



**NEW ZEALAND
RESEARCH
INFORMATION
SYSTEM**

**AOTEAROA NEW ZEALAND'S
COVID-19 RESEARCH RESPONSE**

AUGUST 2022



**MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT**
HĪKINA WHAKATUTUKI

Te Kāwanatanga o Aotearoa
New Zealand Government

Ministry of Business, Innovation and Employment (MBIE) Hīkina Whakatutuki – Lifting to make successful

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EXECUTIVE SUMMARY

The COVID-19 pandemic is one of the most significant events to affect Aotearoa New Zealand in recent history.

It has caused profound economic and social disruption, providing both challenges and opportunities for researchers. This report provides a snapshot of how the Aotearoa New Zealand research community has used this funding to produce world-leading research that has both informed and shaped the pandemic response.

This report shows how innovative organisations have been supported to contribute to the pandemic response. This has included \$10.5 million to support 20 projects led by the University of Auckland, one of Aotearoa New Zealand's biggest research organisations with significant capability in health, medicine and science. This continues the trend seen in our previous report published July 2020.

The report also illustrates how organisations that would not normally be associated with public health have contributed to the response. An example of this is the Xerra Earth Observation Institute which has used satellite data and maritime intelligence to strengthen maritime border security.

Our research organisations are also helping us understand COVID-19 and its implications for our society. Reports on projects funded by government indicate that we are seeing the new knowledge gained from publicly funded research informing our pandemic response.

The field of Public Health and Health Services accounts for around 34 per cent (1,192) of Aotearoa New Zealand's COVID-19-related publications. Of the research activities/publications that were notified to the COVID-19 Research Database and produced by universities, over 50 per cent came from the Universities of Auckland and Otago. These host Aotearoa New Zealand's Medical Schools and have significant health-research capability. These trends are a continuation of those seen in the previous report.

The level of specialisation in our top fields of research shows strong representation of commerce, management, tourism, and services. There were 452 research activities/publications notified to the COVID-19 Research Database were for studies in human society.

Our research is high quality. Aotearoa New Zealand's research publications tagged to COVID-19 are in the top 25 per cent of journals in 13 of the 15 fields measured. It is particularly strong for Marketing and Tourism studies with over 80 per cent of publications being in these highly respected journals. For the fields of Clinical Sciences and Public Health, 60 per cent and 66 per cent of articles respectively are in top-ranked journals. It is noted that Aotearoa New Zealand has more researchers and a higher number of publications in health and clinical disciplines than others, which may mean it is much harder for research efforts to stand out.

Early career researchers continue to be a vital component of our research effort with 29 per cent of the people authoring Aotearoa New Zealand's COVID-19 research outputs having less than five-years of publication experience. This is slightly up from 25 per cent reported in July 2020 and highlights the value of this group to our research efforts.

The report also highlights how we have contributed to the global COVID-19 knowledge base, improving understanding of the pandemic and its effects on our world. Aotearoa New Zealand has maintained a contribution rate of around 0.4 per cent of the total global publications on COVID-19, which is slightly above our usual share of publications (around 0.3 per cent).

It is noted that there has been a temporary trend towards non-traditional methods of publication for COVID-19 research, which has since reverted. In the July 2020 report, we noted around 18 per cent of our COVID-19 research publications were made available through pre-prints. This has now decreased to 7 per cent. It is also noted that 63 per cent of Aotearoa New Zealand's COVID-research outputs were published in open-access journals in 2020, this dropped to 55 per cent in 2021.

Finally, there are indications that the pandemic has allowed us to develop and grow international collaborations. Around 59 per cent of our COVID-19 research outputs were produced in partnership with international collaborators compared to 56 per cent on average across all research. This is an increase from 55 per cent seen for COVID-19 research in 2020. However, it seems that inter-institutional collaboration was lower than average with 16 per cent collaboration for COVID-19 research compared to 23 per cent across all fields. There was also a small increase in single-author papers, which is similar to the trends seen in the July 2020 report.

INTRODUCTION AND PURPOSE OF THIS REPORT

The global COVID-19 pandemic caused significant disruption to the way we live. As governments implemented public health measures to control the spread of the pandemic, people and organisations needed to swiftly adapt to ensure their own safety as well as the continued operation of their businesses and activities.

Challenges included restricted access to facilities and infrastructure, cancellation of conferences and events, and reduced income from commercial work. Recognising that the pandemic had the potential to disrupt research, the government directed funding towards supporting Aotearoa New Zealand's response to the pandemic, and other research with the potential to contribute to wellbeing objectives set out in the Budget 2022 Policy Statement. These objectives include:

- **Physical and mental wellbeing** Supporting improved health outcomes for all New Zealanders and keeping COVID-19 out of our communities.
- **Māori and Pacific** Lifting Māori and Pacific incomes, skills and opportunities, and combatting the impacts of COVID-19.
- **Future of Work** Enabling all New Zealanders and New Zealand businesses to benefit from new technologies, lift productivity and wages through innovation, and support into employment those most affected by COVID-19, such as women and young people.
- **Just Transition** Supporting the transition to a climate-resilient, sustainable and low-emissions economy while building back from COVID-19.

This report showcases how the Aotearoa New Zealand research, science and innovation (RSI) system responded to the challenges of the COVID-19 pandemic. The report combines information from the COVID-19 research database with other sources of information including the Dimensions bibliometric dataset to show both the RSI sectors response and Aotearoa New Zealand's contribution to the global COVID-19 knowledge base. This includes information about some of the research that has taken place including how funding has supported innovative organisations, how our research organisations help us understand COVID-19 and its implications for our society, what our fields of research are, our research quality and the role of early career researchers. We also show how Aotearoa New Zealand research contributions have improved the global understanding of the pandemic, the characteristics of publications and growth and development of collaborations. It is illustrated with vignettes provided by the sector.

During the early stages of the pandemic, the Government spent over \$400 M on new and reprioritised funding to support the RSI system to respond to the pandemic. Information on who received funding from MBIE can be found on the Who Got Funded? page on MBIE's website¹. Information can also be found in the COVID-19 research database² which was set up to capture information from the three main public funders – MBIE, the Health Research Council (HRC) and the Auckland Medical Research Foundation (AMRF). As it contains information provided voluntarily by researchers and organisations willing to share details on their work, it is by no means comprehensive and only records around \$30 million of funded research projects. Some fields may be blank either because the data was not available or the submitter chose not to provide it. The methodology for the COVID-19 research database is covered in Appendix 1.

Funding to support the COVID-19 research response has also come from existing sources including Centres of Research Excellence (CoREs), the Strategic Science Investment Fund, and National Science Challenges, as well as discretionary funding from organisations.

¹ <https://www.mbie.govt.nz/science-and-technology/science-and-innovation/funding-information-and-opportunities/investment-funds/who-got-funded/>
² <https://www.mbie.govt.nz/science-and-technology/science-and-innovation/research-and-data/nzris/covid-19-research-database/>

THE RESEARCH, SCIENCE AND INNOVATION SECTOR RESPONSE IN AOTEAROA NEW ZEALAND

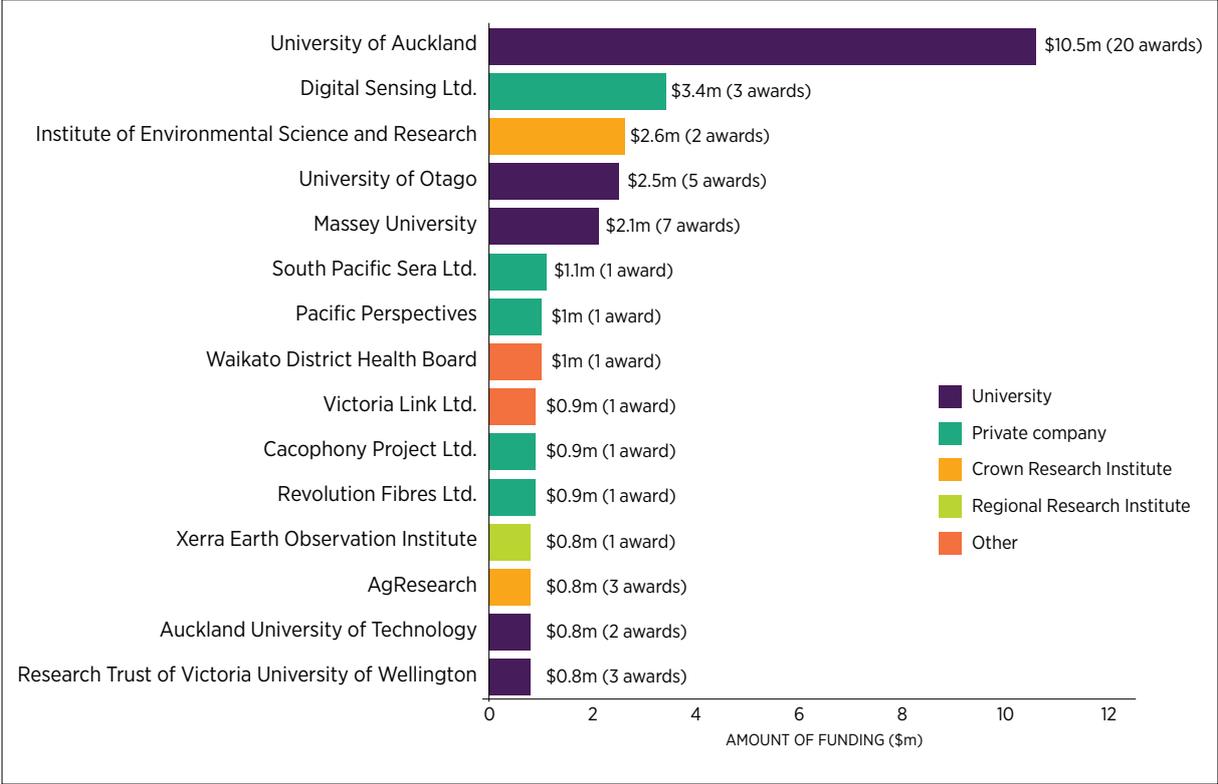
FUNDING HAS SUPPORTED INNOVATIVE ORGANISATIONS TO CONTRIBUTE TO OUR RESPONSE

Information in the COVID-19 research database indicates that the University of Auckland has received the greatest amount of public funding for COVID-19 research (Figure 1) from the AMRF, HRC funds, and CIAF. This is unsurprising considering the University is one of our biggest research organisations and has significant capability in health, medicine and science which are key fields for COVID-19 research. Around \$4 million of the funding is associated with improving Aotearoa New Zealand's epidemic model to inform policy and decision-making capability. More information about projects funded can be found in the COVID-19 Research Database

Of the 15 organisations receiving the most funding in the COVID-19 research database, 5 are private companies, 5 are universities or linked research arms, and 2 are Crown Research Institutes. This reflects the aims of key funding initiatives such as the COVID-19 Innovation Acceleration Fund (CIAF), which is targeted at commercial research and development, prototyping and pre-production activities. The University of Auckland has a strong and successful commercialisation arm (Auckland UniServices), which makes it well placed to compete with firms for innovation funding. It is noted that Digital Sensing Limited also illustrates this and was funded to develop point-of-care COVID-19 diagnostics that use blood-based biomarkers to identify patients infected with COVID-19.

The data also shows how research organisations that would not normally be associated with the COVID-19 response are working to address the challenges of the pandemic. For example, the Xerra Earth Observation Institute has collaborated with other organisations to analyse satellite data and maritime intelligence from across the globe with the aim of strengthening maritime border security and reducing the risk of undetected COVID-19 transmission via maritime borders.

Figure 1: Largest recipients of AMRF, Joint Health Investment, and CIAF funding for COVID-19 research in Aotearoa New Zealand 2021



Data source: NZRIS COVID-19 Research Database

Efficient ethanol-based hand sanitiser production from wine industry grape marc waste

Tanya Rutan and Matias Kinzurik

Bragato Research Institute

\$84,700 (NZD) from the COVID-19 Innovation Acceleration Fund

Increased support for industrial research is valuable for the COVID-19 recovery in New Zealand. In this project, researchers worked with the wine industry to sustainably produce hand sanitiser out of waste materials from winemaking, producing a product valuable in controlling the spread of COVID-19 and allowing wine producers to explore new avenues to diversify their business and create revenue from waste products.

The production trial produced over 100 bottles of sanitiser which were donated to local organisations including St Johns, the Red Cross and local medical centres. As well as controlling COVID-19 spread, the exercise fostered strong relations with the local community and delivered economic and environmental benefits through the use of materials that would have otherwise gone to waste. Wineries would also benefit through cost savings from reducing the amount of waste material, particularly if paying for disposal based on weight.

Although scale-up has not occurred at this point, the project demonstrated the technical feasibility of manufacturing sanitiser using this process and could be used by wineries to handle their by-products.

OUR RESEARCH ORGANISATIONS ARE HELPING US UNDERSTAND COVID-19 AND ITS IMPLICATIONS FOR OUR SOCIETY

Reports on projects funded by government indicate that we are seeing the new knowledge gained from publicly funded research informing our pandemic response.

Infection risk model of airborne transmission to facilitate decisions about PPE (personal protective equipment), ventilation, and isolation in shared indoor spaces

Mark Jermy, Jason Chen, Donald Derrick and Matthew Henderson (University of Canterbury) and Guy Coulson (NIWA)

University of Canterbury and The National Institute of Water and Atmospheric Research (NIWA)

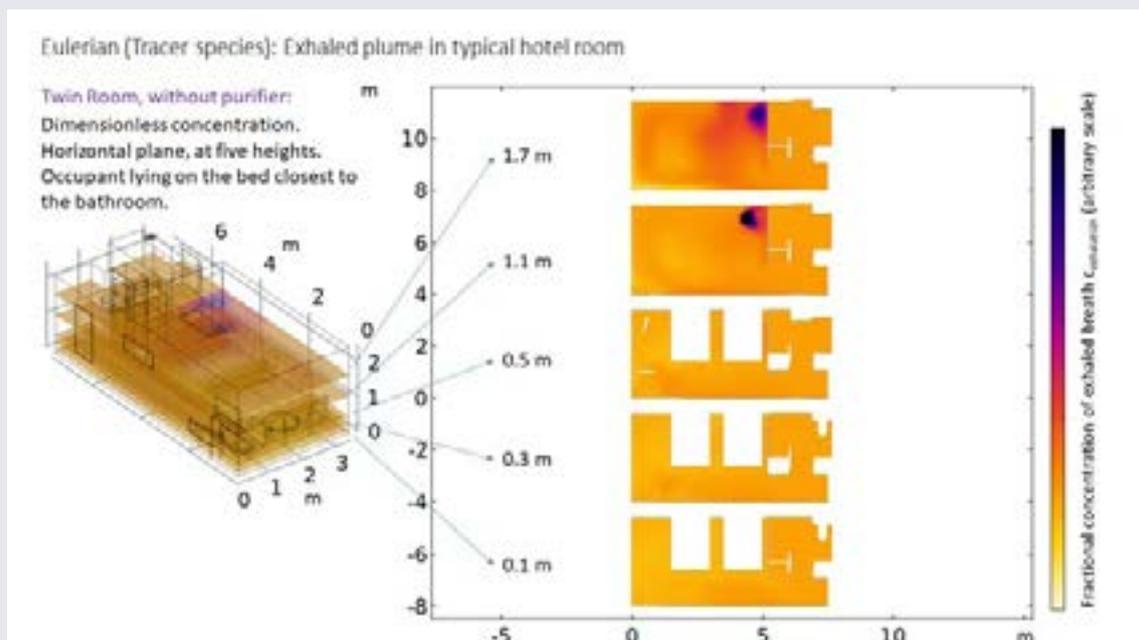
\$513,022 (NZD) from MBIE's COVID-19 Innovation Acceleration Fund

The research project was undertaken by researchers at the University of Canterbury in collaboration with a number of other organisations. These included universities, government agencies, BRANZ (Building and Research Association of New Zealand), providers of residential care, Managed Isolation and Quarantine Facilities (MIQ), DHBs, Fisher and Paykel Healthcare, the NZ Indoor Air Quality Research Centre, the World Health Organisation (WHO) and the Queensland University of Technology.

This project developed methods to estimate the risk of transmission of COVID-19 through the air and estimate the effect of control strategies such as masks, ventilation, and air filtration. This resulted in better understanding of the risks associated with different environments, including MIQ facilities, offices, gyms, buses, theatres, and schools. Researchers worked directly with operators to inform decisions on how indoor spaces were to be used, what ventilation and air cleaning strategies would reduce the risk of infection, and the public health measures needed to support this. This modelling informed protocols and processes that were put in place at the facilities to reduce infection rates and protect the health of people using these facilities.

Illustration 1: Modelling the dispersion of exhaled breath in a typical hotel room (Dr Jason Chen)

Below is a plot of output from some of our modelling methods: the concentration of breath, exhaled by an occupant, throughout a hotel room. The concentration of exhaled breath is a factor in the risk of infection to a worker entering the room. The modelling is based on observed data from particle detection instruments used to determine particle removal rates from test rooms using non-infectious naturally occurring particles.



Most of the research projects notified to the COVID-19 Research Database have been produced by staff at tertiary education organisations (Table 1 below). This is unsurprising given academic staff at universities, which are part of this group, disseminate knowledge through publication of academic papers, and university rankings and other performance indicators often include bibliometric measures, which encourages high publication rates.

Table 1. Research projects by organisations in the COVID-19 database

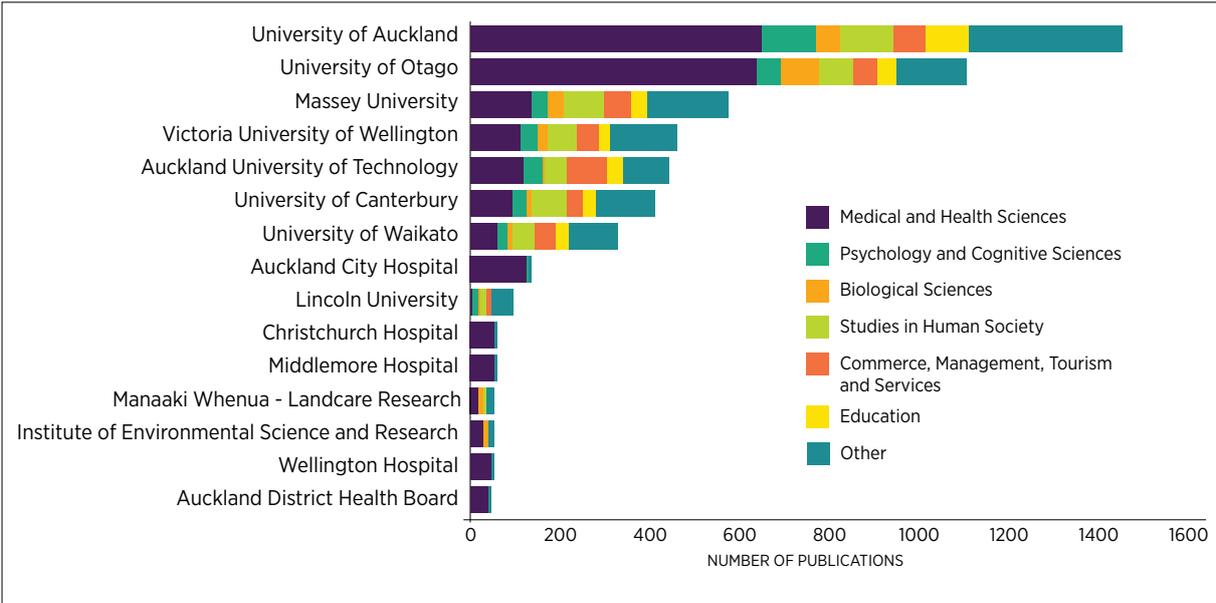
	Total research activities 2020 22
Tertiary Education	177
Crown Research Institute	7
Regional Research Institute	3
Private company	7
Other*	3

*Other includes trusts and private research institutes etc.
 Data source: NZRIS COVID-19 Research Database

Over 50 per cent of the research publications identified as COVID-19 related in the Dimensions dataset, were produced by the Universities of Auckland and Otago (Figure 2 below). While it is unclear which of these publications were funded through specific COVID-19 research funds versus more general public or private funds, it does show that these organisations are improving our national and global understanding of the pandemic. The inclusion of specific funding identifiers in publications would increase the availability of this information in the future and allow us to identify how many were associated with awards from publicly funded COVID-19 research grants.

Strong performance by the Universities of Auckland and Otago likely reflects their established expertise. Both host medical schools and are recognised for their strengths in health, medical and natural sciences, which are the largest research categories of COVID-19 research at both universities. Although all universities are comprehensive and contribute to all broad research categories, the University of Auckland is much larger than the others, which is reflected in its greater share of publications in human society, education and psychology compared to others.

Figure 2: Number of COVID-19-related research publications by organisation in Aotearoa New Zealand January 2020–April 2022



Data source: Dimensions

Unsurprisingly, the field of medical and health sciences dominates the fields of research for our COVID-19-related publications. In addition to the universities, key contributors include large hospitals and the Institute of Environmental Science and Research (ESR). ESR has been responsible for Aotearoa New Zealand's COVID-19 testing and genetic sequencing capability.

Harirū, Hongi and Hau in the time of COVID-19 study

Marama Muru-Lanning, Tia Dawes, Hilary Lapsley, Ngāpare Hopa, Ngahuia Dixon, Charmaine Tukiri, Nicholas Jones, Charlotte Muru-Lanning, Moana Oh, Keri Mills, and Suzanne Woodward

University of Auckland

\$101,922 (NZD) from the Health Research Council's 2020 COVID-19 New Zealand Rapid Response Research

This work explored kaumātua experiences during and shortly after the first COVID-19 lockdown in Aotearoa/ New Zealand, particularly how kaumātua understand the tapu of the body and tikanga relevant to the spread of COVID-19.

The work has had direct impacts on the health of Māori throughout the pandemic. The study looked at how older Māori understand hau (vitality of a person), bodily fluids and the tapu of the body, and how they anticipated navigating advice and regulations around personal distancing, self-isolating, and gatherings. Proper knowledge of how COVID-19 is understood by kaumātua is vital in developing pathways that promote health and wellbeing, beneficial policy formation, healthy and resilient communities and culturally appropriate services for Māori. It is expected that study findings will become integrated into research and teaching literature on Māori health, anthropology, and Māori ageing. The research found that Tikanga, which kaumātua lead on, can be flexible and altered in certain circumstances, a finding that influenced the changes made at marae and for tanghanga during COVID-19.

The findings also underscored that Kaumātua need to hear Māori voices which they trust, presenting information about COVID. The lack of Māori voices in official news sources continued with the second pandemic lockdown, which saw lower rates of vaccination for Māori than other groups. Tremendous efforts were made by Māori health organisations to use community methods to share information. These were successful and contributed to increased vaccination rates and better health outcomes for Māori.

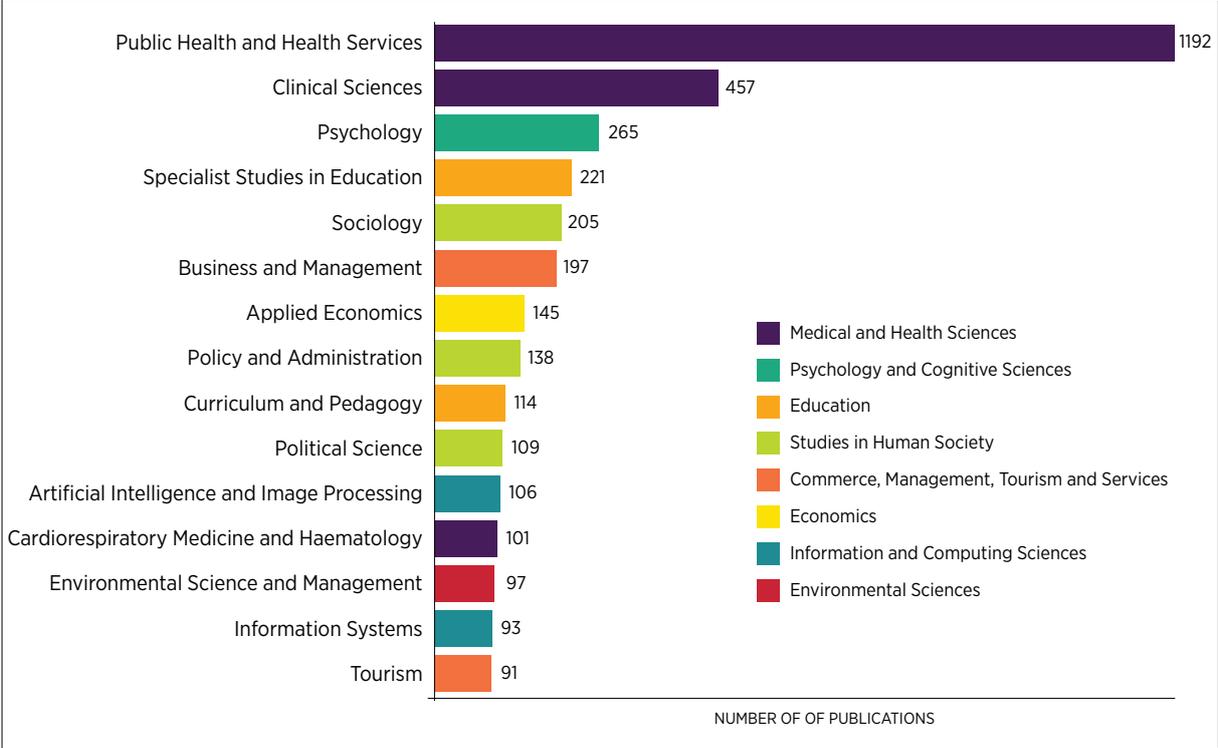
Illustration 2: A Zoom hui with the 'Harirū, Hongi and Hau in the time of COVID-19 research team', including community kaumātua researchers



OUR RESEARCH IS SPREAD ACROSS SOCIETAL AND WELLBEING FIELDS AS WELL AS THE EXPECTED PUBLIC HEALTH AND CLINICAL RESEARCH FIELDS

As shown in Figure 3, Public Health and Health Services, and Clinical Sciences research are the two dominant fields amongst Aotearoa New Zealand’s research response to COVID-19. This is consistent with preliminary trends identified in the July 2020 report and mirrors global trends in COVID-19 publication fields.

Figure 3: Number of COVID-19-related research publications by field of research (FOR) in Aotearoa New Zealand January 2020- April 2022

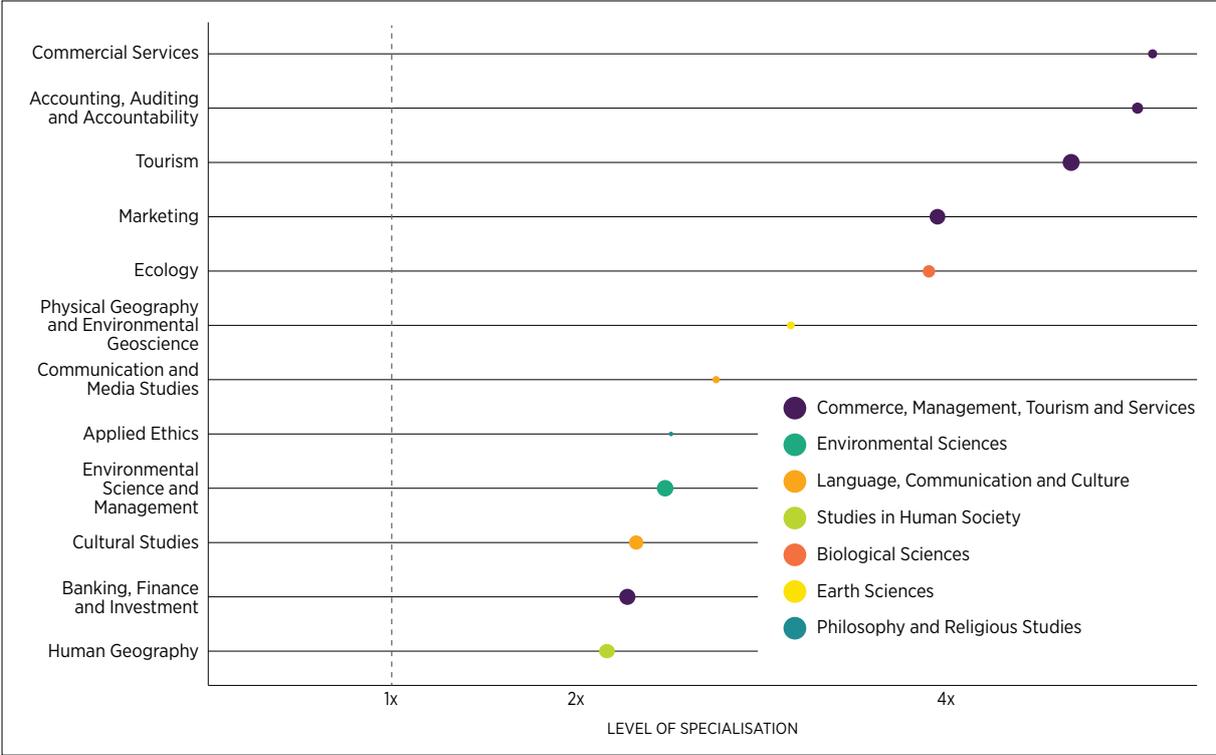


Data source: Dimensions

At the same time, we are also seeing a significant number of research publications classified as studies in human society. This may reflect a change in focus from understanding the cause of the pandemic to addressing its aftermath in sectors of particular importance to our economy, culture, and environment. For example, as indicated in Figure 2, Auckland University of Technology has made a strong contribution in the field of Commerce, Management, Tourism and Services. This not only reflects its areas of strength, but also reflects the importance of the tourism sector to our economy.

In comparison with global research trends³, New Zealand seems to produce a greater proportion of applied research focussed on understanding the socio-economic impacts of COVID-19 than other countries. The level of specialisation in our top fields of research (Figure 4), shows strong representation of commerce, management, tourism, and services fields compared to the global average. This reflects areas of the economy important to Aotearoa New Zealand’s growth and development, which have been the hardest hit by the pandemic.

Figure 4: COVID-19 research specialisations for Aotearoa New Zealand compared to global average



Data source: Dimensions

³ Measured by Revealed Comparative Advantage; see methodology in Appendix for details.

Have Our Say: social connectedness amongst older people during COVID-19 study

Merryn Gott, Tessa Morgan, Lisa Williams, Janine Wiles, Stella Black, Tess Moeke-Maxwell, Anne Koh, Liz Fanueli, Jing Xu, Kathryn Morgan, Hetty Goodwin

University of Auckland

\$98,257 (NZD) from Auckland Medical Research Foundation’s COVID-19 Research Fund

This work, undertaken in collaboration with the Auckland War Memorial Museum and Age Concern, gathered information about the experience and views of 900 older New Zealanders, aged over 60 years, during the first year of the pandemic.

The project created a historical record of older people’s experiences through the creation of a repository hosted by Auckland War Memorial Museum. The study raised awareness of the effect of loneliness and isolation as well as the health and social impacts of lockdowns. Findings have been used to inform policy and process at Age Concern, improving their ability to support older people through this type of event. It has also been used to inform the media around how it reports on the views and experiences of older people through the creation of guidelines for engaging with older people.

Illustration 3: “Dr Ashley was a rock thru lockdown, so I painted him on one.” Painting of Dr Ashley Bloomfield by a Have Our Say participant.



Whitu – seven ways in seven days: a well-being app to help Aotearoa New Zealand’s young people get through the COVID-19 pandemic.

Anna Serlachius and Hiran Thabrew

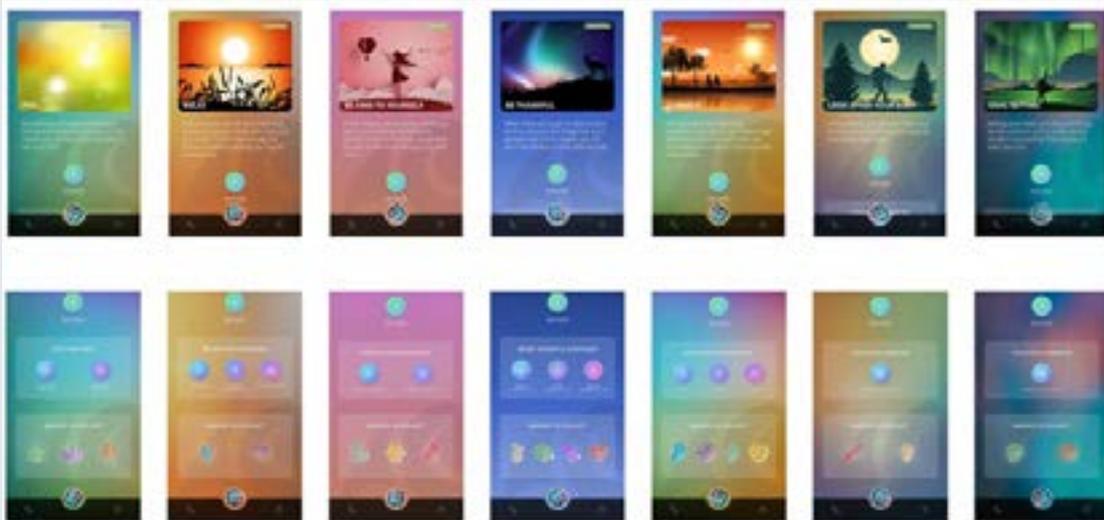
University of Auckland

\$98,281 (NZD) Auckland Medical Research Foundation’s COVID-19 Research Fund

This work was undertaken in response to concerns about the international trends in psychological issues impacting rangatahi in Aotearoa as social distancing and lockdowns commenced. The project co-designed and built a seven-module App with rangatahi and whanau from the Tamaki Makaurau region to help rangatahi mitigate pandemic-related risks. App content is based on evidence-based well-being and mental health management strategies, including cognitive behaviour therapy (CBT), psychoeducation, and positive psychology techniques previously shown to be effective for young people. The team included Māori and Pacific researchers, and the app was developed in a way that was culturally acceptable to Māori users.

In trials, the App was shown to improve emotional and mental well-being, with reductions in anxiety, stress and depression and improved sleep and self-compassion among young people aged 16 and over. A qualitative study with high school students was conducted in early 2022 to evaluate how the content and design of the app might be modified for a school-based trial. The results from this have been shared with their IT partner, who is ready to create a school-based version of the app called ‘Whitu - For School’ (WFS). To improve the bicultural relevance of the app, the group plans to translate all seven modules into Te Reo Māori.

Illustration 4: The Whitu: 7 ways in 7 days app.



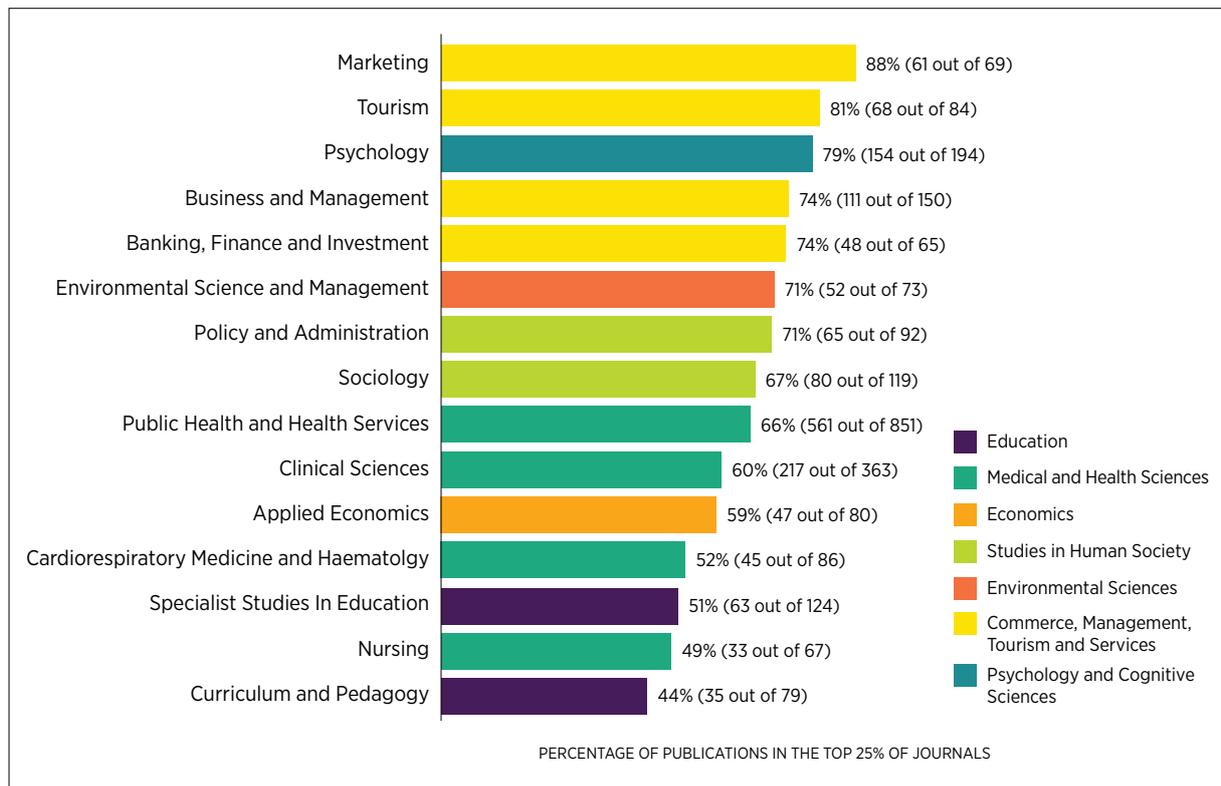
OUR RESEARCH IS PUBLISHED IN WELL-REGARDED JOURNALS

Despite the urgency associated with contributing to the COVID-19 research effort, bibliometric data shows that the quality of our research outputs is likely to be high. The data in Figure 5 show that most of Aotearoa New Zealand’s publications that are tagged to COVID-19 research are published in the top 25 per cent of journals in that particular research field (defined by the impact factor of the journal). This is likely to translate into global recognition of our research strengths and the important contribution we have made to the international pandemic response.

It is particularly interesting to see high proportions of publications in highly regarded journals for the fields of marketing, business and other subjects linked to COVID-19 recovery. This may indicate that this research is supporting Aotearoa New Zealand’s recovery from the pandemic and is being used to inform economic and social changes required to achieve our wellbeing goals. It is worth noting that these fields should be viewed in their broadest sense, for example marketing research could relate to collaborations linked to promoting public health messages as well as business-focussed promotion.

However, we should note that for fields such as public health that are more closely linked to the pandemic response, Aotearoa New Zealand has more researchers and a higher number of publications. This coupled to the global increase in COVID-related health publications may mean it is much harder for research efforts to stand out and our lower relative performance does not necessarily mean we lack excellent quality research in these fields.

Figure 5: Proportion of our COVID-19 research publications in the top 25 per cent of journals by field of research

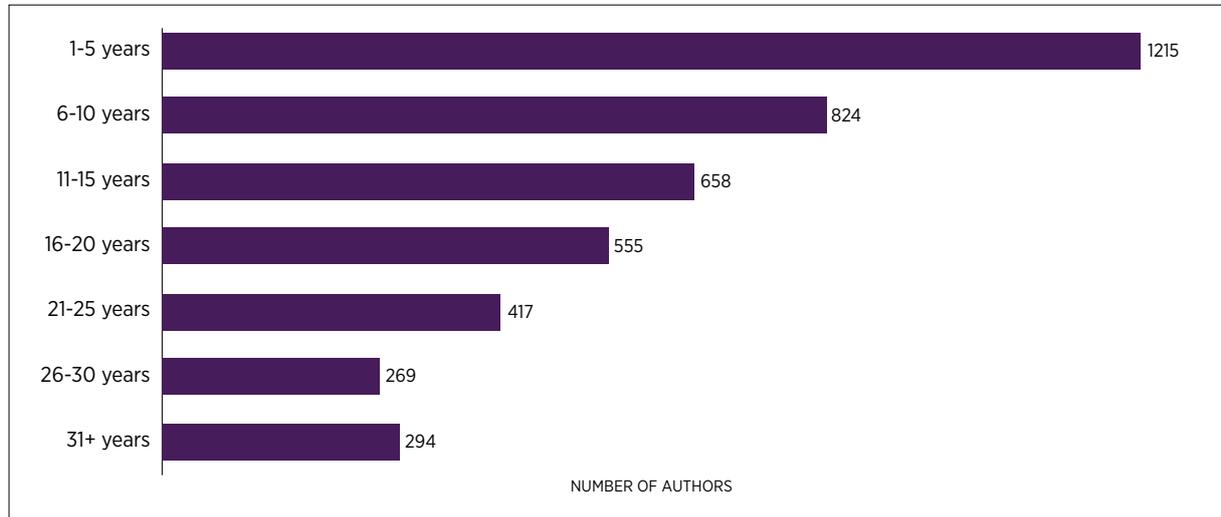


Data source: Dimensions, CWTS Leiden Journal Rankings

EARLY CAREER RESEARCHERS CONTINUE TO BE A VITAL COMPONENT OF OUR RESEARCH EFFORT

Over a quarter (29 per cent) of the people publishing Aotearoa New Zealand’s COVID-19 research are early career researchers (ECRs) with less than five-years of publication experience (Figure 6). This is slightly higher than for authors of all publications in 2019 and indicates that ECRs are in general a vital component of our research effort.

Figure 6: Career stage of Aotearoa New Zealand’s COVID-19 researchers



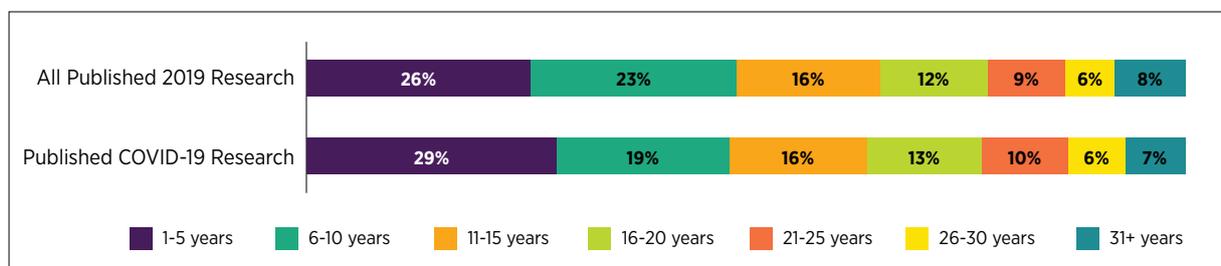
Data source: Dimensions

This is not new and mirrors the pre-COVID situation in Aotearoa New Zealand, underscoring the reliance our RSI system places on our ECRs (Figure 7). It is noted that this data comes from bibliometric sources and only shows researchers who have published in the relevant time periods. For this reason it will not represent all research undertaken by the wider RSI workforce. However, this information is still useful in showing the relative contribution of Aotearoa New Zealand researchers globally.

This is an area of interest to MBIE and other agencies, which are undertaking further research to understand the role of ECRs in the RSI system. This work will be used to inform approaches to talent development and retention, as well as understanding the capability and capacity of researchers across the system.

In recognition of the importance ECRs play and the career stability issues they have experienced due to the pandemic, MBIE funded the MBIE Science Whitinga Fellowships to provide opportunities for our ECRs whose careers had been affected by COVID-19. These one-off fellowships provided support of around \$10 million over two years to support 30 Fellows with the potential to excel in a research environment.

Figure 7: Distribution of career stages before and after the COVID-19 pandemic in Aotearoa New Zealand



Data source: Dimensions

Genomic epidemiology and evolution of COVID-19 in New Zealand study

Jemma Geoghegan and Joep de Ligt

University of Otago and ESR

\$600,000 (NZD) from MBIE's COVID-19 Innovation Acceleration Fund

This work is led by Jemma Geoghegan, an early career researcher who completed her PhD in population genetics at the University of Otago. She is an evolutionary biologist and virologist with a strong research focus on emerging infectious disease including viral evolution, ecology and emergence.

Dr Geoghegan was part of the team that was the first to identify that biological features of viruses could predict human-to-human transmissibility and has combined this knowledge with genomic and epidemiological data to uncover important insights about the epidemiology and evolution of COVID-19. This work helped establish the routine identification and sequencing of COVID-19 strains circulating in Aotearoa New Zealand, and her findings directly informed the Aotearoa New Zealand response to new cases, influencing decisions on changes to alert levels and the introduction of prevention and mitigation measures.

Dr Geoghegan was awarded the 2021 Te Puiaki Kaipūtaiao Maea MacDiarmid Emerging Scientist Award, which is part of the suite of Prime Ministers Science Prizes. The award recognises her significant expertise and outstanding contribution to the research sector.

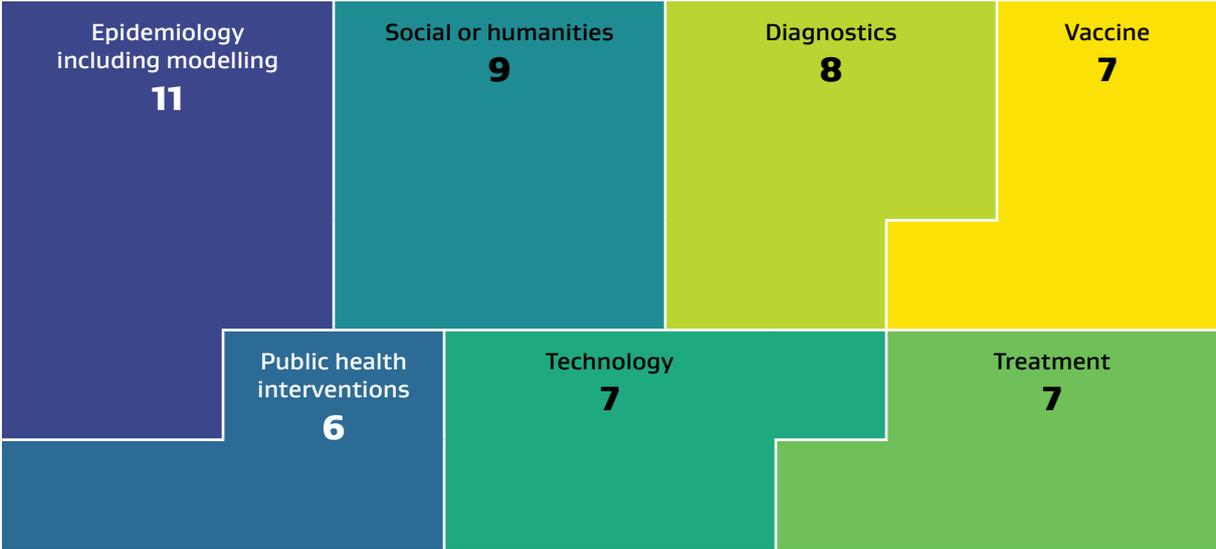
OUR CONTRIBUTION TO THE COVID-19 KNOWLEDGE BASE

AOTEAROA NEW ZEALAND'S CONTRIBUTION HAS IMPROVED GLOBAL UNDERSTANDING OF THE PANDEMIC AND ITS EFFECTS ON OUR WORLD

Aotearoa New Zealand has contributed around 0.4 per cent of the total global publications on COVID-19, which is slightly above our usual share of publications (0.3 per cent). Publications recorded in the COVID-19 research database reflect our known specialities in health and medical research (Figure 8), although it is noted that the database only includes a small subset of Aotearoa New Zealand publications tagged to COVID-19 as reported by database contributors.

As the 2021 RSI System Performance report shows⁴, our research system has a higher publication rate than other nations that form part of the Small Advanced Economies grouping. Aotearoa New Zealand produces around 14 publications per million dollars of investment compared to around 10.3 publications for Australia and 8.6 for Denmark This has continued through our COVID-19 research.

Figure 8: Research activity by type in the COVID-19 database (excludes 'other' category).



Data source: NZRIS COVID-19 Research Database

⁴ <https://mbienz.shinyapps.io/research-science-innovation-report/>

Rapid diagnosis and genome sequencing to follow COVID-19 outbreak

Olin Silander and Nikki Freed

Massey University

\$165,471 from the Health Research Council's 2020 COVID-19 New Zealand Rapid Response Research

This work involved developing a novel method for genome sequencing of COVID-19. This method (the Midnight Method) allowed fast and rapid tracking of outbreaks. The Midnight Method enables countries with limited resources to establish whole genome sequencing for COVID-19. The method has been used in South Africa to track the emergence of the Omicron variant as well as in over 85 other nations such as the UK, USA, and Canada. It is now the only method used in New Zealand due to its ease of use, low cost, and rapid turnaround. Genetic sequencing of samples from COVID-19 patients, carried out through this method has been used to inform studies of virus evolution and epidemiology.

The success of the Midnight Method stems from relationships with two collaborators – Integrated DNA Technologies which manufactures primers necessary for amplifying DNA, and Oxford Nanopore Technologies, which manufactures and distributes the Midnight Kit globally. Oxford Nanopore Technologies has stated that the Midnight method significantly contributed to the value of its initial public share offering with the initial valuation of the company at close to £5 billion (\$7.3 billion NZD).

THERE HAS BEEN A TEMPORARY NEED FOR NON-TRADITIONAL METHODS OF PUBLICATION, WHICH HAS SINCE REVERTED

Our first report, published in July 2020, indicated around 18 per cent) of our COVID-19 research publications were made available through pre-prints. Pre-prints are draft research papers that are shared publicly prior to peer review and are an increasingly common way to share research findings, particularly in critical situations where the usual publication and review methods are subject to delay.

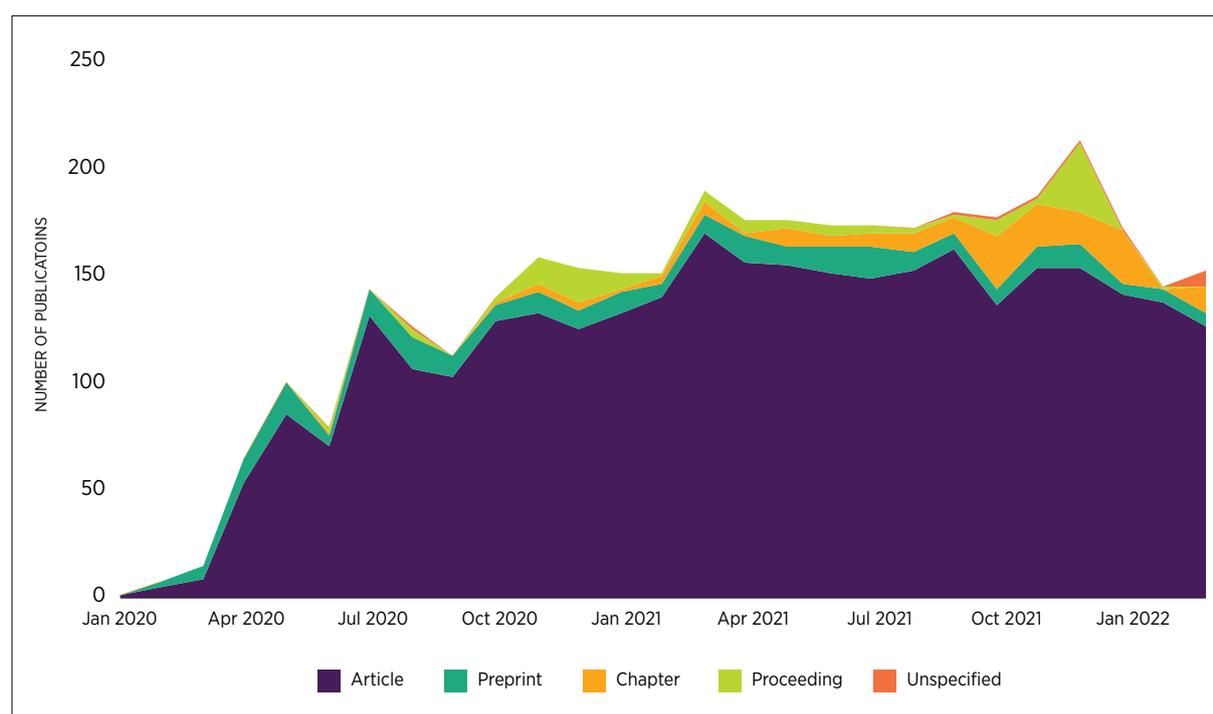
Use of pre-prints for our COVID-19 research has decreased, but is higher than for non-COVID-19 research (Table 2). This might reflect the initial urgency to publish quickly in order to inform the COVID-19 response. Figure 9 shows that the number of pre-prints has decreased with the number of articles and chapters increasing. This may reflect a move back to more traditional publishing behaviours and could reflect the decline in urgency associated with COVID-19 publications as government and the medical community come to grips with the response.

Table 2: Comparison of publications using preprint servers versus open access licences from January 2020 to March 2022

	Preprints	Open access
Global January 2020 to March 2022 total publications	6%	51%
Global COVID-19	2%	70%
New Zealand January 2020 to March 2022 total publications	4%	46%
New Zealand COVID-19	9%	67%

Data source: Dimensions

Figure 9: Aotearoa New Zealand COVID-19 Research Publications by date and type 2020-2022



Data source: Dimensions

It is notable that most of Aotearoa New Zealand's COVID-research outputs are published in open-access journals (Table 3). Open access provides for the transparent sharing of knowledge, thereby allowing others to access information and build on research findings.

Table 3: Publication type for Aotearoa New Zealand COVID-19 research publications for 2021 and 2022

	2020		2021	
	Number	% of total	Number	% of total
Preprint	156	13	172	7
Article (open access)	744	63	1,404	55
Article (closed access)	245	20	720	28
Other*	56	4	237	10
Total	1,231	100	2,533	100

*Other includes conference proceedings, book chapters and monographs.

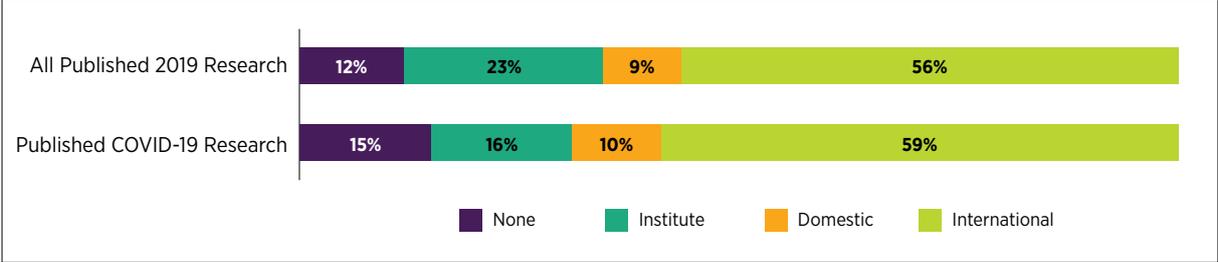
Data source: Dimensions

THE PANDEMIC HAS ALLOWED US TO DEVELOP AND GROW INTERNATIONAL COLLABORATIONS

New Zealand’s research community has embraced working in partnership to address research issues raised by the pandemic (Figure 10), with around 59 per cent of our COVID-19 research outputs produced in partnership with international collaborators. This is around 3 percentage points higher than collaborations for all published research.

However, there are lower levels of institutional collaboration and higher levels of single-author publication, which may reflect a decrease in collaboration at the national level. It is not clear why domestic collaboration rates remain relatively low. It is likely that this is influenced by existing systemic structures and processes as well as pre-existing capacity and capability in COVID research fields.

Figure 10: Collaboration* rates for research before and after the COVID-19 pandemic



Data source: Dimensions

*An ‘institute’ collaboration is where collaborators are from the same institution. A domestic collaboration is between researchers at different institutions, but within the same country. International collaborations are between researchers in different countries.

Predict and Prevent COVID-19: a data driven innovation project

Colin Simpson, David Welch, Nigel French, Mehnaz Adnan, Binh Nguyen, Winston Seah, Andrew Sporle, David Murdoch, Michael Baker and Alexei Drummond.

Victoria University of Wellington

\$533,224 from the Health Research Council’s 2020 COVID-19 New Zealand Rapid Response Research

The group leveraged its collective experience to interpret the data from genomic sequencing so that it could be used to predict the behaviour of the virus in Aotearoa New Zealand and inform the public health response. This included developing and refining methods to link cases to clusters, monitoring cases coming across the border, identifying chains of transmission, and tracking the speed that the virus spreads in the community. Findings were used to inform the Ministry of Health and broader government response to the pandemic, which the OECD’s 2022 Economic Survey recognised as leading to a quick economic recovery.

This study was undertaken in collaboration with researchers at ESR, the University of Auckland, the University of Otago, Massey University and NextStrain, an open-source platform for real-time tracking of pathogen evolution.

Collaboration rates are overall not dissimilar from pre-pandemic levels, which is encouraging given it is more difficult for our researchers to network and connect with others. Although moving conferences and events online has made them more accessible and affordable, anecdotal evidence shows they are often scheduled at times that make it difficult for people based in Aotearoa New Zealand to attend. In addition, researchers have said that online networking lacks the spontaneity of in-person meetings.

Nevertheless, there has been a global trend of international collaborations involving more countries, which means research groups can access diverse experiences and perspectives that support research processes and open up new lines of enquiry. It is particularly important for Aotearoa New Zealand researchers to be able to partner internationally as the lack of COVID-19 patients and samples has been a barrier to some research. A biobank to address this has been funded through the COVID-19 Innovation Acceleration Fund to support validation of diagnostic tests.

APPENDIX 1: DATA SOURCES

THE COVID-19 RESEARCH DATABASE

This report uses information from the COVID-19 Research Database.

The New Zealand Research Information System (NZRIS) team, based at MBIE, administers the COVID-19 Research Database on behalf of the RSI sector. Data is provided by researchers and research organisations and belongs to those who have submitted it. The data collected aligns with standards set by NZRIS.

The database collates data from three funders – Ministry of Business, Innovation and Employment (MBIE), the Auckland Medical Research Foundation (AMRF), and the Health Research Council (HRC) – and research activities from universities, Crown Research Institutes, and independent research organisations. As the information is provided voluntarily by researchers and organisations willing to share details of their work, it is by no means comprehensive and does not cover all COVID-19 funding. Some fields may be blank either because the data was not available, or the submitter chose not to provide it. MBIE is not responsible for the accuracy of the data, and any enquiries about specific research activities should be directed to the organisation or researcher that provided the data.

The initial database was developed and supported by Universities New Zealand. Universities New Zealand, research funders such as the Health Research Council, and key government agencies such as the Ministry of Health and Department of Prime Minister and Cabinet are all supporting this work.

DIMENSIONS DATA

Bibliometrics data was sourced from Digital Science's Dimensions platform available at <https://app.dimensions.ai>, for outputs published between 1 January 2020 to 31 March 2022. Access was granted to subscription-only data sources under the licence agreement. It is noted that there may be some delay between a publication being published and appearing in Dimensions.

COVID-19-related publications were identified using a technique developed by Dimensions in cooperation with immunologists and virologists. Publications were classified as "COVID-19 publications" if they were published in 2020 or 2021, and their title, abstract, or full text matched the following boolean search string:

"2019-nCoV" OR "COVID-19" OR "SARS-CoV-2" OR "HCoV2019" OR "hcov" OR "NCOVID-19" OR "severe acute respiratory syndrome coronavirus 2" OR "severe acute respiratory syndrome corona virus 2" OR (("coronavirus" OR "corona virus") AND (Wuhan OR China OR novel))

A publication was considered to be affiliated with New Zealand if it had at least one author who was affiliated with a New Zealand research organisation. Publications are assigned to organisations using affiliation string matching, performed by Dimensions using the GRID.ac database. Institute names, countries, and types are determined based on GRID data.

Fields of research are classified using the Australian and New Zealand Standard Research Classification (ANZSRC) 2008 system. There are 157 four-digit ANZSRC Fields of Research (FoR) groups, which are in turn aggregated into 22 two-digit ANZSRC FoR divisions. We have generally reported on publications at the four-digit ANZSRC FoR group level. In places, we have aggregated these figures to the two-digit division level, and in these cases, we have referred to this as the publication's division.

Research specialisation is calculated based on “Revealed Comparative Advantage”, which for these purposes is equal to the proportion of publications in a given cohort that fall within a given field of research, divided by the proportion of all publications that fall within the field of research. This index provides a measure of the relative focus given to a specific field of research, centred around one.

Journal rankings are based on the CWTS Leiden University journal rankings (2021 release). Journals are considered to be in the top 25% of journals if they are in the top 25% by SNIP (source normalised impact per paper) score in 2021. More information on this metric is available on the CWTS Leiden University journal rankings website, found at <https://www.journalindicators.com/methodology>.

VIGNETTES

This section lists the vignettes that were used to illustrate the findings of this report. This information was provided by researchers involved in the research work. Vignettes can be viewed in more detail on the science and technology section of the MBIE website. Any questions should be directed to the lead organisation directly.

Funder	Project title	Lead organisation
AMRF	Have our Say: social connectedness amongst older people during COVID-19	The University of Auckland
AMRF	Whitu – seven ways in seven days: a well-being app to help New Zealand young people get through the COVID-19 pandemic	The University of Auckland
MBIE	Efficient ethanol-based hand sanitizer production from wine industry grape marc waste	Bragato Research Institute
MBIE	Genomic epidemiology and evolution of COVID-19 in New Zealand	University of Otago
MBIE	Infection risk model of airborne transmission to facilitate decisions about PPE, ventilation, and isolation in shared indoor spaces	University of Canterbury
HRC	Rapid diagnosis and genome sequencing to follow CoV-2019 outbreak	Massey University
HRC	Harirū, hongiri and hau in the time of COVID-19	The University of Auckland
HRC	Predict and prevent COVID-19: a data driven innovation project	Victoria University of Wellington



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