Australia's National
Science Agency

Australian Centre for Disease Preparedness

2020 | Year in Review

Citation

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NCRIS
National Research Infrastructure for Australia
An Australian Government Initiative

Important disclaimer

Acknowledgement of Traditional Owners

The Australian Centre for Disease Preparedness respectfully acknowledge 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.

Cover image: An aerial view of the Australian Centre for Disease Preparedness.

Contents

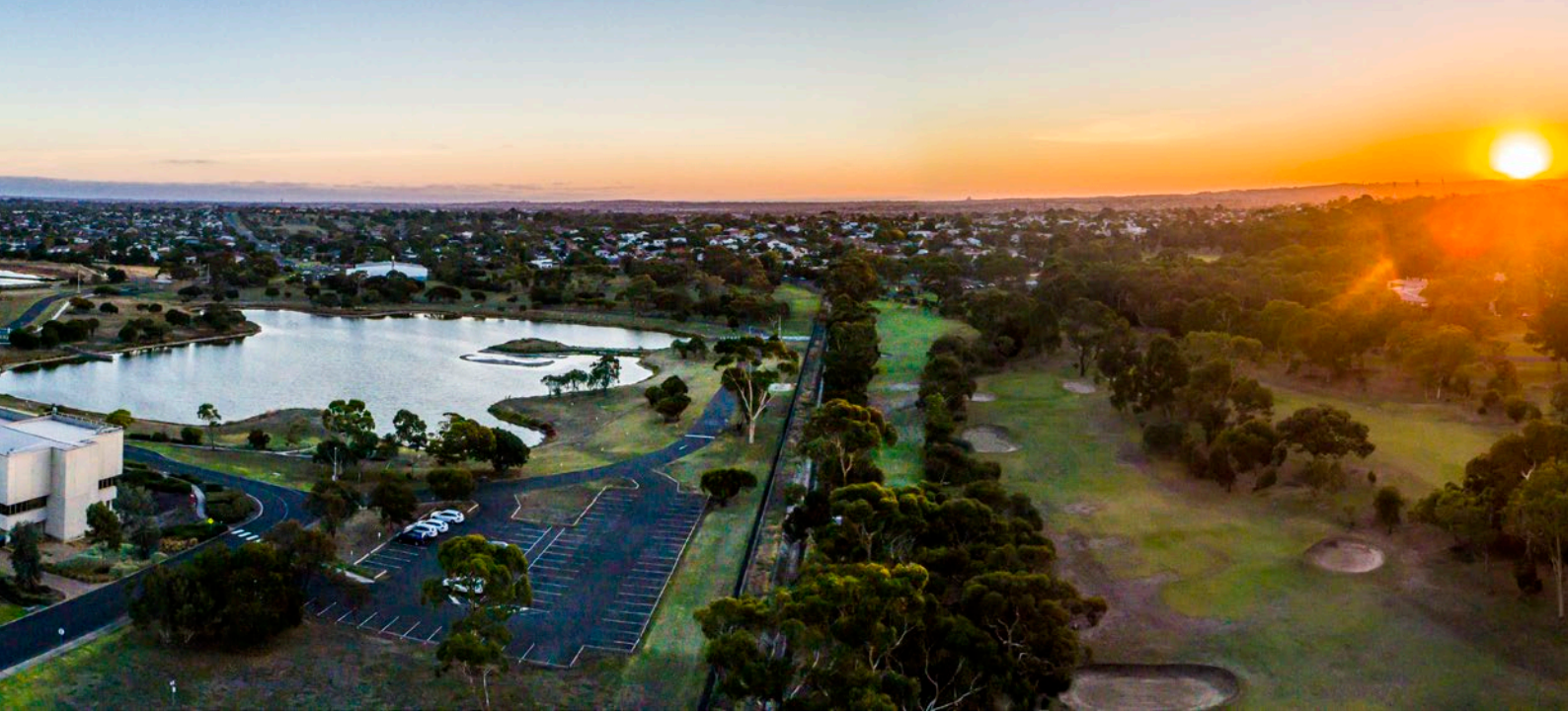
From the Director

By any measure, 2020 was a year of great challenge for our society, economy and environment, largely due to the COVID-19 global pandemic. However, it was a year that also saw significant achievement and advancement of CSIRO's Australian Centre for Disease Preparedness (ACDP), formerly the Australian Animal Health Laboratory (AAHL), a critical element in our nation's response to that threat.

The change in name during 2020 was both timely and appropriate, and better reflects our ongoing work and the responsibility of the facility in bringing together disease protection and biosecurity measures addressing both human and animal health.

ACDP provides Australia's highest level of biocontainment within purpose-built biosecurity infrastructure. Our people and partners work tirelessly – repeatedly demonstrated in this tumultuous year – to protect Australia's valuable livestock and aquaculture industries, and the community, from exotic and emerging infectious diseases. The research we enable, made possible through the combination of our world-leading infrastructure, programs and expertise, helps protect Australia's economy and environment, and the health and wellbeing of our nation.

It was prescient that our relationship with the Coalition for Epidemic Preparedness Innovations (CEPI) pre-dated the emergence of SARS-CoV-2, the causative virus of COVID-19. In October 2019, we pre-qualified with CEPI to develop a pre-clinical vaccine trial pipeline, in anticipation of "Disease-X" emerging from a wildlife source and requiring rapid assessment of candidate vaccines. Our past work with SARS, Ebola, Nipah and Hendra virus equipped us well and we led the world in our response, being the first to carry out such trials. This work contributed significantly to the rapid progress of vaccine validation and authorisation, something we in CSIRO are very proud of.



Working with CSIRO colleagues and partners, we have also contributed to other notable successes by Australia, assisting with the development of other vaccines, studies of virus evolution and the significance of major mutations, and developing novel technologies for the detection and improving understanding of the virus and its survival.

ACDP continues to maintain and develop core capabilities to address all four aspects of preparedness: awareness, assessment, mitigation and response. This includes supporting regional capability by providing technical advice for our neighbours on biosecurity threats. We focus on scientific research and evaluation of emerging disease threats to enhance our expert knowledge base, which is key for contributing to a rapid diagnosis and disease response. This year, we performed more than 5,000 tests for notifiable disease exclusion, as well as response to three near-simultaneous outbreaks of avian influenza in Victoria involving three different virus strains. We also continue to build regional capability by engaging in ongoing education and prevention programs, both nationally and internationally, to help ensure effective surveillance, along with prompt detection and investigation of emerging infectious diseases.

Ultimately, our vision is for a multisectoral 'One Health' approach to disease research involving all three sectors of veterinary, human and environmental health, through collaborations with research institutes, universities, science networks, biotech and industry, brought together through support from national and international donors and leading funding bodies.

Working closely with CSIRO's world-leading biologics manufacturing, human health and data analytics research units, we continue to equip Australia with the capacity to not only predict, prepare, prevent and respond to disease, but also to translate the breakthroughs of Australia's veterinary and medical research communities into real world solutions to our greatest infectious disease challenges.

In achieving this vision, we will deliver the greatest value for Australia and our region through deep expertise, agility and continued cooperative enterprise.

Prof Trevor Drew OBE
Director, Australian Centre for Disease Preparedness

2020 snapshot

3 OIE Collaborating Centres

10 OIE Reference Laboratories

(2 added in 2020)

5 CSIRO business unit collaborations

- Health and Biosecurity
- Data61
- Manufacturing
- Land and Water
- Agriculture and Food

33 International collaborations

(proficiency testing program)

UK
Denmark
Brazil
USA
Republic of Korea
Canada
Germany
Italy
Russia
India
Brunei
Malaysia
Philippines
Bangladesh
Nepal
Bhutan
Sri Lanka
Pakistan
Myanmar
Cambodia
Laos
Vietnam
Thailand
Singapore
China
Japan
Mongolia
New Caledonia
Indonesia
Iran
Saudi Arabia
PNG
New Zealand

5 CSIRO challenges supported

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

5000+
Diagnostic tests performed

7
Post-doctoral fellows

Funded by CSIRO Early Career Researcher and Future Science Platform (FSP) programs

9
Student work placements

19
COVID-19 research studies

Staff awards

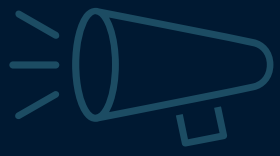
5 team awards

2 team grants

4 individual awards/grants

3569
Media items

43.6 million
Audience reach



Media data is for Aus/NZ with international data unavailable, and excludes social media

100+
Applications for facility use

400+
Public enquiries

70+
Publications

Who we are

ACDP has a dedicated and diverse group of staff who deliver the highest levels of support and expertise in order to maintain the capability and success of the facility. While the facility was renamed the Australian Centre for Disease Preparedness (ACDP) in 2020, this has not changed the critical work and expertise provided by the former Australian Animal Health Laboratory (AAHL).

ACDP has the full range of scientific, technical, engineering and support expertise needed to run the facility effectively. The Operations Group includes areas specialising in accredited Quality Assurance (QA), training, operations, and the Animal Welfare Officer (AWO) in support of the delivery of science.

Working with carp in the ACDP aquatic facility.

Testing samples in the biosecure immunology laboratory.

Delivering opportunity and access

ACDP is a national facility which offers a world-class, high-containment laboratory space and scientific expertise and services. We support collaborative access to facility capabilities for Australian and international academics, government agencies, research organisations and industry to facilitate impactful research of national benefit.

Submissions for access are subject to a formal access process. Applications received are assessed by the ACDP Access Team for their national benefit, scientific merit, and compatibility with ACDP areas of specialist research and strategic aims.

Information about accessing ACDP facilities is available at: https://www.csiro.au/en/Research/Facilities/ACDP/ACDP-Infrastructure/Accessing-our-facilities

In 2020, ACDP received over 200 enquiries for research collaborations and screening compound efficacy related to SARS-CoV-2. These came from a range of science domains including diagnostics, antiviral therapeutics and vaccine production to inactivation studies.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Our capability

ACDP operates across two sites: a high containment facility located in East Geelong, Victoria and a biosecurity level 2 animal facility located in Werribee, Victoria.

World-class research scientists

Our expert research and operational staff work together with human and animal health agencies to protect Australia and our region's livestock and aquaculture industries, and people from infectious disease threats.

Experts work together across multiple disciplines 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 specialist trained animal services team who are highly experienced in the care and welfare of animals. An Animal Welfare Officer (AWO) also compliments the delivery of animal work on site to monitor the welfare of animals and to ensure the application of current best practice techniques. All projects using animals are reviewed by an 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.

Animal work occurs across several facilities including the PC2 small animal facility (SAF), the PC3 and PC4 large animal facility (LAF) and the PC2 Werribee Animal Health Facility (WAHF).

Diagnostic services

Our Diagnostic, Surveillance and Response (DSR) program is central to ensuring Australia's response capability 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 providing evidence of freedom from diseases of interest, facilitating export trade.

International collaboration and capacity building

ACDP delivers an international program to provide support throughout the Asia-Pacific region to ensure the development and maintenance of strategic international relationships, as well as threat preparedness in the wider region.

The program delivers capacity-building activities, including diagnostic and biosafety training, as well as building One Health networks to improve disease diagnosis and emergency outbreak response. The program provides support for technical laboratory and reference materials, applied research, collaborative surveillance activities and proficiency testing programs.

Biorisk management

ACDP provides Australia with the capability to safely hold and conduct work on the most dangerous global pathogens. The Biorisk Management Group has responsibility for ensuring that ACDP operates in a manner that allows our scientists to deliver world renowned science in a microbiologically safe and secure manner in full compliance with our national and international obligations.

Supporting ACDP's commitment to best practice, our internal processes of review, evaluation, education and training ensures that 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.

Image opposite: Our Biorisk Management Group assesses and monitors the safety of the agents we use.

Reference laboratories and collaborating centres

ACDP is an International Reference Laboratory for several diseases and Collaborating Centre for the region. We provide Australia with the diagnostic and surveillance capability to monitor animals for diseases of high consequence.

In June 2020, ACDP was designated as a World Organisation for Animal Health (OIE) Reference Laboratory for both African swine fever (ASF), with Dr David Williams as the designated ASF expert, and for classical swine fever (CSF), with Prof Trevor Drew as the CSF expert.

ACDP reference laboratories provide a vital service to the Australian Government (Department of Agriculture and Department of Health) for monitoring and responding to new and emerging diseases and high-consequence pathogens of animal origin.

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

In addition, ACDP staff 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.

World Organisation for Animal Health

OIE Collaborating Centres:

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

OIE Reference Laboratory designations:

- Bluetongue
- 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 disease
- Epizootic haematopoietic necrosis virus

The Food and Agriculture Organization of the United Nations

ACDP is a designated FAO Reference Centre for Animal Influenza and Newcastle Disease (NDV) and Laboratory Biorisk Management

ACDPs Reference Laboratory role

We work closely with veterinary and human health agencies globally

World Health Organisation

- Member of WHO Network of Laboratories for SARS
- Representation on WHO SARS-CoV-2 Expert Group

National Reference Laboratory

Terrestrial animals:

- 27 diseases of multiple species
- 2 Cattle diseases
- 5 Sheep and goat diseases
- 11 Equine diseases
- 16 Swine diseases
- 10 Avian diseases
- 4 diseases of other species

Aquatic species:

- 24 fish diseases
- 13 diseases of molluscs
- 15 diseases of crustaceans
- 3 diseases of amphibians

Innocuity testing

Image opposite: The insectary facility is supported by NCRIS for research into vector-borne diseases.

NCRIS membership

The Australian Government's National Collaborative Research Infrastructure Strategy (NCRIS) investment in ACDP has supported the development of world-class research infrastructure including PC4 laboratories, a PC3 immunology laboratory, PC3 bioimaging suite and insectary. These facilities are available for use by Australian and international researchers to benefit Australian's national disease diagnostic capability and to strengthen Australia's biosecurity framework through world-leading research.

Maintaining our infrastructure

ACDP part-life refit

The part-life refit project will deliver a range of upgrade and renewal works to ensure the facility meets current and emerging regulatory compliance standards. This will ensure that the facility is fit for purpose both now and into the future. CSIRO Business and Infrastructure Services (CBIS) is managing this $200+ million capital works program under the direction of a Project Control Group and Project Board.

During 2020, the Project Team engaged with user groups to develop a detailed Functional Design Brief (FDB) to fully describe the project. The design brief was approved by the Project Board in June 2020. The FDB is a key component of the tender for design services, which is due for completion by February 2021. The design will be progressed sufficiently to seek public works approval in 2022.

Construction for the ACDP part-life refit project is expected to be completed in 2028.

Electron microscope laboratory design

ACDP has obtained internal funding for the purchase of a new electron microscope (EM). CBIS and scientists are now working closely together to implement the design and build of a new EM Laboratory in the non-secure area.

In addition to housing the electron microscope, the EM Laboratory space includes dedicated space for supporting functions and an office space. The project is being managed by the ACDP part-life refit project team, with construction expected to be completed in 2021.

Ultra-low freezer room

During 2020, CBIS commissioned an ultra-low freezer room in the ACDP secure area. This room houses ultra-low electromechanical freezers which replace the previous LN2 (liquid nitrogen) freezers. This development delivers significant safety benefits by eliminating increased risk of asphyxiation from using LN2 in the secure environment.

Improving our environmental footprint

Previously, ACDP has been exclusively reliant on formaldehyde to perform gaseous decontamination of our laboratory spaces. Formaldehyde is a known carcinogen presenting exposure risks to staff and contractors and whilst appropriate measures are taken to mitigate these risks, finding a suitable alternative is the preferred long-term option. Further, formaldehyde has long cycle times and leaves behind a residue that off-gases.

ACDP facility. Photo: Teresa Limm.

Speciality biocontainment engineering

CSIRO Business and Infrastructure Services (CBIS) provides specialised engineering requirements for the day-to-day operation of ACDP. This includes maintaining critical infrastructure, biocontainment, biosecurity and compliance with regulatory frameworks.

ACDP has 1000 HEPA filters which remove any viruses or bacteria from the air before it is vented from the building.

A project to identify suitable alternatives to use of formaldehyde has commenced in efforts to eliminate this hazard, whilst maintaining efficacy of decontamination.

Potential alternatives have been identified by the Biorisk Management Group (BMG) and investigations into the reduction or elimination of formaldehyde at ACDP are ongoing. Most recently, BMG completed a successful trial using hydrogen peroxide vapour. BMG demonstrated that decontamination of a small animal room using hydrogen peroxide was comparative to formaldehyde by a direct measure of lethality of biological indicators.

Following these successful trials, BMG has commenced decontaminations of BSL2 small animal rooms with hydrogen peroxide. This has reduced our overall reliance on formaldehyde.

In addition, hydrogen peroxide fumigation increases room availability because the decontamination procedure is much shorter, decreasing turnaround time from 48 hours to 4 hours.

Delivery of a new transmission electron microscope (JEOL F200 TEM). Photo: Sandy Crameri.

Science highlights

Delivering impact to the global COVID-19 response

In this extraordinary year of the COVID-19 global pandemic, staff at ACDP have demonstrated their capability and agility. Drawing on CSIRO staff expertise and the world-class capabilities of ACDP a team was assembled and commenced research to understand the new virus within weeks of the World Health Organization declaring a public health emergency.

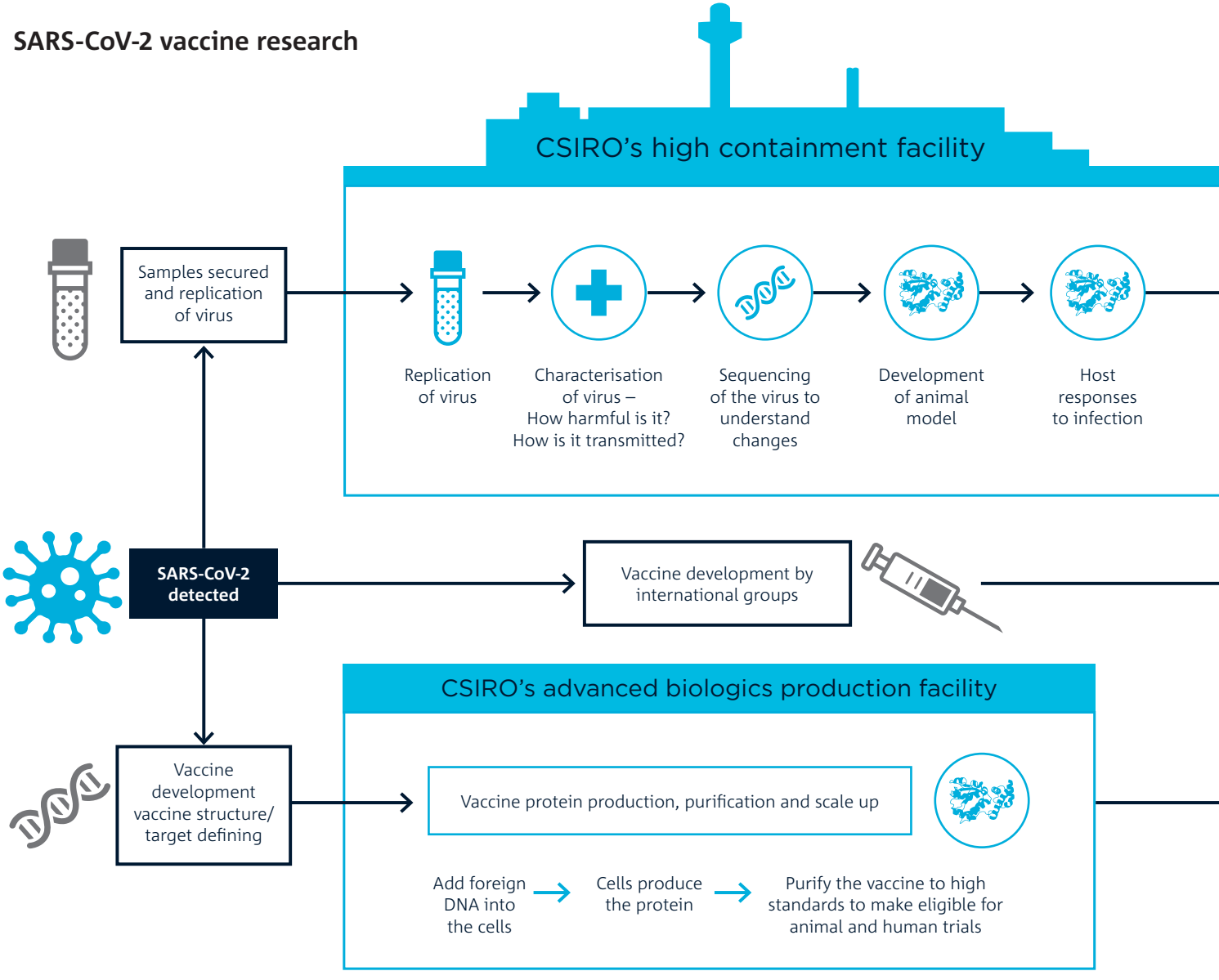
Researchers at ACDP have been studying many aspects of the virus, including virus replication in the host, host response, impacts of virus mutation and virus survival on surfaces. Our work has also provided significant contribution to the global pandemic response through pre-clinical assessment of vaccine candidates in an animal model.

Understanding the new virus

CSIRO researchers studied the SARS-CoV-2's genomic sequence and confirmed that the virus is presently changing into several distinct 'clusters' in different parts of the world. Researchers at ACDP will continue to monitor changes in the virus to understand their potential impact on the development and evaluation of COVID-19 vaccines, therapies and diagnostics.

Our peer-reviewed research paper, *Supporting pandemic response using genomics and bioinformatics: a case study on the emergent SARS-CoV-2 outbreak*, was accepted for publication by the Transboundary and Emerging Diseases journal on 7 April 2020.

SARS-CoV-2 vaccine research



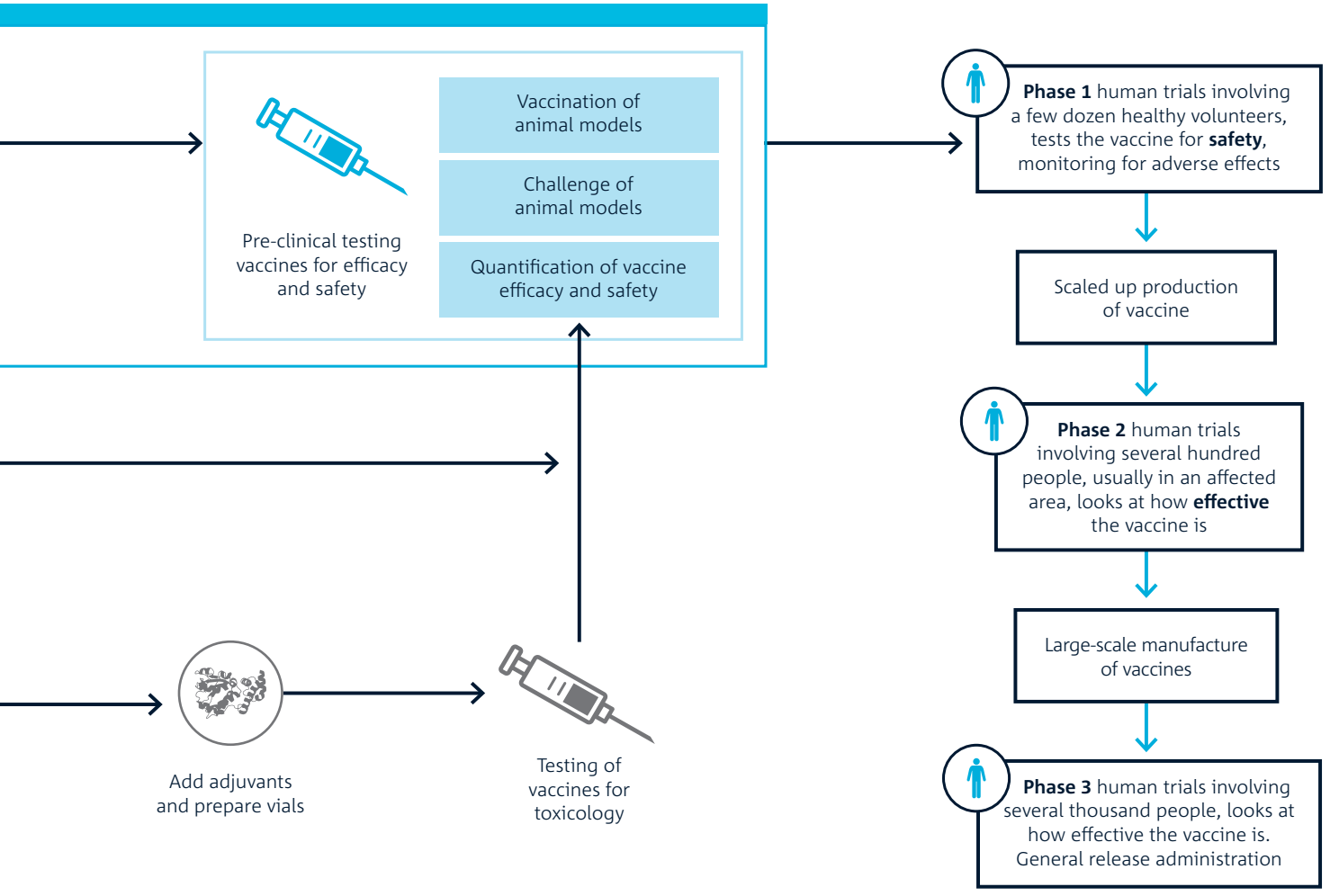
Pre-clinical testing of a vaccine

CSIRO is working as part of a global alliance with the Coalition for Epidemic Preparedness Innovations (CEPI). The goal of this alliance is to accelerate traditional vaccine development and testing.

In February 2020, Health and Biosecurity business unit researchers at ACDP established the ferret model in record time and, during March, were subsequently tasked by CEPI to start the world's first multi-vaccine efficacy study in animals.

In consultation with the World Health Organization, CEPI selected two candidates for pre-clinical testing at ACDP. The vaccine candidates came from Inovio Pharmaceuticals in the US and the University of Oxford in the UK. These were the second and third vaccines globally to undergo pre-clinical trials.

Scientists test COVID-19 vaccines at ACDP.



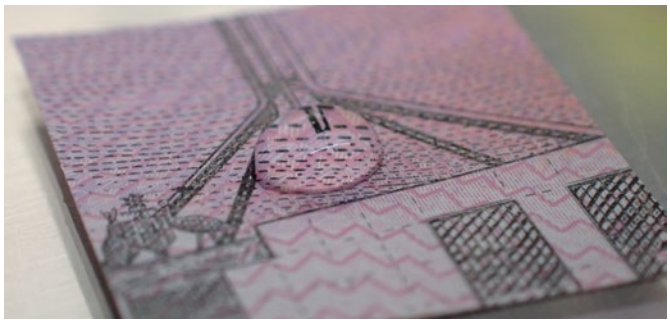
An electron micrograph image of SARS-CoV-2, taken at ACDP. Photo: Sandy Crameri.

Virus survival on surfaces

During 2020, a team from ACDP published a peer-reviewed study on the survival of SARS-CoV-2 virus on surfaces at three different temperatures: 20˚C, 30˚C and 40˚C.

The results demonstrated that SARS-CoV-2 can remain infectious on surfaces for extended periods of time, with cooler temperatures extending the virus survival time. This research helps us better understand the conditions in which SARS-CoV-2 can stay active on surfaces to improve targeted disinfection and deactivation methods.

For more information on our COVID-19 response effort contact Trevor Drew; trevor.drew@csiro.au



Working in our highly secure laboratory, droplets of SARS-CoV-2 in artificial mucous were applied to test surfaces.

SARS-CoV-2 Antiviral Screening Program

In 2020, CSIRO and the Peter Doherty Institute for Infection and Immunity initiated a joint collaboration to screen potential antiviral compounds for efficacy against SARS-CoV-2.

Three types of screening are happening at ACDP: in vitro screening (in cell culture), ex vivo screening (using a model of human epithelial lung cells) and in vivo screening (animal model).

ACDP has also continued to assess further candidates for screening directly with CSIRO's ex-vivo model.

For more information on Antiviral Therapeutic Screening contact Michelle Baker; michelle.baker@csiro.au

Ancillary COVID-19 research on site

ACDP researchers are undertaking a range of additional research activities relating to the COVID-19 response, including improving experimental protocols used for studying the virus and further studying the SARS-CoV-2 virus to improve the global knowledge pool. ACDP also welcomes national or global collaborations looking to undertake impactful research related to SARS-CoV-2.

To enquire about research collaborations related to SARS-CoV-2 contact access2acdp@csiro.au

Delivering animal, human and vector-borne disease research

Reinforcing regional disease detection capability

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

ACDP, partnering with several organisations including Australia's Department of Agriculture, Water and the Environment (DAWE), the Food and Agriculture Organization of the United Nations (FAO) and the World Organisation for Animal Health (OIE), delivers a range of accredited proficiency testing programs for significant diseases. These programs allow laboratories to obtain an authoritative assessment of their testing capability, both in absolute terms and against the performance of their peers.

Many of these testing programs are followed by workshops and laboratory visits, which allow ACDP scientists to work with local laboratory staff to help them address any problems identified and to build up their diagnostic capability in general. Ensuring that our regional neighbours have a strong diagnostic capability for important diseases adds a forward barrier against incursions into Australia, protecting Australian agricultural industries and our economy from the impact of these diseases.

For more information on our work in proficiency testing contact James Watson; james.watson@csiro.au

International visitors attend a biosafety workshop at ACDP in 2020 to learn about best practice in biocontainment. Photo: Phoebe Readford.

African swine fever

Responding to African swine fever in PNG

African swine fever (ASF) is a severe disease of pigs that poses a real and present threat to our region. ASF can lead to the death of almost 100% of infected pigs and has recently emerged in the Highlands of Papua New Guinea (PNG). While ASF does not infect humans, and infected pork is safe to eat, pigs are central to PNG life as they are used for food, economic, cultural and ceremonial purposes.

Through our recent designation as an OIE Reference Laboratory for ASF, ACDP has assisted the PNG National Agriculture Quarantine and Inspection Authority (NAQIA) by performing diagnostic testing on samples collected by NAQIA staff after the initial outbreak, as well as from subsequent surveillance activities.

This work has helped NAQIA track the spread of the disease in the Highlands and determine the effectiveness of control efforts. ACDP has also aided NAQIA's own ASF laboratory diagnostic capability through support for training and equipment needed to perform ASF testing.

This work has been funded by the Australian Centre for International Agricultural Research (ACIAR).

For more information on our diagnostic virology capability contact David Williams; d.williams@csiro.au

Protecting industry from the impact of African swine fever

African swine fever (ASF) has had a devastating impact on Chinese pork production and there is extreme concern for the potential impacts of ASF should the disease make it to Australia. Of concern, the ASF virus is known to survive well in fresh and preserved meat products. As such, the importation of these products into Australia is restricted to manage this risk.

However, there is real concern over illegal importation as these high-risk foodstuffs are frequently intercepted at the border. ACDP is at the centre of testing performed in support of the nation's objective ensuring food safety and security by preventing disease entering Australia. Working with Department of Agriculture, Water and the Environment (DAWE) quarantine staff, ACDP has tested hundreds of seized products from passengers, mail and cargo for both ASF and foot and mouth disease (FMD). A high proportion of these products have been positive for ASF, with a smaller proportion positive for FMD. This included the detection and isolation of infectious ASF virus as well as virus fragments that indicate contamination of the product.

ACDP's work to provide a concrete and quantitative assessment of the scale of risk from illegally imported meat allows Australia's quarantine authorities to ensure that appropriate protections are in place to protect Australian agricultural industries from the impacts of these diseases.

For more information on our work in emergency disease investigation contact James Watson; james.watson@csiro.au

Testing ticks for transmission of African swine fever

African swine fever (ASF) causes a highly lethal disease in pigs and can be vectored by soft ticks in the genus Ornithodoros. Cases have been reported from Papua New Guinea, Timor-Leste and Indonesia, threatening the pig industry and global food security.

To determine the risk of ASF 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 ASF research program at ACDP. By establishing a tick colony and conducting these studies, we are helping to clarify the potential risk of ASF establishment in Australia, which assists in informing policy to prevent disease establishment in these areas.

For more information on the ASF vector-competence study contact Prasad Paradkar; prasad.paradkar@csiro.au

Kangaroo soft tick *Ornithodoros gurneyi* are studied in the ACDP insectary to help assess ASF risk to Australia. Photo: Melissa Khan.

Vaccine administration in livestock

Testing novel ways of vaccine administration for Foot and Mouth Disease

Foot and Mouth Disease (FMD) threatens food security in developing countries and poses a serious threat to the livestock industry trade in 'FMD free' countries like Australia.

FMD can be controlled through an intramuscular (IM) injectable vaccination, with vaccination one of the options for control if FMD were to occur in Australia.

A team at ACDP has been working with MSD Animal Health (the Netherlands) on an alternative Intradermal Application of Liquids (IDAL) technology. This has shown intradermal (ID) vaccine delivery is comparable to IM vaccination but without causing reactions at the site of vaccination.

Further research is now required to adjust the current IM FMD vaccine to the ID format, investigating the use of alternative adjuvants (substances added to a vaccine that help create a stronger immune response) and better understanding the immune responses elicited when vaccines are administered in different ways.

For more information contact on our FMD research contact Nagendra Singanallur; nagendra.singanallur@csiro.au

Staff receive training from Anke Woeckel (pictured holding device) in use of a needle free IDAL device for delivery of vaccine in an FMD vaccine study. Photo: Petrus Jansen van Vuren.

Emerging diseases in Australia

Cutting-edge sequencing platforms reveal clues about movement of *Ehrlichia canis* in Australia

Ehrlichia canis is a blood-borne bacterium that causes the sometimes fatal disease ehrlichiosis in dogs. Although previously considered exotic to Australia, *E. canis* was recently discovered in several dogs in Western Australia and the Northern Territory. Ehrlichiosis is a notifiable disease to Australian veterinary authorities and the discovery of *E. canis* in Australia raised serious concerns about the source of introduction and current distribution across northern Australia.

ACDP recently enhanced its sequencing capacity with the addition of Illumina NextSeq2000 and Oxford Nanopore MinION instruments. These have been used to obtain several near complete *E. canis* genomes. These genomes are now being used in comparative analyses to help understand the movement of *E. canis* throughout Australia and evaluate possible entry routes.

For more information on our sequencing capability contact Matthew Neave; matthew.neave@csiro.au

Staff undertake sample testing in the Diagnostic and Emergency Response Laboratory (DERL).

Influenza outbreak in Victorian poultry industry

During July and August, the Diagnostic Surveillance and Response (DSR) team were at the forefront of an investigation into three different strains of avian influenza detected across six infected farms in Victoria:

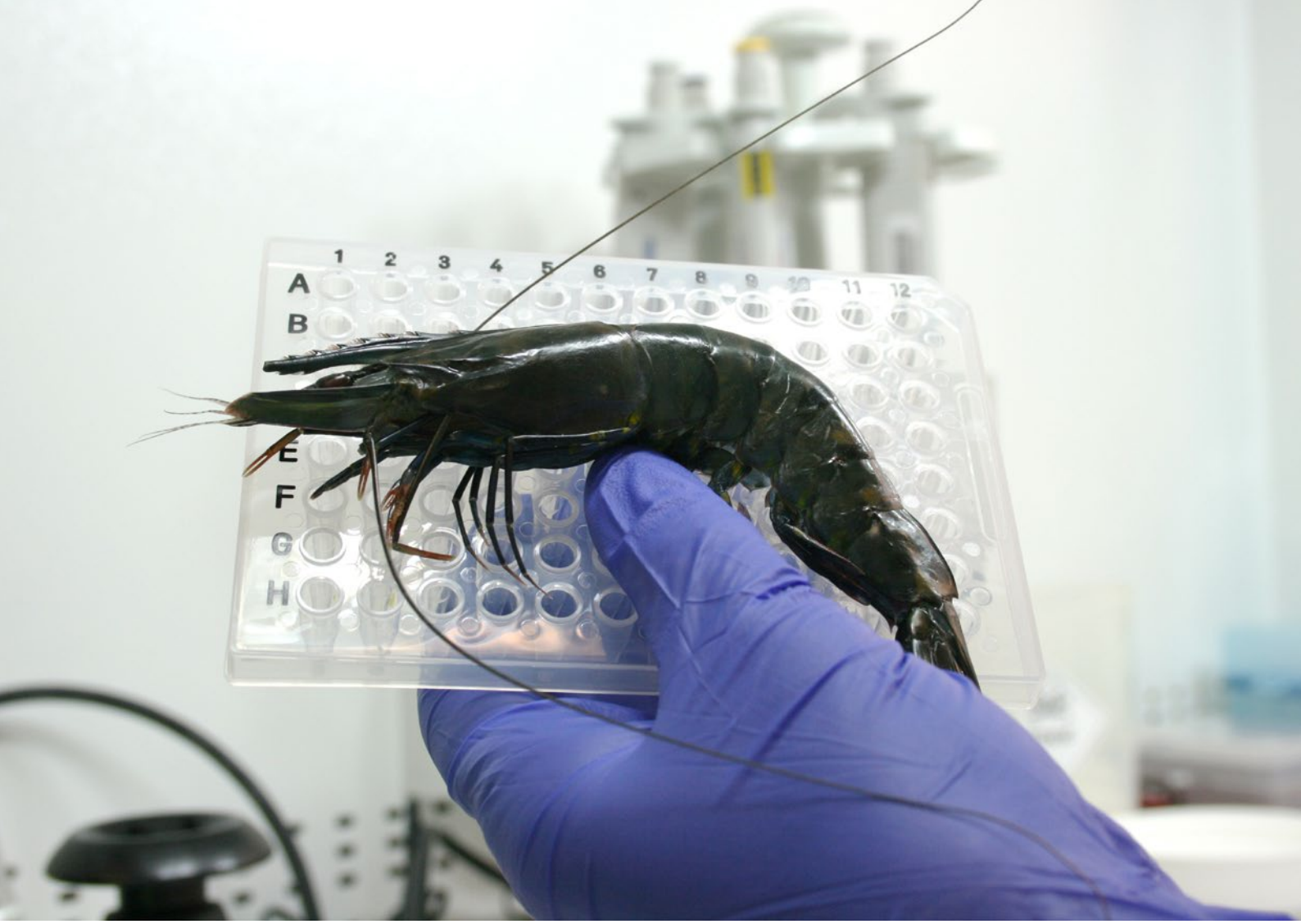
- three egg farms with highly pathogenic H7N7 avian influenza
- two turkey farms with low pathogenic H5N2 avian influenza
- one emu farm diagnosed with low pathogenic H7N6 avian influenza.

When avian influenza outbreaks occur in production birds, it is not unusual for more than one farm to become infected. However, this outbreak was the largest ever recorded in Victoria and it was highly unusual to see three strains, both highly and low pathogenic, occurring at the same time.

High priority testing from the DSR program rapidly delivered results to Victoria's Chief Veterinary Officer (CVO) and team. This allowed them to develop an informed control plan to curb the spread of avian influenza throughout regional poultry industries. This contributed to the outbreaks being rapidly brought under control.

In support of the H7N7 and H7N6 (AI) virus cases, several projects are being undertaken to assess the pathology and virulence of the newly emerging virus strains. Further viral genome sequencing work is also being conducted to better understand this strain of virus.

For more information on our avian influenza capability contact Frank Wong; frank.wong@csiro.au



Prawns are tested for WSSV in ACDPs diagnostic laboratories.

White spot syndrome virus

White spot syndrome virus (WSSV) is a pathogen that has significant impact on the multimillion-dollar Australian prawn and crustacean industry. During 2020, WSSV was re-detected in trawled crabs from northern Moreton Bay and in two diseased prawns from the Logan River in Queensland. The presence of WSSV was confirmed in samples submitted to the ACDP Fish Diseases Laboratory.

Whole genome sequencing of farmed prawn material confirmed the WSSV present was the same as that detected previously from diseased prawn farms along the Logan River in 2016 and a wild crab and prawns from northern Moreton Bay in 2017 and 2018. This demonstrated that WSSV is persisting in the wild and the detections in 2017, 2018 and 2020 were not new incursions.

For more information on the ACDP Fish Diseases Laboratory contact Nick Moody; nick.moody@csiro.au

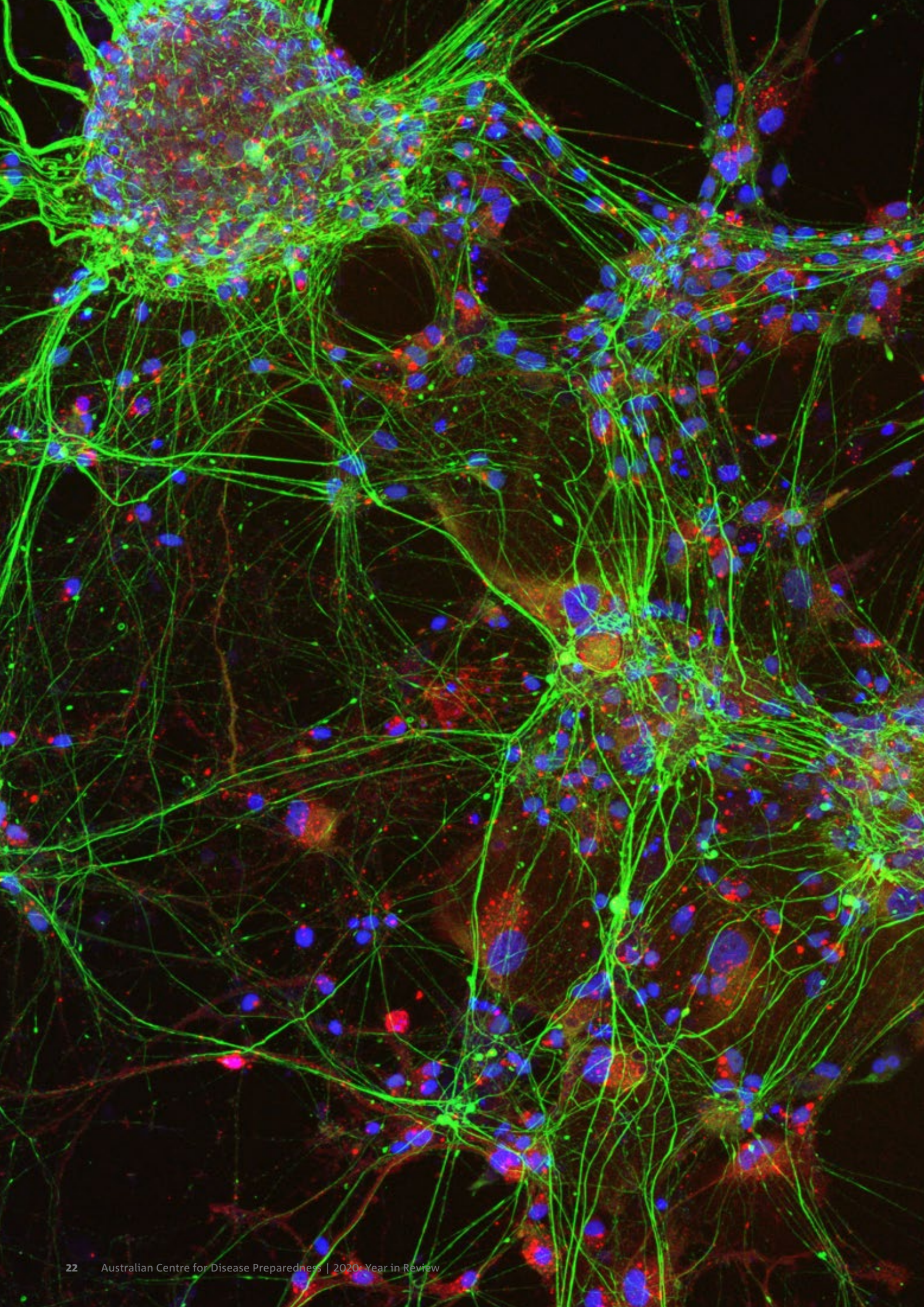
Controlling Buruli ulcer in Victoria

Sometimes called the flesh-eating bacteria, Buruli ulcer is an infection of the skin and soft tissue. In recent years, cases of Buruli ulcer have increased dramatically in Victoria, with control efforts hampered by a lack of clarity about how people contract this disease and how it circulates in the environment.

Health and Biosecurity business unit researchers at ACDP have been conducting a large-scale case-control study of this disease, where potential behavioural and environmental risk factors identified through questionnaires are linked to the physical presence or absence of the causative agent in the environment for individual project participants.

The findings of this study will help clarify the role of different transmission routes for Buruli ulcer and identify potential points for intervention. This will better inform public health policy and ultimately improve our ability to respond to and prevent this disease.

For more information on the Buruli ulcer case-control study contact Kim Blasdell; kim.blasdell@csiro.au



Engineering model systems and novel diagnostic platforms

Precision breeding technologies in poultry

The Genome Engineering (GE) team at ACDP are world leaders in developing and applying new precision breeding technologies in poultry.

The team works very closely with all sectors of the global poultry industry including chicken meat, egg production and poultry genetics companies with a major focus to improve the health and welfare of farmed chickens as well as increase sustainability and safety of poultry products for consumers.

The GE Team are using gene editing technology to improve the resilience of chickens to viral diseases, and the safety of eggs as a food ingredient. The team is also developing a sex selection technology to prevent the culling of male chicks in the egg layer industry and diverting point-of-lay male eggs to high value purposes, including improved influenza vaccine production which relies on fertilised chicken eggs.

For more information on our genome engineering projects contact Kristie Jenkins; kristie.jenkins@csiro.au

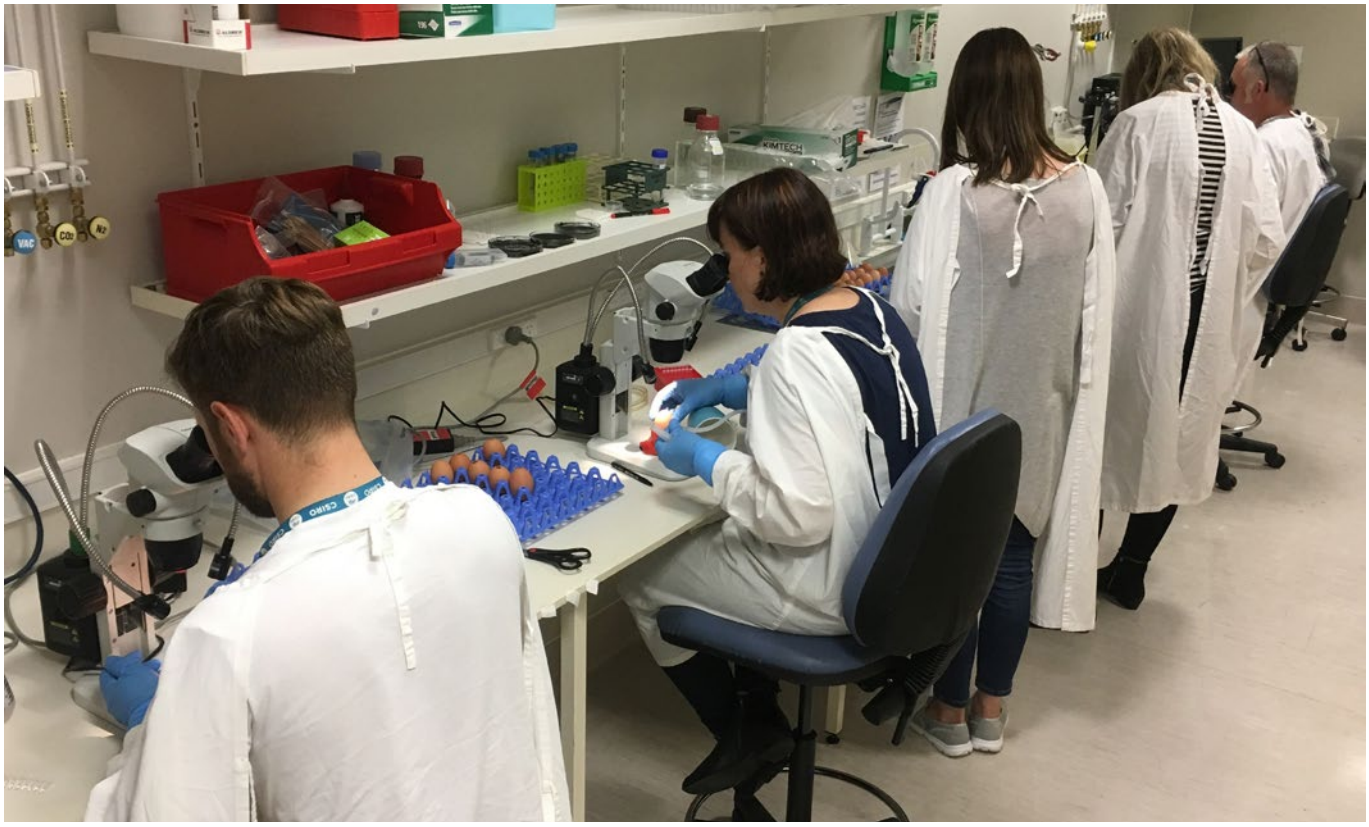
Ex vivo modelling to pave the way to more ethical and sustainable science

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.

Such innovative models will 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 Nathan Godde; nathan.godde@csiro.au



Scientists at ACDP use advanced genome engineering to modify the chicken genome in eggs.

Image opposite: A network of neurons is stained in green to highlight the complexity and interconnection of the cells. Photo: Vinod Sundaramoorthy.

The cane toad on right lacks dark skin pigment and offers proof of concept that gene editing is possible in this species. Photo: Mark Tizard.

Detox-cane toads saving our native wildlife

The cane toad is an invasive pest that is the scourge of the northern tropics of Australia. It has been implicated in the local extinction of many native predator species, such as the Northern quoll, as a result of the lethal cardiotoxin that it uses for self-defence. The genome engineering team from CSIRO Health and Biosecurity have combined their skills with those of the ACDP Small Animal Facility to generate the world's first genome edited cane toads.

The team has adapted a patented new technology, sperm transfection assisted genome editing (or STAGE), to delete genes in the cane toad. In the first instance, a gene responsible for the expression of the dark skin pigment was edited resulting in 'Blondie', a toad with a leg lacking the key pigment.

Through a collaborative research program, a key gene was knocked out in the metabolic pathway by which cane toads manufacture their lethal toxin. Once grown and breeding, these toads should be non-toxic. This will allow them to be used in another project for developing condition taste aversion (CTA), a means of teaching predators not to eat cane toads.

CTA was previously based on cane toad 'sausages' laced with an emetic. However, the detox-cane toads will provide a much more effective teaching aid, with the goal of assisting in conservation programs for Northern quolls (as well as other native predators) to survive the invasion by cane toads.

This is the first step in a longer-term process which could develop genetic biocontrol strategies to interfere with cane toad reproduction and its invasiveness and survival.

For more information on our genome engineering projects contact Mark Tizard; mark.tizard@csiro.au

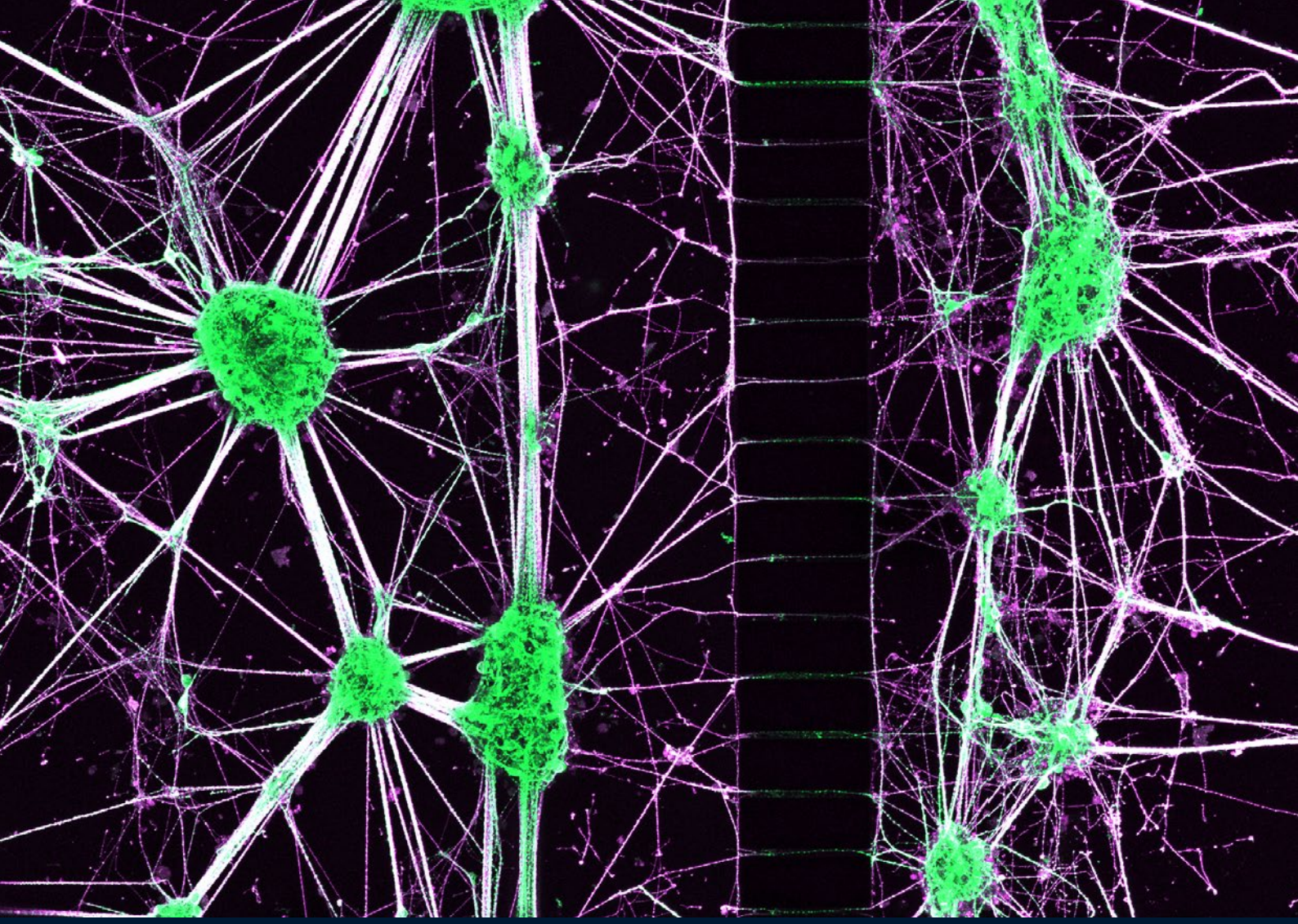
Novel diagnostics for animal diseases

During 2020, CSIRO Health and Biosecurity researchers commenced a project funded by the New Zealand Ministry of Primary Industries to develop novel diagnostics for *Mycoplasma bovis* in cattle. *M. bovis* causes a range of serious disease in cattle, including mastitis, pneumonia and late-term abortions. Previously exotic to New Zealand (NZ), the bacterium was detected there in 2017, which prompted development of a government-led eradication plan.

This plan includes the development of novel diagnostics, as *M. bovis* cannot be reliably diagnosed using existing tests such as polymerase chain reaction (PCR) or serology. The team will investigate whether host biomarkers can indicate *M. bovis* infections that are otherwise hidden, and test biomarker specificity against a range of other livestock diseases.

The project will involve collaboration with Massey University NZ, AgResearch NZ, and colleagues at ACDP, who will contribute expertise in biomarker test validation.

For more information on our novel diagnostics platform contact Cameron Stewart; cameron.stewart@csiro.au



Neuron grown in special microfluidic wells to separate out connections of individual axons in a 'ladder-like' arrangement. Photo: Vinod Sundaramoorthy.

Dr Vinod Sundaramoorthy, Deakin University, Visiting Research Scientist

Investigation of the lethality of rabies virus provides clues to protect brain health

Lyssavirus (including rabies) is the deadliest virus on earth which, despite the availability of vaccines, remains a major threat to humans and animals in many Asian and African countries. The mechanism behind the lethality of rabies virus is poorly understood.

An ACDP collaborative research program has established advanced experimental model systems consisting of brain cells (neurons) in a dish to study rabies virus. The research utilises cutting-edge microscopical analysis, proteomics and genomics approaches to study how rabies virus infects and manipulates the nervous system. In these studies, we have identified that rabies virus has an impressive ability to take control of the host nervous system by keeping the infected neurons healthy for efficient infection. These studies have enabled us to identify new mechanisms responsible for the lethality of the rabies virus.

These findings have also provided clues on how to protect the neurons from ageing, injury and diseases using similar mechanisms used by the rabies virus. This innovative research program at ACDP aims to deliver novel knowledge at the interface of virology and neurobiology to combat brain viral infections and protect brain health.

For information on viral neuropathogenesis studies contact Dr Vinod Sundaramoorthy Visiting Research Scientist, CSIRO-ACDP, Pathology and Pathogenesis group, DSR; vinod.sundaramoorthy@csiro.au


CSIRO

Engagement and outreach

Ex vivo models symposium

In March, ACDP collaborated with CSIRO's Health and Biosecurity and Manufacturing business units to lead a CSIRO Cutting Edge Symposia. Called 'Challenges and opportunities for "ex vivo" model systems', the event highlighted recent developments in 3D tissue culture, stem cell technology, automation, and micro and nanofabrication. The symposium explored challenges for applying these technologies to replicate disease progression and pathogenesis.

A key focus of the symposia was merging cross cutting skills from different disciplines to address challenges and opportunities in technology and product translation. It also included an ACDP showcase where participants visited the site and heard presentations from our Director, Prof Trevor Drew, and several research scientists to capture the essence of the work undertaken at the facility. As a result, a strong network of 70 participants from across CSIRO, academia and industry was developed and given a greater awareness of the ACDP capability through virtual and in-person secure laboratory tours.

Emergency Animal Disease Symposium goes virtual

During October, ACDP held four virtual symposia for Emergency Animal Disease (EAD) involving 400 participants. Topics included African swine fever, *Ehrlichia canis*, COVID-19 and avian influenza outbreaks in Victoria.

The virtual symposium attracted a wide geographical distribution of participants from a more diverse range of professional backgrounds than had previously attended 'in person' symposium, showing the reach and benefit of going virtual.

World 'One Health' Day

During November, ACDP hosted a World One Health Day virtual symposium for the three Geelong Centre for Emerging Infectious Diseases (GCEID) partners: ACDP, Barwon Health Research and Deakin University. This forum heavily promoted the benefits of a One Health transdisciplinary approach towards solving today's critical animal, human and ecological health challenges.

ACDP seminar series

The ACDP seminar series, which was run online in 2020, provides a platform for our staff, students and visiting scientists to present their work to a broader audience of ACDP staff and others in the Geelong research network.

Virtual work experience

Applying the COVID-19 way of working to our outreach activities, ACDP staff conducted a virtual work experience for a group of local high school students during 2020. Despite being online, the students were highly appreciative that ACDP was able to provide a work experience program despite the lockdown restrictions and were able to receive great benefit from the activity.

Image opposite: In March, more than 70 scientists attended the 'Challenges and opportunities for "ex vivo" model systems' symposium held in Geelong.

Developing our people, culture and workforce

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:

- Putting people first
- Further together
- Trusted
- Making it real.

These values seek to ensure that not only do we recognise the important work that our people do but that we also recognise the equal importance of the way the work is done, and how we treat each other – our behaviours must reflect these values at all times.

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

Commitment to our people

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 HSE 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.

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, research ethics and our international outreach programs.

Our Post-Doc Program

At ACDP, we aim to enhance the research capability of the facility through the employment of PhD graduates as Post-Doctoral Fellows (PDF). Our goal is to offer a range of opportunities to our PDFs so that they are better able to pursue a career in research and to develop as future science leaders.

During 2020, ACDP hosted seven PDFs funded from CSIRO Early Research Career (CERC) Postdoctoral Fellowship Program and CSIRO Future Science Platforms.

Successful funding for new PDF positions at ACDP has been secured through the 2020-21 R+ CERC Postdoctoral Fellowships Program by:

- John Bingham from the Pathology and Pathogenesis group for the project ‘Sniffing out pathways into the brain’.
- Sinead Williams from the Risk and Preparedness Group for the project ‘Challenging the lab grown ‘lung’ models for bacterial infection with antimicrobial polymers’.

Our students

In 2020, ACDP hosted nine students in various research areas. In a reflection of the positive and collaborative workplace we create, many students often come back to work for us after finishing their studies.

Scientists working in the highly secure biocontainment laboratory at ACDP.

Social Club

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

During 2020, 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.

International Women's Day guest speaker, Dr Samia Elfekih, shown along with Ms Vicky Boyd, who facilitated the meeting.

Embrace 2020

The 'Embrace' group – a leadership initiative for women – aims to encourage and raise awareness of key roles women can play in science and leadership positions. It provides inspiration and encouragement to our women, to not only continue in science but to influence the direction of science by pursuing management positions and seeing them as worthwhile and a positive challenge.

In 2020, ACDP celebrated International Women's Day with guest speaker, Samia Elfekih, who talked about the Homeward Bound women in leadership program. Interestingly, the complexities of the COVID-19 pandemic have helped to set us up well in the scope of flexible work practices (such as working from home) and support relating to parental leave.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Our success stories

This year we have been challenged more than ever before but we have risen to that challenge and made many significant achievements. We are proud of all our staff and the contributions they have made.

Two teams working on vaccines for COVID-19 and several ACDP support staff are among the winners of this year's CSIRO Awards, which celebrate scientific and professional excellence at Australia's national science agency.

Winners of the Collaboration Medal. Photo Phoebe Readford.

CSIRO Chairman's Medal 2020

Awarded to the ACDP COVID-19 team

The CSIRO Chairman's Medal for Science and Engineering Excellence Award recognises CSIRO teams who have made significant scientific or technological advances that create value for our customers through innovation that delivers positive impact for Australia.

The work of the ACDP COVID-19 team enabled the rapid progression of two leading vaccine candidates through clinical trials with the result of bringing the world a step closer to a safe and effective COVID-19 vaccine. The team had anticipated the need for a pre-clinical trial pipeline and submitted a proposal to the Coalition for Epidemic Preparedness Innovations in October 2019, three months before COVID-19 emerged. The team included more than 90 scientific and support staff at ACDP.

This is an amazing achievement, with CSIRO and ACDP's role in the international effort helping solidify CSIRO and Australia as significant participants in the international science of disease control.

CSIRO Collaboration Medal 2020

Awarded to the COVID-19 Vaccine Development Team

The CSIRO Collaboration Medal recognises the most outstanding cross-CSIRO project involving staff members from three or more business units to resolve a significant challenge for CSIRO.

This award recognised the rapid response by many staff members at ACDP in successfully collaborating within CSIRO and externally on critical research in pursuit of a COVID-19 vaccine.

Representatives from the ACDP COVID-19 team accept the CSIRO Chairman's Medal for 2020. Photo: Phoebe Readford.

Image opposite: Staff wear fully contained biosafety suits with separate air supply when working in the biological containment laboratories.

CSIRO Medal for Support Excellence

Awarded to the Flattening the Response Curve Team

The CSIRO Medal for Support Excellence recognises teams or individuals who support, through projects, initiatives or service delivery, the creation of value for our customers through innovation that delivers positive impact for Australia.

The Flattening the Response Curve team, including staff at ACDP, was recognised for the proactive and focused support that helped our research teams' partner with industry, government and the innovation ecosystem to deliver COVID-19 response and recovery solutions to the communities we serve.

CSIRO Medal for Diversity and Inclusion

Awarded to the domestic family violence and abuse working group

The Diversity and Inclusion Medal recognises and promotes outstanding work in Diversity and Inclusion, either by directly advancing CSIRO's Diversity and Inclusion objectives, or by demonstrating impact arising from inclusive and diverse teams.

This award was given to the domestic family violence and abuse working group, including Caroline Morel who works at ACDP, for the development of a comprehensive and impactful workplace response to support our people impacted by domestic family violence and abuse.

CSIRO HSE Medal for Area Custodian

Awarded to the CSIRO Alerts Notification Service Project Team

This award recognises and promotes the significant contribution made by staff in overseeing and improving the safe operations of higher risk areas across CSIRO.

This team, including Paul Davis at ACDP, was awarded for establishing an emergency alert notification service for the organisation in record time. This system will ensure our people are safe when the unexpected occurs.

Kerry Petty receives a CSIRO Medal for Support Excellence. Photo: Phoebe Readford.

Individual grants and awards

- Matt Neave received a CSIRO Julius Career Award.
- Kathie Burkett won the 2020 CSIRO Digital National Facilities and Collections 'Women in Support' Career Award.
- Vinod Sundaramoorthy (Deakin researcher – CSIRO fellow based at ACDP) obtained an Australian Research Council-Discovery Early Career Research Award.
- Adam Lopez-Denman received a CSIRO Health and Biosecurity ACORN grant.

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Access: CSIRO only | Record Identifier: csiro:EP207397

Our collaborators

International

- Aix-Marseille Université, France
- Butantan Institute, Brazil
- Canadian Food Inspection Agency
- Coalition for Epidemic Preparedness Innovations (CEPI)
- European Virus Archive Global (EVAg)
- Friedrich Loeffler Institute, Germany
- International Atomic Energy Agency
- Kansas State University, USA
- Moredun Research Institute, UK
- New Zealand Ministry for Primary Industries
- Papua New Guinea Institute of Medical Research
- Papua New Guinea National Agriculture and Quarantine Inspection Authority (NAQIA)
- Public Health England, UK
- Roslin Institute, Scotland
- The Biosafety Level 4 Zoonotic Laboratory Network (BSL4ZNet)
- The Food and Agriculture Organization (FAO)
- The Pirbright Institute, UK
- United States Department of Agriculture (USDA), USA
- University of California, USA
- University of Cambridge, UK
- University of Georgia, USA
- US Defence Threat Reduction Agency (DTRA), USA
- Wageningen Bioveterinary Research, Lelystad, The Netherlands
- Wageningen University, The Netherlands
- World Health Organization (WHO)
- World Organisation for Animal Health (OIE)

National

- Australian Animal Health Laboratories
- Animal Health Australia (AHA)
- Australian Centre for International Agricultural Research (ACIAR)
- Australian Rickettsial Reference Laboratory (WHO Collaborative Laboratory for Rickettsial Diseases)
- Australian Government Department of Agriculture, Water and the Environment (DAWE)
- Australian Government Department of Education, Skills and Employment (through the National Collaborative Research Infrastructure Strategy [NCRIS])
- Australian Government Department of Foreign Affairs and Trade
- Australian Government Department of Health
- Australian Government Department of Industry, Science, Energy and Resources
- Bureau of Meteorology
- Fisheries Research and Development Corporation (FRDC)
- National Collaborative Research Infrastructure Strategy (NCRIS)
- Public Health Laboratory Network (PHLN)
- The Geelong Centre for Emerging Infectious Diseases (GCEID)
- Wildlife Health Australia

State

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- Northern Territory Department of Industry, Tourism and Trade
- Queensland Department of Transport and Main Roads
- Tasmanian Department of Primary Industries, Parks, Water and Environment
- Victoria's Barwon Health
- Victorian Department of Jobs, Precincts and Regions
- Victorian Department of Health and Human Services

Medical research and academic institutions

- Burnet Institute
- Charles Sturt University
- Deakin University
- Defence Science and Technology Group
- Griffith University
- James Cook University
- Monash University
- Peter Doherty Institute for Infection and Immunity
- RMIT University (Royal Melbourne Institute of Technology)
- Royal College of Pathologists Australasia
- The University of Adelaide
- The University of Melbourne
- The University of Queensland
- Walter and Eliza Hall Institute of Medical Research

Commercial

ACDP collaborates across a range of commercial partners nationally and internationally. The names of individual partners have been withheld for confidentiality reasons.

Abbreviations and acronyms

AAHL	Australian Animal Health Laboratory
ACIAR	Australian Centre for International Agricultural Research
ACDP	Australian Centre for Disease Preparedness
AHA	Animal Health Australia
ASF	African swine fever
AWO	Animal Welfare Officer
BDC	Business Development and Commercial (CSIRO)
BMG	Biorisk Management Group
BU	business unit
CBIS	CSIRO Business and Infrastructure Services
CERC	CSIRO Early Research Career
CEPI	Coalition for Epidemic Preparedness Innovations
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSF	classical swine fever
CTA	condition taste aversion
CVO	Chief Veterinary Officer
DAWE	Department of Agriculture, Water and the Environment
DSR	Diagnostic Surveillance and Response
EAD	emergency animal disease
EM	electron microscope
ESS	Enterprise Support Services (CSIRO)
FAO	Food and Agriculture Organization of the United Nations
FDB	Functional Design Brief
FMD	Foot and Mouth Disease
FRDC	Fisheries Research and Development Corporation
FSP	Future Science Platform
GCEID	Geelong Centre for Emerging Infectious Diseases
H&B	Health and Biosecurity (CSIRO)
HR	Human Resources
HSE	Health, Safety and Environment
ID	intradermal
IDAL	intradermal application of liquids
IM	intramuscular
IMT	Information Management and Technology (CSIRO)
LAF	large animal facility
LN2	liquid nitrogen
NAQIA	National Agriculture Quarantine and Inspection Authority (PNG)
NCRIS	National Collaborative Research Infrastructure Strategy
NZ	New Zealand
OIE	World Organisation for Animal Health
PCR	polymerase chain reaction
PDF	post-doctoral fellow
PNG	Papua New Guinea
QA	quality assurance
SARS-CoV-2	severe acute respiratory syndrome coronavirus 2
SAF	small animal facility
STAGE	sperm transfection assisted genome editing
UK	United Kingdom
UQ	University of Queensland
US	United States of America
WAHF	Werribee Animal Health Facility
WHO	World Health Organization
WSSV	white spot syndrome virus

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