Australian
Academy *of* Health and
Medical Sciences

Investing in health and medical sciences for improved health and prosperity

2021-22 Pre-Budget submission from
The Australian Academy of Health and
Medical Sciences

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Summary

COVID-19 has driven home the importance of an adaptable, skilled and responsive research and innovation sector working in concert with government, industry and the community. The value of a vibrant health and medical research environment has never been so clear. Measures in the Budget should harness research and innovation to leverage Australia's success in addressing the COVID-19 pandemic, and ensure we are prepared for future national and global health challenges.

Australia's response to the COVID-19 pandemic and its success in maintaining low case numbers and fatalities has been achieved thanks to our effective public health response, and community and government trust in science. The evidence produced through research and innovation has helped navigate the knowns and unknowns imposed by the novel coronavirus and the sector continues to play a vital role. Australia has been at the forefront of research efforts on SARS-CoV-2 and COVID-19 – leading the world in characterising the virus and deploying effective public health measures, and working at the cutting edge to develop diagnostics, vaccines and treatments. Australia was able to move quickly in these areas as a result of the expertise built from past investment in public health and basic laboratory research in areas such as microbiology and immunology.

We propose strategic investments in five areas to ensure that research and innovation are utilised to drive forward Australia's economic and societal recovery from the pandemic and beyond:

Investing in research and innovation

Gross expenditure on R&D must increase annually in real terms and should be returned to a positive trajectory as a proportion of GDP, ideally working towards a longer term goal more consistent with the OECD average. Increased government expenditure on R&D can be leveraged to boost R&D spending from other sectors, such as industry. Long-term, sustainable and predictable government investment will help Australia retain its competitive edge, equip us to address future health challenges and ensure we continue to reap associated economic and societal benefits. Investment is needed throughout the research pipeline – from basic through to translational research and implementation.

Building research infrastructure and workforce capacity

Funding is needed to build Australia's research infrastructure capacity and associated multi-disciplinary expertise, particularly to serve preparedness plans. Facilities must be agile to allow re-purposing if necessary. Future preparedness depends on investment in research and innovation across disciplines in science, health, engineering, social sciences and the humanities to ensure we have the right mix of infrastructure including access to data, knowledge and expertise.

Strengthening and securing our workforce

To support early- and mid-career researchers (EMCRs) across the sector's disciplines, funding should be made available for additional emerging leadership NHMRC Investigator Grants to target the best and brightest applicants in the pool. EMCRs are crucial to delivering the government's long-term vision for a world-leading health and medical research sector, but they have been substantially impacted by the pandemic. We suggest 40 additional awards annually.

Embedding research in the health system to improve health and wellbeing

The benefits of embedding research and its translation in the health system are clear. These endeavours must be a priority objective across the health system and governments should use innovative incentives to encourage service providers to increase their commitment to research. The pandemic has also reminded us of the value of clinician scientists, who must be empowered to undertake both clinical and research responsibilities and given the time and support to do so. The Academy is working to develop a vision for how this can be achieved post-pandemic.

Providing science advice for the benefit of all Australians

Expert scientific advice has played a key role in addressing the pandemic. Australian governments' efforts to seek out the evidence to inform decisions should be celebrated and the renewed bilateral relationship between governments and the sector nurtured and cemented.

Investing in research and innovation

Gross expenditure on R&D must increase annually in real terms and should be returned to a positive trajectory as a proportion of GDP, ideally working towards a longer term goal more consistent with the OECD average.

Research and innovation drive economic growth and productivity, and are therefore crucial to the nation's future prosperity. Data consistently show that investing in health and medical research brings exceptional returns – a recent estimate suggests Australia sees a return of $3.90 for every $1 invested in health and medical research.[1] These trends are seen not only at a national level, but at the state and territory level, as well as internationally.[2,3]

Maximising research efficiency and impact requires long-term, sustainable and predictable funding. However, Australia's investment in research and innovation has been falling behind that of other similar nations – gross expenditure on research and development (GERD) as a proportion of GDP was 2.25% in 2008-09, but only 1.79% in 2017-2018.[4]
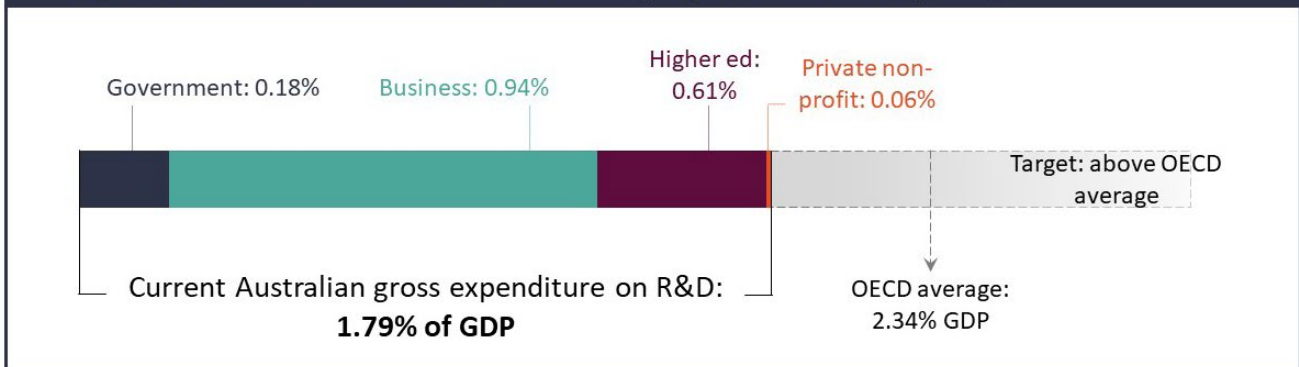
This downward trend is even more concerning given that GERD across the OECD is not only higher, but has been rising – from 2.18% to 2.34% over the decade to 2017 (Figure 1*).[5] As a component of GERD, Australian government spending on R&D has also fallen: from 0.24% of GDP in 2015-2016 to 0.18% in 2017-18, again well below the OECD average of 0.23% for the same period.[6] Government R&D spending is of particular importance due to its role in leveraging other sources of investment.

Fig 1. Gross domestic expenditure on R&D (GERD) as a percentage of GDP *
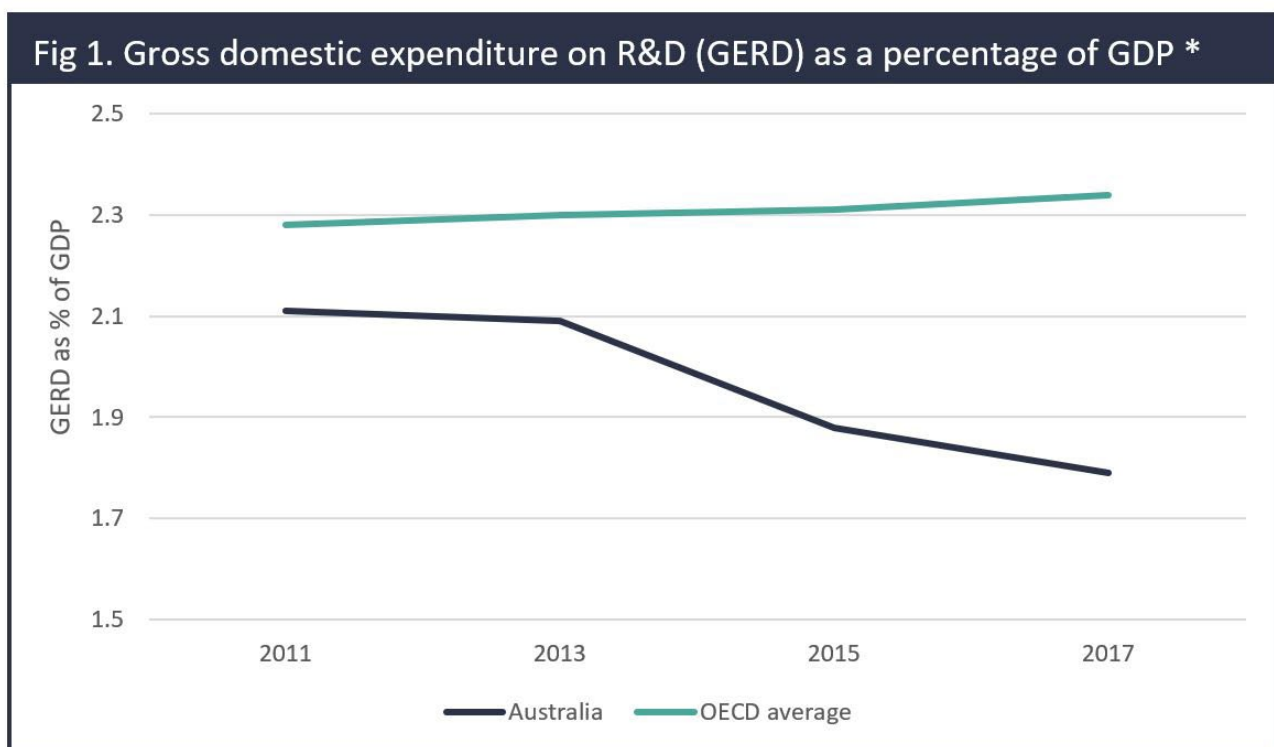
Australian business expenditure on research and development (BERD), a critical component of GERD, has also fallen in recent years, dropping from 1.18% in 2013-14 to 0.94% in 2017-18.[6] Australia needs to foster and promote cross-sector collaboration to attract such investment and drive up BERD. Figure 2 shows the composition of Australian R&D spending in 2017/18.†

Fig 2. Australian investment in R&D as a proportion of GDP (2017) †

Government: 0.18% Business: 0.94% Higher ed: 0.61% Private non-profit: 0.06%

Current Australian gross expenditure on R&D: **1.79% of GDP**

Target: above OECD average

OECD average: 2.34% GDP

Australia's research and innovation base must balance funding across the entire pipeline – from basic through to translational research and implementation. The NHMRC and MRFF have provided an important platform for doing so in health and medical research. A research translation fund to support other disciplines would further enhance Australia's capabilities.

Case study: Supporting pandemic research throughout the research pipeline

Australia has been at the forefront of global research efforts during the pandemic – punching above our weight as a result of our world class research base.

A scientist in Sydney played a key role in the discovery and genomic characterisation of the SARS-CoV-2 virus, which has been fundamental to the rapid development of diagnostic tests worldwide.[7,8]

Researchers in Melbourne were also first to culture the coronavirus in a lab outside of China, providing the data for scientists across the world to refine diagnostics, develop animal models of the disease and begin testing antiviral drugs and vaccines.[9] The virus was isolated from the first cases diagnosed in Australia and Australian researchers were also responsible for discovering the human immune system response to the virus.[10] Separately Australian scientists have pioneered new vaccine platforms and adaptive clinical trial designs, as well as the rapid development of diagnostics that can be used at the point of care, including in remote Indigenous communities.[11,12]

These leading health and medical research efforts were only possible because of long-term Government investment in our public health, virology, immunology and genomics workforces – incorporating basic and clinical expertise. Research and innovation is a pipeline and it has been clear during the pandemic that we have needed expertise from fundamental biomedical research through to clinical and population health, to facilitate translational impact. This is exemplified in our infographic, '*Research translation: vaccine development starts in the lab'*.

†Data sources for Figure 2: Data sourced from the OECD and the ABS, which are reported using a mix of calendar and financial years, but are not reported for every year. To generate Figure 2, we used data related to either 2017 or 2017/18, which we consider to be the most complete recent dataset available. Specific sources are as follows:
GERD: OECD Main Science and Technology Indicators – GERD as a percentage of GDP (2017); ABS Research and Experimental Development, Businesses, Australia – GERD as a percentage of GDP (2017-18) (https://www.abs.gov.au/statistics/industry/technology-and-innovation/research-and-experimental-development-businesses-australia/latest-release#gross-expenditure-on-r-d-gerd-).
GOVERD: OECD Main Science and Technology Indicators – GOVERD as a proportion of GDP (2017).
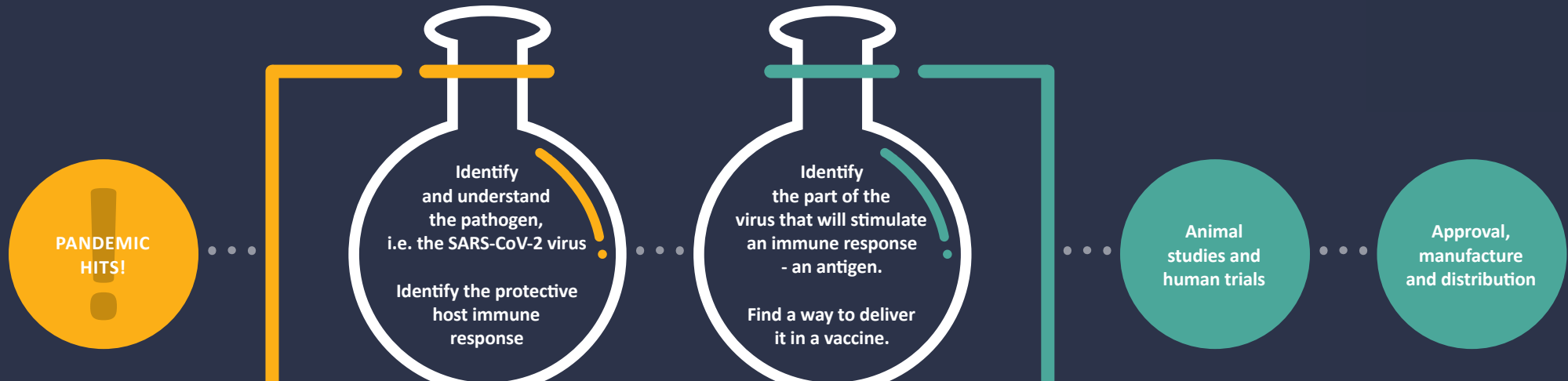BERD: OECD Main Science and Technology Indicators – BERD as a percentage of GDP (2017).
HERD: OECD Main Science and Technology Indicators – HERD as a percentage of GDP (2017).
PNPERD: ABS Research and Experimental Development, Government and Private Non-Profit Organisations, Australia – PNPERD as a proportion of GDP (2016-17) (https://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/8109.0Main%20Features22018-19?opendocument&tabname=Summary&prodno=8109.0&issue=2018-19&num=&view=).
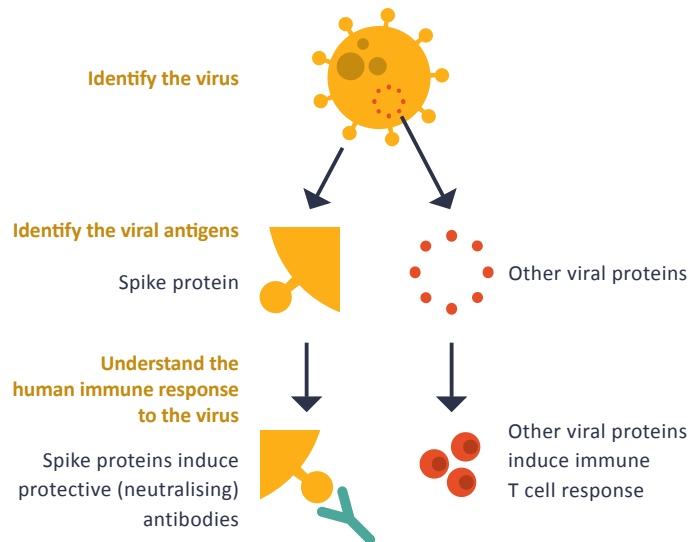All OECD data above sourced from: https://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB

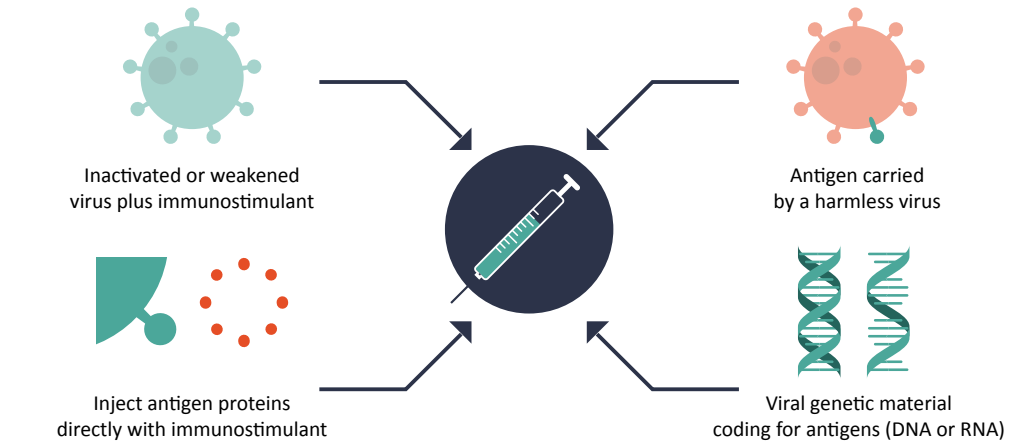# Research translation: vaccine development starts in the lab

PANDEMIC HITS!

Identify and understand the pathogen, i.e. the SARS-CoV-2 virus

Identify the protective host immune response

Identify the part of the virus that will stimulate an immune response - an antigen.

Find a way to deliver it in a vaccine.

Animal studies and human trials

Approval, manufacture and distribution

In the lab . . . .

Virologists, immunologists and other scientists have been **working for decades to understand viruses and other pathogens** so that when a pandemic strikes, they can quickly apply this understanding to:

Identify the virus

Identify the viral antigens

Spike protein

Other viral proteins

Understand the human immune response to the virus

Spike proteins induce protective (neutralising) antibodies

Other viral proteins induce immune T cell response

In the lab . . . .

Vaccine researchers have been working for **many years to develop vaccine platforms** that can be put to use as soon as a pandemic arrives – **against any pathogen**. They need an antigen for the vaccine that will stimulate a strong and durable immune response. They take the new knowledge from virologists and immunologists and get to work with their various platforms. There are four main types of platform:

Inactivated or weakened virus plus immunostimulant

Antigen carried by a harmless virus

Inject antigen proteins directly with immunostimulant

Viral genetic material coding for antigens (DNA or RNA)

Immunostimulants (or adjuvants) are sometimes added to enhance and elicit the correct protective immune response.

Building research infrastructure and workforce capacity

Funding is needed to build Australia's research infrastructure capacity and associated multi-disciplinary expertise, particularly to serve preparedness plans. Facilities must be agile to allow re-purposing if necessary.

To ensure future preparedness, we must start building capacity to address current infrastructure gaps. A 2017 government report identified limitations in Australia's medical countermeasure capabilities, such as capacity shortages to produce vaccines at scale, and we have seen evidence of this during the current pandemic.[13]

Building research infrastructure capacity and developing preparedness plans should incorporate expertise from across the health and medical sector, including our leading research universities, MRIs, industry and NGOs. They should foster agile facilities, for example biologics manufacturing that is designed to be productive at all times and can be quickly repurposed during an emergency to produce vaccines or treatments on Australian soil. The presence of industry in Australia, such as CSL, bolsters our capacity to produce vaccines and treatments, and further research infrastructure investment will attract and retain business to our shores, which is of particular value in emergencies.

Case study: The need for agile research infrastructure during the COVID-19 pandemic

The health and medical research sector has shown considerable flexibility during the pandemic – responding quickly and overcoming barriers to facilitate world-leading research. Studies have been fast-tracked, data have been shared and academic-industry collaborations have been rapidly developed, for the ultimate benefit of patients and the community. However a lack of crucial research infrastructure has limited the nation's capacity to translate our outstanding discovery science into vaccine and therapeutics development and manufacture. In particular, the risks of depending on an international vaccine supply chain have highlighted the need for local advanced manufacturing facilities.

Research infrastructure includes not only physical facilities and equipment, but also data assets and the data science expertise needed to ensure that sound evidence for health policy and practice is extracted from these data.[14] Australian health data are currently fragmented across jurisdictions and sectors with complex governance that hinders their use for innovative research.[15]

The COVID-19 pandemic has highlighted the critical need for a national, accessible, data asset that spans all states and territories. This will bring together disease notifications, primary care and hospital records, and death registrations to enable rapid generation of evidence about the impacts of pandemics and other emergencies, and answer additional critical questions to improve health and health services. This will also be crucial if we are to make best use of artificial intelligence in future.[16]

Strengthening and securing our workforce

To support early- and mid-career researchers (EMCRs) across the sector's disciplines, funding should be made available for additional emerging leadership NHMRC Investigator Grants to target the best and brightest applicants in the pool.

Strategic investment in disciplines across science, health, engineering, social sciences and the humanities will ensure we are equipped with the right mix of knowledge and expertise to address future challenges. Indeed, Australia's success in tackling the pandemic has relied on findings using a multi-disciplinary approach. The infographic, *'How interdisciplinary expertise is coming together to address the pandemic',* outlines key examples.

In particular, EMCRs play an important role in securing the future of our health and medical science workforce. However they face a particular set of challenges, and the sector is at risk of losing talented researchers at these career stages, who are crucial to delivering the government's vision for a world-leading health and medical research sector, now and in the future. Programs are required to support EMCRs in navigating these growing challenges so that we retain talent and nurture future leaders. AAHMS currently operates a highly regarded career development and engagement program, which could be broadened, with appropriate resourcing, to provide this crucial support.

We must utilise the full breadth of talent of Australia's research sector, with ongoing investment in programs that drive up diversity and inclusion in STEMM.

Case study: The impact of the pandemic on EMCRs

The pandemic has had profound impacts on the health and medical research sector, with funding and job security identified as concerning challenges for EMCRs. Our discussions with EMCRs have highlighted a number of causes of career disruptions due to the pandemic. This has included delays to funding processes and data acquisition, reduced funding opportunities, and reduced access to building networks and collaborations. These challenges all impact on EMCR ability to build experience and track record, vital foundations for future success.

Additionally, the university sector is under considerable financial strain and large numbers of academic staff have been made redundant.[17,18] These changes impact on EMCRs in two ways – firstly, there is little residual capacity for our research intensive universities to provide financial support; and secondly, academic mentors may no longer be working in the sector.

Call for funding

Funding is the primary mechanism through which these challenges can be addressed. We propose a program of support for early career health and medical researchers that would fund 40 additional emerging leadership (EL) NHMRC Investigator Grants per year:

- **Goal:** to ensure that we are supporting rising stars in health and medical research as part of Australia's recovery from the COVID-19 pandemic.

- **Delivery:** funding to support 40 additional Investigator Grants (20 EL1 and 20 EL2 levels) each year, starting with the forthcoming round. These additional awards could be targeted to the top 20 in each cohort, with recipients recognised and celebrated by giving the fellowships a specific title to signal their prestigious nature. Such recognition is valuable for building the career of an EMCR.

- **Outcomes:** increase overall success rates of these schemes and ensure that future research leaders are retained in the sector. Based on data from the most recent grant announcements, this approach would substantially increase success rates: from 12.4% to 15.4% for EL1 and from 10.0% to 15.1% for EL2.[19]

- **Process:** use the NHMRC Investigator Grant scheme to call for proposals and manage the peer review and ranking process.

- **Costs:** the required funding for each set of fellows would be $12.9M for EL1 and $31.2M for EL2: a total of $44.1M for 40 fellows across the two levels (based on 2021 funding rates, and it should be noted that additional salary top up will need to come from universities).[19,20] This program would need to continue for 3-5 years to address the period during which the impacts of the pandemic will be hardest felt.

How interdisciplinary expertise is coming together to address the pandemic

Expertise from across the disciplines has been crucial during the pandemic. This figure highlights just some of those contributions - it is by no means a comprehensive account.
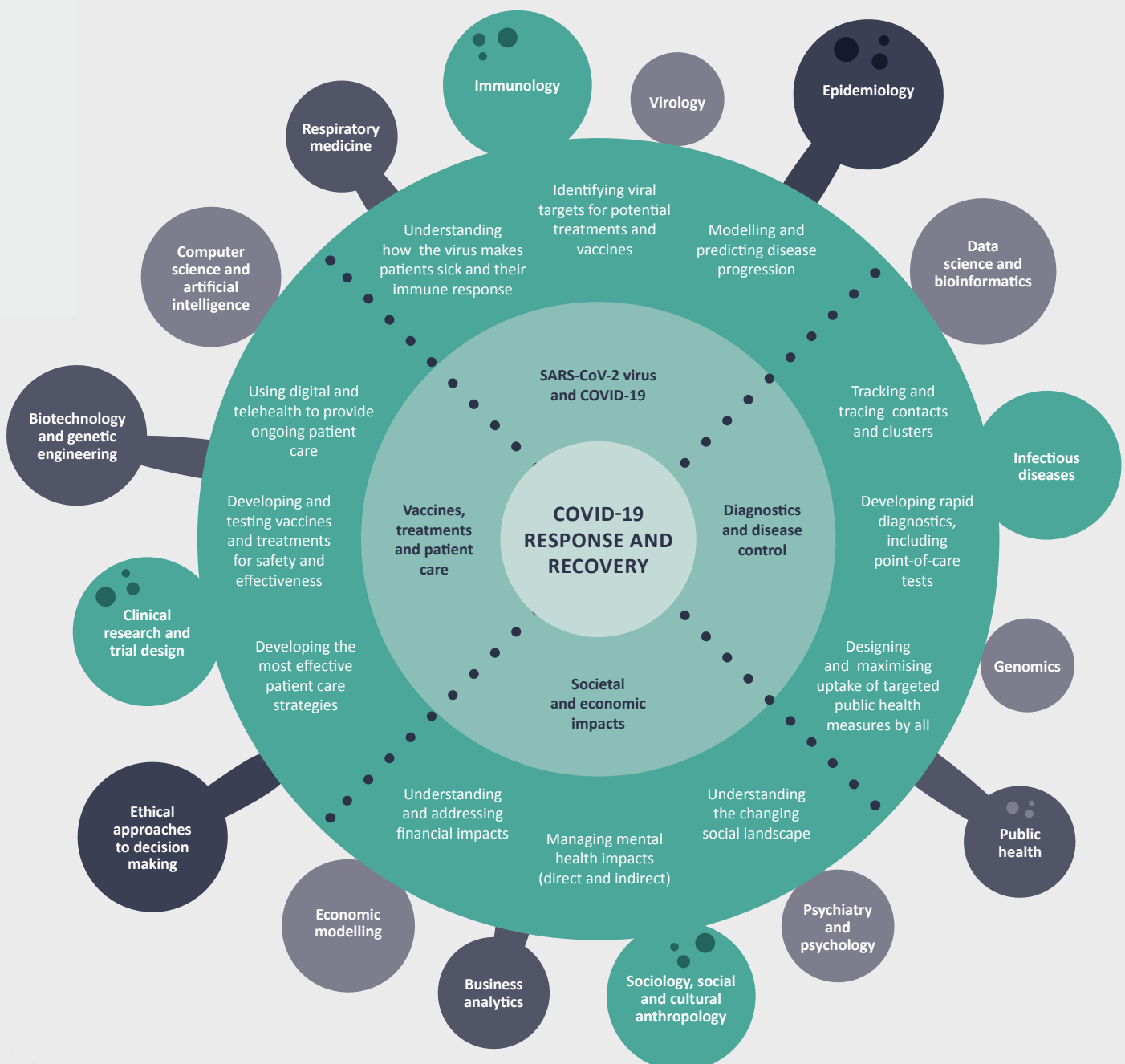
Embedding research in the health system to improve health and wellbeing

The benefits of embedding research and its translation in the health system are clear. These endeavours must be a priority objective across the health system and governments should use innovative incentives to encourage service providers to increase their commitment to research.

A thriving health and medical research sector underpins the nation's health. We have seen this play out as Australia has tackled the urgent threat of the COVID-19 pandemic and before that, the 2019/20 bushfires. Research and innovation will also be essential in addressing longer term health challenges, including chronic diseases, an ageing population and rising health inequalities, especially among Aboriginal and Torres Strait Islander communities. Better health brings societal and economic benefits.[21]

Health spending has grown faster than GDP over the past decade in Australia.[22] Research and innovation in health and medicine can deliver more efficient and effective care, but this is only possible if these endeavours are properly embedded and incentivised in the health system.

There is strong evidence that research-active hospitals and health services see direct benefits in patient outcomes and quality of care, compared with those that are not research-active. These benefits are not only seen in patients involved in studies, but also in other patients being cared for in similar care settings – the standard of care clearly improves.[23–26]

Clinician scientists are crucial to enable research-embedded healthcare as they provide leadership at the nexus of clinical practice and research. These individuals face a highly demanding career path, needing to undertake years of training as both a clinician and a researcher. This pathway can be difficult to navigate at the best of times, but the additional challenges caused by the COVID-19 pandemic amplify the barriers.

The Academy is working to develop a vision for how this can be achieved post-pandemic and we look forward to sharing our findings and recommendations as they emerge.

Case study: Pandemic benefits of embedding research into the health system

Based on a proactive approach to embedding research into the health system, Australian researchers participating in a global study known as REMAP-CAP[Δ] have had a research protocol agreed and ready to go since 2016.[11] In the event of a pandemic, this would allow researchers to rapidly start recruiting patients and testing treatments.

Their plans came to fruition when they recruited their first Australian COVID-19 patient as early as 10 March 2020. They have since been able to support global efforts to identify the most effective treatments for COVID-19.[27]

Δ Randomised, Embedded, Multi-factorial, Adaptive Platform Trial for Community-Acquired Pneumonia

Providing science advice for the benefit of all Australians

Expert scientific advice has played a key role in addressing the pandemic. Australian governments' efforts to seek out the evidence to inform decisions should be celebrated and the renewed bilateral relationship between governments and the sector nurtured and cemented.

The pandemic has demonstrated the value of interdisciplinary science advice in supporting interpretation and analysis of evidence in highly challenging and fast-changing circumstances. Along with the other Australian Learned Academies, AAHMS has been delighted to contribute to these efforts, especially through the Rapid Research Information Forum (RRIF), a joint initiative to ensure that science and research are put to best use for the benefit of the nation.[28] Expert advice and analysis on relevant issues can support and inform decision-making, and the Government has used such input effectively during the pandemic.

There is an opportunity to build on this successful partnership, making use of the best available evidence and expertise, to drive Australia's response to the pandemic and to support policymaking in other areas. Collectively, the Australian Learned Academies are a valuable national asset with memberships of expert Fellows that, with additional resourcing, would be well placed to provide a more sustainable source of authoritative analysis and input. The value placed on science advice will also help us attract global research talent that will strengthen the sector and bolster the role it is able to play in delivering future prosperity.

This submission was produced through input from Academy Fellows and Associate Members, including our Council, Reports Committee, COVID-19 Expert Committee and Mentorship Committee. The Academy is most grateful to these contributors.

It was reviewed and approved for publication by the Academy's Executive.

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We acknowledge the traditional custodians of the land on which our offices stand and on which we hold our meetings and events across the country. Aboriginal and/or Torres Strait Islander peoples were the nation's first scientists, and they remain the spiritual and cultural custodians of their land.

We pay our respects to elders past, present and emerging.

The Australian Academy of Health and Medical Sciences is the impartial, authoritative, cross-sector voice of health and medical science in Australia. We advance health and medical research in Australia and its translation into benefits for all, by fostering leadership within our sector, providing expert advice to decision makers, and engaging patients and the public. We are an independent, interdisciplinary body of 426 Fellows – elected by their peers for their outstanding achievements and exceptional contributions to health and medical science in Australia. Collectively, they are a representative and independent voice, through which we engage with the community, industry and governments.

The Academy is uniquely positioned to convene cross-sector stakeholders from across Australia to address the most pressing health challenges facing society. We focus on developing future generations of health and medical researchers, on providing independent expert advice to government and other stakeholders, and on providing a forum for discussing progress in health and medical research with an emphasis on translating research into practice.

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