Australia's National
Science Agency

Australian Centre for Disease Preparedness

2021 | Year in Review

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Acknowledgement of Traditional Owners

The Australian Centre for Disease Preparedness respectfully acknowledges the Wadawurrung people of the Kulin Nation, the Traditional Owners of the land on which we undertake our science and business today. We pay our respects to their Elders past and present.

We thank the Wadawurrung people for their custodianship of the land and acknowledge their deep connection with this country. We strive to learn from their unique perspective and knowledge.

Important disclaimer

The information included in this document is based on the calendar year from 1 Jan 2021 to 31 Dec 2021.

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Cover image: CSIRO's Australian Centre for Disease Preparedness is located in Geelong, Victoria.

Contents

From the Director

The work of CSIRO's Australian Centre for Disease Preparedness spans a spectrum of infectious disease, reflecting the critical importance of integrating disease control to encompass people, our domestic and companion animals, and our wildlife and their ecosystems.

The emergence of SARS-CoV-2 has continued to dominate much of our work over the past year. Our scientists have built on our ground-breaking work in the development of the first animal model for SARS-CoV-2, undertaking metabolic profiling and studies of innate immune responses, to better define the course of disease and correlates of immunity following vaccination and infection. We have also been contributing to studies of the susceptibility of other animals to this virus, along with the risks of transmission back to humans. Our work with CSIRO colleagues on *in silico* analysis of SARS-CoV-2 variants has also provided valuable insights into the evolution of this virus, along with analysis and interpretation of the complex data being made available worldwide.

We continue to serve the nation's agriculture and food production industries, as Australia's national reference laboratory for most nationally notifiable diseases. We provide expert consultancy to federal and state agriculture departments on animal diseases, their detection and control. We work closely with state diagnostic laboratories and have delivered over 39,000 tests as part of our diagnostic, surveillance, quarantine and exclusion testing activities for cases of suspect disease.

The unique natural fauna of Australia also presents additional challenges in disease emergence. This year Hendra virus genotype 2, previously only seen in flying-foxes, was isolated from a horse. This served as a timely reminder of the constant threat posed by the spillover of viruses from wildlife, and the need to better understand the drivers for such events and reduce the associated risk of their occurrence.

Our work also extends to the Asia Pacific region, where our active international program builds laboratory capability in the diagnosis of important animal diseases such as African swine fever, which has destroyed almost half of China's breeding pig population and now threatens Australia's near neighbours.

These many challenges have also provided opportunities to improve the capability of our facilities, develop the skillsets of our people, and develop broader capability in Australia, through the work of our Academic Board in partnership with Australian universities. We have recently commissioned a new electron microscopy suite, and will shortly commence a major refurbishment of our facility to ensure it remains capable of delivering to Australia's needs for the next 35 years.

2021 has been a very successful year for CSIRO's ACDP and, while the future path of COVID-19 in 2022 is difficult to predict, the future of ACDP is clear. We have a pivotal role to play as the nation's premier One Health institute, leading our preparedness and response to future animal and zoonotic infectious disease threats.

Professor Trevor Drew
Director, CSIRO's Australian Centre for Disease Preparedness

2021 snapshot

3 OIE Collaborating Centres

10 OIE Reference laboratories

6 new COVID-19 research projects

39,212 tests performed

5 CSIRO challenges supported

- Food security and quality
- Health and wellbeing
- Resilient and valuable environments
- Future industries
- Secure Australia and region

Partnering in

2 CSIRO Missions

- Infectious Disease Resilience
- Antimicrobial Resistance

14 students

9 post-doctoral fellows

38 million media audience reach

49 new facility access applications approved

93 public enquiries regarding ACDP capabilities

77 publications

About us

CSIRO's Australian Centre for Disease Preparedness (ACDP) provides Australia's highest level of biocontainment within a purpose-built biosecurity facility.

Through our world-leading infrastructure, research programs and scientific expertise, the research ACDP enables helps protect Australia's valuable livestock and aquaculture industries, and the community, from exotic and emerging infectious diseases.

Our expert research and operational teams work together across multiple disciplines at ACDP, adopting a One Health approach that recognises the health of people, animals and the environment are interconnected.

Together, our staff:

- Increase Australia's preparedness and capability to rapidly respond to biosecurity challenges, including human and animal health and biosecurity threats
- Conduct fundamental research to increase understanding of infectious agents of significance to human and animal health
- Support development and testing of vaccines and therapeutics for a broad range of human and animal diseases
- Maintain world-class national facility infrastructure and accreditation.

Tissue culture researchers store and catalogue frozen stocks of important cell lines.

Our engineering teams work behind the scenes to ensure the facility services are in working order.

Delivering opportunity and access

Alongside our core research and diagnostics program, ACDP also serves as a national facility, supporting collaborations with Australian and international academics, government agencies, research organisations and industry, to access the high-containment research infrastructure and capabilities for infectious disease research. Our national facility role extends Australia's capabilities in research and development and improves pathways for research to translate to applied uses.

To enable this work, our access2ACDP Program facilitates requests for information, collaboration or consulting services to ACDP. The program coordinates a review process for all proposed onsite research, ensuring the research:

- Will result in high impact science
- Is aligned with ACDP's purposes and capabilities
- Is safe and beneficial to the Australian community.

For more information, see csiro.au/about/facilities-collections/ACDP/Accessing-our-facilities.

In 2021, ACDP received over 75 external enquiries for research collaborations from Australian and international entities, including universities, private industry and other research organisations. Collaborations were sought across a range of science domains including diagnostics, pre-clinical assessments, and COVID-19 vaccine and inactivation studies.

Our capability

ACDP prides itself on its dedicated and diverse workforce, who apply their skills across scientific and support roles to maintain this world-class facility and deliver impactful science.

Our scientific expertise extends across the disease and science spectrum, from diagnostics, pathogenesis and epidemiology, to virus characterisation, test development and animal studies.

Supporting scientific research are highly specialised operations teams who maintain facility biocontainment, biosafety, quality assurance, training, site security and monitoring, engineering and infrastructure maintenance.

ACDP operates across two sites: a high containment facility in East Geelong with laboratories at Physical Containment Levels 2, 3 and 4, and a Physical Containment level 2 animal facility in Werribee, Victoria.

ACDP's core activities

We work to protect Australia's livestock and aquaculture industries and wildlife from emerging disease threats, and ensure the competitiveness of our agriculture and trade.

Disease identification and characterisation

In addition to housing research projects, as a national facility ACDP is tasked with characterising emergency terrestrial and aquatic animal diseases, so authorities can stay informed on the threats they pose to Australia.

National emergency disease response

ACDP's facilities are purpose-built so we can respond quickly and effectively to disease outbreaks, whilst meeting our quality assurance standards.

Diagnostic services

We provide quality assured diagnostic services for new, emerging and exotic emergency animal diseases, using accredited and validated tests.

Emergency preparedness and response

Our staff undertake regular training to be ready to respond to an emergency animal disease outbreak. New insights are incorporated into emergency animal disease response plans.

Technical advice and support

We provide expert advice on emergency animal diseases, diagnostic policy and biosecurity issues.

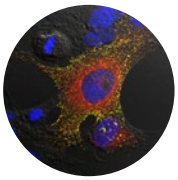
Reagent and specimen supply

We provide specialised reagents for emergency animal disease for diagnostic activities in Australian state and private laboratories, and for outbreak response in neighbouring countries.

Laboratory diagnostic activities are routinely proficiency tested and reagents must be adequately quality assured.

Molecular epidemiology

We undertake molecular research studies on emergency animal diseases to inform epidemiological investigations, i.e. disease origins, distribution and patterns of infection.



We also contribute to national disease surveillance programs.

Support to international activities

We provide scientific and diagnostic expertise to support Australia's national interests in the region and beyond.

Training

We provide specialised training for Australian veterinarians and diagnosticians in emergency animal disease recognition and diagnosis.

Research and development

We conduct research and development to support ACDP's diagnostic capability in areas such as: assessment of novel technologies for improved diagnostic testing; new diagnostic tests to address identified gaps in capability; and pathogenesis studies to enhance understanding of control strategies for key diseases.

Our highly trained research teams support a One Health approach which recognises the health of people, animals and the environment are interconnected.

World class research scientists

Our expert research teams work collaboratively with human and animal health agencies in a One Health approach, to protect Australia and our region's livestock and aquaculture industries, and our people, from infectious disease threats.

Our scientists collaborate with state, national and international researchers and organisations to deliver our two main research objectives:

- Increase Australia's preparedness and capability to rapidly respond to biosecurity mega-shocks, including human and animal health and biosecurity threats
- Protect Australia and our region from emerging disease threats.

Animal research services

Research projects undertaken at ACDP are supported by a specialised, trained Animal Services Team comprised of veterinarians and animal technicians who are highly experienced in the care and welfare of animals.

An on-site Animal Welfare Officer works alongside the Animal Services Team and is responsible for monitoring the welfare of animals and ensuring current best practice techniques are applied during planning and conduct of research projects involving animals.

All research project proposals involving animals are reviewed by an independent Animal Ethics Committee to ensure they are conducted in compliance with the Australian Code of Practice for the care and use of animals for scientific procedures.

ACDP has capability to conduct research with animals across Physical Containment Levels 2 to 4.

Diagnostic, surveillance and emergency response services

The Diagnostic, Surveillance and Response program at ACDP is central to ensuring Australia's response capability to infectious disease events and contributes to both passive and targeted surveillance.

Effective disease control and surveillance systems are not only important for quick diagnosis and response to disease outbreaks, but also for confirming the absence of diseases of interest – which is essential to facilitate export and import trade.

This year, the supporting role and work conducted by the Diagnostic, Surveillance and Response team at ACDP was acknowledged by Agriculture Victoria, who won the Government Award in the 2021 Australian Biosecurity Awards, for their efforts in the successful response to the 2020 avian influenza outbreak at six properties in Victoria.

Our Diagnostic, Surveillance and Response program has significantly contributed to detection of avian influenza outbreaks over the past three years.
Credit: A. Terracini, Flickr, CC-BY-2.0

International collaboration and capacity building

ACDP delivers an international program to provide greater stability, prosperity and resilience across the Asia-Pacific region.

Australian agriculture benefits significantly from the absence of several high-impact diseases from overseas. Many of these diseases are present in our region and, in some cases, in near-neighbour countries.

Ensuring our regional partners have the capability to detect and control these diseases significantly reduces the risk of these diseases reaching our shores. It also leads to positive impacts on food security in affected countries.

ACDP's International Program has always had a strong presence in the region, running many programs to support improved laboratory management, including biorisk and biosafety management, quality assurance, laboratory data management and communication. In addition, our scientists provide equipment and training in animal health surveillance techniques, diagnostic testing and emergency response protocols.

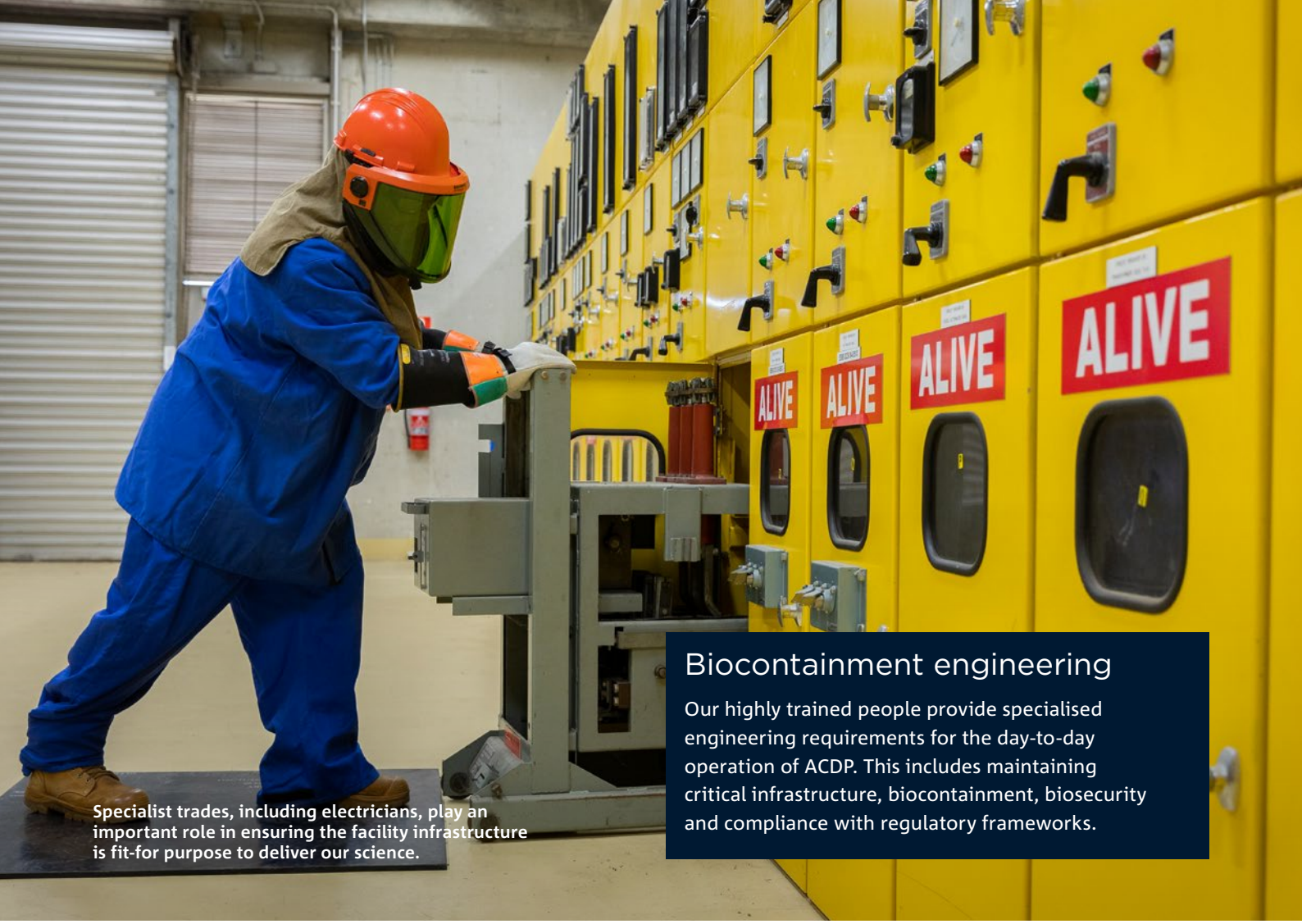
Complimentary to this work, the Proficiency Testing Team at ACDP delivers a range of accredited proficiency testing programs for significant diseases, such as African swine fever and avian influenza.

As one of the region's high biocontainment laboratories, many of our researchers maintain World Organisation for Animal Health (OIE) Reference Laboratory designations. As part of the responsibilities involved with these designations, ACDP scientists provide confirmatory testing and advice for emergency animal disease outbreaks to countries throughout the region.

In addition, our research scientists maintain accreditation in three OIE Collaborating Centres: Capacity building for veterinary laboratories, New and emerging diseases, and Diagnostic test validation science in the Asia-Pacific region. This work is vital to encourage the use of OIE standards and ensure transparency in the global animal disease situation.

In 2021, the International Program team undertook a long-term planning process to review the purpose of the program and develop priority focus areas to build the team's current international footprint and expand in new directions.

The resulting document will guide activities for the next five to 10 years but includes actions to be implemented in the next year. The document will be reviewed regularly, particularly in response to changing priorities and risks in the region.



Specialist trades, including electricians, play an important role in ensuring the facility infrastructure is fit-for purpose to deliver our science.

Biocontainment engineering

Our highly trained people provide specialised engineering requirements for the day-to-day operation of ACDP. This includes maintaining critical infrastructure, biocontainment, biosecurity and compliance with regulatory frameworks.

Biorisk management

ACDP provides Australia with the capability to safely hold and conduct work on the most dangerous pathogens in the world. Through the expertise and dedication of the Biorisk Management Group, research at ACDP is microbiologically safe and secure, in full compliance with our national and international obligations.

Supporting our commitment to best practice, our internal processes of review, evaluation, education and training ensures ACDP operates at or beyond the highest levels of national compliance and safety. The experience developed by ACDP in biosecurity, biocontainment and biosafety is highly valued by governments and customers around the world.

Restricted access protocols ensure high standards of biocontainment and workplace safety across our research and diagnostic activities.

Reference laboratories and collaborating centres

ACDP is an International Reference Laboratory for several diseases and hosts Collaborating Centres for the region.

Our reference laboratories fulfil a vital service to Australia and the Australian Government (the Department of Agriculture), providing the diagnostic and surveillance capability to monitor and respond to new and emerging diseases and high-consequence pathogens of animal origin.

ACDP is a World Organisation for Animal Health (OIE) Collaborating Centre for Laboratory Capacity Building, New and Emerging Diseases and Diagnostic Test Validation Science in the Asia-Pacific region. We have responsibility for generating new knowledge, networks and techniques that improve the use and interpretation of data and information in protecting human and animal health.

In addition, many of our researchers are members of national and international committees and expert groups that advise and support governments to provide education and implement controls to minimise the impact of emerging diseases.

ACDPs Reference Laboratory role

We work closely with veterinary and human health agencies around the world

World Organisation for Animal Health (OIE)

OIE Collaborating Centres:

- Laboratory Capacity Building
- New and Emerging Diseases
- Diagnostic Test Validation Science in the Asia-Pacific Region

OIE Reference Laboratory designations:

- Bluetongue virus
- Hendra and Nipah virus diseases
- Highly pathogenic avian influenza and low pathogenic avian influenza (poultry)
- Newcastle disease
- African swine fever
- Classical swine fever
- Abalone herpesvirus
- Ranavirus
- Yellow head virus genotype 1
- Epizootic haematopoietic necrosis virus

World Health Organisation (WHO)

- Member of WHO Network of Laboratories for Severe Acute Respiratory Syndrome
- Representation on WHO Severe Acute Respiratory Syndrome Coronavirus 2 Expert Group

The Food and Agriculture Organization of the United Nations (FAO)

FAO Reference Centre designations:

- Animal Influenza and Newcastle disease
- Laboratory Biorisk Management

The Bioassay Research and Development team helps develop bespoke reagents needed for new diagnostic tests and assays.

Delivering assays for diagnosis, surveillance and response to disease outbreaks

Australia's response to emerging and existing biological threats to animal health requires development of new reagents and assays suitable for detection and identification of disease agents. Diagnosis of disease informs appropriate actions aimed at mitigating the threat to our animals, industries and people.

The Bioassay Research and Development team at ACDP develops and manufactured novel diagnostic tests and bioreagents suitable for detection of veterinary and zoonotic diseases. While SARS-CoV-2 assay-related activities were prioritised, the team also delivered reagents used in assays or studies of foot and mouth disease, influenza, Aujeszky's disease, Hendra virus and bovine respiratory disease.

The assays and reagents developed support ACDP's diagnostic services program and external customers. This important role forms an integral part of the Diagnosis, Surveillance and Response program at ACDP and the Australian Government Department of Agriculture, Water and the Environment's efforts to ensure Australian biosecurity.

For more information on Bioassay R&D at ACDP contact Grant Peck, grant.peck@csiro.au

Ethical and sustainable cell culture capability

Modelling disease in animals and humans places significant ethical, safety and logistical challenges around research and therapeutic development. Similarly, obtaining a continual source of primary cells from animals and humans for in vitro experimentation has practical challenges.

In response, researchers at ACDP have generated a renewable stem cell culture platform used for studying human and animal host-virus interactions, as a novel way to understand pathogen biology and identify biomarkers which could be used in future surveillance and drug discovery activities.

These ex vivo models are already helping to identify effective drugs to treat COVID-19, through the development of clinically relevant tissue systems (CSIRO's sySTEMS initiative). Such innovative systems compliment in vivo models of disease and assist us in reducing, replacing and refining the animal experimentation and research we do.

For more information on our cell culture capability contact Dr Sinéad Williams, sinead.williams@csiro.au or Dr Elizabeth Pharo, liz.pharo@csiro.au

96-well plates of cells are cultured for high-throughput drug screening tests.

Maintaining our infrastructure

ACDP part-life refit

In 2020, we received $220M to future-proof ACDP's extensive high-containment laboratories and ensure the continuation of CSIRO's capability to prevent and respond to exotic and emerging animal and zoonotic diseases in Australia.

ACDP's part-life refit project will deliver a range of upgrade and renewal works to ensure the facility is aligned with emerging, and more stringent, regulatory compliance standards. This will ensure the facility is fit for purpose into the future.

Provision of a new laboratory wing

In 2021, ACDP proposed an amendment to the part-life refit project, involving the construction of a new wing connected to the existing building. This option was in lieu of the upgrade of a commensurate area in the existing facility and significantly reduces the risk of a disruption of service during the facility upgrade.

The new adjoining wing will provide space for collaboration, incorporating state-of-the-art facilities that will meet Australia's needs in disease preparedness for the next 35 years.

The wing will have approximately 1100m^2 of lab area at Physical Containment Level 3.

Design company Aurecon appointed

Approval for the new wing enabled the next stage of the project to proceed with the appointment of a design services team.

After a lengthy tender process, engineering, design and advisory company Aurecon was appointed to design the new laboratory spaces for the part-life refit project.

Design meetings with users commenced in November and will progress towards a Public Works Committee submission in 2023.

An artist's impression of the new wing at ACDP.

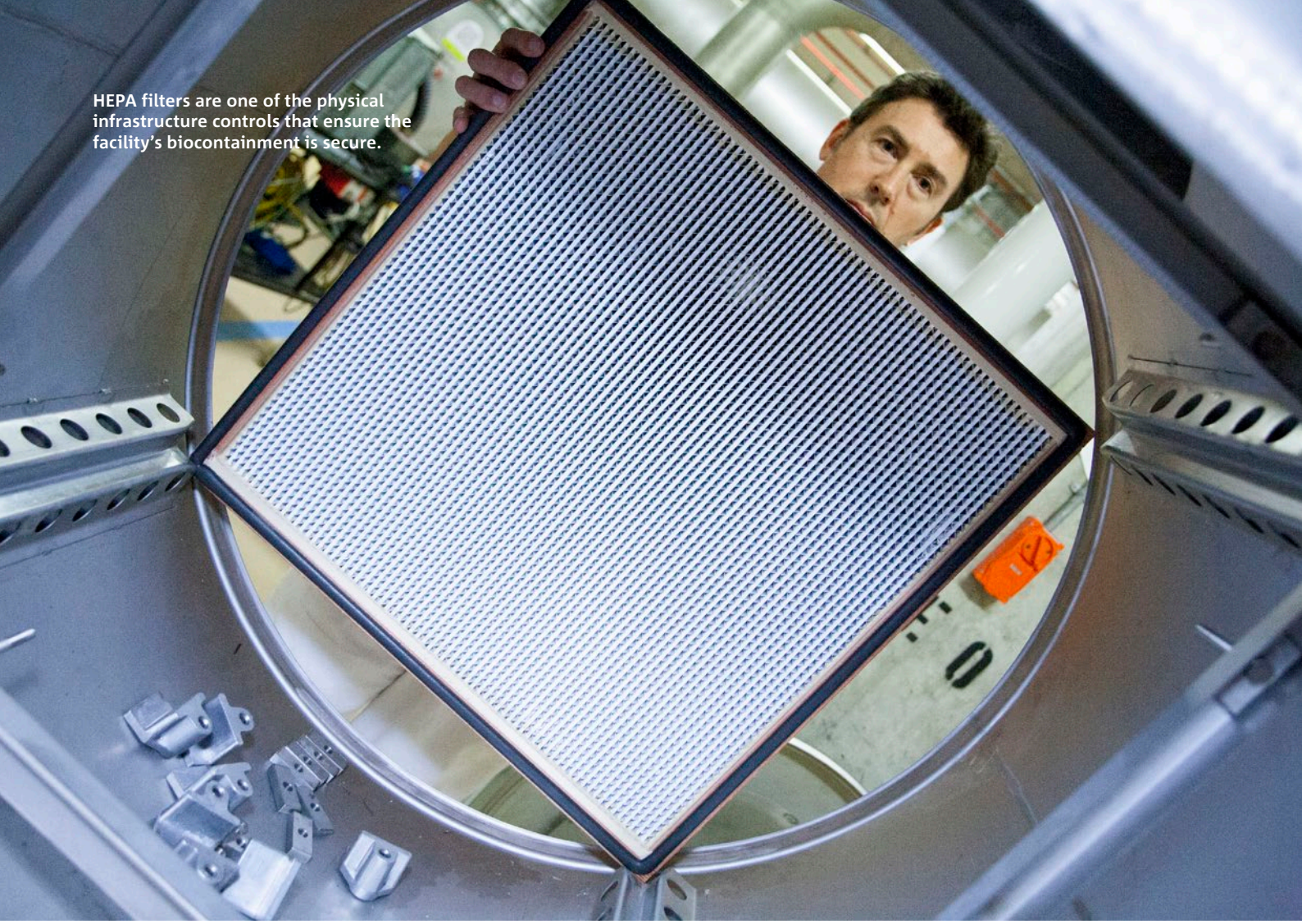
Regular upkeep of specialist equipment, such as PC4 suits, ensures the highest level of safety for our researchers and quality of our research.

National Collaborative Research Infrastructure Strategy (NCRIS) investment

The Australian Government's National Collaborative Research Infrastructure Strategy (NCRIS) investment in ACDP has enabled the opportunity for CSIRO to deliver world-class research infrastructure for use by Australian and overseas researchers to benefit Australian's national disease diagnostic capability and strengthen the country's biosecurity framework. Continued operational funding allows ACDP to support high quality research that will drive greater innovation in the Australian research sector to help solve national and global health challenges.

Access to these facilities has enabled CSIRO's research on COVID-19, such as testing of vaccines and antivirals, and research to gain an understanding of the SARS-CoV-2 virus, including genomic sequencing and imaging.

NCRIS funded infrastructure at ACDP includes Physical Containment Level 4 laboratories, a Physical Containment Level 3 immunology laboratory, Physical Containment Level 3 bioimaging suite and the Physical Containment Level 3 insectary.



HEPA filters are one of the physical infrastructure controls that ensure the facility's biocontainment is secure.

New electron microscopy laboratory suite

In 2020, ACDP received Science and Industry Endowment Fund support for the purchase of a new electron microscope. Support staff and scientists worked closely together to implement the design and build of a new electron microscopy laboratory suite. The new suite is in ACDP's non-secure area, making the facility more readily accessible to staff and external researchers.

The laboratory was recently completed and the electron microscope commissioning will be completed in 2022.

Improving our environmental footprint

Until now, ACDP has had to rely on formaldehyde to perform gaseous decontamination of laboratory spaces. While appropriate measures are taken to protect staff and contractors from potential health risks of working with formaldehyde, finding a suitable alternative is the preferred long-term option.

To find a long-term suitable alternative to formaldehyde, the Biorisk Management Group at ACDP conducted a project to identify potential alternatives. Hydrogen peroxide vapour was identified as a possible substitute. If suitable levels of decontamination can be achieved, hydrogen peroxide fumigation is safer and increases room availability because the decontamination procedure is much shorter. In Physical Containment Levels 2 and 3 rooms, decontamination times are reduced from four days to one. At Physical Containment Level 4, the time is reduced from seven days to three.

In 2020, staff completed a successful trial demonstrating that decontamination of a room using hydrogen peroxide was comparable to formaldehyde by a direct measure of lethality of biological indicators. The team successfully transitioned to hydrogen peroxide for all Physical Containment Level 2 room decontaminations.

In 2021, the team continued further trials with hydrogen peroxide vapour, expanding the trials to include biological safety cabinets and HEPA filter housings as well as the small animal rooms. The trials showed successful decontamination of biological indicators.

Our scientists are working towards novel solutions for some of our biggest science challenges.

Science highlights

Our research continues to focus on all four aspects of disease preparedness: awareness, assessment, mitigation and response. Our approach encompasses the One Health concept, which incorporates research across veterinary, human and environmental health.

COVID-19 research

Since the start of the pandemic, researchers at ACDP have been heavily involved in the global response to COVID-19.

AstraZeneca vaccine pre-clinical research published

In May this year, peer-reviewed results from our preclinical evaluation of the University of Oxford-AstraZeneca COVID-19 vaccine in our ferret model were published in the scientific journal *npj Vaccines*.

The preclinical study, conducted by CSIRO at ACDP in 2020, evaluated the vaccine's efficacy when delivered in one or two doses, through either an intramuscular injection or by nasal drops.

The study found:

- The vaccine triggered a strong immune response in ferrets.
- The vaccine significantly reduced viral loads in nasal and oral samples from vaccinated ferrets, indicating it could be helpful in preventing ongoing transmission of the virus.
- Nasal delivery of the vaccine has the potential to further improve its efficacy.

Pre-clinical evaluation of 'warm vaccine' Mynvax

Most of the approved COVID-19 vaccines now in use around the world require some form of refrigeration, which significantly complicates the logistics around transport, storage and delivery, particularly in rural and remote regions.

Researchers at the Indian Institute of Science and biotech start-up Mynvax have developed a heat tolerant vaccine candidate that does not require refrigeration. The vaccine remains stable at 37°C for up to a month and at 100°C for up to 90 minutes.

Researchers at ACDP contributed to Mynvax's pre-clinical evaluation by assessing vaccinated mice sera for efficacy against key coronavirus variants, including the Delta variant.

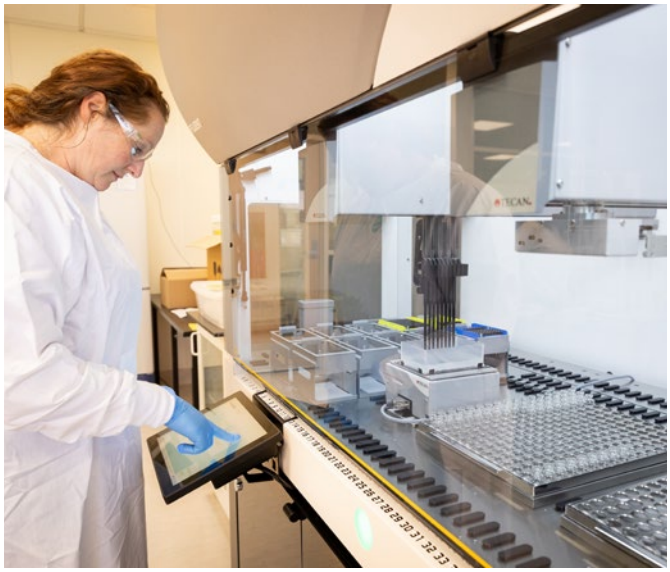
The published results showed that Mynvax formulations triggered a strong immune response in mice to SARS-CoV-2. These results were to support selection of the most suitable candidate for human clinical trials in India, planned for late 2021.

Rapid screening tool for COVID-19 treatments

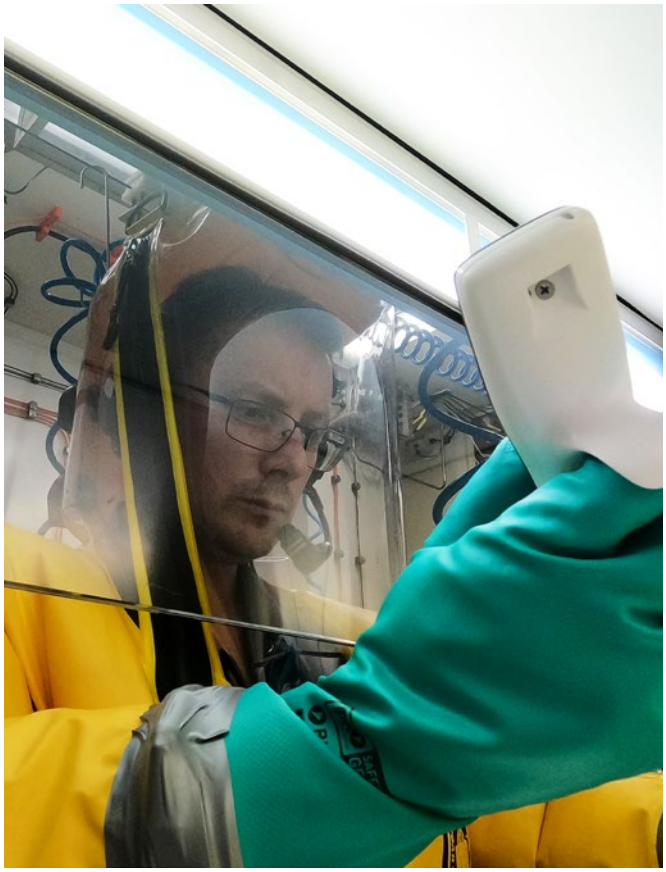
Researchers at ACDP are leading a new project which received $1 million in funding from the Australian Government's Medical Research Future Fund, matched by $736,000 from CSIRO.

The project aims to develop a multi-tissue drug screening tool, tailored for infections from SARS-CoV-2 and variants of concern. The rapid screening tool will use four types of clinically relevant human tissues – lower respiratory tract, lung, neural and cardiac tissues – specifically selected based on how SARS-CoV-2 infects people.

The tool will screen existing drugs with the aim to have identified three suitable drug candidates, already approved by the Therapeutic Goods Administration or the US Food and Drug Administration, to progress to phase two and three human clinical trials within a year.



Automated equipment enables fast, high-throughput experimentation and minimises the health and safety risks of repeated strain injury for technical staff.



Our biocontainment specialists work on testing COVID-19 stability on a range of surfaces.

Earlier detection of COVID-19 infection

Scientists at ACDP have developed a way to detect COVID-19 earlier in the infection cycle using the body's own biomarkers and machine learning.

Instead of looking for the virus, the approach looked to understand the body's own response to infection. This often occurs before a virus can amplify to detectable levels.

Researchers measured three host molecules, or biomarkers, in a patient's blood and showed they could detect COVID-19 with 99 per cent accuracy.

There is no currently available commercial technology to measure biomarkers. We're undertaking further research to bring the COVID-19 biomarker test closer to reality.

Other SARS-CoV-2 research

CSIRO's COVID-19 experts continue to track the evolution of the SARS-CoV-2 virus and variants.

For more information on our COVID-19 research, contact Dr Paul De Barro, paul.debarro@csiro.au

Hendra virus research

Hendra virus is a zoonotic disease transmitted from flying-foxes to horses, and from horses to humans. CSIRO has been involved in Hendra virus research since its emergence in Australia in 1994, and our researchers have made a significant contribution to current understanding of the virus and preparedness against future events.

Confirming the Hendra vaccine is highly effective

The Equivac HeV vaccine for horses was released by Pfizer Animal Health (now Zoetis) for use in Australia at the end of 2012. This year, scientists at ACDP conducted a study to assess how the Equivac HeV vaccine has been performing in the field.

The study used horse serum samples submitted to ACDP over a six-year period, from 2014-2020. All samples were from horses that had received between one and 12 doses of the vaccine. The samples were sent from veterinarians requesting the Hendra virus serum neutralisation test. ACDP is the only lab in Australia that can conduct this test.

The test detects the presence of 'neutralising antibodies', which bind to the virus and stop it from infecting cells and replicating. A high amount of antibodies in the serum (or high titre) provides a greater level of protection for the horse.

The study showed the vaccine was highly effective in protecting horses, provided they had received at least three vaccinations (two doses three to six weeks apart, and a third dose six months later). Full results were published in July.

New genetic type of Hendra virus uncovered

This year, researchers at ACDP published a paper documenting a new genetic type of Hendra virus in flying-foxes.

After monitoring flying-fox samples from 2013-2021, the research team found the new genetic type in grey-headed flying foxes in Victoria and South Australia, and in the little red flying-fox in Western Australia. These results confirm the virus can be found in four species of flying-fox, confirming Hendra can be found across a broad region of Australia.

They called the new type Hendra Virus Genotype 2 (HeV-g2).

Working with Hendra virus at Physical Containment level 4 has been a speciality of CSIRO researchers for many years.

A separate project called 'Horses as Sentinels', led by the University of Sydney and CSIRO and funded by a Biosecurity Innovation Program grant from the Department of Agriculture, Water and the Environment, detected the same genetic type in early 2021, in testing conducted on samples collected from a horse from Queensland in 2015.

In October 2021, the new genetic type was also detected in a horse near Newcastle in New South Wales, the most southern case of Hendra virus infection yet recorded.

As HeV-g2 is genetically very similar to the original Hendra virus, which can be deadly, our researchers say there is a risk to horses in all areas where flying-foxes are found in Australia.

Our diagnostics scientists and the 'Horses as Sentinels' project team have been working closely with vets and laboratories around Australia to implement improved tests for horses with signs of Hendra virus disease. The tests can detect and differentiate both types of Hendra virus with a high degree of accuracy.

Fortunately, while further research is needed, researchers expect the current Hendra virus vaccine will also work against the new Hendra virus variant.

For more information on Hendra research at ACDP contact Dr Kim Halpin, kim.halpin@csiro.au

For more information on the Horses as Sentinels project contact Dr Ina Smith, ina.smith@csiro.au

African swine fever

African swine fever is a severe disease of pigs that poses a real and present threat to our region.

Supporting PNG's response to African swine fever

As an accredited World Organisation for Animal Health Reference Laboratory for African swine fever, ACDP has continued to assist the Papua New Guinea (PNG) National Agriculture Quarantine and Inspection Authority (NAQIA) by performing diagnostic testing on samples collected by NAQIA staff for critical surveillance activities.

Our staff have also delivered technical advice, training and development activities for field-based and laboratory diagnostic methods, including more accurate tests through funding by the Australian Centre for International Agricultural Research.

This successful project has resulted in new funding from the Department of Foreign Affairs and Trade, for ACDP to continue to strengthen and support PNG's ability to detect and control priority animal diseases, using African swine fever as a test case disease.

Our support for other Pacific Islands countries has involved advice and assistance on procurement of African swine fever rapid antigen test kits for field testing, accompanied by virtual training sessions, funded and facilitated by the Pacific Horticultural and Agricultural Market Access Program and the Pacific Community.

By supporting PNG and the Pacific Islands to strengthen animal disease surveillance, diagnosis and control, we can help to improve food security and market opportunities for PNG, Australia and the entire Asia-Pacific region.

For more information on our diagnostic virology capability contact Dr David Williams, david.williams@csiro.au

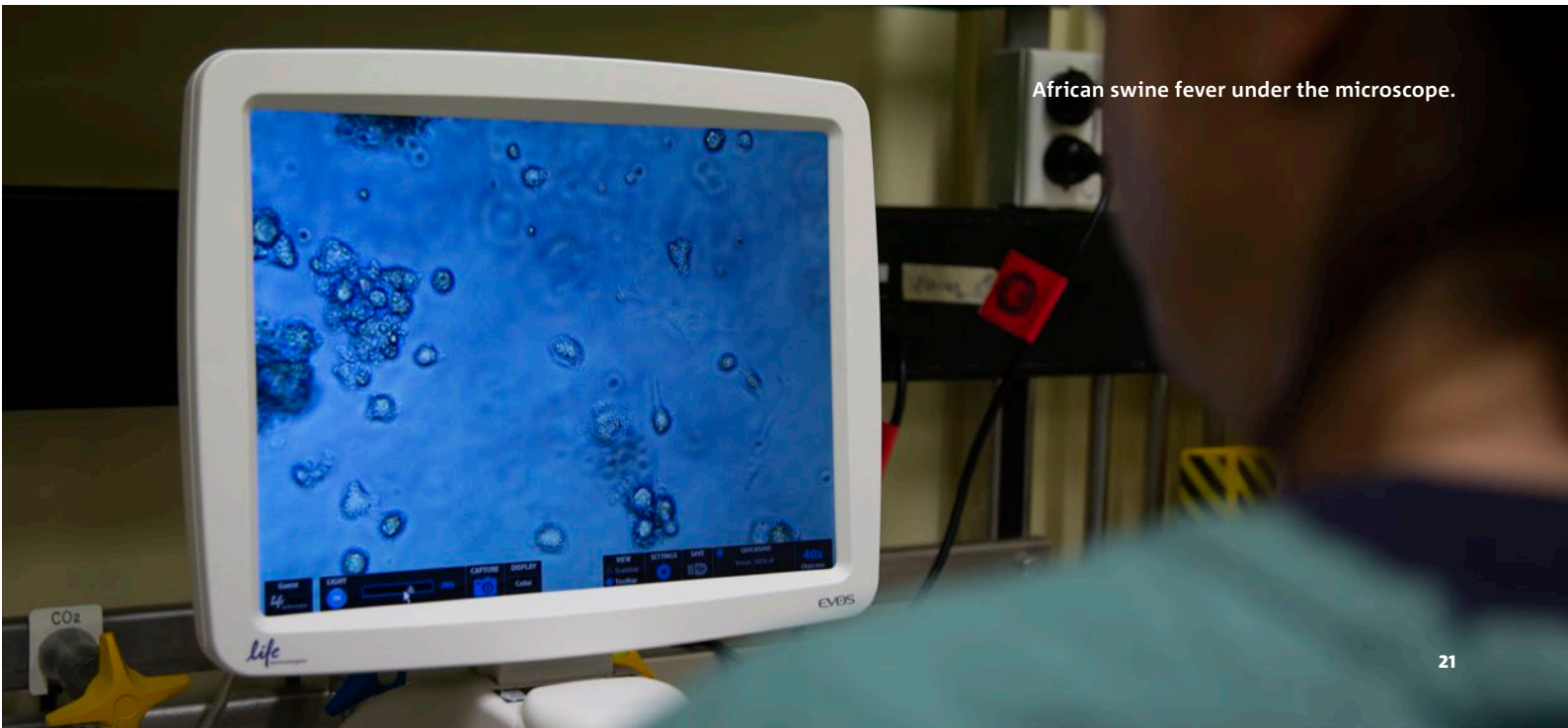
Testing ticks for transmission of African swine fever

African swine fever can be carried by soft ticks in the genus *Ornithodoros*.

To determine the risk of the virus becoming established in Australia, CSIRO is conducting vector-competence studies in the native Australian soft tick *Ornithodoros gurneyi* (kangaroo soft tick). This is part of an overarching African swine fever research program at ACDP.

By establishing a tick colony and conducting these studies, we are helping to clarify the potential risk of African swine fever establishment in Australia, which assists in informing policy to prevent disease establishment in these areas.

For more information on this study contact Dr Prasad Paradkar, prasad.paradkar@csiro.au



African swine fever under the microscope.

Emerging diseases in the region

The recent emergence of exotic arbovirus disease threats in the region requires heightened biosecurity and surveillance measures in Australia to protect our disease-free status.

Lumpy skin disease

Lumpy skin disease is a disease of cattle and buffalo caused by a capripox virus. Up to 50 per cent of infected animals may not show clinical signs, but other animals can be severely affected, with mortality reaching 10 per cent in some outbreaks.

In recent years, lumpy skin disease has moved into the Asia-Pacific region, increasing the risk of it reaching our shores.

Management of the disease relies on vaccination, control of animal movements and culling infected animals. After its emergence in Asia, exclusion testing requests for this disease have increased over the past three years.

A whole genome sequencing pipeline for lumpy skin disease is important for rapid virus characterisation, including assessment of recombination events, differentiation of vaccine and wild-type strains, and to inform phylodynamic assessment of virus transmission pathways.

The lumpy skin disease genome is challenging to sequence as it is unusually large (151 kbp) and contains repetitive regions. To overcome these obstacles, researchers at ACDP are developing a probe enrichment procedure combined with short-read (Illumina) and long-read (Oxford Nanopore) sequencing, to allow the complete sequencing of viral genomes derived from both infected clinical specimens and virus isolates.

For more information on lumpy skin disease research contact Dr Tim Bowden, tim.bowden@csiro.au

Research at ACDP suggests *Ehrlichia canis* may have reached Australia via Asia or the Middle East.
Credit: Gary Alpert, CC BY SA 3.0

Comparative genomic analysis of the first *Ehrlichia canis* detections in Australia

Ehrlichia canis is one of the most prevalent tick-borne pathogens of canines globally. For many decades Australia was thought to be free of the pathogen, but this abruptly changed in May 2020 when *E. canis* was detected throughout much of northern Australia.

This raised questions about how long *E. canis* had been present in Australia and where it may have originated. The pathogen is difficult to sequence due to its intracellular location and challenges associated with culturing.

Researchers at ACDP have developed a probe enrichment technique, allowing us to recover three complete genomes from Western Australia, Northern Territory and South Australia. Although reference data is lacking, our genomic data suggest that *E. canis* in Australia may have originated in Asia or the Middle East and was recently introduced, spreading rapidly throughout northern Australia.

For more information on *Ehrlichia canis* research contact Dr Anthony Keyburn, anthony.keyburn@csiro.au or Dr Tristan Reid, tristan.reid@csiro.au

African horse sickness

African horse sickness is a serious, often fatal vector-borne disease of equids and is listed as an International Organisation for Animal Health disease of international concern. The virus is primarily transmitted by biting midges and is endemic to sub-Saharan Africa, but a widespread outbreak was reported in Thailand in 2019, and the virus was then reported in Malaysia in September 2020.

Despite the risk of vector migration and movement of animals spreading the disease into nearby regions, African horse sickness has not been reported in Australia.

With the outbreak in South East Asia, ACDP has had an increase in laboratory submissions for African horse sickness disease exclusion, from two in 2018 to 71 in 2021.

African horse sickness is a rapidly evolving segmented RNA virus that readily reassorts with different strains. This makes whole genome sequencing particularly important for detecting reassortment events and tracking the rapidly evolving surface proteins.

With funding from the Department of Agriculture, researchers at ACDP are working on understanding which biting midges in Australia feed off horses, and which are capable of transmitting African horse sickness.

Researchers at ACDP are developing denaturation and probe enrichment techniques, combined with short-read and long-read sequencing, to robustly and reproducibly sequence whole African horse sickness genomes.

For more information on African horse sickness research contact Dr Debbie Eagles, debbie.eagles@csiro.au

Foot and mouth disease

Foot and mouth disease: emergency vaccination in livestock

Foot and mouth disease (FMD) threatens food security in both developed and developing countries and poses a serious threat to the livestock industries and trade for 'FMD-free' countries like Australia.

Intramuscular injectable vaccination is one option for control if FMD occurred in Australia, along with other approved control measures. However, in pigs, vaccines can often result in inflammation at the site of inoculation, leading to poor vaccination rates in pigs and reluctance to vaccinate in endemic countries. Poor vaccination techniques can also result in inadequate antibody responses in pigs.

A team at ACDP is working on an alternative intradermal vaccination technology, using a needle-free device. The response to vaccination with this intradermal vaccine delivery is comparable to intramuscular vaccination, does not cause reactions at the vaccination site, and is safer for the operator.

The team also used a novel systems approach to measure the early immune responses in vaccinated pigs, before antibodies are detected. This provided new understanding of the post-vaccination immune response using the different vaccination methods and the information can be used to design vaccines and adjuvants for improved vaccine efficacy.

Our researchers are analysing results from genome sequencing investigations.

The FMD Ready project is helping to improve surveillance, preparedness and return to trade for emergency animal diseases, using FMD as a model.

FMD Ready project

Australia needs to be prepared to rapidly recognise and react to exotic animal diseases that can cause devastation to our livestock industries. These effects can be through mortalities, morbidities, and lost production, and diseases such as FMD would also lead to severe economic impact due to lost export markets and trade restrictions.

The FMD Ready project*, led by researchers at ACDP in collaboration with CSIRO colleagues and Charles Sturt University, together with multiple partners, aimed to increase Australia's preparedness to exotic disease incursions by developing tools that can be used prior, during and after an outbreak, using FMD as a model.

The project also investigated ways to increase stakeholder participation in surveillance, which is essential to ensure we recognise and respond to emerging situations as quickly as possible. The sooner control measures are initiated, the smaller the impact of an exotic disease such as FMD.

This project involved close collaboration between a team of researchers with diverse backgrounds and across a range of disciplines. It allowed us to successfully validate our diagnostic tests and generate data on the efficacy of the vaccines in our vaccine bank.

We refined models to test different methods of control prior to outbreaks, including estimates of cost of the different options. We also created tools that can be applied during an outbreak to trace the origin and spread of the disease.

Collectively, these outcomes will assist with Australia's preparedness for a disease incursion.

For more information on foot and mouth disease contact Dr Wilna Vosloo, wilna.vosloo@csiro.au or Dr Nagendra Singanallur, nagendra.singanallur@csiro.au

*This project is supported by Meat & Livestock Australia, through funding from the Australian Government Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program, and by producer levies from Australian FMD-susceptible livestock (cattle, sheep, goats, and pigs) industries and Charles Sturt University (CSU), leveraging significant in-kind support from the research partners. The research partners for this project are the Commonwealth Science and Industrial Research Organisation (CSIRO), CSU through the Graham Centre for Agricultural Innovation, the Bureau of Meteorology (BOM) and the Australian Department of Agriculture, Water and the Environment, supported by Animal Health Australia (AHA).

Abalone disease outbreak

In May, an outbreak of abalone viral ganglioneuritis was detected in wild abalone populations off the coast of Victoria. The disease had not been detected since 2010 but an outbreak of the same disease in 2006 affected up to 80 per cent of the wild abalone population in Victoria's Western Zone Abalone Fishery.

Abalone viral ganglioneuritis is a herpesvirus specific to abalone, which can cause high mortalities in both farmed and wild abalone populations.

Staff from Agriculture Victoria sent samples to our scientists for confirmatory testing and on 3 May, we confirmed the presence of the causative agent, haliotid herpesvirus-1.

Further genomic testing confirmed that it was the same haliotid herpesvirus-1 Vic strain of the virus responsible for the original outbreak in Victoria in 2006.

ACDP's Fish Diseases Laboratory hosts the World Organisation for Animal Health Reference Laboratory for infection with abalone viral ganglioneuritis, and other aquatic diseases.

In addition to testing, our scientists have contributed to setting research priorities to identify gaps in knowledge, working in consultation with state governments, industry and the Fisheries Research and Development Corporation.

For more information on ACDP's Fish Diseases Laboratory contact Dr Nick Moody, nick.moody@csiro.au

Partnering to eradicate Mycoplasma bovis in New Zealand

Mycoplasma bovis causes a range of serious disease in cattle, including mastitis, pneumonia and late-term abortions.

Researchers from ACDP, in collaboration with Massey University and AgResearch, New Zealand, are contributing to the effort to eradicate *Mycoplasma bovis* from New Zealand livestock industries. Funded by the New Zealand Ministry for Primary Industries, the team has been tasked with developing a novel technology to improve disease detection rates in cattle, as *Mycoplasma bovis* cannot be reliably diagnosed using existing tests.

Our researchers have developed an assay that identifies *Mycoplasma bovis* cases based purely on the host response to infection, rather than assaying for the pathogen itself. This assay is being assessed via World Organisation for Animal Health guidelines for diagnostic test validation for infectious diseases. If this technology can improve or complement existing diagnostic strategies, it will be incorporated into the New Zealand *Mycoplasma bovis* surveillance and eradication plan, while also exemplifying how new approaches can improve detection of infectious diseases.

For more information on disease mitigation technologies contact Dr Cameron Stewart, cameron.stewart@csiro.au

Australia produces nearly half of the world's wild-caught abalone, so keeping wild and farmed populations healthy is very important to our aquaculture industry.

Our people

Our people are central to the work and success of ACDP, and the important outcomes we deliver for the nation.

CSIRO promotes four workplace values:

- People first
- Further together
- Trusted
- Making it real.

These values seek to ensure that not only do we recognise the important work our people do, but that we also recognise the equal importance of the way the work is done, and how we treat each other.

These values unite us in our purpose and are wholly embraced by the team at ACDP.

Our people are highly trained scientific, technical and professional officers who are committed to high standards of work, and to ensuring the safety and wellbeing of each other. This commitment is underpinned by our health and safety committees, institutional bio-safety committees, and biorisk and health, safety and environment procedures.

ACDP seeks to maintain the highest standards of training for all its people to ensure they understand both their personal responsibility for their own safety as well as the responsibility for the safety of their colleagues.

As a part of CSIRO, ACDP is a workplace that promotes continual learning and strives for a best practice approach in all work and processes, including to animal ethics, quality assurance systems and proficiency testing, research ethics, and our international outreach programs.

Engagement and outreach

STEM outreach

In late 2021, staff at ACDP were invited to participate in a student outreach program aimed at high achievers in high school science from across Australia. The students were finalists in the BHP Foundation Science and Engineering Awards, which are Australia's most prestigious school science and engineering awards and a partnership between the BHP Foundation, CSIRO and the Australian Science Teachers Association.

Scientists, Mark Tizard, Michelle Lockhart and Dan Layton provided the students with a brief history of how they ended up in science and the path they took to get there, including sharing their achievements and where they derive their inspiration. Our researchers reported the students were incredibly engaged and asked questions well above their pay grade. We look forward to participating again next year.

ACDP Seminar series

The ACDP seminar series was held online in 2021. It provides a platform for our researchers, students and visiting scientists to present their work to a broader audience onsite and to others in the Geelong Research network.

Professional development

We actively promote ongoing training and other development opportunities to our people. CSIRO offers a broad range of learning and development opportunities, including face-to-face and blended programs, self-directed learning resources, and on-the-job development. Supplementing formal development opportunities are initiatives such as coaching and mentoring, and the potential to attend or present at conferences.

This year we are proud of two of our pathologists, Jemma Bergfeld and Willy Suen, who passed their exams for The College of American Pathologists and received their board-certification. These internationally recognised, high-ranking conferrals enable us to offer a high level of aptitude in our pathology team and deliver the highest standard of pathology services.

Many of our people took advantage of the broad range of professional development opportunities available to all CSIRO staff.

Our teams at ACDP are highly trained scientific, technical and professional officers who are committed to high standards of work, and to ensuring the safety and wellbeing of each other.

CSIRO actively promotes ongoing training and development opportunities for our people. Two of our pathologists received their board certification to The College of American Pathologists this year.

Indigenous engagement

Aboriginal and Torres Strait Islander peoples were Australia's first scientists and CSIRO recognises that the knowledge, innovation and practices maintained by Aboriginal and Torres Strait Islander people in their connection to Country can significantly contribute to research and development and solving national challenges.

ACDP is committed to delivering actions under the CSIRO Reconciliation Action Plan, building enduring relationships with Aboriginal and Torres Strait Islander communities, organisations and people across scientific knowledge sharing, education, employment, and pursuing research and innovation to create a positive impact to the lives of all Australians.

In 2021 ACDP established an Indigenous Engagement Working Group to oversee the development of an action plan for ACDP in meeting its commitments under the CSIRO Reconciliation Action Plan.

As a first step, the group commenced activities to build appreciation and understanding in staff of the challenges faced by Aboriginal and Torres Strait Islander peoples and the opportunities that greater cultural awareness can bring to our approaches to scientific enquiry and research.

Early career research development

New academic board

ACDP's new academic board was established to support students undertaking formal scientific research in pursuit of postgraduate qualifications.

The overall objective of the Board is to ensure ACDP maintains the highest standards in research training, scholarship opportunities and collegiate culture. This is achieved by ensuring student projects are of high-scientific quality, have appropriate financial support, and that students receive high-quality supervision.

The aim is to ensure a positive and rewarding research experience for the student, and the delivery of high-quality and rigorous scientific outcomes from student projects that advance knowledge in the field.

This year, the Board received funding for a new PhD government scholarship position for a joint ACDP-Charles Sturt University student.

CSIRO Early Research Career Postdoctoral and Engineering Fellowships

CSIRO Early Research Career Postdoctoral and Engineering Fellows work alongside leading researchers on projects of national and global significance. They undertake independent research and are mentored by senior scientists, while being given access to generous personal development and learning opportunities.

We aim to enhance the research capability of ACDP through the employment of PhD graduates as CSIRO Early Research Career Fellows. Our goal is to offer a range of opportunities to develop successful candidates as future science leaders.

ACDP hosted nine Early Research Career Fellows in 2021.

One of our early research career fellows, in the foreground, is using a digital microscope to monitor cell culture growth.

Our culture

Staff wellbeing

The COVID-19 pandemic has caused significant ongoing disruption and uncertainty for everyone, and we acknowledge the strain this has placed on our people. ACDP held several sessions to support our people to cope with these stressors in 2021, with particular emphasis on stress and fatigue management and coping with lockdowns.

Our people at ACDP also participated in a CSIRO-wide fitness initiative in 2021, with our participants earning the top spot and reflecting our site's commitment to health and wellbeing.

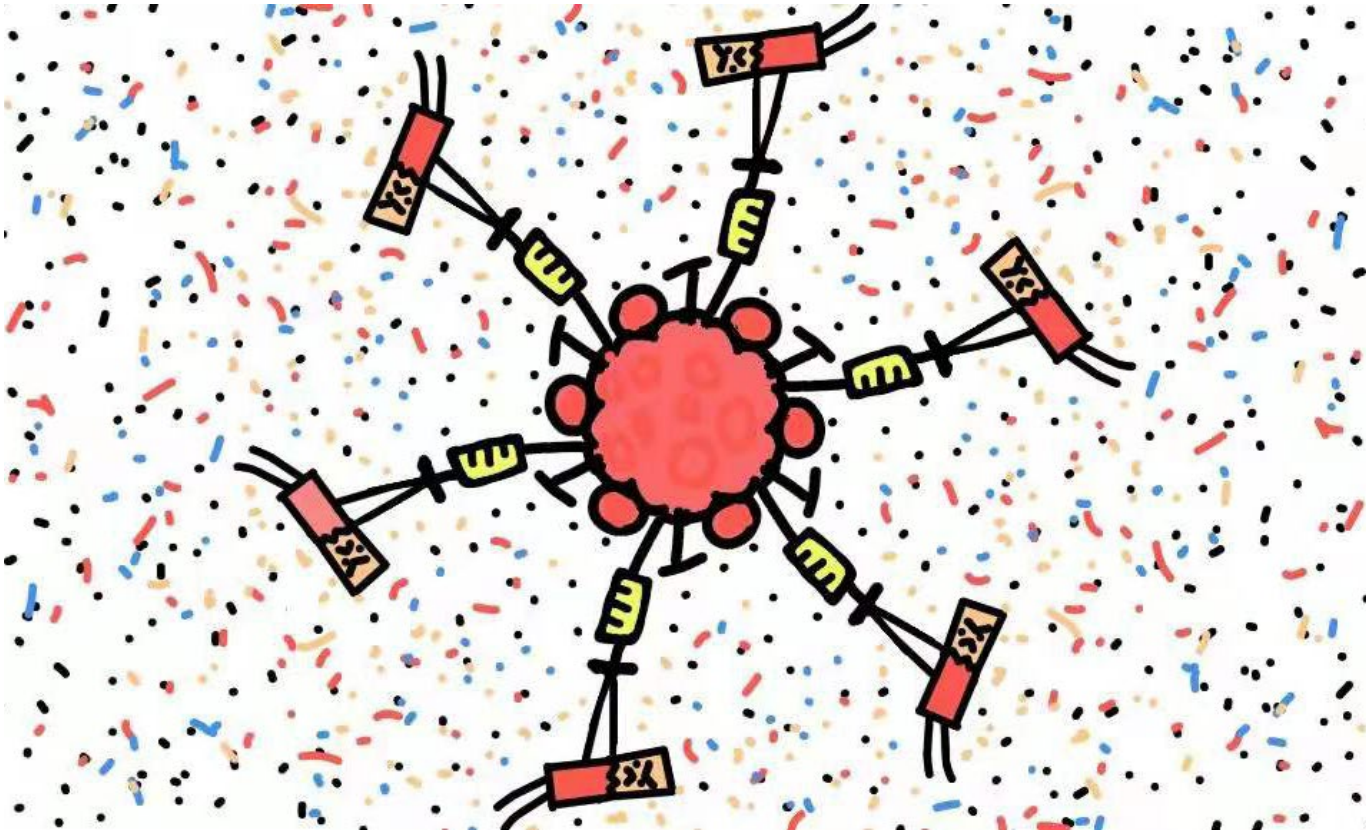
ACDP's social club adapted to open air activities in line with COVID-19 protocols.

Social Club

The ACDP Social Club aims to make the workplace an enjoyable and inclusive place for all. Our hard-working committee of 16 staff regularly organises social events for people to meet, arranges services such as the tea and coffee supply, and holds functions to mark special dates.

In 2021, the Social Club offered important support to our staff as the COVID-19 pandemic refocussed the team in their efforts to assist and connect staff during a period of disruption and stress.

Most of our social activities have been online, but intermittent face-to-face activities have included a Biggest Morning Tea fundraiser, and a 'Welcome back to ACDP' lunch which offered a brief connection for our people between shutdowns. Online quizzes, virtual trivia, Bar and Grills, and many discounted tickets to events offsite have also provided opportunities to connect during another socially distanced year.



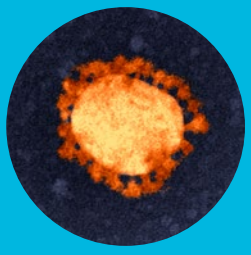
The social club asked our employees' children to draw what their parents do at work. This digital illustration depicts the team effort of our staff to combat COVID-19.

Future focus

The coming years will see several challenges for our research and operations as Australia and the world recover from COVID-19. Yet for ACDP as a national facility, the world's focus on the importance of scientific research and preparedness against emerging infectious diseases will harness several key opportunities to grow and position ACDP as a critical part of cutting-edge Australian science research and infrastructure.

One Health

Animal and zoonotic disease preparedness and response



Strengthening biosecurity in our region

Building capability for national and regional biosecurity and resilience


Protecting our way of life

Improved health and wellbeing of all Australians



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