurate information provision to the community.

5 https://digitalhealthcrc.com/telehealth/

Outcomes in people who contracted COVID-19

Researchers at the **Australian National University** National Centre for Epidemiology and Population Health are leading a study that aims to quantify outcomes in all people diagnosed with COVID-19 in Queensland, over time and relating to patient sociodemographic and health characteristics.

The study links Queensland COVID-19 notification data to routinely collected health data, including hospital admissions, emergency department data, death data, and general practice data. The study will provide valuable information to understand the predictors of outcomes in people diagnosed with COVID-19 and to measure the impact of COVID-19 on the population. Queensland Health has funded the study.

Remote learning – supporting teachers, schools and parents

The rapid change to remote learning has presented major challenges to Australia's schools, teachers, students and families. The **University of Canberra** is working to provide advice, relief and development for ACT educators, schools and families should not be capitalised.

The University's Education Faculty has worked with the ACT Teacher Quality Institute to get students working in partnership with school teachers to deliver online teaching.

The **University of Canberra's** STEM Education Research Centre has redeveloped its early years professional learning (PL) program so teachers can gain PL at distance, with substantial uptake across the region.[6]

Modelling stimulus impact on socioeconomic groups

The National Centre for Social and Economic Modelling (NATSEM) was established at the **University of Canberra** in 1993 to develop microsimulation models for the Federal Government and to undertake broad social and economic modelling and research. A major modelling task was to develop STINMOD – a model of the personal income taxation and government benefits system. NATSEM has updated STINMOD in response to the Federal Government stimulus package.

The Federal Government heavily relies upon this model through Treasury, Social Services and Employment to understand how policy impacts on families and the broad impacts on different socioeconomic groups across the country.[7]

6 https://www.canberra.edu.au/research/faculty-research-centres/stem-education-research-centre
7 https://natsem.canberra.edu.au/about-us/

New South Wales

New South Wales, Australia's most populous state, is home to world leading health and medical research. It is also the headquarters of many of Australia's private sector health innovation companies and recognised as the Australian centre for medical devices. Much of research described here is from organisations that are based largely in Sydney but who have a national or indeed an international outlook.

The **Centenary Institute** is a leading independent medical research institute with a particular focus on cancer, inflammation and cardiovascular disease. Its strength is in uncovering disease mechanisms and applying this knowledge to improve diagnostics and treatments for patients and find cures for some of the most chronic diseases affecting today's society. The Institute is located on the border of the University of Sydney Campus and the Royal Prince Alfred Hospital.[8]

The **Digital Health CRC**, based in Sydney, has a national network of partners across academia and industry. It aims to use research and innovation in digital health to deliver significant economic and business development opportunities, as well as better health.[9]

Evidentli is a software company that empowers doctors, nurses, researchers and healthcare managers to quickly and accurately mine knowledge from real-world patient data. Its offerings include AI-powered data automation that cleanses, federates and standardises data, as well as research automation tools that group, screen, compare and summarise data in order to generate live evidence for clinicians, policy makers and others.[10]

The **Garvan Institute of Medical Research**, a leader in genomics research, has made significant advances in understanding of the genome, epigenome, protein and in cell analysis technology since its inception in 1963. With world leading expertise and capabilities in genomics, its mission is to harness all the information encoded in our genome to better diagnose, treat, predict and prevent disease.[11]

The **George Institute** is a leading independent global medical research institute established and headquartered in Sydney, with additional major centres in China, India and the UK and an international network of experts and collaborators. Its mission is to improve the health of millions of people worldwide, particularly those living in disadvantaged circumstances, by challenging the status quo and using innovative approaches to prevent and treat non-communicable diseases and injury.[12]

The **Hunter Medical Research Institute** (began in 1998 as a partnership between the University of Newcastle and the Hunter New England Local Health District and has today evolved into a world-class research institute in the Hunter Region of NSW with 1500 medical researchers, students and support staff striving to prevent, treat and defeat a multitude of serious illnesses.[13]

The **Ingham Institute of Applied Medical Research** has about 40 research groups working across five research streams in South Western Sydney. These include: Cancer Research, Clinical Sciences Research, Population and Health Services Research, Injury and Rehabilitation Research, Mental Health Research[14]

8 https://www.centenary.org.au/about/
9 https://www.digitalhealthcrc.com/about-us/
10 https://www.evidentli.com
11 https://www.garvan.org.au/about-us/about-the-garvan-institute/
12 https://www.georgeinstitute.org/who-we-are
13 https://hmri.org.au/about-hmri
14 https://inghaminstitute.org.au/where-we-work/research-reach/

New South Wales

Macquarie University was founded more than 50 years ago to offer students, staff and partners a more flexible alternative to the university model prevailing at that time. Macquarie University prides itself on being innovative an taking an interdisciplinary approach, with an emphasis on impact and engagement with society and industry.[15]

MedLab Clinical is a NSW based medical research company with expertise in nanotechnology for the delivery of medicines.[16]

The **Sax Institute** is a national leader in promoting the use of research evidence in health policy. It aims to be the bridge between researchers and health decision makers, giving each the tools to work more closely together to benefit all Australians.[17]

Now 50 years old, the **University of Newcastle** is a world-class institution with strong ties to its region.[18]

The **UNSW Sydney** is one of Australia's leading research and teaching universities. Established as a university in 1949, it can trace its roots back more than a century.[19]

The **University of Sydney** is Australia's oldest university with campuses and research facilities across NSW and beyond. It undertakes a broad range of research at a world-class level.[20]

Western Sydney University (WSU) is one of Australia's newer universities. It has six campuses located in Greater Western Sydney and a mission that links its activities to the development of the region.[21] Research in different parts of Western Sydney University (WSU) is aimed at supporting government, industry and the community in responding to the pandemic.

The **Westmead Institute for Medical Research** is a large medical research institute located at Westmead in Sydney's western suburbs. The institute is closely affiliated with Sydney Medical School and Westmead Hospital and comprises approximately 450 medical research and support staff.[22]

Established in Wollongong in 1975, the **University of Wollongong** now has ten campuses and a broad range of capabilities in research and teaching from biomaterials to mental health.[23]

15 https://www.mq.edu.au
16 https://www.medlab.co/about/about-medlab
17 https://www.saxinstitute.org.au/about-us/
18 https://www.newcastle.edu.au/about-uon/our-university
19 https://www.unsw.edu.au/about-us/university/history
20 https://www.sydney.edu.au/about-us.html
21 https://www.westernsydney.edu.au
22 https://www.westmeadinstitute.org.au
23 https://www.uow.edu.au/about/

UNDERSTANDING THE CORONAVIRUS SARS-COV-2

First release of the gene sequence of COVID-19

The **University of Sydney** was part of the consortium led by Fudan University, Shanghai, which released the world's first gene sequence of COVID-19 on 10 January 2020.[24] It also led the team of ten scientists and pathologists at NSW Health Pathology's Institute of Clinical Pathology and Medical Research (ICPMR) and clinicians at the University of Sydney and Westmead Hospital on genome sequencing of the coronavirus and growing the live virus from real patients as opposed to using synthetic materials.[25]

This helped provide access to faster, reliable diagnostic testing for infected patients. The "virus isolates" were passed to the World Health Organisation and other scientists around the world for research and vaccine development.

Detecting genetic variation

Using the **Garvan Institute's** cutting-edge Nanopore genome sequencing technology, researchers are sequencing the coronavirus genome in infected patients to detect genetic variation that may provide critical data to inform Australia's COVID-19 response in real-time. The team's work has potential to shed light on how the coronavirus evolves, identify virus sub-strains that may be more or less infectious and crucially, guide better treatments.

COVID-19 surveillance

In collaboration with researchers at the **UNSW** Kirby Institute, the Garvan team have already begun analysing the genetic material of virus samples from patients at multiple hospitals in Eastern NSW with COVID-19, and are actively optimising protocols to improve accuracy and scalability of tracing and treatment. The researchers' work will contribute to an international network of COVID-19 surveillance, which has already analysed hundreds of coronavirus genomes.

Co-infection information for flu season

In addition, the researchers are developing an assay to agnostically detect other known human respiratory viruses, including influenza, which could provide invaluable co-infection data for individual patients – critical for the healthcare system in the lead-up to Australia's flu season.

COVID-19 sub-strains and transmission rates

Genome sequencing of coronavirus may also allow researchers to identify any emerging coronavirus sub-strains that could be more or less infectious than current strains. There is also the potential to reveal patients with abnormally high transmission rates, and uncover how the virus responds to new treatments or vaccines.

24 https://www.sydney.edu.au/science/about/our-people/academic-staff/edward-holmes.html
25 https://www.pathology.health.nsw.gov.au/about-us/our-leadership-team/dominic-dwyer

New South Wales

Clinician decision-making tool to adapt to changing conditions

The COVID-19 pandemic has shown how quickly clinicians needed to be able to adapt to changing conditions. By addressing some of the issues faced in accessing and sharing national data sets to support front line care, the **Digital Health CRC's** Clinical Data and Analytics Platform (CDAP) will support decision-making by clinicians by providing nationally available real-time analytics on the progression of COVID-19 to severe disease. **Digital Health CRC** partners involved in the project include **QUT, Monash University**, the **University of Sydney,** Queensland Health and NSW Health.[26]

Evidence base to address challenges in the medical system from COVID-19

Evidentli is part of several global research collaborations with the aim to develop the medical evidence base to better understand treatment efficacy, progression, and complications associated with COVID-19. Evidentli has partnered with Columbia University, Oxford University, the Mayo Clinic, Erasmus University and 300 other Research Institutes to develop medical research protocols which will provide the evidence base to address the challenges to the medical system caused by COVID-19.

Evidentli is also part of both Oracle and Amazon Web Services (AWS) global COVID-19 response efforts, serving as the medical research infrastructure capability in each solution.

Enabling medical research be undertaken 30-80 times faster

Evidentli's technology enables medical research to be performed 30-80x faster than traditional means and it allows real time medical research collaborations, peer review, and translation into practice.[27]

THERAPIES

Nanotechnology to deliver COVID treatment via nose and mouth

MedLab Clinical has a patented delivery system that uses nanotechnology to deliver medicines in nanoparticles that can be more readily absorbed when administered directly into the mouth or nose.[28] MedLab is investigating if its technology can be used for some of the medications currently being developed and tested for treating patients with COVID-19. This could significantly change the method by and speed at which effective doses could be administered to patients.

Engineering COVID-19 antibodies

A research team from the **Garvan Institute's** Centre for Targeted Therapy is developing monoclonal antibodies designed to target surface proteins of SARS-CoV-2, the novel coronavirus that causes COVID-19, which the virus needs to infect human cells. The team will employ in-house expertise at Garvan to engineer antibodies, and will work with collaborators at the **UNSW** Kirby Institute to validate leads and progress these antibodies into clinical trials.

These antibodies could be produced in laboratories and injected monthly as an antiviral treatment to provide patients with 'passive immunity'. The potential antiviral therapy could be particularly suited to at-risk individuals, including the elderly and chronically ill patients, and could be administered as a preventative therapy to health workers on the frontline.

26 https://www.digitalhealthcrc.com/joint-media-release-digital-health-platform-aids-clinicians-in-covid-19-treatment/
27 https://www.evidentli.com/post/new-covid-19-suite-now-in-piano
28 https://www.medlab.co/about/about-medlab

Delivering antivirals to the lungs for treatment

A team at the **Hunter Medical Research Institute** (HMRI) has developed nanoparticles for delivering existing or new anti-viral treatments/ drugs to where these drugs can have the most impact – to the site of infection, the cells that line the lungs. The ability of the nanoparticles to deliver the treatment to the site of infection, differentiates this treatment from any other anti-viral available. The technology could support the delivery of available treatments and drugs currently in clinical trials for COVID-19.

Testing repurposing existing drugs

The HMRI is also a partner in the national ASCOT study, testing several different existing drugs to see if they can be re-purposed to assist COVID-19 patients. The HMRI Clinical Trials Unit is providing pro- bono support to co-ordinate the NSW trial centres.[29]

Examining chronic disease impact

The **Centenary Institute** is utilising its high containment PC3 facility to infect respiratory epithelial cells (lungs cells) and mice with SARS-CoV-2. The mice being infected include those with chronic diseases that increase susceptibility to COVID-19. The aim is to rapidly develop and test potential treatments.[30]

Therapies being developed and tested at the **Centenary Institute** include: drugs that target inflammatory responses to reduce excessive inflammation that are effective in other inflammatory respiratory diseases (such as asthma, COPD and influenza). Discovering and refining critical molecules required for viral pathogenesis, using state-of-the-art screening technologies (such as RNA-sequencing, proteomics and CRISPR), developing synthetic virus-neutralising particles that can enter COVID-19 infected cells and specifically suppress viral growth.

The **Centenary Institute** is also planning to use revolutionary techniques to rapidly optimize new biologic drugs which can be scaled up for mass production to initiate trials.

29 https://hmri.org.au/news-article/clinical-trial-repurpose-existing-drugs-covid-19-treatments
30 https://www.centenary.org.au/research/inflammation/coronavirus/

New South Wales

TESTING AND DIAGNOSTICS

Around the world, individuals have vastly different responses to infection with COVID-19 – some have mild or no symptoms, others suffer severe respiratory symptoms that are fatal.

Most effective DNA testing

Researchers from the **Westmead Medical Research Institute** and **Sydney University** are using expertise in viral genome sequencing and analysis, to better understand SARS-CoV-2 and evaluate the most effective DNA testing for the virus.

Predicting different immune responses

Garvan Institute researchers are proposing to use cellular genomics and machine learning techniques to investigate the differences in the immune response between patients with mild and severe symptoms. They hope to develop a test that provides a 'snapshot' of the immune cells in a patient's blood that could predict how severe their respiratory symptoms will be over time.

In preliminary experiments, the researchers discovered they could detect immune cells linked to different symptoms from blood samples and bronchoalveolar lavage fluid samples (taken from the lungs). Further, initial experiments point to the role of genetic differences between individuals influencing the expression of genes that control the functions of these immune cells.

Using protocols already developed at the Garvan-Weizmann Centre for Cellular Genomics, the researchers plan to develop a rapid test to generate cellular information that could help predict a patient's disease severity and inform potential treatment options, in real-time.

Early-warning system for detecting patients at high risk

Researchers from the **University of Sydney's** School of Computer Science are working with Chinese intensive care doctors to develop an early warning system to detect patients at high risk of impending clinical deterioration in order to reduce the mortality rate.[31] The work is part of the broader project to develop a smart diagnosis and warning system for rapid screening of stroke, cancer, pneumonia and other diseases.

Researchers from the **University of Sydney** and **Westmead Institute** have also been developing indicators to predict the progression of COVID-19. They found one type of immune cell, called neutrophils, was one of the main causes of patients deteriorating after they get influenza. They have already successfully used an AI and big data approach to develop an early warning system in patients with flu-like illness.[32]

Improving radiological detection

A team from the **University of Sydney** led by Professor Patrick Brennan has developed a free online radiology training and research platform available to diagnosing clinicians globally that could improve radiological detection of disease by 34% and can contribute to improved diagnoses of COVID-19. It is being delivered through a consortium involving DetectED-X (a University of Sydney Start Up), clinical experts and the leading medical companies GE Healthcare & Volpara, who will ensure global adoption of the platform.

31 https://www.sydney.edu.au/engineering/about/our-people/academic-staff/albert-zomaya.html
32 https://www.sydney.edu.au/medicine-health/about/our-people/academic-staff/benjamin-tang.html

HEALTH SYSTEM AND WORKFORCE

Macquarie University's Australian Institute for Health Innovation (AIHI) is closely engaged with Australian hospitals and the healthcare system more generally. The Institute conducts world-class research to catalyse performance improvement in healthcare services and systems in Australia and internationally.[33]

The AIHI has several projects and initiatives underway that are supporting Australia's health system with the response to COVID-19. Some of these are existing projects where the need for innovation has been accelerated by the demands paced on our health system buy COVID-19.

AIHI research includes translating the experience of international frontline clinicians dealing with COVID-19 into the Australian context. They are also collecting real time data to learn from the experience of Australian frontline clinicians dealing with COVID-19; developing alternative models of healthcare delivery to keep people out of hospital; and tackling loneliness and social isolation by integrating health and social services.

There is also a strong patient centred approach through integrating care for people with chronic disease making access to care easier and learning how patients manage chronic health conditions at home during COVID-19. The use of technology also features, with the use of AI on chest CT scans to predict severity and management for COVID-19 and employing Chatbots in the fight against the COVID-19 pandemic.

These projects are supporting the overall aim of redesigning our health system to cope with 21st Century crises as evidenced by COVID-19, catastrophic bushfires and an ageing population.

Improving patient flow and bed availability for a surge

The **Sax Institute** is developing a systems model to help hospitals respond to the COVID-19 pandemic and better manage their resources. It will show patient flows and availability of hospital beds and healthcare staff over time, identifying bottlenecks and constraints in the likely surge in patients as the pandemic unfolds. It will let healthcare planners ask 'what-if' questions, such as the potential impact of doubling ICU beds on patient flow and healthcare workforce, allowing hospitals to better prepare for the surge.

Modelling the disease impact on demand

In response to the COVID-19 outbreak, **Western Sydney University's** Centre for Research Mathematics and Data Science (CRMDS). has modelled the disease impact on the health system in Sydney, particularly on demand for ICU and mortuary services.[34] The project was initiated in consultation with an ICU specialist at Westmead Hospital and has modelled scenarios to reflect the effectiveness of a range of disease spread mitigation measures implemented.

Risk to healthcare workers from exposure to COVID-19

The **University of Sydney** and the Centre for Infectious Diseases and Microbiology, Westmead Hospital is investigating the risk to healthcare workers exposed to or diagnosed with COVID-19 when using personal protective equipment and the prevalence of asymptomatic infection and transmission.[35]

33 https://www.mq.edu.au/research/research-centres-groups-and-facilities/healthy-people/centres/australian-institute-of-health-innovation/about-AIHI

34 https://www.westernsydney.edu.au/crm/home

35 https://www.wslhd.health.nsw.gov.au/Education-Portal/Research/Research-Categories/Centre-for-infectious-Diseases-and-Microbiology-Public-Health

New South Wales

Re-useable masks

AusAir is a company founded in 2017 through the University of Sydney's flagship Genesis Startup Program. The company has designed a reusable mask, which features a washable skin and botanical filters. It has passed preliminary P2 and KN95 testing and blocks over 97% of fine particle matter often included in air quality reports. They are now looking for manufacturers which have filter media that scores well in terms of bacteria, virus, and particulate matter filtration.

Vital signs monitoring platform

Reducing the patient load in hospitals by keeping patients out of hospital whilst still being able to monitor key vital signs, has become a high priority during COVID-19 as a way to reduce workloads and the risk of infection to often unwell and vulnerable patients.

Medical Monitoring Solutions, **Western Sydney University** and the **Ingham Institute of Applied Medical Research** at Liverpool are clinically validating an Australian innovative and disruptive, low cost, wearable digital health platform to monitor remotely and 24/7, multiple vital signs including temperature, heart rate and respiration function.[36]

A smart phone can display the data in real time and is also sent to a secure cloud database for remote clinician access, further analysis and the development of predictive tools via artificial intelligence. The Saiiv Vital Signs Platform will be able to be used in hospitals, aged care settings and the home. The recent extension of telehealth provides a further potential opportunity for the use of this technology.

Tracking COVID-19 in aged care facilities

The **George Institute** is part of a large team working with the Western Sydney Centre for Population Health to track the burden of viral diseases in aged care facilities in the west of Sydney. The study is looking at attack rate, hospitalisation, and death rates of viral respiratory infection outbreaks in adults aged over 65 years in these facilities. As this study has been running for a few years, it is now ideally placed to immediately track the COVID-19 pandemic in these facilities.

Ramping up manufacturing PPE

The **University of Newcastle** has drawn on its expertise in engineering and its close links to industry to respond rapidly to the need for Personal Protective Equipment. They have been able to move rapidly from prototype to manufacturing, with the Australian National Fabrication Facility team based at the University contributing to the build of the shield assembly line.[37]

Ventilator prototype

The **University of Newcastle** has also worked with local company AMPControl on the company's ventilator prototype. Safearth and NewieVentures are two other Hunter-based engineering companies that joined the collaboration. All three companies have close ties to the University.[38]

36 www.saiiv.com
37 https://www.newcastle.edu.au/newsroom/featured/university-minds-meld-to-address-covid-19-equipment-shortages
38 https://www.newcastle.edu.au/about-uon

New South Wales

COMMUNITY

Modelling physical distancing and the spread of COVID-19

COVID-19 has attracted researchers from beyond the disciplines popularly associated with health and medical research. One example of this is the Complex Systems Research Group at the **University of Sydney's** Faculty of Engineering. Research published by this group which modelled physical distancing provided evidence early in the pandemic's Australian spread that physical distancing could be very effective in reducing the spread of the coronavirus in Australia's population.[39] Evidence like this is critical to guiding policy and giving Australian governments and the public confidence that these measures are worth the cost and inconvenience.

Cross-disciplinary research – personal and social factors on health

Western Sydney University's Translational Health Research Institute (THRI) brings a strong, cross-disciplinary focus to understanding the impacts of complex, inter-related personal and social factors on health. Relevant projects include extending an existing long-running study of hospital-based self-harm and mental health that examines factors such as unemployment, alcohol consumption and social media. What with particular focus on the impact of COVID-19. The model will support the forecast of current and future disease burden and understanding of population-level distress, wellbeing and planning.

They have also initiated an investigation of the impact of COVID-19 on community access to primary and community care with analysis of chronic illness, psychosocial outcomes, self-harm, alcohol related harms, mental health, injury/accidents and domestic violence. The project builds on a long running partnership and study with Went West Primary Health Network.

They are also looking at a simulation of human factors in viral spread including social networks and drivers of contact (e.g. fear, social contagion) in collaboration with Boston University and Virginia Modelling, Analysis and Simulation Centre (Old Dominion University). A US focused model is to be adapted for the Australian context and consider data collection from sources such as GPS inputs and social media feeds

Vulnerable groups and cultural and social issues

Western Sydney University's Young and Resilient Research Centre (Y&R) has a particular focus on the impact of communication technologies amongst young people; the Institute for Culture and Society (ICS) works across disciplinary boundaries on questions of cultural and social change and is the largest dedicated research concentration of its kind in Australia.[40]

The Y&R and ICS are collaborating with THRI on specific projects to bring together epidemiological and sociological approaches to understand the impacts of adolescent and adult engagement with social media as a source of health information. The groups are able to provide live tracking of engagement patterns for immediate translation to public health communications and wider response strategies to COVID-19.

39 https://arxiv.org/pdf/2003.10218.pdf
40 https://www.westernsydney.edu.au/ics

With **Western Sydney University's** Transforming early Education and Child Health (TEACH) Research Centre, the CRMDS, Y&R and ICS are able to undertake rapid analysis and longitudinal studies of the impact of the pandemic on vulnerable groups such as young children and their families, adolescents and young people, ageing, culturally and linguistically diverse (CaLD) communities, disabled communities, and low-income households.

Well-established partnerships with key agencies and community groups are fundamental to **Western Sydney University's** capability in these fields and ensure work is meaningful and impactful in mitigating the risks of social disadvantage and inequality caused by the virus.

Some of these projects include working with community housing, public housing and private rental sectors to understand the impacts of the crisis on vulnerable low-income households . This has already been recognised by the NSW Parliament and considered by the National Cabinet.

The team is also working with partners including local health districts to develop culturally appropriate resources for CaLD communities to study the impact of changes to allied health service delivery on CaLD communities, develop social technologies that minimise stress and reduce isolation for aged,particularly those living with dementia, and develop educational material and resources for families of those with an intellectual disability, many of whom are less experienced in dealing with the challenges of disease control.

How to communicate prevention with communities at risk

Researchers from the **University of Sydney's** Schools of Medical Sciences and Public Health have teamed up to study community awareness, perceptions and behaviour about COVID-19, its prevention and management. The objective of the research is to inform how to best communicate to the community about risk.

Researchers from the **Westmead Institute for Medical Research** and the **University of Sydney's** School of Public Health are undertaking related research into optimal communication strategies for different occupational groups and members of the public regarding appropriate infection prevention and control responses.[41]

The **University of Sydney Business School** is also undertaking research into the Role of Social Media in Individual and Collective Decision Making in relation to pandemics.[42]

The Sydney Social Sciences and Humanities Advanced Research Centre at the **University of Sydney** is studying the role of bad information and flawed cognition in the spread of COVID-19. The project aims to discover what kinds of (dis) information spread on English and Mandarin language online outlets re: COVID-19, and are there differences? Is it possible to 'inoculate' people against bad information?[43]

41 https://www.apprise.org.au/project/fast-tracked-new-covid-19-projects-meet-areas-of-urgent-need/
42 Ibid
43 Ibid

New South Wales

Indigenous groups – culturally appropriate messaging

The **George Institute's** Aboriginal and Torres Strait Islander Health Program team is working with communities and Aboriginal health organisations around culturally appropriate COVID-19 messaging and crisis response.

Impact on wellbeing, here and overseas

Researchers from the **University of Wollongong School of Psychology** are undertaking a study into the impact of COVID-19 on the wellbeing of Australians. The online survey collects anonymous information on demographic characteristics, personality aspects, mental health and attitude towards COVID-19.[44]

The study is part of a broader international project looking at the impact of COVID-19 on the wellbeing of people throughout the world in collaboration with universities in Brazil, United States, Italy, China, Taiwan, Saudi Arabia and the United Kingdom.

The project aims to investigate the associations between personality aspects and behaviour in the face of measures to contain COVID-19 and how different personality profiles tolerate the restrictions associated with the containment measures.

Virus-free air

Ensuring virus-free air is a critical component of prevention for infectious outbreaks, especially in populated spaces such as schools, childcare facilities and hospitals.

Reducing COVID-19 in air flow and on surfaces

A team from the **University of Sydney's** School of Chemical and Biomolecular Engineering has developed plasma technology that has the potential to inactivate COVID-19 in air flows or on surfaces. The technology could be integrated into air ducts or as stand-alone room treatment unit technology. No chemicals, gases or dielectric materials are needed for our design and the energy used is low.[45]

Another team from the same school has developed a catalytic filter to accumulate and kill coronavirus immediately. The filter can be used in ventilators or air-purifiers in the office, apartments, hotels, hospitals and airports; it can also be used in a reusable face mask.[46]

44 https://uow.au1.qualtrics.com/jfe/form/SV_0TBaF767oSQWZw1
45 https://www.sydney.edu.au/engineering/about/our-people/academic-staff/patrick-cullen.html#collapseprofilere-searchinterest
46 https://www.sydney.edu.au/engineering/about/our-people/academic-staff/jun-huang.html


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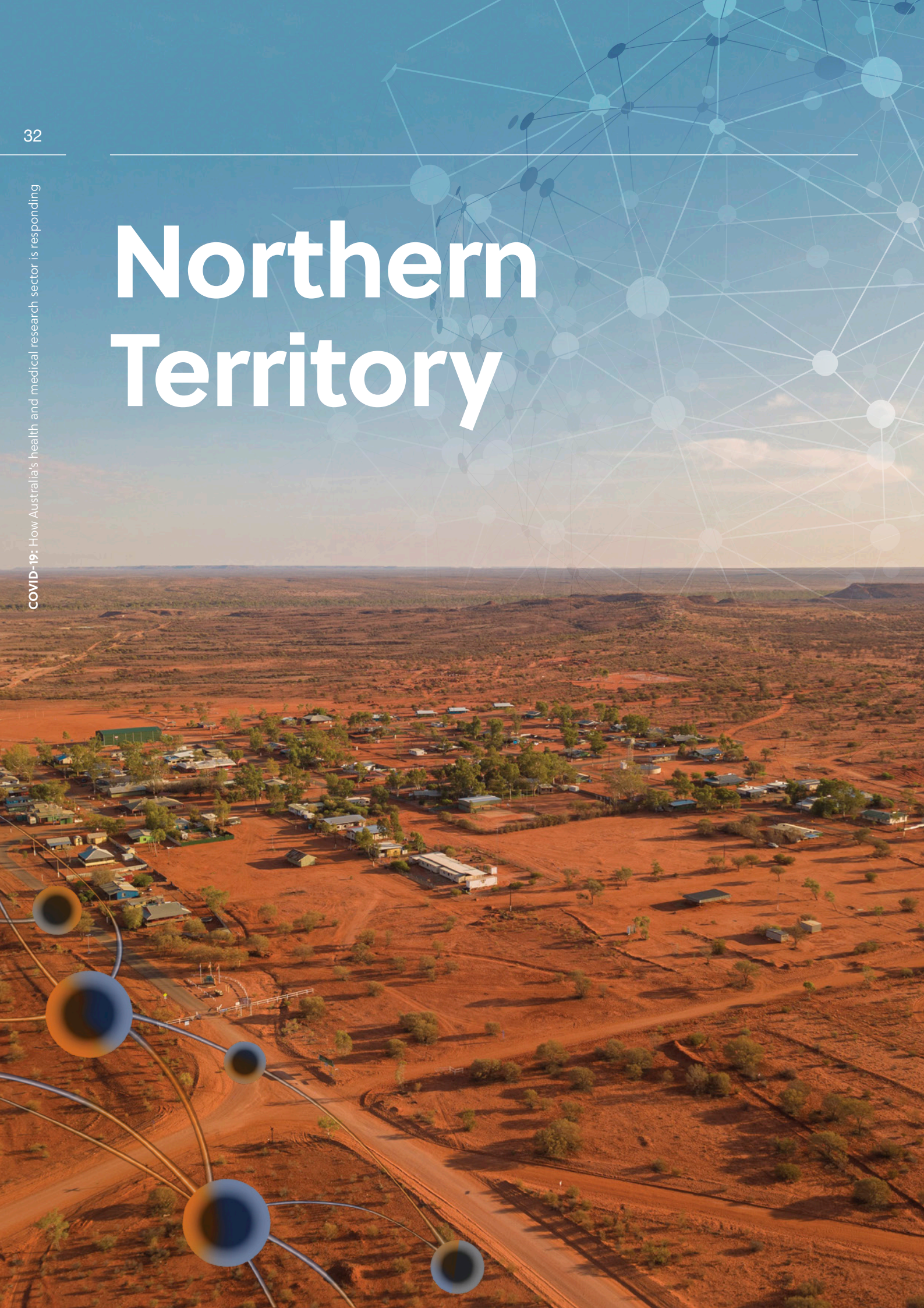
Northern Territory



Australia's Northern Territory has Australia's smallest population. It is also closely connected to Australia's northern neighbours.

Charles Darwin University is based in Darwin at the heart of Australia's tropical north. It is the Australian university located closest to the Asia-Pacific region and has close ties to many of the countries to Australia's north.[47]

The **Menzies School of Health Research** is dedicated to improving the health and wellbeing of Indigenous Australians, and is a leader in global and tropical research into life-threatening illnesses. Its work spans central and northern Australia, and developing countries within Australia's region.[48]

HEALTH SYSTEM AND WORKFORCE

3D printing new copper door handles

Charles Darwin University has partnered with technology developer SPEE3D to use 3D printing technology to coat door handles with copper in high traffic areas as a possible solution to help reduce the viability of viruses such as COVID-19.

Studies have shown that copper is an effective antimicrobial material. The process, known as ACTIVAT3D copper, has been developed by modifying SPEE3D's 3D printing technology, using new algorithms for controlling their metal printers to allow existing metal parts to be coated with copper.

SPEE3D worked in collaboration with the Advanced Manufacturing Alliance (AMA) at CDU to conduct the initial trial to coat a touch plate and door handle on its Casuarina campus in Darwin, Australia. The SPEE3D team developed a process to coat a stainless-steel door touch plate and other handles in just 5 minutes.[49]

COMMUNITY

Advising the Northern Territory, Queensland and Timor Leste

The **Menzies School of Health Research** is supporting the Northern Territory, Queensland and Timor-Leste governments in their responses to COVID-19. This includes providing high-level strategic advice, training, enhancing testing and guidance on infection control and patient care.

The school is also looking at how it can better support and inform indigenous communities about the risks of COVID-19. This has included developing COVID-19 health messages in Aboriginal languages and other targeted resources for people with chronic conditions.[50]

47 https://www.cdu.edu.au/about-cdu
48 https://www.menzies.edu.au
49 https://www.cdu.edu.au/news/engineering-solution-help-fight-covid-19
50 https://www.menzies.edu.au/page/Research/COVID-19/

Queensland

Queensland is Australia's third most populous state and has a long history of health and medical research. It is home to some of Australia's leading health and medical researchers and institutions.

Established in 1989, **Bond University** is Australia's first private not-for-profit university and is located at Robina, on the Gold Coast.[51]

James Cook University's research strengths reflect its Northern Queensland location, with a focus on the tropical environment and disease.[52] It is the home of the Australian Institute of Tropical Health and Medicine.[53]

Established over 40 years ago, and the first and largest university on the Gold Coast, **Griffith University** is a comprehensive, research-intensive and industry focused university. Its teaching and research spans six campuses in South East Queensland and all disciplines.

Mater Research Institute is part of a collaborative research institute with The University of Queensland and works across Mater's hospitals and health services, The University of Queensland and the Translational Research Institute.[54]

Established 75 years ago by the Queensland Government, **QIMR Berghofer** is focused on improving health by developing new diagnostics, better treatments and prevention strategies, specifically in the areas of cancer, infectious diseases, mental health and complex disorders. Working in close collaboration with clinicians and other research institutes, QIMR Berghofer is home to more than 600 scientists, students and support staff.[55]

Queensland University of Technology (QUT) is a major Australian university with a global outlook and a real-world focus. It characterises itself as 'a university for the real world' because of its close links with industry and its industry relevant teaching and applied research.[56]

Founded in 1909, The **University of Queensland** (UQ) is one of Australia's leading research and teaching institutions. [57]

The **Translational Research Institute (TRI) combines clinical and translational research to** advance progress from laboratory discovery to application in the community. The TRI's founding partners are The University of Queensland, Queensland University of Technology, Mater Medical Research Institute and Queensland Health.[58]

51 https://bond.edu.au/about-bond
52 https://www.jcu.edu.au/about-jcu/about-jcu
53 https://www.aithm.jcu.edu.au
54 https://www.materresearch.org.au/About-us
55 https://www.qimrberghofer.edu.au/about-us/
56 https://www.qut.edu.au/about/our-university
57 https://www.uq.edu.au/about/university-profile
58 https://www.tri.edu.au/about

Queensland

UNDERSTANDING THE CORONAVIRUS SARS-COV-2

Children and COVID-19

While we know that children have a much milder experience of COVID-19 there are significant remaining questions around how readily children are infected and **whether children are a source of infection** for other children and adults, i.e. are they 'spreaders of COVID-19. This question, which has implications for a range of government policies, particularly in relation to schools and childcare, is being investigated by the **University of Queensland.**

Patients with diabetes and susceptibility and long-term immunity

In conjunction with Mater Medical Research at the **Translational Research Institute,** the **University of Queensland** is recruiting patients with and without diabetes who have been infected to determine whether all patients with diabetes are susceptible to severe COVID-19 or if there is a subset that is particularly susceptible. Researchers will also be investigating the patients' long-term immunity to the virus and determining if this wanes faster in patients with diabetes.

Viral spread and airflow

QUT's International Laboratory for Air Quality and Health (ILAQH) is a WHO Collaborating Centre on Air Quality and Health.[59] It is investigating the airborne route of COVID-19 infection, and drawing on previous research on the SARS 1 pandemic. The research suggest the strong possibility that the COVID-19 virus could spread through airflow, with implications for the ventilation of indoor public places to remove the virus carrying particles to the outside and limit or stop air recirculation within buildings.[60]

VACCINE DEVELOPMENT

Molecular clamp for developing a vaccine

The **University of Queensland** was tasked by the Coalition for Epidemic Preparedness Innovation (CEPI) to use its vaccine technology to develop a coronavirus vaccine, and has collaborated with the **Doherty Institute** to demonstrate and understand its immune response. The key to the rapid development of this potential vaccine, which could be available in as little as 12 months, is UQ's 'molecular clamp' technology.

Results to date indicate that the vaccine candidate works as expected, with independent testing by the Doherty Institute finding high levels of antibodies capable of neutralising infection by the live virus in cell culture. Viroclinics Xplore is undertaking further testing of the vaccine in multiple animal models.

59 https://research.qut.edu.au/qutcds/staff/lidia-morawska/
60 https://www.qut.edu.au/institute-of-health-and-biomedical-innovation/about/news/news?news-id=161312

Enhancing the immune response from a vaccine

The group recently announced a collaboration with Cytiva to enable key manufacturing activities and discussions are ongoing with other commercial entities. Other partners include Lonza, Thermo Fisher Scientific, Syneos Health and the **CSIRO** and the team has also been given access to key adjuvant technology (adjuvants enhance the immune response to the vaccine) from **CSL**/Seqirus, Dynavax and **GSK**.[61] **GSK** is collaborating with CEPI to make adjuvant technology available to support rapid development of candidate vaccines, and have engaged with the **University of Queensland** through this partnership.[62]

The **University of Queensland** has received funding for its vaccine research from the Queensland and Commonwealth Governments, the Ramsay Foundation and the **BUPA Health Foundation.**

THERAPIES

Repurposing HIV and malaria medication

University of Queensland researchers are participating in the national ASCOT clinical trial involving hospitals across Australia and New Zealand to determine the best way to repurpose two existing drugs – a HIV medication and an anti-malaria drug.

The clinical trial follows from the medications being given to some of the first patients in Australia infected with COVID-19, who have all completely recovered without any trace of the virus left in their system. Most people with COVID-19 do eventually recover, so a large-scale clinical trial is required to determine whether the treatment would be effective.

A team of international researchers led by ShanghaiTech University and including **University of Queensland** researchers has tested over 10,000 approved drugs, drug candidates in clinical trials and other compounds as potential leads for fighting COVID-19. The research involved a program of high-throughput drug screening, both in laboratories and using computer software to predict how different drugs bind to the virus.

The main COVID-19 virus enzyme, Mpro, was targeted as it plays a pivotal role in viral replication and transcription – but as humans don't carry this enzyme, drugs that target Mpro are likely to have low toxicity for people. Researchers identified six drugs that appear to effectively inhibit the enzyme, with one drug of particular interest. They have made results of the study available for researchers across the world.

61 https://www.uq.edu.au/news/article/2020/04/uq-covid-19-vaccine-shown-induce-potent-protective-response-pre-clinical-trials

62 https://www.gsk.com/en-gb/media/resource-centre/our-contribution-to-the-fight-against-2019-ncov/

Queensland

Treating antibodies over-reacting to the virus

For many infections a phenomenon called Antibody Dependent Enhancement (ADE) can enhance the severity of the disease rather than protect against the infection. Preliminary evidence reveals that patients with severe COVID-19 infections may have ADE leading to lung damage, resulting in the need for intensive care, and causing significant damage.

University of Queensland investigators have successfully treated bacterial infections in patients displaying ADE by removing plasma from a patient's blood and filtering it to remove antibodies, before returning it back into the body. In addition, the patients are treated with intravenous immunoglobulin (concentrated antibodies from healthy people), which suppresses the inflammatory response and protects against other infections.

Researchers will initiate a trial of this existing, safe and widely available intervention in COVID-19 patients at six different hospital sites in Australia. If successful, the treatment could be readily re-purposed to treat COVID-19.

Inhibiting cardiovascular and renal complications

University of Queensland researchers also plan to test specific enzymes for their ability to block SARS-CoV-2 from incubating in people, thus inhibiting the dangerous cardiovascular and renal complications associated with COVID-19. If the pre-clinical trial is successful, the research team has the necessary infrastructure and international collaborations to progress to a phase one clinical trial.

Multinational evaluation of heart-lung bypass support

Extracorporeal Membrane Oxygenation (ECMO) is a treatment that uses a pump to circulate blood through an artificial lung back into the bloodstream, providing heart-lung bypass support when the lungs are not functioning. The **University of Queensland** is collaborating on the ECMOCARD study; a multinational study of patients with COVID-19 in 230 participating hospitals and Intensive Care Units across 42 countries and 6 continents.

The study aims to identify clinical features, incidence of ICU admission, use of mechanical ventilation and ECMO, ECMO technical characteristics and duration, compilations and survival of patients with COVID-19. This study will help to evaluate whether ECMO is effective and for which patients.

'Plan B' with no vaccine

Researchers at **Bond University** are turning their attention to how we address COVID-19 if there is no vaccine, or a vaccine is years away. They have been looking at 'Plan B' and some of the research that is still required to establish how we can most effectively live with COVID-19 in the long term. They recently reviewed all the randomised controlled trials for physical interventions to interrupt the spread of respiratory viruses, including interventions such as masks, hand hygiene, eye protection, social distancing, quarantining, and any combination of these.[63]

Many of the trials were of low quality or small sample size, and for some types of interventions, there were no randomised trials. One advantage of non-drug interventions is they are likely to be useful in addressing future pandemics.

TESTING AND DIAGNOSTICS

Detecting biothreats and COVID-19

QUT's Molecular Microbial Pathogenesis Group is part of a collaborative project to develop a diagnostic platform for the rapid detection of biothreat agents under DMTC Ltd's National Medical Countermeasure Initiative.[64] DMTC was established in 2008 under the Australian Government's Defence Future Capability Technology Centre Program and has recently embarked on a number of activities including medical countermeasures.[65] Research partners include the Australian Government's Defence Science and Technology Group, **CSIRO** and Microbio Pty. Ltd. As a result of the COVID-19 pandemic, the project team has added SARS-CoV-2 to the list of pathogens under investigation.

63 https://www.medrxiv.org/content/10.1101/2020.03.30.20047217v2
64 https://research.qut.edu.au/infectionandimmunity/projects/molecular-microbial-pathogenesis-research/
65 https://dmtc.com.au/about/about-dmtc/

Queensland

HEALTH SYSTEM AND WORKFORCE

Using suncreen to evaluate handwashing

QUT's **Institute of Health and Biomedical Innovation** is adapting technology developed to monitor the application of sunscreens as a tool to evaluate individuals' handwashing techniques. The 'smart' handwashing station integrates a UV light and camera technology to provide a visual representation of how clean your hands are after washing. This could be used as a training and quality improvement tool in high-risk settings such as hospitals and aged care centres.[66]

Redesigning respiratory clinics

James Cook University infection control experts are working with Aspen Medical to redesign buildings and procedures for new GP-led respiratory clinics.[67] The clinics are being established by the Australian Government across Queensland in response to the COVID-19 pandemic. Separate from hospital-based 'fever clinics', the clinics are community-based and aim to take the pressure off hospitals and GP clinics, while ensuring treatment when a patient's symptoms may not be from COVID-19 but still indicate a different respiratory illness.

Infection prevention and clinic placement

The **James Cook University** team is reviewing places nominated as potential clinics in relation to infection prevention and control principles, and recommending the changes required to the physical environment. Once the Australian Government approves the clinic, the team returns and trains the staff on infection prevention and control processes, and does a final audit. The program is an Australian Government initiative through the Department of Health, and part of the National Health Plan Response to Coronavirus announced in March.

COMMUNITY

Impact on physical activity and health

University of Queensland researchers are participating in a multinational project investigating the effects of the measures taken to control COVID-19 on people's personal lives, with a special focus on physical activity and health. Participants are recruited via social media (Facebook, Twitter etc.) and specialist societies in the respective countries to complete an anonymous, online questionnaire.

Sources of pandemic information

A **James Cook University** researcher is investigating what people know about the COVID-19 virus and where they get their information from in order to be better prepared for the recovery phase – and the next pandemic.[68]

66 https://www.qut.edu.au/institute-of-health-and-biomedical-innovation/about/news/news?news-id=161049
67 https://www.jcu.edu.au/news/releases/2020/april/jcu-specialists-work-on-new-coronavirus-clinics
68 https://www.miragenews.com/community-help-wanted-for-covid-study/

While there has been extensive advice provided to the Australian community regarding transmission, symptoms, minimising personal risk and strategies of social distancing, for many people there is still a level of confusion or uncertainty.

The purpose of the survey is to identify any problems with the information people have been provided. This information can then be used to develop recommendations to help governments and individual Australians better prepare, manage and respond to the recovery phase and to future pandemics.

Impact on people vulnerable to the virus

The Hopkins Centre at **Griffith University** focuses on disability and rehabilitation, and is undertaking a range of research projects on the impact of COVID-19 on people who are particularly vulnerable to the illness itself, and also to the longer-term community impacts.[69]

The Dignity Project utilises a platform for gathering consumer opinion and experiences about COVID (and other crisis) preparedness.[70] The Centre is collecting COVID-related information through this platform in the next few weeks. The Centre's Ambassadors (citizen researchers with a disability) are preparing statements about a range of topics that impact on them, including ethical decision-making, social networking and technology to support services in the home.

The Centre's HablTec Lab is also central to issues of delivering rehabilitation in the home through innovative technology, which is increasingly relevant in an environment in which people who are especially vulnerable to infection are being encouraged to self isolate.[71]

Re-using successful hygene education

Researchers at the **QIMR Berghofer** have a long and successful experience with developing and implementing hygiene education measures as effective public health preventive intervention. *'The Magic Glasses'* is a cheap, successful and engaging cartoon-based hygiene education package for schoolchildren that has been rigorously tested and deployed with considerable success across Asia.[72]

Originally developed for combating intestinal parasitic worms, it can be readily adapted for COVID-19 as an effective public health preventive intervention due to the similarity in hygiene messages – notably hand washing. The essential need for social distancing will also be powerfully emphasised.

Working with collaborators at the **Australian National University**, the aim is to produce an 8-minute Magic Glasses video targeting the coronavirus and implement it via YouTube and other social media platforms and/or across the school system in Australia and further afield.

69 https://www.hopkinscentre.edu.au/about-us
70 https://www.hopkinscentre.edu.au/project/the-dignity-project-26
71 https://www.hopkinscentre.edu.au/project/habitec-the-sociotechnical-space-81
72 https://www.qimrberghofer.edu.au/magic-glasses/

South Australia

South Australia has a long history of health and medical research. The South Australian Government has invested heavily in the last decade in establishing the Adelaide BioMed City (ABMC), one of the largest health and life sciences precincts in the Southern Hemisphere.[73]

Flinders University was established in 1966 and its main campus is located in Adelaide's Bedford park, adjacent to Flinders medical Centre.[74]

The **University of Adelaide** was established in 1874 and is the third oldest Australian university.[75] The Robinson Research Institute at the University of Adelaide is a collective of internationally renowned researchers in human reproduction, pregnancy and child health who focus on the early stages of life to improve the health and well-being of children and families.[76]

The **University of South Australia** is the State's largest university. Established in 1991 it has its origins in technical and teacher training colleges.[77]

UNDERSTANDING THE CORONAVIRUS SARS-COV-2

Biobank to examine immune memory

The **University of Adelaide's** Robinson Institute is establishing the COVID-SA biobank to map the immune response to COVID-19 enabling an in depth study of adults, pregnant mothers and children at risk from or with COVID-19.

Specifically, the Institute aims to establish evidence of altered immune cell subsets and immune profiles for different stages of infection and recovery, and for asymptomatic carriers. A longitudinal biobank across the disease profile will enable an analysis of the formation of protective immunological memory, and if antibody producing B cell populations are formed, these may provide insights into an antibody mediated therapy for COVID-19.

The risk of poor outcomes from COVID-19 in the vulnerable young

Young children infected with COVID-19 are more at risk of serious illness than older children. The effects of COVID-19 on vulnerable ventilated newborns, children and young adults with COVID-19 who require intensive care is unknown. A better understanding is essential to help clinicians treat the COVID-19 infection, predict the risk of poor outcome, and mitigate the likely long-term impact on respiratory function.

The **University of Adelaide's** Robinson Institute's proposed study will investigate the immune response in the lung and bloodstream, and relate this to clinical parameters of illness severity, in order to discriminate the risk of poor outcome in sick newborns, children and young adults with a COVID-19 infection. The work will yield important insights into disease pathogenesis, informing future clinical management and potentially future development of therapeutic interventions.

73 https://adelaidebiomedcity.com
74 https://www.flinders.edu.au/about
75 https://www.adelaide.edu.au/about/
76 https://www.adelaide.edu.au/robinson-research-institute/about/
77 https://www.unisa.edu.au/about-unisa/Our-History/#event-thesouth-australian-school-of-art-was-established-by-charles-hill

South Australia

VACCINE DEVELOPMENT

Using cloud technology to accelerate vaccine development

A team at **Flinders University** is collaborating with **University of Sydney** and US company, Oracle Cloud technology, to test a vaccine candidate against the SARS-CoV-2 coronavirus. The vaccine candidate has been developed rapidly, using previous experience in developing a SARS coronavirus vaccine, and the genomic sequence of the COVID -19 virus made available by the Doherty Institute in January. Oracle's Cloud technology enabled the team to "dramatically speed up our ability to analyse the COVID-19 virus and use this information to design the vaccine candidate."[78]

THERAPIES

Rapid development of a local low cost ventilator

The Cystic Fibrosis Airway Research Group (CFARG) led by the **University of Adelaide** is working with 4Dx, the SA Health and Medical research Institute and the Women's and Children's Health Network to rapidly develop and test a ventilator for use in the COVID-19 pandemic. The control software of this ventilator unit is simple but highly configurable, and it has been thoroughly tested "in the field".

It can also be built from readily available food-grade parts at low cost and in high volumes, using local manufacturing and Australian supply chains that are not dependent on currently unreliable international supply and shipping systems. The project vision is to make the ventilators available in Australia as well as overseas, particularly in developing countries where ventilators are often not available and the impact of COVID-19 is likely to be severe.

TESTING AND DIAGNOSTICS

Non-invasive detection of respiratory distress

The **University of Adelaide's** Institute for Photonics and Advanced Sensing has an existing project with a technology to rapidly detect signs of respiratory distress in a non-invasive way that could be conducted in public. This may have potential in assisting to identifying COVID-19 patients.[79]

HEALTH SYSTEM AND WORKFORCE

Mask testing facility

The **University of South Australia** and **Flinders University** are collaborating on development of a mask testing facility for surgical and particulate (e.g. N95 equivalent) masks, supporting local manufacture.

Infection in young people and the spread

Identifying people with asymptomatic or mild infection who may be transmitters of the SARS-CoV-2 virus is of critical importance to control of disease in the broader community. Young people represent a minority of cases, but it is unknown if they have milder infections which contribute to virus spread in the community.

A research collaboration between the **University of Adelaide's** Robinson Institute, the **University of Western Australia** and **University of Sydney** aims to determine the frequency of infection in symptomatic and asymptomatic children and young people in metropolitan and regional communities and to determine whether mild or asymptomatic infection with SARS-CoV-2 is associated with presence of SARS-CoV-2 antibodies.

78 https://www.sciencedaily.com/releases/2020/04/200403103944.htm
79 https://www.adelaide.edu.au/ipas/

This study will provide vital information that will be critical in future endeavours to control SARS-CoV-2, including prioritising of public health strategies such as school closures and re-openings, and development of targeted vaccine strategies, including age groups for vaccination for control of SARS-CoV-2 infection.

Finding early interventions for vulnerable people with the COVID-19

Reducing the number of hospitalisations due to COVID-19 will decrease the burden on the health care system. Identifying people who are vulnerable to being hospitalised with COVID-19 and treating them with drugs that can reduce the severity of symptoms so they don't require hospitalisation could be a useful strategy.

The Robinson Institute is proposing to use epidemiology to identify vulnerable populations and the potential biological pathways of COVID-19. Approved therapeutics and antiviral drugs that target those pathways will be identified. High-risk groups can be recruited for testing and early interventions.

Impacts of the virus on pregnant women

Exposure to infectious diseases during pregnancy can have life-long effects on the health of the foetus due to foetal inflammatory injury and immune system development during this critical window. The scientific literature shows in countries with a high burden of infectious diseases there are life-long effects due to developmental programming effects that impact the health of the population.

Currently, there is little information about the short-term and long-term effects of COVID-19 on pregnant women and outcomes for their infants. The Robinson Institute is investigating how the effects of this global burden of COVID-19 on future generations could be assessed for the future public health effects.

COMMUNITY

Resources for veterans

The **University of South Australia's** Quality Use of Medicines and Pharmacy Research Centre is the provider of Veterans' MATES, a resource funded by the Department of Veterans' Affairs to improve the use of medicines and health care service by Australian veterans. It has produced specific resources to support the health of veterans during the COVID-19 pandemic.[80]

80 https://www.veteransmates.net.au/topic-59

Tasmania

Tasmania's population is, on average, older than other Australian states and territories, making it particularly vulnerable to COVID-19.

Founded in 1890, the **University of Tasmania** is the fourth oldest university in Australia. Its research focus reflects its place as the southernmost university in Australia, with research institutes like the Australian Maritime College (AMC), and the Institute for Marine and Antarctic Studies. The Menzies Institute for Medical Research performs internationally significant medical research leading to healthier, longer and better lives for Tasmanians.

UNDERSTANDING THE CORONAVIRUS SARS-COV-2

Whether smokers are more vulnerable to the virus

Identifying those susceptible to COVID-19 as well as those who are capable of asymptomatic transmission are important goals for managing the disease at a community level. Does smoking or vaping make people more susceptible to COVID-19? Researchers at the University of Tasmania are investigating whether the existence of more adhesion sites in the lungs of smokers and vapers could make them more vulnerable to COVID-19, and whether this can also increase the viral transmission within the community.

TESTING AND DIAGNOSTICS

Adapting explosive detection for rapid detection of COVID-19

A collaboration between the **University of Tasmania** and Greyscan aims to develop the chemistry needed to rapidly detect SARS-COV-2. Greyscan's existing technology, the world's first automated inorganic explosive trace detection device, is able to detect explosive traces and has anti-terrorist applications. This project aims to adapt the technology platform to the rapid detection of the SARS-COV-2 virus.[81]

HEALTH SYSTEM AND WORKFORCE

Tools for emergency clinicians

There is an urgent need to support Australian Emergency Department (ED) clinicians with real-time tools as the COVID-19 pandemic evolves. Monash University, and the University of Tasmania are working with the Emergency Departments of Tasmania's hospitals to provide flexible and responsive clinical tools to determine the predictors of key ED-relevant clinical outcomes.

The COVID-19 Emergency Department (COVED) Quality Improvement Project includes all adult patients presenting to the four participating EDs and meeting contemporary testing criteria for COVID-19. Outcomes measured include being COVID-19 positive and requiring intensive respiratory support. The dataset has been embedded in the Electronic Medical Record and the COVED Registry has been developed. Regression methodology will be used to generate clinical prediction tools. This project will support EDs during this pandemic.

81 https://greyscandetection.com

Tasmania

COMMUNITY

How the COVIDSafe app is being received

With the Australian Government's COVIDSafe app promoted as a major public health measure and one of the keys to relaxing restrictions on the Australian population, understanding how it is being received by Australians is critical.

A University of Tasmania research project seeking to understand how Tasmanians are experiencing and adjusting to life in the time of COVID-19 is finding old mobile phones and a lack of trust in government are the main reasons Tasmanian residents say they cannot or will not download the COVIDSafe app. Almost 25 per cent of 652 survey respondents say they will not download the app, while another 28 per cent are still unsure. Nearly 40 per cent say they have downloaded COVIDSafe.

While 38 per cent of those who say they will not download the app cite privacy reasons and lack of trust in how the Federal Government will use the data, 15 per cent say they cannot comply with the initiative because their phones are out of date, incompatible or have no space for the app. People in Tasmania also wanted more certainty and clarity about source codes and legislative protection.[82]

Health literacy in children

Communication has been a key component of how Australia has responded to COVID-19, and how people receive and respond to messages about COVID-19 is likely to be affected by their health literacy. A **University of Tasmania** project will examine children's health literacy in relation to the COVID-19 pandemic.

Health literacy in this project refers to how children access information (through their parents, on the internet, through TV or social media), understand information about COVID-19 and what their information needs and understandings are. Information will be collected from children aged 7-12 years old in Tasmania and their parents through a short online survey distributed through professional social media groups, personal and professional networks.

Impact on LGBTIQ communities

Previous research suggests that marginalised communities, including LGBTIQ people, are further impacted in disasters and public health emergencies. A project by researchers at the **University of Tasmania** aims to identify the key concerns of the Tasmanian LGBTIQ community during COVID-19 in order to inform local service providers' support for this group during the pandemic. To achieve this aim, the project will involve one online survey open to anyone over the age of 14 who identifies as LGBTIQ+ in Tasmania.

82 https://www.utas.edu.au/communications/general-news/all-news/covidsafe-uptake-in-tasmania-limited-by-out-of-date-phones,-privacy-concerns

Older people maintaining exercise at home

Self isolation and 'stay at home' restrictions could exacerbate falls and poor physical function in older people. The **University of Tasmania's** Menzies Institute for Medical Research has been involved in a national collaboration creating a new website to support older Australians to stay active, safely, at home.

The Safe Exercise at Home website shares simple functional exercises and gives ideas of safe ways for older people to increase activity levels while at home.[83] Accessible via desktop or mobile, the website provides information and instructional videos at three different levels of function and fitness, as well as tips on staying motivated and safe while exercising at home.

The Safe Exercise at Home website was developed by physiotherapists from across Australia with clinical and academic expertise. The collaboration includes the University of Tasmania, University of Sydney, University of Melbourne, Monash University, Curtin University, University of South Australia and University of Queensland in partnership with the National Ageing Research Institute, Sydney Local Health District (NSW), Western Health (VIC) and Peninsula Health (VIC). The website is endorsed by the Australian Physiotherapy Association.

83 https://www.safeexerciseathome.org.au

Victoria

Victoria is home to some of Australia's leading health and medical research in Australia's universities and medical research institutes. It is also home to some of the key facilities of CSL, Australia's largest pharmaceutical and blood products company, and the CSIRO. The Parkville Precinct, anchored around the Royal Melbourne hospital and the University of Melbourne, has become world recognised as the greatest geographic concentration of health and medical research in Australia and a key precinct globally.[84]

The **Burnet Institute** is an Australian medical research institute with a mission to deliver better health for vulnerable communities in Australia and internationally.[85]

The **Commonwealth Scientific and Industrial Research Organisation** (CSIRO) is Australia's national science research agency. Two of its key Victorian facilities, the biologics production facility in Clayton and the Australian Centre for Disease Preparedness at Geelong are engaged in the response to COVID-19.[86] [87]

Deakin University was established in 1974 and has multiple campuses across Victoria as well as overseas and has considerable expertise in health research.[88]

The **Doherty Institute** is a joint venture between the University of Melbourne and the Royal Melbourne Hospital.[89] It combines research, teaching, public health and reference laboratory services, diagnostic services and clinical care in infectious diseases and immunity. It is the home of several WHO regional reference laboratories for infectious diseases, including influenza and hepatitis.

La Trobe University was established in 1964 as the third university in Victoria. More than 2500 academics and graduate researchers at six campuses undertake research at La Trobe University across Victoria.[90]

Monash University is one of Australia's leading universities and ranks among the world's top 100. It is closely aligned with Melbourne's Alfred Hospital, Victoria's primary treatment site for COVID-19 patients.[91]

84 https://www.doherty.edu.au/uploads/content_doc/MBP-Brochure_WEB.pdf
85 https://www.burnet.edu.au/about/4_overview
86 https://www.csiro.au/en/Showcase/COVID-19-vaccine
87 https://www.csiro.au/en/Do-business/Services/Biology/Recombinant-protein-facility
88 https://www.deakin.edu.au/research
89 https://www.doherty.edu.au/about/overview
90 https://www.latrobe.edu.au/about/vision/research
91 https://www.monash.edu/research/latest-covid-19-research

Victoria

The **University of Melbourne** is the oldest university in Victoria and the second oldest in Australia. It has numerous institutes and centres of research engaged in work related to COVID-19[92]

The **Murdoch Children's Research Institute** (MCRI) is the largest child health research institute in Australia and one of the top three worldwide for research quality and impact. Many of its 1200 researchers are also clinicians at the Royal Children's Hospital in Melbourne, where the Institute is based.[93]

Swinburne University started as a technical college in 1909 before becoming a university in 1992. It has research strengths in astronomy; physics; engineering; materials science; computer science and information technology; design and innovation; health sciences; neurosciences; and mental health.[94]

The **Walter and Eliza Hall Institute for Medical Research** (WEHI) is one of Australia's oldest and leading biomedical research organisations, with a national and international reputation for performing highly influential basic and translational research.[95]

UNDERSTANDING THE CORONAVIRUS SARS-COV-2

First to grow the virus

The **Doherty Institute** was the first laboratory outside China to grow the virus and shared it internationally with other laboratories to support the global research effort.[96]

Mapping the genetic changes to the virus

COVID-19 mutates about the same rate as the flu. Researchers at the **University of Melbourne's Department of Biochemistry and Molecular Biology** have previously developed a platform for rapidly characterising the consequences of mutations on patient treatment and management.

They are applying this to map the genetic changes being observed in COVID-19 around the world, and in particular what the potential consequences of these might be for ongoing drug and vaccine development. Using these insights, they are helping to design new drugs and vaccines that will be less likely for COVID-19 to develop resistance against.

Whether neurons are infected by COVID-19

Patients with COVID-19 have described loss of taste and smell as symptoms of disease. This may reflect infection of neurons found at the interface of the nasal passage and brain. There is evidence that the receptor for the COVID-19 coronavirus is expressed in the brain and therefore that neurons may be a susceptible to infection.

Infection of neurons in the brain may complicate treatment of COVID-19 and explain symptoms of disease including headache, vomiting, nausea and respiratory distress. Researchers at the **University of Melbourne's** Department of Microbiology and Immunology and the **Doherty Institute** are working to determine whether neurons can be infected with coronavirus.

92 https://about.unimelb.edu.au/leadership/vice-chancellor
93 https://www.mcri.edu.au/about
94 http://www.swinburne.edu.au/media/swinburneeduau/about-swinburne/docs/pdfs/swin-annual-report-2018.pdf
95 https://www.wehi.edu.au/about
96 https://www.doherty.edu.au/news-events/news/coronavirus

Mathematical modelling to assist government decision-making

The **University of Melbourne's** Melbourne School of Population and Global Health and the Department of Mathematics and Statistics have been working together to use mathematical modelling to develop scenarios that assist governments' decision making around the response to COVID-19. This is no accidental pairing- the Department has a focus on mathematical and computational biology and the School of Population and Global Health has a Modelling and Simulation Unit, funded by the NHMRC, in the Centre for Epidemiology and Biostatistics.[97]

Profiling immune responses to assist diagnosis and immunotherapies

The **Burnet Institute** is developing monoclonal antibodies that are essential for profiling the immune response in humans and animals after infection with COVID-19. These have the potential to be applied to aid in the development of novel point-of-care diagnostics and are also potential immunotherapies.

Providing key advice to government

The **Burnet's** Director and CEO, Professor Brendan Crabb AC, and other senior staff are involved in multiple COVID-19 responses committees, such as the National Advisory Committee on COVID-19, and are providing strategic advice to the Chief Medical Officer, state Chief Health Officers and Departments of Health.

Burnet is working directly with the Australian Department of Health to collate and provide rapid, data-driven technical briefs and policy options to Federal and state Chief Medical Officers across a broad range of key policy, public health and clinical responses. **Burnet** staff have also been seconded to the Victorian Department of Health and Human Services, providing an additional layer of expertise to support the Victorian response.

The NHMRC has funded the Australian Partnership for Preparedness Research on Infectious Disease Emergencies (APPRISE) since 2016 as a Centre of Research Excellence to develop research and evidence to inform Australia's capacity to prepare, respond and recover from infectious diseases.

APPRISE coordinates multidisciplinary research teams and key stakeholders to provide a national focus and international links for infectious disease research and has played a leading role in Australia's response to COVID-19.[98] Researchers from the **University of Melbourne** and the **Doherty Institute** are providing epidemiological advice, disease modelling and/or information sharing on key international working groups and national committees.

Modelling for risk assessments and preparedness in the Asia-Pacific region

Looking to assist our regional neighbours, the Australian Government Department of Foreign Affairs and Trade has requested technical advice from a consortium led by the **University of Melbourne.** Drawing on an established track record of research to support pandemic preparedness, the advice will comprise mathematical and computational modelling to support risk assessment and preparedness planning for COVID-19 in focus countries in the South-East Asian and Western Pacific Regions.

Studying individuals and families with COVID-19

There is much to learn about COVID-19 from studying individuals with COVID-19 and their families. Studies are being undertaken in Australia based on the World Health Organisation's FFX (First Few X) FFX protocol, involving a partnership between the Australian Government Department of Health's Office of Health Protection, State and Territory Public Health Units, University of Melbourne, the Doherty Institute, APPRISE CRE and Australian National University.

97 https://mspgh.unimelb.edu.au/research-groups/centre-for-epidemiology-and-biostatistics-research/modelling-and-simulation

98 https://www.apprise.org.au/what-we-do/

Victoria

Working through the state/territory public health units, confirmed COVID-19 cases and their household contacts will be interviewed to provide enhanced data on their household structure, disease symptoms and relevant medical history. Viral swabs will be taken at regular intervals from household contacts to detect asymptomatic, pre-symptomatic and early cases of COVID-19 transmission.

Additional research components of the FFX study will include genomic analysis of viral sequences from the viral swabs to help understand viral diversity and transmission patterns within the Australian context.

Blood samples collected from household contacts at the end of their self-isolation period will enable serological analysis. This will increase understanding of the spectrum of disease severity, including risk factors, and allow estimation of infectiousness. This information can be used to guide overall strategic objectives and help determine the most efficient and effective targeted public health response actions.

VACCINE DEVELOPMENT

The **CSIRO** is involved in key research in the rapid global response to the novel coronavirus outbreak with its Australian Centre for Disease Preparedness (ACDP) at Geelong playing a key role in testing of potential vaccines. The ACDP has extensive very secure laboratories, including animal facilities, able to undertake research on high-risk pathogens.

Following successfully growing the virus in the containment labs at ACDP, **CSIRO** researchers undertook susceptibility studies in ferrets in order to generate a reliable animal model in which to test vaccines.

In consultation with the World Health Organisation, vaccine candidates from the University of Oxford and Inovio Pharmaceuticals were identified to undergo the first pre-clinical trials at **CSIRO**, which are being undertaken at ACDP.[99]

99 https://www.csiro.au/en/Research/Health/Infectious-diseases-coronavirus/Our-response/Understanding-the-virus

Researchers at ACDP also continue to investigate the physical and molecular characteristics of this virus and also the nature of the immune response in their animal model.

Australian vaccine candidate scaled up for clinical trails

Meanwhile, at the Biologics production facility at Clayton, **CSIRO** scientists have begun to produce and scale-up the **University of Queensland's** vaccine candidate for COVID-19, which is a specially designed protein. Initially focused on a medium-scale (20 litres) production of COVID-19 vaccine candidate for toxicology studies and testing by the **University of Queensland**, they are concurrently scaling up the vaccine candidate to 50 litres, which will be more than enough for phase-I clinical trials and the associated testing.[100]

Antibody assays

Burnet Institute staff are developing antibody assays that have multiple uses for vaccine development including understanding how antibodies develop and their specificity in natural COVID-19 infection – this is an essential component to developing vaccines that stimulate a safe, protective immune response, pre-clinical evaluation of potential vaccines and evaluation of the antibody responses in human clinical trials of vaccines

THERAPIES

Repurposing existing drugs

Researchers at the **Doherty Institute** and the Royal Melbourne Hospital in Australia have launched the Australasian COVID-19 trial (ASCOT) to study two existing drugs for treating coronavirus.

The trial is designed to assess the safety and effectiveness of lopinavir/ritonavir and hydroxychloroquine at more than 70 hospitals across the country and 11 in New Zealand.

In laboratory tests, HIV medication lopinavir/ritonavir, and malaria drug hydroxychloroquine demonstrated the ability to stop SARS-CoV-2, the novel coronavirus that causes Covid-19.

The ASCOT study will evaluate the ability of these drugs to prevent disease progression to the point where patients would require a ventilator in the intensive care unit.[101] **AbbVie** is providing medicines to the national stockpile to support this trial.

High-throughput screening of drugs

The National Drug Discovery Centre (NDCC) is a collaborative facility at the **Walter and Eliza Hall Institute** (WEHI) funded by the Victorian and Australian Government, philanthropy and the Institute's own investment. The NDDC enables researchers to accelerate the discovery and development of new medicines.

WEHI has identified two proteases (a type of enzyme) in the SARS-CoV-2 virus and will use the high-throughput screening facility and expertise at the NDDC to identify drugs that that target and inhibit these proteases. This will accelerate the development of new medicines for COVID-19 and other coronaviruses.[102]

100 https://www.csiro.au/en/Research/Health/Infectious-diseases-coronavirus/Our-response/Manufacturing-a-vaccine
101 https://www.apprise.org.au/the-covid-19-treatment-trials-that-learn-as-they-go/
102 https://www.wehi.edu.au/research-diseases/immune-health-and-infection/coronavirus

Victoria

Screening existing antivirals

The **Doherty Institute** and **CSIRO's** Australian Centre for Disease Preparedness (ACDP) have established a joint process for screening existing antiviral drugs, compounds and antiseptics to establish their antiviral activity against SARS-CoV-2.

Identifying antibodies to block the virus

Walter and Eliza Hall Institute (WEHI) is using its expertise in biologics to better understand the virus in order to develop new therapeutics from human antibodies. Biologics medicines mimic antibodies – proteins produced by immune cells – to fight infection and are already in clinical use for diseases such as cancer and autoimmune conditions.

WEHI is harnessing its infectious disease research capabilities and collaborate with other organisations, including **CSL**, to identify antibodies that can block coronavirus infection. These can be rapidly engineered to become suitable for clinical testing as a COVID-19 therapy. The antibody screens will also provide vital research tools for better understanding the biology of the virus causing COVID-19, an important step towards effectively fighting it and other coronaviruses of future global concern.

Platforms of medical research equipment to rapidly find drugs to treat COVID-19

The Bio21 Institute of the University of Melbourne is contributing its expertise in drug discovery and some of the biggest platforms of medical research equipment in Australia to rapidly find and develop drugs to treat COVID-19 in collaboration with its sister institute, the **Doherty Institute**, Bio21 Industry tenant SYNthesis, the **Walter and Eliza Hall Institute** (WEHI) and the **CSIRO**.

Using tuberculosis treatment to boost immunity

A large national clinical trial initiated by The **Murdoch Children's Research Institute** is testing whether the Bacille Calmette-Guerin (BCG) vaccine, which boosts humans' 'frontline' immunity, can protect healthcare workers exposed to SARS-CoV-2 from developing severe symptoms.[103]

Previous studies have shown that BCG reduces the viral load, and lessens their symptoms, when people are infected with respiratory viruses similar to SARS-CoV-2. BCG was originally developed against tuberculosis, and is still given to over 130 million babies annually for that purpose.

The BRACE trial has commenced vaccinating an eventual 4000 medical workers in hospitals across Australia, half of whom will be given the BCG vaccine. Sarah and Lachlan Murdoch have donated $700,000 to the trial, and other supporters include the Royal Children's Hospital Foundation and the Minderoo Foundation. National coordination of the trail involves Western Australia's **Telethon Kids Institute** and the South Australian Health and Medical Research Institute (SAHMRI).

The researchers hope to show that improving 'innate' immunity of frontline healthcare workers will provide crucial time to develop and importantly, validate, a specific anti-COVID-19 vaccine. The trial has now attracted Gates Foundation funding, enabling t to expand internationally.

103 https://www.mcri.edu.au/news/murdoch-children's-research-institute-trial-preventative-vaccine-covid-19-health-care-workers

Victoria

Novel antiviral drugs inhalation directly into the lungs

The **Burnet Institute** is working on novel drugs with antiviral action, such as ACE2 inhibitors, are being screened for their ability to prevent or to treat COVID-19 infection. The Burnet is examining if, how and why these drugs are effective against COVID-19 and then turning the best performing drug candidates into formulations that can be inhaled to deliver the drug directly to where the virus is in the lungs.

Trialing hydroxychloroquine on health workers

Walter and Eliza Hall Institute is collaborating with major hospitals across several states on the COVID SHIELD trial, which plans to invite the participation of doctors, nurses and other health workers who are at risk of acquiring infection from the virus that causes COVID-19.

Evidence is emerging that the drug hydroxychloroquine, used for more than 70 years to treat autoimmune conditions such as lupus, may have antiviral activity that could prevent COVID-19 in patients, but we need to test this more. Trial participants would be provided with hydroxychloroquine for four months to prevent COVID-19. The proposed trial would involve 2250 people, half of whom will be on the drug, and half on placebo.

Assessing whether experimental drugs reduce infection responses in airways

Infections of the lung with Coronaviruses like the one causing the COVID-19 can be so severe as to require patients in ICU to be placed on a ventilator. Many of these patients will recover but will have lung damage and scarring. Joint research by the **CSIRO** and the **University of Melbourne** is analysing the infection responses of the airway lining cells to assess whether established and experimental drugs can reduce the inflammation and scarring caused during the viral pneumonia.

Using plasma from recovered patients to treat current patients

CSL is partnering with some of its global competitors, including Japanese Group Takeda Pharmaceutical, on a potential treatment. This involves taking plasma from people who have recovered from COVID-19 and using it to develop a treatment that could help current patients.[104]

CSL has announced that its facility at Broadmeadows in Victoria will be one of the first in the world to start production of COVID-19 Immunoglobulin, which could be used to treat people seriously ill with complications caused by the virus, particularly those whose illness is progressing towards the need for ventilation.

People in the community who have recovered from COVID-19 infection and are able to donate plasma have the opportunity to contribute to the development of these treatments, each of which could provide a valuable addition to treating people who may have become infected with the virus.

An estimated 800 plasma donations are required to make sufficient COVID-19 Immunoglobulin to treat 50 to 100 people seriously ill with COVID-19 complications within the clinical trial. The product will be developed using plasma donations made in Australia by people who have recovered from COVID-19, in partnership with **Australian Red Cross** Lifeblood.

104 https://www.csl.com/news/2020/20200506-csl-behring-australia-commences-development-of-treatment-for-serious-cases-of-covid-19

Prevention molecule with a vaccine for immediate and long-term protection

Researchers at the **Doherty Institute** have shown that co-administration of a simple molecule (Pam2Cys), invented in their laboratory, with the influenza vaccine causes immediate and long-term protection against the virus which in turn reduces the likelihood of secondary invasive bacterial infection.

They have also shown that administration of the molecule alone affords immediate (short- lived) protection against respiratory viruses that is non-specific. Intra-nasal administration of the molecule with a vaccine provides immediate non-specific protection and elicits highly specific anti-viral antibody and potent cell mediated immunity. These findings have important implications in preventing viral and bacterial respiratory infections and could be relevant to COVID-19.

TESTING AND DIAGNOSTICS

Rapid diagnostic test

The current method to diagnose active COVID-19 infection is complex, slow and expensive.

Work is progressing at the **Burnet Institute** on the development of a rapid diagnostic test to help identify people who have been infected with COVID-19. This will enable rapid isolation of people with disease to prevent further transmission, improve our understanding of who is being infected particularly as many infections are mild or even asymptomatic, and keep frontline health workers and other emergency staff working through excluding COVID-19 infections in those continually exposed to the virus through caring for patients with COVID-19.

A team at **Monash University** also aims to develop a new diagnostic test for acute COVID-19 infection that uses a simpler and faster detection method of its genetic material than current tests. They will do this using a DNA amplification technology called loop mediated isothermal amplification (LAMP).

The simplicity of LAMP means that by combining with an electrochemical sensor, it can potentially be incorporated into a small, handheld, portable point of care test device, similar to a blood glucose test kit.

The research program aims to create a one-step LAMP-based assay for detecting DNA converted from the SARS-CoV-2 and then develop a device prototype able to perform COVID-19 diagnosis using nasal/throat swab. If successful, this device could then be adapted to test for other diseases, including future pandemics.[105]

Biomarkers to predict severity of disease progression

Monash University is also part of a global collaboration (Australia, Italy and the USA) using samples from local and Italian COVID-19 patients and healthy volunteers. The samples will be analysed at Monash University to examine if early biomarkers predict the difference between severe and moderate disease; and determine how the immune system responds within the first four weeks from exposure.[106]

This research has direct clinical applications to stratify and monitor patients and staff, including determining safety to return to the frontline, It is also critical to subsequently monitoring immune responses to a novel COVID-19 vaccine in a clinical trial to be coordinated by the Italian collaborator.

105 https://www.monash.edu/medicine/news/latest/2020-articles/shining-a-light-on-rapid-diagnosis-of-covid-19-infection-the-lamp-test

106 https://www.9news.com.au/national/coronavirus-scientists-monash-university-alfred-health-develop-immunity-test-for-covid19/6e995442-7026-423c-9fd0-9a9e11784ea6

Victoria

Radiography and AI for early diagnosis

A team from the **University of Melbourne's** Department of Biochemistry and Molecular Biology is using artificial intelligence to rapidly diagnose patients using their chest X-rays, differentiating COVID-19 from other infections. This will allow for more rapid patient triaging using standard and highly portable equipment available at most sites.

Biobank of virus samples from patients to predict patient outcomes

Researchers from **Monash University**, the **Burnet Institute** and the Alfred Hospital are using a newly established biobank at the Alfred Hospital to investigate why patients are affected so differently by COVID-19. The project is collecting blood and respiratory swabs from COVID-19 patients in Melbourne to thoroughly test what the virus does and how it behaves in different people. Repeated samples are collected from infected patients while they are unwell and also after they have recovered to study the virus and how the immune system is responding.

Patients' clinical information from hospital data is also collected. The samples frozen in the 'bank' can then be analysed together with the patient data, with the aim of predicting which patients get hit the hardest.

Understand the impact of the virus on young people

Why do children seem less likely to get COVID-19 and why are they often less Ill than adults? Monash University has undertaken several ambitious longitudinal clinical studies investigating molecular mechanisms of disease in challenging populations such as preterm infants.

The latest example of this work is a study exploring the pulmonary microbiome and its interplay with the immune system in infants and children. This study is being expanded to answer critical questions relevant to COVID-19, such as why the disease usually takes a milder course in infants and children, whether vertical transmission (i.e. during pregnancy) occurs, and whether or not breastfeeding is safe.

High-throughput genomics diagnostic test

Drawing on the expertise of the **Walter and Eliza Hall Institute** (WEHI) in genomics and in collaboration with the Royal Melbourne Hospital's pathology department, research is being undertaken to develop a high throughput genomic diagnostic test to identify SARS-CoV-2 infection, using CRISPR technology. **WEHI** is fast-tracking this research by building on funding provided through MRFF Stage One Frontiers funding and the Victorian Government.

HEALTH SYSTEM AND WORKFORCE

Expanding new facilities quickly

Rapid increases in COVID-19 cases have overwhelmed health systems around the world, leading to demand for new facilities to be rapidly constructed and commissioned. Two separate projects from the **University of Melbourne's** School of Engineering are responding to this need.

The Melbourne School of Engineering is working with government agencies and an industry group on design and manufacture of modular prefabricated ICU units for field hospitals that can be deployed quickly around Australia in the emergency of Covid-19.

Prefabricated sanitising chamber

University of Melbourne's infrastructure and biomedical engineers are working with the **Doherty Institute** on the development of a prefabricated chamber capable of sanitising people within 30 seconds and able to be located at high-risk sites of COVID-19 exposure. The prefabricated sanitising chamber is a preventative measure which will help to protect frontline workers such as medical staff, police officers and other essential services workers.

Personal ventilation hood to reduce patient droplets

Researchers from **University of Melbourne's** Melbourne School of Engineering have worked in collaboration with Western Health to design a personal ventilation hood for hospital beds to help contain the droplet spread of coronavirus (COVID-19) in intensive care units (ICUs).

The transparent, movable personal ventilation hood sucks air away from the patient while creating an effective droplet containment barrier. The device is also large enough to accommodate other medical equipment that might be attached to the patient.

The hood helps to confine bigger droplets to a known area around the patient while smaller droplets are sucked away through an attached ventilation system and filtered out through a high-efficiency particulate air filter. The hoods are first being trialled at Footscray Hospital; if successful they can be deployed more widely. [107]

Support for families of patients in ICU

With COVID-19 leading to patients requiring extended treatment in intensive care units and under strict isolation, **Deakin University's** Centre for Quality and Patient Safety Research (QPS) is partnering with Alfred Health to investigate how to best support and communicate with these patients' family members.[108]

Impact of PPE on health workers

Deakin University's Centre for Quality and Patient Safety Research (QPS) is also partnering with Alfred Health to study the impact on health workers of the use of PPE for long periods. Information about injuries (eg. soft tissue) could lead to changes to the design and/or use of PPE.

107 https://about.unimelb.edu.au/newsroom/news/2020/april/researchers-design-ventilation-hoods-for-hospital-beds-to-help-contain-covid-19-spread?utm_content=story&utm_medium=social&utm_source=twitter

108 https://www.deakin.edu.au/qps

Victoria

Evaluation of drive through testing

To reduce the load of screening suspected cases from general practices and hospitals, 'drive through' models of care where patients can be assessed in the clinic car park have commenced in recent weeks across Australia and overseas, and now augmented by dedicated drive through test sites in shopping centre car parks.

However, the safety and efficacy of this model have not been evaluated to determine whether this is safe for both clinic staff and patients. Researchers from the **University of Melbourne's** Department of General Practice, **Deakin University** and the **Doherty Institute** aim to evaluate a "drive through" respiratory clinic to inform the development of robust clinical protocols to optimise clinician and patient safety.

Global real time surveillance of cases

Severe acute respiratory infection (SARI), of which COVID-19 is just one example, continues to be of major relevance to public health worldwide. Even before COVID-19 there have been multiple SARI outbreaks around the world in the last 10 years. The 2009 H1N1 pandemic was estimated to result in more than 200,000 respiratory deaths globally.

SPRINT SARI is a hospital-based surveillance database that will enable the real time tracking and reporting of the sickest patients with COVID-19 in Australian hospitals and Intensive Care Units. **Monash University** is part of this major international collaboration, the primary aim of which is to establish a research response capability for a future pandemic.[109]

Impacts on pregnant women

The **Burnet Institute** is documenting the maternity health system response to the COVID19 pandemic, especially the planning, processes and impacts on women, newborns and health staff. This will provide critical insights to guide maternity service adaptations for COVID-19, and strengthen preparedness for future pandemics and other large-scale emergencies.

Living guidelines

The National COVID-19 Clinical Evidence Taskforce is receiving $1.5 million from the Medical Research Future Fund (MRFF) to deliver 'living guidelines' on the clinical management of patients with suspected or confirmed COVID-19 infection across primary, acute and critical care settings.

The Taskforce, which includes a large coalition of peak health professional bodies, has been convened by the Australian Living Evidence Consortium, led by Cochrane Australia based in the School of Public Health and Preventive Medicine, **Monash University.**

The Taskforce will analyse emerging national and international research and data on COVID-19 to provide frontline health care workers with the most up-to-date information and advice on the disease in a rapidly evolving environment. Their recommendations will be continually reviewed and updated in near 'real-time' to ensure that clinicians are able to provide the best possible care.[110]

109 https://isaric.tghn.org/sprint-sari/
110 https://www.greghunt.com.au/1-5-million-to-support-clinical-management-of-covid-19/

Economic costs

The economic costs of COVID-19 will be significant, not only due to the unprecedented costs of controlling the virus, but also its impact on trade and businesses. Researchers at the Centre of Cardiovascular Research and Education in Therapeutics at **Monash University** are assessing the outbreak through a health economic lens, in order to inform more cost-effective treatment and preventive strategies. The findings will also help with the management of future crises.

Mental health resources for staff

Frontline health care workers dealing with COVID-19 experience significant stress that is both more severe and different to that experienced by others in the general community.

To assist frontline healthcare workers, researchers at **Monash University** have developed a new approach. 'Alfred Minds' is a new collaborative between the Monash Alfred Psychiatry research centre and Alfred Hospital Adult Mental Addiction and Health.

The group has developed a range of resources and tools for all Alfred staff designed to provide information and assistance across a broad range of psychological situations. All hospital staff can access the toolkits that contain different tips for managing anxiety, sleep, boredom, isolation and fear. A survey for Alfred staff is being specially conducted to understand more about the experiences of clinicians providing frontline service.

Local production of surgical masks

Responding to a global shortage of Personal Protective Equipment (PPE), the **CSIRO** is working with the Australian Government and Victorian manufacturers Textor Technologies and Med-Con in an effort to build local capability and supply of materials to rapidly address demand for medical materials needed to respond to COVID-19.

As part of the collaboration, **CSIRO** is helping identify and test materials produced by Victorian manufacturer, Textor Technologies, for their performance and potential use in surgical facemasks. The CSIRO is also developing potential alternative materials that may be used in mask manufacture. If successful, the materials can be produced in Victoria and supplied to local surgical mask manufacturer, Med-Con, who will grow their operations to meet rapidly increasing demand.[111]

Meeting the needs of young people with traumatic injuries

The impact of COVID-19 has been felt across the whole health sector, including disability services. A collaboration between the **University of Melbourne, Murdoch Children's Research Institute,** Disability Care Australia, Brain Injury Australia, Spinal Cord Injury Australia, Transport Accident Commission has been investigating the delivery of services to young people with disability.

In 2019, they conducted an environmental scan of leading national and international organisations from health, education, insurance and disability sectors to understand rehabilitation models for young people with disability due to major traumatic injuries. The collaboration now has the opportunity to build on this work to examine the organisations' responses during the acute, adjustment and recovery stages of the COVID-19 pandemic. Specifically, they aim to identify enablers, barriers, and best-practice innovative approaches to meeting the ongoing needs of young people with traumatic injuries.

111 https://www.csiro.au/en/News/News-releases/2020/Covid19-expert-commentary

Victoria

Minimising the impacts on disability support workers

Another collaboration between the **University of Melbourne's** School of Global and Population Health, Melbourne Disability Institute, and the **University of New South Wales,** Canberra aims to describe and monitor the working conditions, and the health and well-being, of disability support workers (DSWs) in Australia during COVID-19 to inform interventions to promote their health and well-being.

This study is critical because COVID-19 created unprecedented conditions making DSWs at high risk of exposure and transmission of COVID-19 through their work (e.g. assisting with teeth brushing). Many DSWs also see other changes to their working conditions (e.g. reduced hours, less control, higher demands), which previous research (including articles from the research team) shows significant effects on mental health.

The research will ascertain the potential consequences for people with disabilities that DSWs support. The aim is to rapidly translate survey findings into proposed key lessons that can inform how best to support DSWs during the COVID-19 crisis and other future crises to minimise the impact on DSWs and people with disabilities.

Impact on the utilisation of disability action plans

Existing research by the **University of Melbourne** School of Population and Global Health, the Victorian Department of Health and Human Services, the Department of Social Services and the **University of New South Wales** into how NDIS plans are utilised across Australia has been amended to investigate the impact of COVID-19 on plan utilisation. The aim is to develop recommendations for improving utilisation in Victoria and how policy interventions could be evaluated.

Telepractice delivery for early childhood intervention

With the onset of the COVID-19 epidemic, the Australian early childhood intervention (ECI) sector is another that is facing an unprecedented challenge. Most ECI services have had to switch their mode of service delivery from home-based or clinic-based visits to various forms of telepractice, which has presented many challenges for families and providers alike. The aim of the proposed study by **Murdoch Children's Research Institute,** Royal Melbourne Institute of Technology, Noah's Ark Inc, and **Monash University** is to examine the impact that the COVID-19 pandemic is having on ECI service provision and to provide guidance to families and providers on how to ensure effective support and maintain best practice, with a particular focus on their experience of telepractice delivery.

Victoria

Face-to-face assessment restrictions on infants at high risk of development disabilities

In yet another example of the disruption of services, guidelines recommend infants at high risk of cerebral palsy and other developmental disabilities, such as infants born preterm or with brain injury, are monitored closely following birth with developmental assessments and referred to early intervention as needed.

With face-to-face assessments restricted due to COVID-19, there are many infants and their families who may miss out on timely assessment and support. The aim of research by the **University of Melbourne,** Royal Women's Hospital, Royal Children's Hospital, **University of Sydney** and the **Cerebral Palsy Alliance** is to create an online education module for health professionals (health and disability sectors) on how to use telehealth to facilitate early detection for infants at risk of developmental disabilities, along with resources for families.

COMMUNITY

Public health measures to stop community transmission of COVID-19 are currently the only tools we have to interrupt transmission and avoid a large epidemic of the kind faced by Europe and the USA.

The 'social licence' of the COVIDSafe app

The Australian Governments' COVID Safe App is one such public health measure and while the initial take up rate has been good, there is strong resistance to it in part of the Australian community. **University of Melbourne's** School of Psychological Sciences is seeking to understand the 'social licence' for the introduction of the COVID App and other policies to combat the COVID-19 pandemic. Under what conditions is there broad community acceptance and endorsement for these tracking policies, beyond formal legal permissibly?

To understand this, the researchers are surveying a nationally representative sample of Australians, iteratively over time as the COVID-19 pandemic progresses, about their opinions of various hypothetical and actual government policies. Using this data, they will be able to better understand the social consequences of various COVID-19 response policies, as well as help determine their efficacy in the real world.

They also have international collaborators (e.g. in the UK, US, Taiwan, Japan, Germany, Spain, and Israel), allowing cross-cultural comparisons and greater international insights that will help support the formulation of appropriate public policy to fight the spread of COVID-19 around the world.[112]

112 https://psychologicalsciences.unimelb.edu.au/chdh/news/COVID-19-tracking-social-licence

Using social media to monitor restrictions

Restricting movement in our community is another critical public health measure that can help slow the spread of SARS-CoV-2 2. The **University of Melbourne's** School of Computing and Information Systems is analysing the mobility data released by Facebook during the Covid-19 crisis to monitor the impact Government restrictions are having. This analysis uses data provided by Facebook, under the Facebook Data For Good initiative.[113]

Examining handwashing behaviours

Handwashing has been another critical defence against COVID-19. While a habit for most of us, handwashing has become a focus of attention as a key preventive behaviour for contacting and infecting others with COVID-19. However, handwashing recommendations are complex.

Researchers from the **University of Melbourne's** School of Psychological Sciences and Poland's SWPS University of Social Sciences and Humanities aims to investigate changes in the handwashing behaviours of individuals during the COVID-19 pandemic, and the social cognitive determinants of these behaviours. The project forms the Australian component of a worldwide study.

The ability of vulnerable people to self isolate

Burnet Institute staff are working with the most vulnerable in the Australian community such as young people, pregnant women, people living with or at risk of Hep C, people who inject drugs and people in the justice system. The aim is to understand people's behaviours, experiences and needs, and their ability to successfully self-isolate for COVID-19 and negotiate critical health services.

The impact of COVID-19 on the health and wellbeing of young people

The **Burnet Institute** is also working directly with young people to understand the impact of COVID-19 on their health, behaviour and wellbeing. This knowledge is essential to developing strategies for young people to maintain health and social connection, particularly as they currently make up the highest proportion of people infected but are unlikely to be seriously unwell.

113 https://people.eng.unimelb.edu.au/vkostakos/covid19/

Victoria

The changes in social and economic wellbeing of all Australians

The University of Melbourne's Melbourne Institute is conducting a survey to gauge the impact of COVID-19 in Australia. The survey tracks changes in the economic and social wellbeing of Australians living through the effects of COVID-19 and provides a snapshot of how Australians are faring during the pandemic.

It has been designed to support evidence-based analysis of how Australians are adapting to various changes in Federal and State government policies as the pandemic evolves, and contains responses from 1,200 Australians aged 18 years and over. The sample is stratified by gender, age and location to be representative of the Australian population.[114]

We know that different people in our community will be affected in different ways, but understanding these impacts requires research. The following are just some examples of research focusing on particular groups.

Telehealth physical rehabilitation for stroke survivors

While there is strong evidence that rehabilitation reduces disability in stroke, COVID-19 has led to restricted outpatient services and reduced access to rehabilitation for stroke survivors.

Traditional rehabilitation relies on physical assistance from therapists and specialised equipment. There are also safety considerations for stroke survivors and carers. There is an urgent need for an evidenced-based guide to providing safe physical rehabilitation via telehealth to people with moderate/severe physical disability following stroke.

Researchers at the **University of Melbourne, University of Newcastle, University of Adelaide,** and Western Health are developing a telehealth physical rehabilitation program for people with moderate to severe stroke using an integrated knowledge translation approach.

114 https://melbourneinstitute.unimelb.edu.au/__data/assets/pdf_file/0004/3347851/Taking-the-pulse-of-the-nation-6-11-April-FV.pdf

Targeted services for high-risk children with developmental disabilities

Without targeted service provision, children with developmental disabilities and their families may be disproportionately adversely affected by direct and indirect effects of the COVID-19 pandemic.

Researchers from the **University of Melbourne,** Royal Children's Hospital, **Australian Catholic University** and CanChild Centre for Childhood Disability Research in Canada aim to mitigate the adverse effects of the pandemic on high-risk children with complex developmental disabilities. Where benefits are demonstrated, the Royal Children's Hospital Department of Neurodevelopment & Disability will embed longer-term implementation by using participatory implementation research methods to develop, to implement and evaluate a system of telehealth and remote support, adapting the service provision to the changing needs of children and families throughout the pandemic.

Support for families with young people with Autism to reduce stress and conflict

COVID-19 and the requirement to self-isolate has been linked to increased levels of stress and domestic violence. The **University of Melbourne** is collaborating with a range of community groups on research to investigate the difficulties of familial conflict, high-risk behaviours, and sources of support for families living with a child/young person with Autism Spectrum Disorder (ASD). The project has been amended to also investigate the further impact of COVID-19 on family support and conflict.

Examining whether remote monitoring of home ventilation is a substitute for clinic attendance

People with COVID-19 are not the only ones who need a ventilator. Over 800 Victorians live well at home with non-invasive ventilation (NIV), most of whom have ventilatory failure secondary to their disability (motor neurone disease (MND), muscular dystrophies, spinal cord injury, etc). People with disabilities are understandably reluctant to attend hospital to start NIV (usual practice) during the COVID-19 pandemic.

NIV@Home, a joint project by the **University of Melbourne,** Victorian Respiratory Support Service and Austin Health will pilot whether using home NIV implementation and remote patient monitoring to substitute for day admissions and clinic attendance in people with disabilities is a feasible model.

Finding priority areas where unique health services are needed during the pandemic

We know that access to healthcare affects people's health and wellbeing in normal times but what about in a pandemic? The School of Psychology and Public Health at LaTrobe University is building on its existing expertise in spatial studies which use geographic information system methods to clarify priority areas in Australia, where resources, and unique health services offerings need to be delivered.[115]

115 https://scholars.latrobe.edu.au/display/alakhani

Victoria

Monitoring the health and wellbeing of Australians

There is an urgent need to understand the short- and long-term impacts of COVID-19 on the mental health of Australians. The Centre for Mental Health at Swinburne University is conducting a monthly survey on the impact of COVID-19 on the mental health of Australians (the COLLATE project). It is recruiting 50,000 people aged 18 or over living in Australia 8,000 people completed the survey in April 2020, the first month it was conducted. The survey provides a way of monitoring the ongoing mental health of Australians and the impact of COVID-19.116

Using long-term studies to map the impacts of COVID-19 on young families

The **Murdoch Children's Research Institute** is leveraging its expertise in and capability in large-scale long-running intergenerational health studies that will act as a 'virtual observatory', mapping the constellations of COVID-19's knock-on effects on children and families. This includes advanced storage and retrieval facilities for biological samples taken during clinical and observational studies. [117]

Using an app for remote health monitoring

In collaboration with the National Trauma Research Institute at Alfred Hospital Monash Health, the **Western Sydney University, UNSW** and Cyber CX, **Deakin University** researchers are working on app to remotely support and monitor people who are quarantined at home. The system will have:

- a data collection app;
- decision aids
- nurse/clinician interface to monitor patients and decide on interventions (sent as short messages); and
- a mechanism to trigger an alert to a paramedic team.

Identifying families and children most at risk of mental health issues

The COVID-19 pandemic presents significant risks to the mental health of the Australian population. A project at **Deakin University's** Centre for Social and Early Emotional Development (SEED), seeks to investigate the week-by-week impact on families of unprecedented lifestyle changes associated with social distancing.

In partnership with the Victorian Government, this project will track parents over the pandemic and provide timely information on the mental health effects of the emerging COVID-19 crisis on parents, families and children in Australia. It will identify adults and families most at risk of experiencing mental health problems and identify factors that may provide levers for successful clinical and public health intervention to reduce risk.[118]

116 https://twitter.com/collateproject
117 https://www.mcri.edu.au/news/australian-covid-19-modelling-and-international-data-reassuring-parents-teachers-according
118 https://www.deakin.edu.au/qps

Using Google search terms to monitor mental health outcomes, including suicide

The **University of Melbourne's** Melbourne School of Population and Global Health is working with the University of Toronto and the Medical University of Vienna to see if online search trends can, in some cases, be an early proxy indicator of mental health related outcomes including suicide. They conducted an observational study of Google search terms, worldwide and in the US, to see if there were changes in 12 pre-specified terms over 5 years. The research is being expanded to include COVID-19.

Helping other countries in their COVID-19 health response

In Myanmar, PNG and other countries, the **Burnet** is supporting governments with modelling to understand how they can maximise impacts through the best use of existing (limited) funds in responding to COVID-19.

Funders, including the Australian Department of Foreign Affairs and Trade (DFAT), have requested that current activities be re-purposed where possible to support COVID-19 activities in countries where the Burnet works. In PNG, this involves:

- training health workers in the use of personal protective equipment (PPE) and helping hospitals to establish infection prevention control (IPC) guidelines and procedures;
- assisting health facilities to prepare for managing COVID-19 patients with virtual clinical training;
- training laboratory staff in COVID-19 diagnostic testing;
- supporting COVID-19 surveillance; and
- developing community education activities.

Victoria

Teacher and student awareness of COVID-19 in Myanmar

In Myanmar, the **Burnet Institute's** adolescent health program will conduct COVID-19 prevention training for laboratory technicians with the Regional Health Department in Magway and support COVID-19 awareness activities for teachers and students in the monastic schools' program.

Evaluating the value of online music for the disability community

Live music performances have been drastically curtailed by COVID-19, although there has been a move to take performances online. But does this work equally well for all audiences? Researchers from the **University of Melbourne's** Faculty of Fine Arts and Music aim to examine the ways in which online music gatherings can respond to the additional levels of isolation and restriction experienced by members of the disability community during the COVID-19 pandemic.

Since many disabled children, adolescents and adults engage in music making, listening, and singing in their everyday life, this project will offer a structure to scaffold social interactions with a new online community. The project team will partner with participants to evaluate how, when and why different types of online music gatherings might be of value, and to whom.

Adapting wellbeing index to study Australians

The Deakin-Australian Unity Wellbeing Index has been measuring the general wellbeing of Australians since 2001. The study, conducted by **Deakin University's** Centre for Social and Early Emotional Development (SEED), is being adapted by to provide a nationally representative study of the subjective wellbeing during the COVID-19 Pandemic in Australia.

Developing re-usable PPE with antiviral properties

Stopping the coronavirus from lingering in the environment is critical to preventing infection. In collaboration with HeiQ Australia, **Deakin University's** Institute for Frontier Materials is addressing this issue by developing an antiviral and antimicrobial treatment for textile surfaces that is durable to laundry conditions. 119 This could lead to the development of personal protective equipment that has antiviral properties but can still be laundered and re-used safely and effectively.

How alcohol consumption has changed during the pandemic

The Australian media has reported increases in the online sale of alcohol during COVID-19. Researchers from the **University of Melbourne's** School of Psychological Sciences are following up participants in the existing CheckMyControl studies previous studies to investigate how alcohol consumption might have changed due to the CoVid-19 pandemic.120

Addressing the health needs of people with a disability in remote NT

Remote communities already have difficulties accessing health services, and this issue is acute for people living with disabilities. What has been the impact of COVID-19? The **University of Melbourne's** School of Population and Global Health is working with the Machado-Joseph Disease Foundation on a project to address the needs of Aboriginal Australians living with disabilities from the remote Northern Territory. Travel to these communities has been banned due to COVID-19, meaning people with disabilities are cut off from service providers.

119 https://www.deakin.edu.au/ifm
120 https://checkmycontrol.org.au

The overall aims of the project are to improve access to timely, accurate and culturally informed information and services to: minimise deterioration in physical and mental health by changing service delivery models and maximise service delivery and research capacity that is accessible, prevention focussed and addresses Aboriginal workforce needs and informs future health care policy and service provision.

Daily check in with COVID-19 patients to monitor their health

While some COVID-19 patients are hospitalised, the majority are in self-isolation in their homes. The **University of Melbourne's** School of Computing and Information Systems is building a semi-automated case management platform to track symptoms effectively and prevent overwhelming healthcare professionals. 'Conversational agents' will be in contact with patients through a chat interface daily, triggering symptom surveys and providing general information about self-diagnosis, isolation measures, and mental health support.

The collected data is used to analyse the progression of symptoms related to COVID-19 and the effects of self-isolation on mental-health.

Identifying health and carer issues of people with Multiple Sclerosis

A team of researchers from the **University of Melbourne's** School of Population and Global Health, the **University of Western Australia** and Murdoch University are working with MS Australia. The project will identify issues raised and experienced by people with Multiple Sclerosis and their carers during the COVID-19 pandemic and identify policy-relevant templates for healthcare implementation to address urgent needs through the adjustment and recovery phases of this pandemic. It is hoped this will have broader applicability to other people living with disability and their carers, and help improve the delivery of services and support.

Western Australia

Western Australia has some unique features when it comes to health and medical research, including a long history of linking publicly held data for public health and research purposes. Since its commencement in 1995, The WA Data Linkage System has become one of the most comprehensive, high quality and enduring linkage systems worldwide. Today it contains over 150 million records spanning over fifty routinely linked datasets.[121]

In recent years, successive Western Australian governments have identified the strategic importance of health and medical research and innovation and have actively encouraged and invested in it.

Curtin University's origins lie in technical education and the establishment of the Western Australian Institute of Technology in 1967. Becoming a university in 1987, it now has nine campuses across five countries.[122]

Established in 1991, **Edith Cowan University** (ECU) has grown rapidly, and has major campuses in Perth and Bunbury.[123]

The **Harry Perkins Institute of Medical Research** was established in 1998, and has grown to become one of the nation's leading adult medical research centres, with over 450 research and clinical staff.[124]

The **University of Western Australia** is the State's first university, established in 1911. It has grown substantially in the last century, with major campuses in Perth and Albany and various other facilities across the state.[125]

The Western Australian Health Translation Network (WAHTN) is the only Advanced Health Research Translation Centre in WA.[126]

UNDERSTANDING THE CORONAVIRUS SARS-COV-2

Real-time data and samples for WA researchers

Information about the spread and development of COVID-19 is critical. The **WAHTN's** immediate priority is building a platform for real-time accurate patient data supported by biological samples that can be relayed in a de-identified manner for all WA to researchers and scientists. This collaboration will enable all researchers to have access to high quality data, samples and analysis; thus minimising duplication, reducing costs and maximising output for patient care.[127]

Examining the longer-term impacts of COVID-10 on the lung and heart

Inflammation has an important role in the development and progression of cardiovascular disease. COVID-19 is associated with a high rate of lung infection (pneumonia), and it is uncertain for how long the inflammatory changes of pneumonia remain in the lungs once people have recovered from their symptoms and whether this is associated with adverse long-term outcomes.

121 https://www.datalinkage-wa.org.au/data/wa-data-linkage-system/
122 https://about.curtin.edu.au/history/
123 https://www.ecu.edu.au/about-ecu/welcome-to-ecu
124 https://www.perkins.org.au
125 https://www.uwa.edu.au
126 https://www.wahtn.org
127 https://www.wahtn.org/wa-covid-19-research-collaboration/

Western Australia

A study by researchers at **University of Western Australia's** Faculty of Health and Medical Sciences aims to determine if there are persistent areas of inflammation in the lungs in patients who have recovered clinically from COVID-19 pneumonia, and also to assess whether there is evidence of increased blood vessel inflammatory activity in these patients, which may be a predictor of increased risk for future heart disease.

If this study shows that persisting lung inflammation is associated with increased blood vessel inflammation, affected patients may require additional treatment to prevent adverse cardiovascular consequences. Future studies would include testing of treatments to reduce blood vessel inflammation, with the aim of reducing risk of cardiac disease and improving health outcomes for post COVID-19 survivors.

VACCINE DEVELOPMENT

Human trial of vaccine candidate in coming months

Linear Clinical Research, a subsidiary of the **Harry Perkins Institute of Medical Research,** will conduct a human trial of a vaccine candidate COVID-19 S-Trimer, which has been developed by China-based, global biotechnology company Clover Biopharmaceuticals.[128] Clover started work on the coronavirus vaccine in January this year. The program has expanded to include collaborations with renowned vaccine development experts around the world such as **GSK,** Dynavax, and Coalition for Epidemic Preparedness Innovations (CEPI).[129]

The Phase 1 clinical trial of the COVID-19 S-Trimer vaccine is planned to involve healthy adult and healthy elderly trial participants. Linear will be seeking volunteers to participate in the study within the next 2 months.

If successful, a larger Phase 2b/3 clinical trial involving thousands of people around the world would be conducted immediately, and it is hoped that the COVID-19 vaccine will be widely available upon confirmation of its safety and efficacy.

THERAPIES

Treatment trials

There are several good treatment candidates that can be tested through urgent clinical trials, and WA scientists and clinicians are well placed to commence a number of these trials, some of which are part of a larger international collaboration. The WA COVID-19 Research Collaboration, led by the WAHTN, has identified several trials that have the ability to be implemented immediately, including (but not limited to):

- ASCOT trial – a randomised controlled trial for adults who are hospitalised with COVID-19 to determine if any of the treatments will prevent admission to the Intensive Care Unit, thus improving outcomes and reducing deaths.
- REMAP-CAP trial – a platform trial for ICU patients designed by a global network of clinicians during the 2009 H1N1 pandemic.
- BRACE trial – repurposing a vaccine used for tuberculosis (BCG) to preventing infections in our health care workers.
- IFN trial – determining whether inhaled interferon (IFN) administered daily to subjects tested for COVID-19 during quarantine would reduce the spread of infection.[130]

128 https://www.linear.org.au/trials/covid-19/
129 https://www.linear.org.au/blog/wa-to-be-at-the-heart-of-the-fight-against-covid-19/
130 https://www.wahtn.org/wa-covid-19-research-collaboration/

The effects of high blood pressure medications and COVID-19

People with high blood pressure and cardiovascular disease are at higher risk of death if infected with COVID-19. Because high blood pressure is so common around the world and over one-third of people with high blood pressure are prescribed ACE inhibitors and angiotensin receptor blockers, this project led by researchers at **Harry Perkins Institute of Medical Research** aims to better understand the effects of these high blood pressure medications and COVID-19 so as to better treat and manage these patients.

Trialing a drug to modify immune responses for patients with COVID-19

Pentoxifylline is a safe and inexpensive oral drug that has been shown to modulate immune responses and the pathogenesis of acute respiratory distress syndrome. The Fiona Stanley and Fremantle Hospitals Group is proposing a randomised control trial to investigate the effect of oral pentoxifylline therapy in outpatients newly diagnosed with COVID-19.

Patients who test positive for COVID-19 will be randomised to commence pentoxyfylline or no pentoxyfylline in the early stages of diagnosis, and followed up for 28 days to assess any significant differences in time to improvement, mortality, hospital admission, ICU admission and requirement for ventilation. It is hypothesised that pentoxyfylline will reduce the duration of symptoms and the severity of disease, thus reducing hospital admissions, ICU admissions and ventilation.

HEALTH SYSTEM AND WORKFORCE

Developing a nurses' evidence-based wellbeing resiliency program

The wellbeing of Australia's healthcare workforce is critical to Australia's response to the COVID-19 pandemic, which comes at a time where there is already a shortage of experienced nurses, nationally and internationally, particularly specialist-experienced nurses. If the experience of countries already dealing with huge numbers of COVID-19 patients is repeated in Australia, the shortage of nurses is likely to become worse.

At **Curtin University's** School of Nursing, Midwifery and Paramedicine, research is being undertaken to explore the impact of the crisis on nurses' and midwives' mental wellbeing. The study aims to capture real time data about nurses' professional and personal well-being before, during and after the crisis using online surveys and interviews to determine the impact on nursing during the time of the pandemic.

This data will be used to adapt an existing evidence-based resiliency program that can be delivered to nurses and subsequently evaluate the impact of the program on nurses' well-being.

The team is also looking to make it an international project involving colleagues across Australia, Hong Kong, the United Kingdom and the Middle East. Partners in the project are members of the International Collaboration for Occupational Resilience.[131]

131 https://www.cqu.edu.au/research/organisations/international-collaboration-for-occupational-resilience-icor

Western Australia

Best ways to support nurses at risk

Will healthcare workers simply stop turning up to work? **Edith Cowan University** researchers are exploring the experiences of Australia's essential frontline workforce in regard to accessing PPE, altered standards of care, impact on life and work, and ultimately the effect has on their decision to continue working during the pandemic. Understanding what affects health workers' willingness to continue placing themselves and their families at risk can guide decision about how we best support them at this time when we need them to keep doing what they are doing.

Local manufacturing of face shields

Harry Perkins Institute of Medical Research The **University of Western Australia,** WA Department of Health and Adarsh Australia have teamed up to manufacture up to 10,000 face-shields initially to support the WA health system and protect frontline workers responding to COVID-19.[132] The Therapeutic Goods Administration-approved shields have started production through the Department of Health at a factory in Malaga.[133]

COMMUNITY

Monitoring patients at high-risk of heart complications

Individuals with a history of heart disease or risk factors for developing heart problems such as high blood pressure or diabetes, appear to be at particularly high risk of developing worse conditions if they are infected by COVID-19. In addition, COVID-19 often affects the heart, even in patients with no prior history of heart problems.

A study at **University of Western Australia** will collect information about pre-existing heart problems and treatment on all patients admitted to the three largest public hospitals in Perth and will follow them up looking for any evidence of cardiovascular complications.

Similar data is being collected in other big hospitals in Australia and around the world. Combining these data will provide information as to which patients are at highest risk of heart complications, helping with public advice and treatment.

The study will also follow patients up after they recover from COVID-19 and leave hospital to see if this is associated with any long-term effects on the heart and also to see if those patients who have cardiac problems associated with COVID-19 have any further heart or other health issues.

132 Adarsh Australia is a leading manufacturer of custom metal and plastic components in Perth, Western Australia https://www.adarsh.com.au

133 https://www.perkins.org.au/wa-expertise-produces-10000-face-shields-to-support-frontline-health-workers/

Guide to health professionals about breast-feeding and COVID-19

Have you considered the particular predicament of a breast feeding mother who has suspected or confirmed COVID-19? A team at the **University of Western Australia** has. Early guidelines regarding breastfeeding and COVID-19 published in the Lancet recommended routine separation of mother and infant with cessation of breastfeeding.

This is of great concern as almost every component of breastmilk has an immunoprotective role and breastfeeding provides important protection against infection for infants. These recommendations risked placing infants in the vulnerable first year of life at increased danger of severe COVID-19 infection.

To address this, the **University of Western Australia** has published guidance for doctors and health professionals on breastfeeding and COVID-19 in their online lactation care support resource, LactaMap[134]. These recommendations help guide decisions about when and where it is appropriate to continue breastfeeding and when it is not. They are being accessed globally and have already been updated twice as new evidence emerges.

COVID-19 restrictions are expected to result in negative health behaviours such as reduced exercise, unhealthy eating, poorer stress management, and increased substance abuse. These could lead to an increase in both the incidence and severity of chronic disease, placing increased cost and pressure on Australia's health system.

134 www.lactamap.com

Western Australia

Evaluating the impact and supporting vulnerable older Australians

The Exercise Medicine Research Institute at **Edith Cowan University** has been researching the impact of COVID-19 self-isolation and physical distancing on physical and mental health of older people with existing chronic disease in particular cancer and neurological disorders. It has implemented a research program to rapidly evaluate the COVID-19 impact on vulnerable older Australians and implement and evaluate support and intervention programs that will ameliorate these risks.

Insights into how teachers and school communities have managed

Australia's schools have been a particular focus of attention as the nation's response to COVID-19 has unfolded. The whole or partial closure of schools to many students, the implementation of remote learning and the implications for students in their last year of school have also been significant issues, and much of the burden of communicating and managing these changes has fallen on our schools' leaders.

Research being undertaken at **Edith Cowan University's** School of Education is seeking to understand how educational leaders and teachers experienced the COVID-19 crisis. This research will inform educational leadership research and theory and provide educational systems, schools and their staff with insights that could be useful in developing policy and improving educational leadership practice.

Another stream of research is focused on how school leaders, school administration staff, school psychologists, nurses and chaplains managed and responded to the crisis within their respective school communities. The objective of this research is to inform health policy, protocols and procedures aimed at supporting the physical health and mental wellbeing of school communities during health-related crises.

Delivering care digitally – people with chronic neurological conditions

Australia's social distancing and self-isolation measures have had particular implications for individuals with chronic conditions who need regular care and assistance to maintain their health.

For example, multidisciplinary therapy is recommended for individuals living with chronic neurological conditions such as Parkinson's disease (PD), multiple sclerosis (MS) and Huntington's disease (e.g. PD, MS and HD). These interventions positively impact on brain health, cognition, movement, mood, sleep and quality of life (QoL). However, these programs are typically delivered by specialists in a face-to-face manner, which places patients at risk during the COVID-19 pandemic.

Advances in technology have enabled complex interventions, such as multidisciplinary care, to be delivered digitally. This delivery method is safe, cost-effective and sustainable and reduces pressure on primary healthcare resources.

Comparing digital delivery of care with face-to-face care models

The Exercise Medicine Research Institute at **Edith Cowan University** is developing, delivering and evaluating the feasibility and efficacy of a novel digital healthcare application (NEURO-ACTIVE), compared to usual care (under COVID-19 restrictions), on the Quality of Life and clinical outcomes for individuals with chronic neurological conditions.[135]

This study involves researchers and clinicians partnering with leading not-for-profit organisations. If proven effective, this digital healthcare application could be introduced into the community and change standard care for patients permanently, even after the COVID-19 pandemic has gone.

135 https://www.exercisemedicine.org.au

Vulnerability of people experiencing homelessness to COVID-19

The Home2Health team within the School of Population and Global Health at the **University of Western Australia** is involved in research and evidence led-advocacy around the high vulnerability of people experiencing homelessness to COVID-19.

The team has been working in close collaboration with the Homeless Healthcare primary care practice as well as colleagues in two major public hospitals that regularly see homeless patients. All of the research has been undertaken quickly in response to the evidence of need seen by health and homelessness services.

Analysis of hospital data for 799 people who were rough sleeping in 2019 showed that 34% of this group had attended hospital in the last 3 years with a primary diagnosis for one of the COVID-19 risk factors (age, diabetes, hypertension, heart disease, respiratory conditions, suppressed immunity).

This information has informed the strategy put forward by a rough sleepers working group to the WA Department of Communities homelessness taskforce.

Close collaboration with UK researchers and healthcare experts to adapt their comprehensive COVID homeless sector plan to the WA context, and get advice on its implementation. This has been shared with colleagues at St Vincent's Health Australia and other homelessness and health colleagues in other states.

Long-term studies of the impact of COVID-19 on our health

Long term studies of large groups of people can teach us a lot about how disease progresses, how we age and the impact of lifestyle on our health. The Busselton Healthy Ageing Study, which is part funded by a grant from the Federal Department of Health, is including new questions and capturing data that will help us understand the short and long term consequences of COVID-19.[136]

Capturing the impact of depression, anxiety and stress on chronic disease

This project, undertaken with research colleagues from the **University of Western Australia's** School of Psychology will use extant and new survey data to capture the prevalence and incidence of depression, anxiety and stress in a regional Western Australian population as a result of the COVID-19 pandemic.

It will investigate the mental health impacts of the COVID-19 pandemic and relation to chronic diseases and multi-morbidity in the group. Information gained from this initiative will contribute to the evidence-base to guide ongoing and future WA public health system resources and use relevant to an ageing demographic vulnerable to the social, economic and health impacts of the COVID-19 crisis.

Long-term health impact of infection prevention strategies

The WAHTN has developed a community-based research program (CIVIC Study) in collaboration with health outcomes researchers across the State to prospectively determine the long-term impact of exposure to COVID19 and the health implications of infection prevention control strategies.

CIVIC will include online collection of details about lifestyle, cardiac and respiratory risk factors as well as mental health and wellbeing. The plan is for this to be the framework from which focussed community and longitudinal research could be targeted to specific groups or to the broader cohort.

While the immediate focus is on existing and imminent clinical trials, and underlying supports, it is just as important to immediately set a framework to examine the broader questions on the social and mental health impacts of the COVID -19 crisis.

What's next

The World Health Organsiation has identified some 15 infectious diseases that have the potential to become international threats[137]. There is a very real possibility that COVID-19 pandemic will not be the only pandemic we see in our lifetime.

Our response to COVID-19 has drawn on earlier work in response to the AIDS epidemic, malaria and other infectious diseases. So too will the incredible research recorded in this Report will both serve Australia in the current pandemic and be drawn on by researchers working to fight the next pandemic. Learning from the regulatory and funding challenges that slowed us down will strengthen the next health and medical research response.

While the volume of work written in these pages is testament to the incredible response of Australia's health and medical research community to the COVID-19 pandemic, it has come at a cost.

The sudden 'downing of tools' that must happen when reserachers are called upon to pivot their research towards an urgent pandemic throws existing projects, and their funding streams, off course. When social distancing forces us out of our laboratories or prevents studies from progressing, it means experiments go cold and precious time and data is lost. Like other parts of the economy, health and medical research is suffering.

Universities account for more than half of all annual Australian expenditure on health and medical research and development to the tune of around $4.1 billion in 2018[138]. Without income from international students, university funding for health and medical research comes under threat. So too does the pipeline of research, and researchers, relied upon by Australians to safeguard their health.

In our next report, *The impact of COVID-19 on health and medical researchers,* Research Australia looks at the challenges researchers themselves are facing. We begin to think about how we re-design a health and medical research system which is agile enough to cope with pandemics and a regulatory system which is rigourous without slowing down progress.

Importantly, how do we make sure that Australia has an enduring health system driven by evidence based health and medical research that provides and assures a quality of life for all Australians. We have this opportunity today.

137 https://www.who.int/emergencies/diseases/managing-epidemics/en/
138 https://www.abs.gov.au/ausstats/abs@.nsf/mf/8111.0 R&D expenditure on SEO of Health

Research Australia members cited in this report

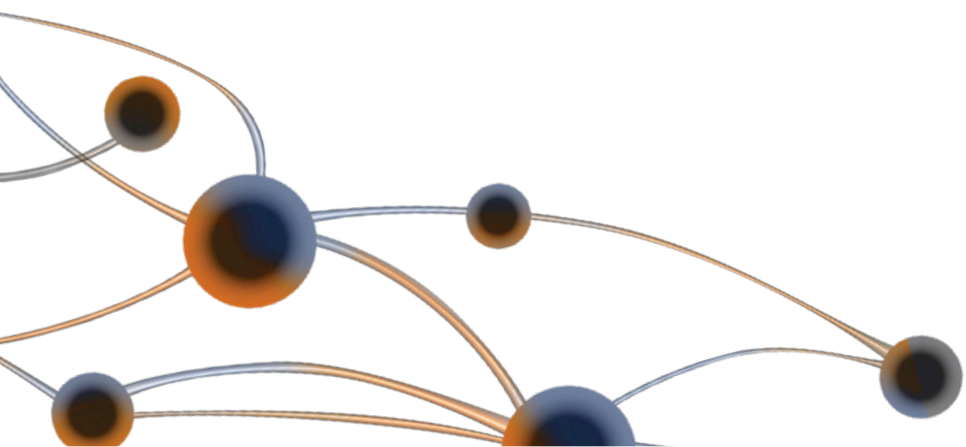
Acknowledgements

Research Australia is grateful to the many members who didn't hesitate to contribute to this report.

Together, we have briefed over 100 state and federal politicians on the work our health and medical research and innovation community is doing in facing this pandemic and the number grows as our strong advocacy on COVID-19 continues.

We would like to acknowledge that this report is not a complete catalogue of all COVID-19 related research underway in Australia but a useful snapshot. We appreciate that not all Research Australia members had the capacity to contribute in these challenging times and we continue to identify other opportunities to showcase the work of all Research Australia members.

Research Australia welcomes requests for further information on any research into COVID19 – whether it is cited in this report or otherwise – by contacting our Sydney office on (02) 9295 8546 or our Melbourne office on (03) 9662 9420.



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University of Melbourne

RESEARCH AUSTRALIA

CONNECTING ▪ ENGAGING ▪ INFLUENCING

SYDNEY
384 Victoria Street Darlinghurst NSW 2010
P 02 9295 8546
E admin@researchaustralia.org

MELBOURNE
Level 5, 215 Spring Street Melbourne 3000
P 03 9662 9420
E admin@researchaustralia.org

www.researchaustralia.org