CENTRE FOR
Eye Research
Australia

Hope in sight

Annual Review 2019

Our story

Vision is precious and no one should ever lose the gift of sight.

We're deeply committed to conducting eye research with real-life impact and finding ways to prevent people from going blind.

As an international leader in eye research, we use our world-class knowledge and expertise to achieve better treatments and faster diagnosis of eye disease.

Our goal is to prevent vision loss – and ultimately, find cures to restore sight. As true innovators, our scientists are on the brink of new discoveries every day.

With your support we can continue this world-leading research and accomplish scientific breakthroughs previously deemed unattainable.

Our aim is to offer hope to people affected by vision loss and protect the sight of everyone in need.

With CERA, there's hope in sight.

CENTRE FOR
Eye Research
Australia

THE UNIVERSITY OF MELBOURNE

the royal victorian
eye and ear
hospital

Contents

Chair and Managing Director's message

At the end of 2019 there was much optimism that 2020 would be the start of an exciting new era in eye research.

Since then the unprecedented events of early 2020 – catastrophic Australian bushfires and the devastating global impact of the COVID-19 pandemic – have created personal and economic hardship throughout our community.

Now we are all trying to navigate our way in a much more uncertain world.

Despite these challenges, CERA remains committed to pursuing our new Strategy for 2020-25 and working towards our goal of *A world free from vision loss and blindness.*

The theme of our 2019 Annual Review is *Hope in sight.* This reflects our optimism that despite the traumatic events of 2020, our research can make lives better for people experiencing vision loss and blindness.

A better future

In 2019, as we set our new Strategy, we were excited by the many possibilities offered by new technology and research.

Advances in gene and cell therapy and the increasing sophistication of devices like the bionic eye are offering new hope for patients with conditions that were previously considered untreatable.

Big data, artificial intelligence and the incredible power of new imaging technology are giving us exciting new tools to understand eye health, diagnose disease earlier and prevent blindness.

The idea of restoring lost sight – once considered the realm of science fiction – is now a realistic possibility.

Our research impact

In 2019, we continued to be at the forefront of international eye research.

We led the development of the world's most detailed genetic map of the human retina, providing new insights which will help future research to prevent and treat blindness.

We collaborated with the Nganampa Aboriginal Health Service and Fred Hollows Foundation to trial artificial intelligence screening tools in remote Indigenous communities.

We helped lead an Australian partnership that identified new genes associated with glaucoma, work which could lead to a new screening test to detect those at highest risk.

In a world-first, our scientists showed that a simple eye test could be used to detect the early signs of Alzheimer's disease.

We also had a highly successful year in securing funding from the National Health and Medical Research Council which will support critical research into age-related macular degeneration, cellular reprogramming and artificial intelligence research.

Many of these successes were only possible because funding from CERA's supporters helped our researchers perform the early work essential for success in nationally competitive grant applications.

Thank you

We are extremely grateful to the individual donors, philanthropic trusts and foundations who supported us in 2019, and are humbled by that ongoing support during troubled times in 2020.

We are also incredibly proud to be part of a thriving biomedical precinct in Melbourne, with many of our colleagues playing a key role in research to combat COVID-19. Their work highlights the critical role of medical research in bringing hope and solving global health problems.

We value our talented, dedicated CERA team who are inspired every day to develop new treatments and cures for eye disease.

We are thankful for our enduring partnerships with the Royal Victorian Eye and Ear Hospital and the University of Melbourne, our member organisations, our Patron, the Hon Linda Dessau, and our Honorary Governors.

Together, we can all move one step closer to *A world free from vision loss and blindness.*

Professor Keith Martin
Managing Director

Olivia Hilton
Chair

Vision for the future Strategic Plan 2020-25

In 2019 we developed a new Strategic Plan to guide our research from 2020-25.

Working to a new goal of *A world free from vision loss and blindness*, our new Strategy focuses on three key research domains:

Innovative diagnostics and treatments – Developing new methods to diagnose, prevent and treat vision loss, including a flagship project to establish a Melbourne Centre for Ocular Gene and Cell Therapy.

Regenerating vision – Drawing on the potential of new therapies to restore lost vision, continuing to advance the trial and development of devices to restore vision, and playing a founding role in an international collaboration to regenerate the optic nerve.

Understanding eye health – Using data to identify public health challenges and deploying artificial intelligence and other technologies to increase access to screening programs, promote earlier detection and prevent disease progression.

↑ **Chair Olivia Hilton and Managing Director Professor Keith Martin.**

Year at a glance

180 publications
in peer-reviewed journals

$2.73m in government grants

$1.37m in philanthropic grants

$2.34m in donations and bequests

24% increase in eye donations to Lions Eye Donation Service

22% increase in corneal transplants

NHMRC success

- Synergy Grant for AMD research
  Professor Robyn Guymer
- Ideas Grant for cellular reprogramming
  Dr Raymond Wong
- Investigator Grant for artificial intelligence in eye health
  Professor Mingguang He and Dr Stuart Keel

5 student completions

Treatments and diagnostics

At 80, Denis Paraskevatos is continuing his lifelong passion for building replica ships, thanks to eye research.

The retired naval engineer combines extensive historical research and intricate handiwork to build museum-quality ships that have attracted acclaim in Australia and internationally.

But after losing sight in his right eye to age-related macular degeneration (AMD) in 2002, he relies heavily on his left eye and a magnifying glass to continue his craft.

The regular injections preserving his sight, now standard treatment for 'wet' AMD, are the result of many years of clinical research.

CERA's Professor Robyn Guymer AM was part of the early international trials which proved the treatments were effective - and further research to refine clinical protocols and better individualise treatments.

Denis says he will never forget Professor Guymer's work to save his sight.

"Not having vision curtails your activities and you can't participate in the community in the way you desire," he says.

"It takes away the colour of life, it prevents you from seeing a face – and a face tells you a lot about a person."

↗ **Smooth sailing: Research helped save Denis Paraskevatos' sight.**

"It takes away the colour of life, it prevents you from seeing a face – and a face tells you a lot about a person."

– Denis Paraskevatos

"Understanding what is different about this high risk group is the key to saving sight."

– Professor Robyn Guymer AM

↑ Researchers unite: (from left) Professor Alice Pébay, Dr Brendan Ansell, Dr Zhichao Wu, Professor Melanie Bahlo and Professor Robyn Guymer AM. Absent: Professor Erica Fletcher.

Strength in numbers

World-renowned macular researcher Professor Robyn Guymer AM is leading a new collaboration to tackle age-related macular degeneration.

Age-related macular degeneration (AMD) affects millions of elderly people worldwide. In Australia, one in seven people over 50 has the disease and it's the leading cause of severe irreversible vision loss in this age group.

Despite advances in recent years, there are still many unanswered questions about the disease. There are currently no effective treatments for 'dry' AMD, or specific ways to slow progression of the disease.

It's also unclear what puts some people with AMD at much greater risk of losing their sight.

This problem is too big for a single researcher or group to solve on their own, so now a team of Melbourne scientists has united to find the answer.

The team, which also includes scientists from the US and the UK, harnesses expertise in eye health, artificial intelligence, genetics, stem cell research and bioinformatics.

Together they will conduct the world's most intensive study to determine what causes the highest risk form of AMD and develop new treatments to prevent vision loss.

World-first study

The research team is led by Professor Robyn Guymer AM. Chief Investigators include CERA colleague Dr Zhichao Wu, professors Erica Fletcher and Alice Pébay from the University of Melbourne and Professor Melanie Bahlo and Dr Brendan Ansell from the Walter and Eliza Hall Institute.

Late in 2019, the team was awarded $5 million in the inaugural year of the National Medical Health and Research Council's new Synergy Grants scheme, which is designed to encourage diverse groups to come together to address an important need.

Professor Guymer says the grant will support the team for five years to investigate the factors that put some people with AMD at much higher risk of losing their vision.

"If we can understand these factors, we can start to specifically tailor treatments to help this high-risk group," Professor Guymer says.

"Currently, all cases of AMD are lumped together as one disease, but it is now clear there is at least one group of patients at increased risk of losing vision.

"With new imaging techniques, we can detect subtle differences between people with AMD and these differences provide important clues about why some are more at risk as their disease progresses. This has opened an exciting new area of research.

"Understanding what is different about the high-risk group, who can be determined by modern imaging techniques, and why this group is more likely to lose vision, is the key to saving sight."

Cracking MacTel 2's genetic code

Carol Whittle first noticed something was wrong with her sight when she was reading the newspaper.

"It seemed like words were missing," she says, "so I went to see my optometrist."

After a series of tests, Carol was diagnosed with the rare genetic disease macular telangiectasia type 2 (MacTel 2).

"No-one in my family knew of anyone who had it, or had any serious vision problems."

MacTel 2 is a rare, untreatable disease which causes a loss of central vision. Fortunately for Carol, her symptoms have not deteriorated. However, she is keen to help others who live with MacTel 2 and is now part of research at CERA to help find a treatment for the disease.

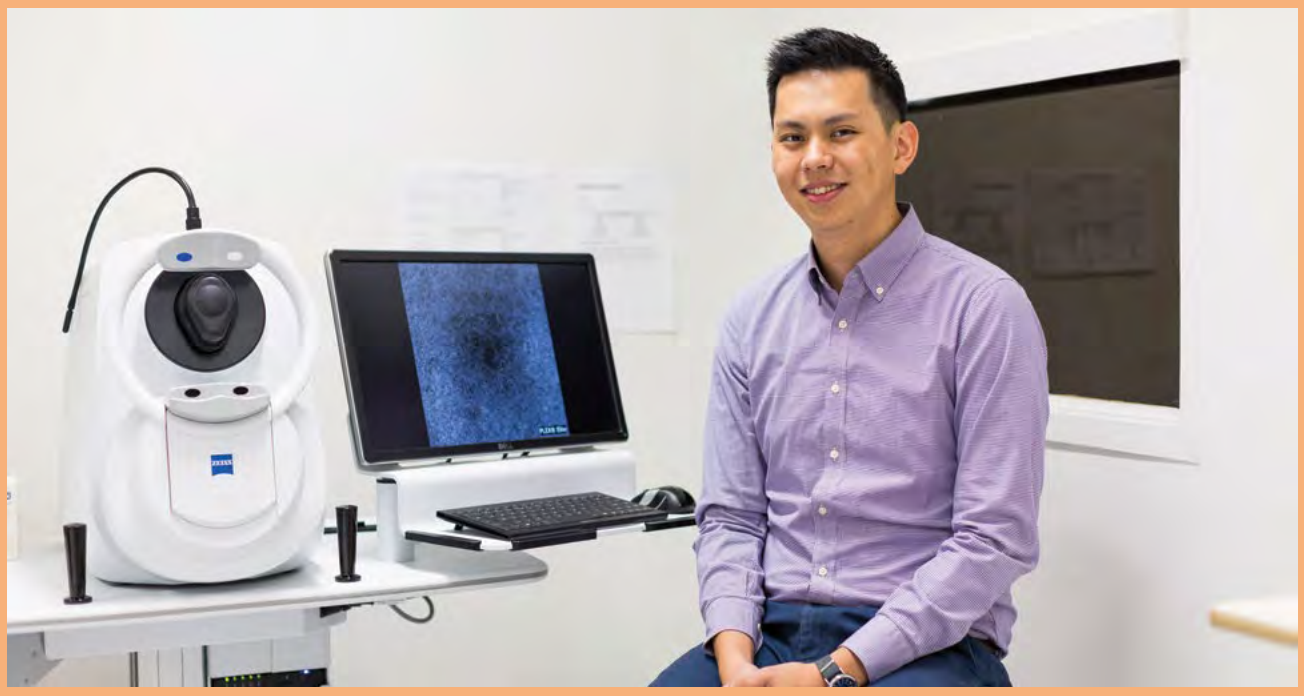
In 2019 CERA was part of an international consortium that published research in the *New England Journal of Medicine*, identifying two new genes associated with MacTel 2 and linking low levels of the amino acid serine to the disease.

The findings pave the way for potential future treatments for MacTel 2 and provide important clues for researchers studying other macular and neurodegenerative diseases.

Professor Robyn Guymer AM and her team have been part of the MacTel 2 study, led by Professor Martin Friedlander from the Lowy Medical Research Institute for 15 years.

The research was funded by the Lowy Medical Research Institute, Australian National Health and Medical Research Council, National Eye Institute (US), National Institutes of Health (US) and National Science Foundation (US).

↑ **Helping others: (from left) Professor Robyn Guymer AM, Clinical Trial Manager Melinda Cain and Carol Whittle.**



Predicting AMD's path

Although one in seven Australians over 50 will develop signs of age-related macular degeneration (AMD), not all are at risk of severe vision loss.

But in the early stages of AMD, it can be difficult for eyecare practitioners to determine who is at most risk so that they can be monitored more carefully. With careful monitoring, early detection can enable treatment to prevent irreversible vision loss.

Three years after diagnosis, most AMD patients with the early signs of the disease will be stable, but about one in four will show signs that the disease is progressing.

Some will have 'wet' AMD, where abnormal blood vessels inside the eye leak or bleed. Others will develop late stage 'dry' AMD where retinal cells die, leading to irreversible vision loss.

↑ **Sharp focus: Dr Zhichao Wu is using imaging technology and artificial intelligence to track AMD.**

Currently there are effective treatments for wet AMD if it's picked up early enough, but there are no effective therapies for dry AMD.

Dr Zhichao Wu's studies aim to identify patients most likely to develop vision-threatening complications, so specialists can intervene earlier to save sight.

His research uses optical coherence tomography (OCT), a powerful imaging technique, and artificial intelligence.

In one study, Dr Wu and colleagues will collect OCT and OCT angiography (OCTA) images to determine the progression of wet AMD. In other studies, they will map the macular function in those with the later stages of dry AMD.

Dr Wu is supported by the BrightFocus Foundation, Perpetual IMPACT Philanthropy Program and the Macular Disease Foundation Australia.

What is clinical genetics?

Clinical genetics focuses on the clinical and genetic study of inherited eye diseases such as glaucoma, retinitis pigmentosa and Leber's Hereditary Optic Neuropathy (LHON).

Our researchers first try to understand how defects in our genes – the basic unit of heredity – play a role in these diseases.

Then they use this knowledge to develop new treatments or to find better ways to screen people who could be at risk.

New genes reveal glaucoma risk

Professor Alex Hewitt is part of a national collaboration to develop a screening tool for glaucoma.

A ground-breaking study into the genetics of glaucoma has led to a test that can reveal your risk of developing the disease. And it has the potential to revolutionise the way we screen for it in the future.

Glaucoma affects an estimated 300 000 Australians and is the leading cause of irreversible blindness worldwide. It's also one of the most commonly inherited human diseases: risk increases up to ten-fold if your parent or sibling has glaucoma.

Risk factors like age and family history have long been our best estimate of whether someone will develop the disease.

But Australian researchers have now discovered new genes that can more accurately predict individual glaucoma risk.

"For the first time we've been able to clearly show that people with different genetic loads have different likelihoods of developing glaucoma," says Professor Alex Hewitt, Principal Investigator Clinical Genetics and one of the lead researchers in the study.

The research, which culminated in an article published in the journal *Nature Genetics* in early 2020, focused on primary open angle glaucoma.

This is the most common form of glaucoma in people of northern European descent. Interestingly, the researchers found that the test also worked well in people from South Asia. This means that a larger population than expected may benefit from the test.

The research team is now working to get the genetic test into clinics within the next two years.

Armed with a genetic test, clinicians will be able to categorise their patients as low, medium or high risk of glaucoma and set a personalised screening plan.

As glaucoma often has no symptoms until there's advanced vision loss, people at high-risk will be encouraged to undergo frequent eye checks. This increases the chance that glaucoma is detected and treated before permanent and irreversible vision loss occurs.

Eventually, a similar test could be used for population-wide screening of glaucoma.

"We're hoping this could be like bowel cancer screening," says Professor Hewitt. "Imagine if a saliva DNA collection kit is sent to you when you turn 50. You mail it back and a few weeks later receive a report card that shows your risk of glaucoma and how often you need to get your eyes checked.

"It's an exciting prospect."

← Members of CERA's Clinical Genetics team (from left) Dr Helena Liang, Principal Investigator Professor Alex Hewitt, Linda Clarke, Lisa Kearns and Dr Sandra Staffieri.

Extraordinary vision sparks Alzheimer's breakthrough

Philanthropy has turned a 'left-field' idea into technology that could soon be used to diagnose Alzheimer's disease.

The best discoveries often begin with a dream that seems unlikely at the time.

Researchers Associate Professor Peter van Wijngaarden and Dr Xavier Hadoux believed they could develop an eye test to detect the early signs of Alzheimer's disease utilising technology like that used in NASA satellites.

Their idea turned into action in 2015 when prominent scientist Professor Bob Williamson AO, the scientific director of the Yulgilbar Alzheimer's Research Program, challenged them to develop their concept.

Last year, they published a study in *Nature Communications* which showed that their new test accurately identified brain changes that suggest Alzheimer's disease.

A few months later, they received funding to develop the technology into a camera that can be used in eye clinics.

"Our initial idea was left of field," says Associate Professor van Wijngaarden. "But hyperspectral imaging technology could soon become reality thanks largely to philanthropists like 'Bails' Myer AC who supported our research from the start."

The new test uses a special camera with multicolour imaging to measure a protein, amyloid beta, which is associated with Alzheimer's disease and accumulates in the retina at the back of the eye up to 20 years before symptoms appear.

Dr Hadoux says hyperspectral imaging uses a rainbow-coloured light to see the retina in a new way.

New light

"Our study shows that there are differences between the way the light is reflected from the retinas of people with amyloid beta deposits in the brain and from the retinas of people with lower levels of the protein," he says.

Associate Professor van Wijngaarden says philanthropy has permeated every stage of the research.

"The project has been backed from the very start by Baillieu and Sarah Myer, Samantha Baillieu AM and Jeanne Pratt AC via the Yulgilbar Alzheimer's Research Program.

"The H&L Hecht Trust, Viertel Foundation, Joan Margaret Ponting Trust, Coopers Brewery Trust, Cylite CEO Steve Frisken and National Foundation for Medical Research and Innovation also provided tremendous support."

Philanthropy also funded the expensive research camera needed for the non-invasive test, and the team is now developing a less costly version with support from the National Foundation for Medical Research and Innovation.

More research

The team is also embarking on a larger, second study, supported by new grants from the Alzheimer's Drug Discovery Foundation (ADDF) and Perpetual's IMPACT Philanthropy Program.

This included more than $600 000 from the ADDF, via a grant backed by Bill Gates, Leonard Lauder, Jeff and MacKenzie Bezos and the Dolby Foundation.

In December, Enlighten Imaging, a start-up company incubated at CERA and led by Associate Professor van Wijngaarden and Dr Hadoux, received Australian Government BioMedTech Horizons grant support to help bring this technology from the lab to the clinic. This funding, together with that provided by the National Foundation for Medical Research and Innovation, will help to make this promising technology accessible to all.

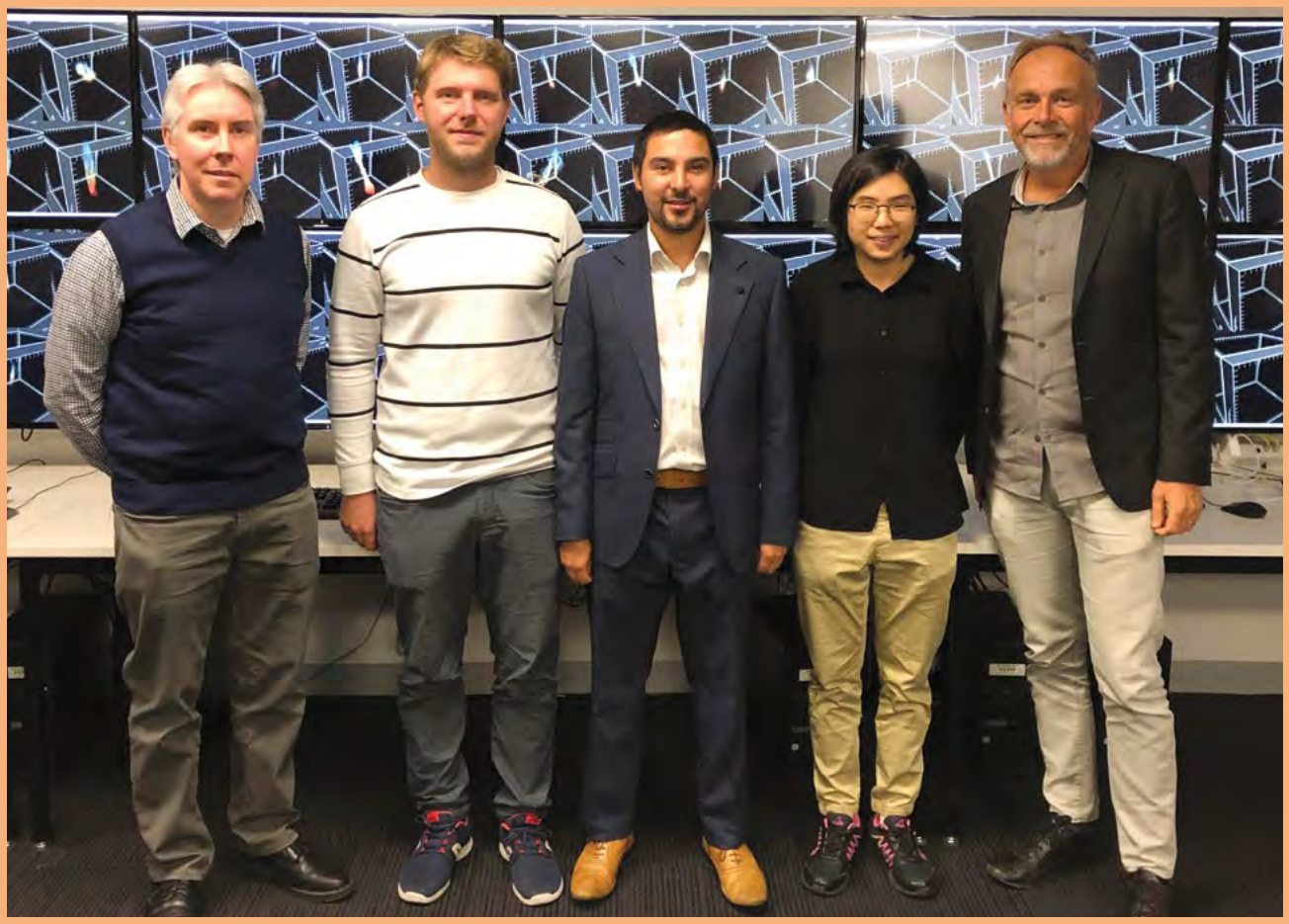
The next steps

Associate Professor van Wijngaarden and Dr Hadoux hope that within five years all eye clinics will be equipped with this technology to test for Alzheimer's and possibly other brain diseases.

Both say that their work, which could dovetail with research into early therapies for Alzheimer's disease, would not have been possible without the generosity of others.

"There's no way that we would have gotten it off the ground," Associate Professor van Wijngaarden says. "Sustained support from philanthropists and other organisations is now yielding real results."

↑ **Rainbow flash: A multicoloured light detects the early signs of Alzheimer's disease.**



"The research they are doing is certainly cutting edge."

– Dr Steve Frisken

↗ Diverse skills: Research collaborators (from left) Professor Christopher Fluke, Dr Xavier Hadoux, Dr Christian Daish, Dr Suk Yee Yong and Dr Steve Frisken.

Giving internships a great image

An innovative internship program is giving graduate students the opportunity to use their skills in an industry setting.

Dr Christian Daish has learned that an internship can be out of this world.

The PhD graduate was part of the Australian Postgraduate Research Intern (APR.Intern) program and undertook a six-month stint working with Dr Xavier Hadoux and Associate Professor Peter van Wijngaarden who are developing a simple eye test to detect Alzheimer's disease.

A biomedical engineer, he used advanced computational approaches to investigate image registration and advance the use of the study's hyperspectral camera.

Dr Daish, who has recently taken a product development position at a Melbourne biotech company, says the internship was a wonderful opportunity to showcase his expertise while learning new skills. Being paid was also 'a life saver'.

"For the students it's fantastic, because they're getting paid and gaining experience. It taught me some technical skills that I hadn't previously had, for example in machine learning (AI)," he says.

"As a biomedical engineer it was great to see the clinical application of research."

A helping hand

The internship was funded by prolific inventor Dr Steve Frisken, who donated his share of the 2018 Australian Prime Minister's Prize for Innovation to the team.

Dr Frisken is CEO of Melbourne company Cylite, which creates next-generation imaging and metrology systems for ophthalmic and related markets.

The physics buff was impressed by the project, which uses similar technology to some of his work, and the team's determination.

"The research that they're doing is at the cutting edge," Dr Frisken says. "We're certainly looking very keenly at the potential positive human impact. It's a very good use of money as well."

Industry setting

The not-for-profit APR.Intern program connects PhD students with innovative organisations and pays them to research in an industry setting.

Dr Daish was the CERA team's first intern. Dr Frisken's donation also funded astrophysics PhD graduate intern Dr Suk Yee Yong.

Thanks to Dr Frisken's generosity, the team may be able to recruit a third intern.

Dr Hadoux says it's a win-win as interns have good knowledge in their field, so make a worthy contribution while improving their experience, research skills and employment prospects.

"It's amazing," he says. "They're really bright. Having them is super, super helpful."

CERA would also like to thank Justin Mabbutt from APR.Intern for facilitating this internship.

About keratoconus

Globally, the prevalence of keratoconus grew from 1:2000 in 1986 to 1:375 in 2016.

Early on, the thinning of the cornea caused by keratoconus can be managed with glasses, contact lenses or collagen crosslinking which uses vitamin B2 and ultraviolet light to slow disease progression.

Many patients need a corneal transplant, which has a 20 per cent rejection rate. Most face huge treatment costs and changes in the corneal curve often require frequent prescription updates.

Keratoconus is the second largest cause of corneal transplants (22 per cent) behind Fuch's corneal dystrophy.

Growing demand for corneas has caused a worldwide shortage of donor tissue. About 12.7 million people are on corneal transplant waiting lists.

Conquering keratoconus

Dr Srujana Sahebjada is leading a new study to find the genetic causes of a corneal disease which mostly affects children and young people.

Meeting young people experiencing the debilitating impact of keratoconus set Dr Srujana Sahebjada on a career path to find out what causes the disease and how to prevent it.

"Although the prevalence of keratoconus is increasing, there is still a lot we don't know about the disease, its causes and the ways to prevent the condition," says Dr Sahebjada. "I am endeavouring to change that."

Keratoconus thins the cornea - the clear window at the front of the eye which plays a critical role in our vision - until it develops a cone-shaped bulge that distorts vision and may eventually require a corneal transplant.

"Keratoconus can have such a big impact on a young person's life. Some had to give up study or put career dreams on hold because of multiple corneal transplants.

"I met children who were affected and many patients who talked of the great discomfort and pain of wearing the rigid contact lenses needed to treat the condition.

"Yet there was frustration that their condition was not understood and their experiences were not acknowledged because they looked so well despite their vision problems.

"I felt they deserved so much more recognition and wanted to do research which could help alleviate their suffering."

Dr Sahebjada is now leading a new study, supported by the Perpetual 2019 IMPACT Philanthropy Program, to investigate genetic causes of the disease.

She hopes to identify high-risk patients and stop the disease's progression, reducing the need for transplants.

The impact of philanthropy

Dr Sahebjada says philanthropic support is critical for researchers studying diseases like keratoconus which are not as well known in the community.

The funding from the Perpetual IMPACT Philanthropy Program will pay for her salary to collect the tissue, analyse the data and perform the experiments, including expensive Ribonucleic acid (RNA) sequencing.

Dr Sahebjada has spent 10 years working to reduce the burden of keratoconus by identifying clinical and environmental risk factors.

Gaining new insights

She has also established the Keratoconus International Consortium (KIC) to co-ordinate global efforts.

The program is supported by the Victorian Lions Foundation Inc and led by Dr Sahebjada, CERA Principal Investigator Corneal Research Associate Professor Mark Daniell and Professor Paul Baird from the University of Melbourne.

Dr Sahebjada's research is also supported by several individual donors.

An eye on the future

Dr Tom Edwards was involved in a pioneering gene therapy trial in the UK. Now he wants Australians to have access to cutting-edge treatments for vision loss and blindness.

Advances in gene therapy are bringing new hope of treating eye diseases that have for many years been considered untreatable.

Until recently, someone with an inherited retinal disease like retinitis pigmentosa or Stargardt's disease, or a patient with extensive optic nerve damage from glaucoma, was told there was nothing that could be done to help them.

But now around the world there are several active clinical trials for ocular gene therapies which could potentially stop vision loss from progressing – or even restore some sight.

Dr Tom Edwards, a clinician-scientist and a vitreoretinal surgeon, was involved in a world-first gene therapy trial at the University of Oxford and is now continuing his research at CERA with the hope of helping Australian patients.

What is gene therapy?

In its simplest form, gene therapy involves using a modified virus to deliver a correct copy of a gene into the eye to make up for the lost function caused by genetic mistakes in the patient's own cells.

Sometimes it also involves inserting a gene that is known to protect cells from degeneration and disease.

CERA is conducting research to develop gene therapies for inherited retinal diseases and glaucoma, and also to better understand the genes that cause these diseases.

Dr Edwards says CERA's co-location and partnership with the Royal Victorian Eye and Ear Hospital has been critical to making this bench-to-bedside research program possible. And now, a new Ocular Genetics Clinic at the hospital is bringing patients and researchers closer together.

"It's the only clinic in Australia that has an ophthalmologist, a clinical geneticist, a genetic counsellor and a specialised genetics orthoptist located together," says Dr Edwards.

"A major strength is that patients seen in the Ocular Genetics Clinic can be linked to researchers at CERA who are studying their specific genetic eye disease," he says. "There are not many places where patients would have such direct access to researchers."

The clinic, along with a new natural history study of inherited retinal diseases (See *Tracking inherited retinal disease* Page 38-39) between CERA and the University of Melbourne, will be key avenues for gaining a better understanding of genetic eye diseases in Australia.

Combined expertise

Dr Edwards says the overall goal is to combine this expertise and infrastructure to develop a Centre for Ocular Gene and Cell Therapy in Melbourne.

"More people could receive clinical and genetic testing for inherited eye diseases," he says.

"It would give Australians access to new gene therapies and increase the pool of eligible patients for local clinical trials.

"Establishing a centre that can handle all these activities, and do it to a gold-standard level, is what we want to achieve."

Dr Edwards also acknowledges the importance of developing CERA's emerging researchers, who will continue this work into the future.

"One of our researchers, Dr Sloan Wang, recently had the opportunity to visit the laboratory in Oxford where I did my fellowship, after being awarded a travelling scholarship by the Company of Biologists," he says.

"The MacLaren group at the Nuffield Laboratory of Ophthalmology are world leaders in retinal gene therapy so it was a hugely valuable experience for Sloan."

Dr Edwards' research is supported by the Marjorie M Kingston Trust and the Annemarie Mankiewicz-Zelkin Fellowship Fund.

↑ **Advancing gene therapy: Researchers (from left) Dr Sloan Wang, medical student Daniel Liu and Dr Tom Edwards.**

Regenerating vision

Sisters Kate and Nicole Barrett were born 18 months apart and have always been there for each other.

Retinitis pigmentosa – an inherited eye disease that causes progressive, irreversible vision loss – runs through their relationship.

Kate, 35, was diagnosed at six and told she would be blind by 13.

"Then, I was told I would be lucky to make it to 20," says Kate, who now has guide dog Misty to help her navigate the world.

As her sight declined, Kate has earned qualifications in counselling and criminology, written children's history books, married and had twin girls Abigail and Aurora.

Nicole, 33, was diagnosed two days before her 18th birthday. Despite the initial shock, she went on to develop a successful career in occupational therapy. Her vision is stable.

"I just live each day and hope my vision stays the same," she says.

Kate and Nicole say new gene therapy research gives them hope that in their lifetime there may be a treatment for retinitis pigmentosa, either to stop vision loss or restore sight.

Kate's wish is simple: "I hope that my sight can stay where it is so I can see my daughters graduate and get married. That would be irreplaceable."

↗ Hope for the future: Nicole and Kate Barrett with twins Aurora and Abigail and guide dog Misty.

"I hope that my sight can stay where it is so I can see my daughters graduate and get married. That would be irreplaceable."

– Kate Barrett

"This project aims to convert and repurpose retinal cells within the eye into new photoreceptors, promoting retinal regeneration and visual repair."

– Dr Raymond Wong

Converting cells: CERA researchers Daniel Urrutia Cabrera, Dr Raymond Wong and Crystal Nguyen.

Reprogramming the retina

Dr Raymond Wong is leading research to use cellular reprogramming to turn eye cells into light sensing photoreceptors to restore sight.

The retina is a thin layer of tissue at the back of the eye, made up of millions of cells that are essential for vision.

For people with inherited retinal diseases such as retinitis pigmentosa, a genetic 'mistake' causes these cells to stop functioning, leading to vision loss and blindness. Once these cells are lost, there is currently no effective way to restore sight.

CERA's Cellular Reprogramming Unit, led by Dr Raymond Wong, is working to unravel the mysteries of the retina and develop treatments for eye disease using cellular reprogramming and stem cell technologies.

Now they're one step closer, having developed the world's most detailed gene map of the human retina – and receiving an Ideas Grant from the National Health and Medical Research Council to support their cellular reprogramming research over the next three years.

Retinal cell atlas

The retinal cell atlas project was led by Dr Wong in collaboration with Dr Samuel Lukowski from the Institute for Molecular Bioscience at the University of Queensland and Associate Professor Joseph Powell from the Garvan Institute of Medical Research.

It was the first Australian contribution to the Human Cell Atlas Project – a global project to create reference maps of all human cells to better understand disease.

"By creating a genetic map of the human retina, we can understand the factors that enable cells to keep functioning and contribute to healthy vision," says Dr Wong.

"It can also help us understand the genetic signals that cause a cell to stop functioning, leading to vision loss and blindness. This understanding is the first step to better identifying what causes disease and ultimately developing treatments."

Regenerating photoreceptors

One way the retinal atlas will help future research is in the emerging area of cellular reprogramming. Through this advanced technology, it may be possible to convert other cells in the eye into new photoreceptors – the light-detecting cells in the back of the retina – and restore sight.

This is a major project Dr Wong and his team are working on in 2020 and beyond, thanks not only to the grant from the NHMRC, but also the Kel & Rosie Day Foundation and Retina Australia.

"This project aims to convert and repurpose retinal cells within the eye into new photoreceptors, promoting retinal regeneration and visual repair.

"It will provide preclinical evidence of the potential of this therapy to treat photoreceptor loss, as seen in retinitis pigmentosa and other inherited retinal diseases including Stargardt's disease and age-related macular degeneration."

Improving the eye's 'transport system'

Professor Keith Martin's team is working to improve the 'transport system' within the nerve fibres of the eye. They've discovered that a molecule called protrudin may hold the answer.

"We've found that if we increase the amount of protrudin or change the way it's working, we can improve transportation along the nerve fibres," says Professor Martin. "And getting the right molecules to the right place at the right time can improve the ability of that nerve to repair.

"We are still at a relatively early stage, looking at the fundamental mechanisms of how protrudin is working. But what we've seen is the strongest regeneration of any technique we've used before."

Repairing the optic nerve

Professor Keith Martin is investigating using gene therapy to protect and repair the optic nerve and restore sight for patients who have lost their vision to glaucoma.

The optic nerve is the connection between the eye and the brain – a bit like a cable that connects a camera to a computer. It plays an essential role in our vision, allowing the brain to receive electrical signals from the back of the eye, so it can interpret them as images.

Glaucoma interrupts this transfer of visual information. As the disease develops, the optic nerve becomes progressively damaged, leading to gradual loss of peripheral vision. If left untreated, it can lead to blindness.

Currently, glaucoma treatment is largely aimed at lowering eye pressure to protect the optic nerve and prevent further damage. This can slow or even stop the progression of vision loss. But for about 15 per cent of patients, vision continues to deteriorate, despite the best available treatments.

Professor Keith Martin, CERA's Managing Director and one of the world's leading experts in glaucoma, believes gene therapy could change this.

New potential

"Gene therapy is offering new potential and hope for patients whose glaucoma does not respond to conventional treatments," says Professor Martin.

"Gene therapy to treat eye disease is advancing at a faster pace than arguably in any other branch of medicine."

In a ground-breaking and ambitious new project, Professor Martin and Professor James Fawcett from the University of Cambridge are striving to develop new treatments, including gene therapy, that could strengthen and repair the optic nerve, potentially restoring lost vision.

Professor Martin, who joined CERA in February 2019 from University of Cambridge, is currently building his Melbourne team as the research moves into its next phase.

"Essentially what we're trying to do is protect the optic nerve from damage but also increase its ability to regenerate after injury," Professor Martin explains.

Restoring vision may be some way off – but these early days are showing it is a realistic possibility for the future.

"In the past it seemed impossible that we'd be able to regenerate the optic nerve. We can potentially do this now, but it remains to be seen how much vision can be restored," says Professor Martin.

"There is still much work to do and we will continue to work hard on this with the help of our supporters."

This research is supported by funding from UK charity Fight for Sight.

← **New potential: Professor Keith Martin says gene therapy could regenerate the optic nerve.**

About the cornea and corneal endothelium

The cornea is the clear window at the front of the eye which plays a critical role in our vision.

Cells of the corneal endothelium, a fine layer at the back of the cornea, help pump fluids out of the cornea and keep it transparent so that light can pass into the eye, enabling us to see.

When these cells fail because of ageing, trauma or disease, the cornea swells and becomes cloudy, leading to vision loss and blindness.

Around the world, almost five million people are blind in both eyes because of corneal disease, many because of the failure of their corneal endothelium cells.

In Australia about half of all corneal transplant surgeries are performed because of problems with patients' corneal endothelia.

Future focus: Dr Karl Brown is developing a tissue-engineered corneal epithelium.

Engineering a new future for transplants

Support from the DHB Foundation is propelling CERA research to overcome a worldwide shortage of suitable donor corneas.

Around the world, more than 12 million people are missing out on sight-saving corneal transplants because of a major shortage of donor corneas.

To help overcome this problem, CERA researchers Associate Professor Mark Daniell and Dr Karl Brown are developing a tissue-engineered corneal endothelium.

Their research is investigating using a patient's own or donor cells to grow a new corneal endothelium on a hydrogel film.

Their research could eventually lead to an unlimited supply of corneas for transplant, eliminating the need for donated corneal tissue. Techniques that use a patient's own cells could also overcome the problem of rejection.

Culturing cells in the lab

Currently, the team is using corneal endothelial cells from eye tissue that has been donated specifically for research.

"But in the future, we will use also the patient's own cells or adult pluripotent stem cells," explains Dr Brown. "Cells will be cultured in the laboratory on a patented, ultra-thin hydrogel film – taking about two weeks to grow an engineered corneal endothelium."

The researchers aim to develop the technique so it can be used in human transplants.

"After removing diseased corneal endothelial cells, the biodegradable film would be implanted with the sheet of cells," says Dr Brown.

"The cells would work to restore vision and the film dissolves harmlessly after delivering them."

Philanthropic boost

Late in 2019, the team received major philanthropic backing from the DHB Foundation which funded a four-year research fellowship for Dr Brown.

The Foundation's founder is passionate about medical discovery and keen to invest in the development of early-career researchers knowing that it is increasingly difficult for them to receive government grants.

Until recently, Dr Brown spent much of his time seeking funding, despite his research showing much promise.

"To have security for four years is really incredible," Dr Brown says. "It means I can focus on working in the lab."

CERA thanks the team at Equity Trustees for facilitating the generous gift.

The team has also received a grant from the US-based Eversight Center for Vision and Eye Banking Research that will also enable them to compare the difference between tissue grown from the donor's own cells and those derived from stem cells.

Associate Professor Daniell says philanthropy has been critical in supporting the research which has 'incalculable potential'.

Solving the mysteries of mitochondria

Dr Isabel Lopez Sanchez has dedicated her career to solving the mysteries of how mitochondria – the tiny powerpacks in our cells – can lead to vision loss and blindness.

In 2019, Dr Lopez Sanchez spent five months at Sweden's esteemed Karolinska Institute as a Wenner-Gren Fellow.

The Institute is a global hub for mitochondrial research and Dr Lopez Sanchez's experience in Assistant Professor Joanna Rorbach's lab has laid the groundwork for an international collaboration into mitochondrial disorders. CERA's newest Principal Investigator, Dr Lopez Sanchez leads research into Leber's Hereditary Optic Neuropathy (LHON). It's a rare disease that can lead to sudden vision loss and blindness when mitochondrial changes cause the retinal ganglion cells in the back of the eye to stop working.

"Karolinska leads the way in identifying and providing diagnoses to patients with genetic bases to their diseases," says Dr Lopez Sanchez.

At Karolinska, Dr Lopez Sanchez shared CERA's advances in patient sample collection, and developed expertise in molecular biology techniques including CRISPR gene editing. She is now using these techniques to test for genetic factors and generate cell lines 'in-vitro' at CERA.

Individual mitochondrial diseases are quite rare but there are similarities in genetic causes and clinical outcomes.

"If we understand one disease better then we can get more insights into what's happening in other disorders," she says.

↑ **Global effort: Dr Isabel Lopez Sanchez is part of international efforts to learn more about mitochondrial disorders.**

A generous gift to glaucoma research

Kathleen Rankin was born on Armistice Day in 1918. With an auspicious birth date and the middle name 'Peace', she was destined to make a mark on the world.

An independent spirit, Kathleen valued education and adventure. She graduated with a Bachelor of Arts from the University of Melbourne and hitchhiked through Europe in the 1950s. She later forged a career as a law clerk and continued to work well beyond retirement age, into her 80s.

Her second cousins Christine Parkinson and Anne Mulcahy remember Kathleen fondly as a strong and independent woman who valued family and friends, education and commitment to work.

When she passed away in 2016, her bequest to the University of Melbourne included a commitment to glaucoma research, the Kathleen Rankin Bequest. This generous gift is now supporting critical work by CERA's mitochondria and neurodegeneration researchers.

"Kathleen had glaucoma and was treated by Professor Gerard Crock (Australia's first Professor of Ophthalmology) at the Royal Victorian Eye and Ear Hospital," explains Christine. "She had a great respect for Professor Crock which is in part reflected in her bequest but so too her appreciation for the work done by researchers and scientists in helping to improve treatments and to finding a cure."

The Kathleen Rankin Bequest is a key supporter of Associate Professor Ian Trounce's investigations into glaucoma.

↑ **Valued support: Associate Professor Ian Trounce with Anne Mulcahy and Christine Parkinson.**

Understanding eye health

With a passion for photography and live music, Ian Smith has snapped some of Australia's most famous musicians over the past five decades.

Ian has been a fixture at gigs around Melbourne since the 1970s, but complications from diabetes almost put an end to his unofficial role as a chronicler of Melbourne's live music scene.

A visit to his optometrist revealed diabetic macular oedema – where bleeding in the back of the eye causes fluid build-up and swelling of the retina and can lead to irreversible vision loss.

Ian is now part of a trial at CERA's Clinical Trials Research Centre where he receives monthly eye injections to test a new therapy for the disease.

The results will provide vital new information for clinicians and could change the way the disease is treated.

Ian's experience has made him acutely aware of the importance of regular eye checks for people with diabetes – and of research to find new treatments to help save people's sight.

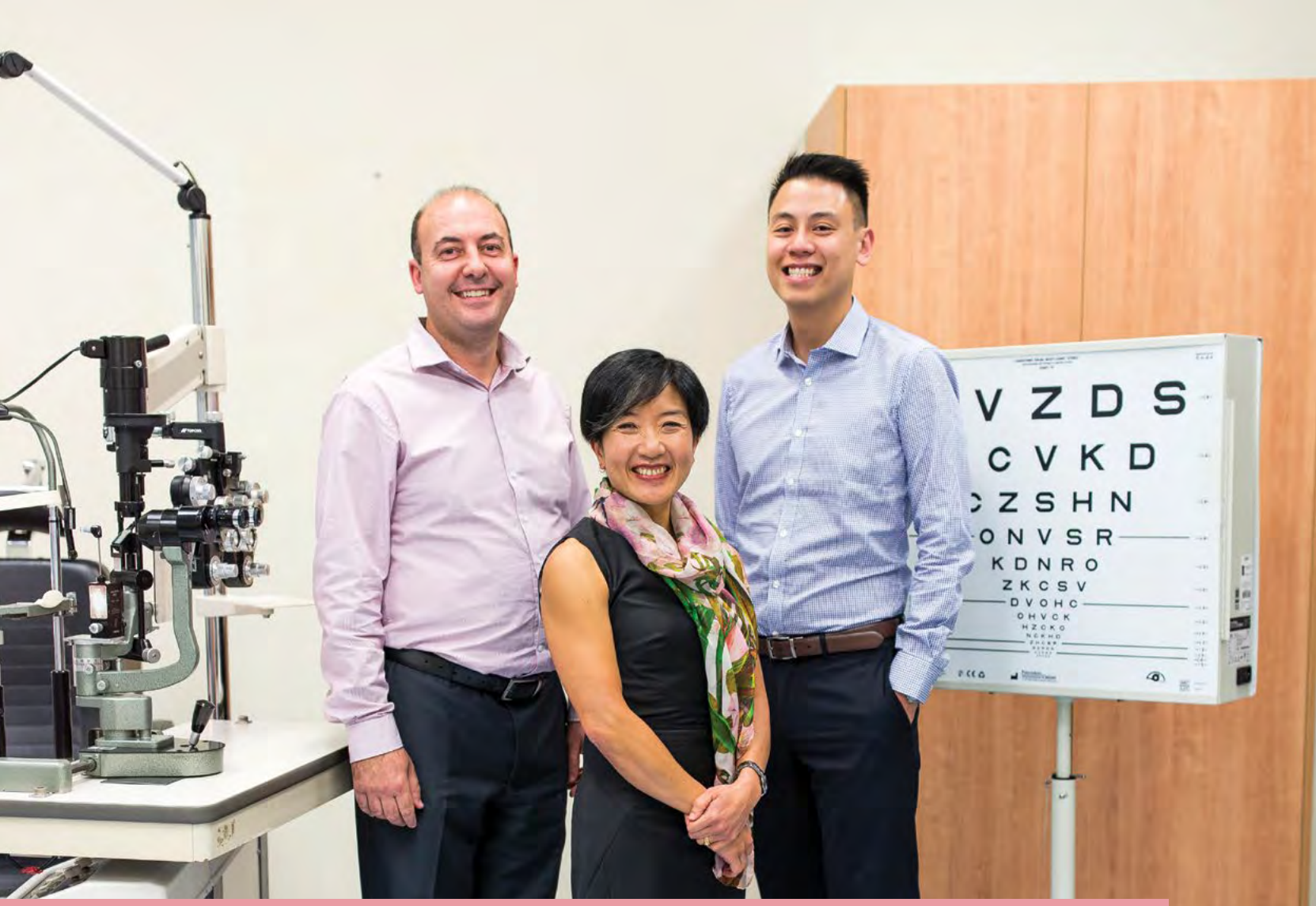
"It's great to know that people are doing research so that people like me can keep their sight. Being part of the trial has been a great experience," Ian says.

"I give the team here 11 out of 10."

↗ Great experience: Ian Smith has been part of a trial investigating a new treatment for diabetic macular oedema.

"It's great to know that people are doing research so that people like me can keep their sight. Being part of the trial has been a great experience."

– Ian Smith



Taking trials into the community

In 2019, CERA's Clinical Trials Research Centre (CTRC) reached out into the community to expand access to its ground-breaking clinical trial research.

The CTRC, which is located in the Royal Victorian Eye and Ear Hospital, opened its first branch in Rowville to enable local patients to take part in clinical trials without having to travel to the city.

The initiative is part of the Eye Trial Research Network which aims to increase its geographic reach and the range of diseases CTRC can cover.

The CTRC's researchers partner with private and public ophthalmology clinics to run the trials in network locations.

"We actually send coordinators out to the sites that help with the running of trials," says Lyndell Lim, Head of the CTRC. "It's going extremely well."

CTRC Manager Marios Constantinou says there are now plans to expand the network to other locations and beyond, to give more patients access to innovative treatments.

Gathering evidence: CTRC Manager Marios Constantinou, CTRC Head Associate Professor Lyndell Lim and Senior Study Coordinator Thuy Chau.

From trials to better treatments

Our Clinical Trials Research Centre plays a critical role in helping develop new treatments for eye disease – and ensuring they are safe, effective and make a difference for patients.

Behind every new treatment on the road to a cure for eye disease is a robust clinical trial process.

"Clinical trials are critical to get the evidence we need to prove that new drugs and treatments really work, and improve outcomes for patients," says Head of CERA's Clinical Trials Research Centre (CTRC) Associate Professor Lyndell Lim.

"The research we publish provides important insights for eye care specialists and can lead to new treatment protocols for patients.

"Just last year, two of our studies led to new treatment paradigms for the treatment of patients with uveitis and diabetic macular oedema."

In 2019 the CTRC conducted 19 trials with a total of 156 patients at its Melbourne location and another three involving 15 patients through its eye trial network.

"They covered all of the major causes of blindness, in addition to some rarer diseases and ranged from early Phase I to Phase IV clinical trials for drugs and implants."

Collaboration and partnerships

CTRC partners with organisations such as the Royal Victorian Eye and Ear Hospital, the Royal Australian and New Zealand College of Ophthalmologists (RANZCO), the Department of Surgery at the University of Melbourne, Baker IDI, Sydney Eye Hospital and Lions Eye Institute.

It also collaborates with industry partners and international research institutes such as the US National Institutes of Health.

Research success

Researchers from the CTRC published several major papers during 2019, some in partnership with other institutes.

Associate Professor Lim says large multi-centre collaborations enable researchers to run prospective studies which follow participants over a longer period.

One local CTRC study published in *The British Journal of Ophthalmology* compared the two standard treatments for patients with Diabetic Macular Oedema who were having cataract surgery. It found that both improved vision but that the steroid treatment required fewer patient visits.

Two large multinational studies involving CTRC and funded by the National Institutes of Health were also published. The POINT study showed that injecting steroids into the eye rather than around the eye was more effective for treating macular oedema due to uveitis.

Published in the *Journal of American Medical Association*, the FAST study looked at two common treatments for non-infectious uveitis and found the cheaper version was as good if not better.


Canon

AI to close the Indigenous eye care gap

A new artificial intelligence tool developed at CERA aims to identify people at risk of eye disease and provide diagnoses and referral for treatment on the spot.

Indigenous Australians are almost four times more likely to develop diabetes. One in 10 Indigenous Australians will develop vision-threatening diabetic retinopathy.

In 2019, CERA began a 12-month trial with The Fred Hollows Foundation and the Nganampa Health Council in seven remote Indigenous communities in Central Australia's Anangu Pitjantjatjara Yankunytjatjara (APY) Lands.

As part of the trial a local eye health nurse is using the AI tool to conduct eye tests on 250 people. A sophisticated computer program reviews retinal images taken by a typical fundus camera. It identifies and grades eye diseases within seconds.

Dr Jane Scheetz, who led the study with Professor Mingguang He, says the AI tool's algorithm was developed and tested over five years using more than 200 000 images of the back of the eye.

These images included common blinding eye diseases from different ethnic populations around the world.

Utilising 'deep learning', the computer program can process large amounts of data to recognise problems with the back of the eye and make informed decisions on its own.

Before the AI system was introduced, the usual pathway for investigating potential eye disease included sending images to Adelaide for review by an ophthalmologist.

Because the AI system can assess images instantly patients are provided with results on the spot. By offering instant results and immediate referral for treatment, the AI tool may well prove to be a game changer.

"A major problem with diabetic eye disease is that sometimes it's not noticed until it's too late," says Dr Scheetz.

"The hope is that people will also get used to checking in regularly.

"If you can pick people up earlier and consult with them and show them what's happening, hopefully we will be able to prevent some eye diseases or progression of disease."

The trial will conclude with interviews with staff involved with the study to discuss experiences and the pros and cons of the new technology.

The next step will be to compare the AI tool against current telemedicine models and measure accuracy, cost-effectiveness, ease of use and patient and clinician acceptance.

← **Testing technology: Patient Elizabeth Dunn, the Nganampa Health Council's Cathy Starr and Fabrizio D'Esposito from The Fred Hollows Foundation trial the new technology. Photo: Michael Amendolia, The Fred Hollows Foundation.**

Tracking inherited retinal disease

Researchers have joined forces to learn more about inherited retinal disease and identify patients suitable for future trials.

Five years ago, someone diagnosed with an inherited retinal disease (IRD) would have been told that progressive and irreversible vision loss was inevitable.

And because their diseases were largely considered untreatable, little effort was put into researching the impact the disease would have on their sight or their prognosis over the longer term.

But rapid advances in technologies like gene and cell therapy mean that treatments to correct the problem and stop vision loss are now being trialled overseas and could soon become available.

While these treatments are potentially life-changing, researchers don't yet know all the patients who could benefit or how to find them.

An additional challenge is that with more than 200 different genes associated with inherited retinal diseases, each treatment is targetted to specific genes, and many people with IRD do not have an exact diagnosis.

Tracking progress

To solve this problem, Dr Lauren Ayton is leading a group of 21 investigators from CERA and the University of Melbourne to identify, assess and track the estimated 16 500 Australians with IRD.

"We will bring people with a diagnosed IRD in for a comprehensive eye examination and genetic testing," says Dr Ayton.

"This will allow us to create a database with information about their vision, their genetic profile and whether they're interested in taking part in clinical trials.

"As new treatments come up, the patients will be ready to go."

This research has another important outcome – a better understanding of the sub-types of IRD and how they progress.

"At the moment we have a limited understanding of the natural history of many inherited retinal diseases," says Dr Ayton.

"By retesting people on our database every few years, we will be able to link the changes in their vision and eye health with their type of IRD."

National effort

The Royal Victorian Eye and Ear Hospital and the Lions Eye Institute in Perth have started testing the first few hundred patients with plans to go nationwide.

"Our eventual goal is a national register, which would list everyone in Australia who could be eligible for a new IRD treatment," says Dr Ayton.

"It's an incredibly exciting time. Several ground-breaking new treatments, like gene therapy and stem cells, are being developed right here in Melbourne. Plus, we have the international expertise and collaborations required to build this database and natural history study.

"In a few years we're going to be in an excellent position to make sure that anyone who's diagnosed with IRD can access these exciting new treatment options."

What is IRD and why do we need a register?

Inherited retinal disease is an umbrella term for a range of genetic eye diseases that cause retinal cells to stop functioning properly - including retinitis pigmentosa, macular dystrophy and a range of rarer genetic conditions.

Over time, the photoreceptor (light-sensing) cells can die, leading to vision loss and blindness.

More than 200 genes are known to be associated with retinal diseases. These genetic errors can be passed down from parent to child, but this doesn't always result in disease.

This means an inherited retinal disease can strike even when there is no known family history of it.

The aim of the national register is to better understand the natural history of IRD, identify patients who might be eligible for clinical trials and create a central repository of de-identified information on the types of IRDs in Australia.

The register will include a patient's genetic profile, clinical vision information and eye health data.

Anyone with IRD will be eligible to register, once it's rolled out nationally. This will either be through their eye health provider or they can self-register on the CERA website.

↑ **Team effort: Researchers included in the natural history study are (from left) Maria Kolic, Dr Carla Abbott, Dr Sloan Wang, Dr Lauren Ayton, Dr Tom Edwards, Fleur O'Hare, Associate Professor Penny Allen, Daniel Liu and Elizabeth Baglin.**

Seeing the people behind the stats

CERA's biostatistician Dr Myra McGuinness is also a registered orthoptist who previously specialised in strabismus and amblyopia.

While her job is to analyse data from CERA studies, Dr McGuinness says her clinical training as an orthoptist has been invaluable in her work.

"I associate each number with a real person that I have seen in the clinic, and that brings great meaning to my work," she says.

Nicole Tindill previously worked at Nature Publishing Group, an international scientific and medical publisher, as a technical lead for online scientific publications.

"I am inspired by CERA's ability to improve people's quality of life through saving sight and energised by the opportunity to implement emerging technology which strengthens the quality of our research data," she says.

Turning images into numbers

Biostatisticians and data managers play a critical role in helping researchers make sense of massive amounts of information.

Modern technology allows researchers to see minute details within an eye's layers, yielding massive amounts of data.

"This helps researchers understand how the eye works and how eyes change over time," explains CERA biostatistician Dr Myra McGuinness.

"With all this data, we need to be innovative to be able to turn those images into numbers, and then use sophisticated statistical methods to make sense of all those numbers."

As data becomes more complex, Dr McGuinness and her colleague Research Technology Manager Nicole Tindill, play an increasingly important role in CERA's research.

Their specialist skills are crucial in developing research systems and analysing material such as eye scans and patient questionnaires. They support projects from start to finish, analysing data at the design, execution, completion and translation stages.

Keeping data secure

Security is paramount and constantly reviewed, requiring frequent collaboration with legal and governance colleagues to ensure integrity and privacy are maintained.

Ms Tindill manages numerous electronic data systems that host several terabytes of clinical data.

← Supporting research: biostatistician Myra McGuinness and Research Technology Manager Nicole Tindill.

"We are the first site in Australia to have implemented OpenEyes, an open-source electronic medical record system developed specifically for ophthalmology," she says.

In 2019, CERA centralised its data management services and invested in specialised statistical software to be rolled out to all researchers in early 2020.

Following a successful pilot, Ms Tindill also plans to develop a new platform to attract and make it easier for patients to learn about and join clinical and research trials.

"We would now like to expand this database to allow anyone in Australia to register their interest with us and be informed of new eye research developments," she says.

Continually improving

Dr McGuinness says research participants, who volunteer their time for the greater good, are at the crux of everything CERA does.

"We show our respect to those participants by making the most of the valuable information they give to us," she says.

Ms Tindill says this means developing the best possible systems.

"Our aim is to provide researchers with support, easy to use systems and robust data management processes that allow them to focus more on the research and not be overwhelmed by managing their data."

Congratulations to Joshua Foreman for winning a Chancellor's Prize

Congratulations also to our 2019 graduates.

Maciej Daniszewski PhD
Using induced pluripotent stem cells to model primary open-angle glaucoma.

Jessica Tang PhD
Optimising the clinical utility of the photopic negative response to probe changes in glaucoma.

William Yan MPhil
The global socioeconomics of vision impairment and cataract surgery.

Sandra Staffieri PhD
"A glint or a squint should make you think!" Towards the earlier diagnosis of retinoblastoma.

Rose Tan PhD
Topographic rod function in intermediate age-related macular degeneration.

Nurturing eye research talent

The future is bright for CERA PhD graduate Dr Joshua Foreman, who was awarded the University of Melbourne's 2019 Chancellor's Prize.

CERA alum Dr Joshua Foreman is driven by a desire to improve eye health for under-served communities around the world.

During his PhD research supervised at CERA, he played a key role in the design and implementation of the National Eye Health Survey (NEHS), the first nationally representative survey of eye health in Australia.

In recognition of his contribution, Dr Foreman was awarded the University of Melbourne's 2019 Chancellor's Prize for Excellence in the PhD Thesis.

This is the most prestigious award given to PhD graduates and recognises scholarly excellence, international recognition and impact of research.

His supervisors Dr Mo Dirani, Associate Professor Peter van Wijngaarden and Dr Stuart Keel, agreed this achievement was extremely well-deserved.

"Dr Foreman is an exemplar of the values of integrity, respect, compassion and accountability that lie at the heart of the University and CERA," says Associate Professor van Wijngaarden.

"I have every confidence that Joshua will follow in the footsteps of Professor Hugh Taylor to make enduring contributions to Indigenous eye health and ophthalmic epidemiology."

Dr Foreman's research findings have been used extensively by the eye health sector and have played a key role in driving changes in eye health policy and service delivery.

His findings on the eye health of Indigenous Australians and the prevalence of diabetic retinopathy have been instrumental in supporting significant national approaches to the issues.

Now, Dr Foreman is consolidating his research experience in the United States. As the recipient of a National Health and Medical Research Council Sidney Sax Overseas Public Health and Health Services Early Career Fellowship, he is working on ground-breaking research with a team at New York University and the University of California, Berkeley.

Teleophthalmology and AI

This work will explore the potential of teleophthalmology and artificial intelligence-assisted image analysis to reduce avoidable vision loss and blindness from diabetes in under-served minority communities.

On his return to Australia, he plans to apply these learnings to sight-saving eye health programs for Aboriginal and Torres Strait Islander people.

Dr Foreman says his time at CERA has played an incredible role in shaping his career so far.

"Without CERA, I would not have completed such a fantastic project, nor would I have been awarded the Chancellor's Prize or this wonderful fellowship that is presently allowing me to expand my horizons."

Principal Investigators and Lead Researchers

Associate Professor Penny Allen

Bionic Eye Project

MBBS, FRANZCO

Associate Professor Michael Coote

Surgical Glaucoma Research

MBBS, FRANZCO, GAICD

Associate Professor Mark Daniell

Corneal Research

MB BS, MS, FRANZCO, FRACS

Dr Thomas Edwards

Retinal Gene Therapy Research

MBBS, PhD, FRANZCO

Dr Stuart Keel

Ophthalmic Epidemiology

BOrth (Hons), PhD

Professor Darren Kelly

Director Enterprise and Innovation (until October 2019)

BAppSci (MelbLabSc) PhD FASN

Dr Nathan Kerr

Glaucoma Surgical Trials

MBChB, MD, FRANZCO

Associate Professor Lyndell Lim

Clinical Trials Research

MBBS, DMedSci, FRANZCO

Associate Professor Peter van Wijngaarden

Ophthalmic Neuroscience

MBBS, PhD, FRANZCO

Dr Raymond Wong

Cellular Reprogramming

B.Biomed Sci (Hons), PhD

Professor Robyn Guymer AM

Macular Research

MBBS, PhD, FRANZCO, FAHMS

Professor Mingguang He

Ophthalmic Epidemiology at the University of Melbourne

MD, PhD, FRANZCO

Associate Professor Wilson Heriot

Vitreoretinal Research

MBBS, FRANZCO

Professor Alex Hewitt

Clinical Genetics

BMedSci (Hons), MBBS, PhD FRANZCO

Dr Isabel Lopez Sanchez

Mitochondrial biology and disease

BSc, PhD

Associate Professor Chi Luu

Macular Research

BOrth(Hons), GradDip(Epi&Biostats), PhD

Professor Keith Martin

Glaucoma Research

MA BM BCh DM MRCP FRCOphth, FRANZCO, FARVO, ALCM

Associate Professor Ian Trounce

Mitochondria and Neurodegeneration

BSc, PhD

For more details about our research leaders visit cera.org.au

A new leadership team is guiding CERA into the new decade.

↑ Meet CERA's Executive team: (from left) Professor Robyn Guymer AM, Associate Professor Peter van Wijngaarden, Leah Borsboom, Professor Keith Martin and Sarah Rainbird.

Executive team

In 2019, we welcomed a new Managing Director and some new faces to our leadership team.

In 2019, there were key new appointments to CERA's leadership as a new Managing Director, Chief Operating Officer and Head of Philanthropy and Fundraising joined the executive team.

In February, world renowned clinician-scientist and glaucoma researcher Professor Keith Martin started as CERA Managing Director and Ringland Anderson Chair of Ophthalmology at the University of Melbourne.

Professor Martin joined CERA from the University of Cambridge where he led ground-breaking research to develop a gene therapy to reduce optic nerve damage in glaucoma that is currently heading towards clinical trial.

Sarah Rainbird was appointed as Head of Philanthropy and Fundraising, joining CERA from Save the Children Australia where she was National Manager, Individual and Family Philanthropy.

Sarah is a senior management professional with 22 years of experience in fundraising, business development, stakeholder relationship management and corporate law.

Leah Borsboom, formerly CERA's Head of People Development, was appointed Chief Operating Officer.

Leah is a senior HR leader, qualified lawyer and graduate of the Australian Institute of Company Directors. She specialises in employee relations, workforce planning, remuneration, change management and leadership development.

The new appointees join deputy directors Professor Robyn Guymer AM and Associate Professor Peter van Wijngaarden on the leadership team.

Professor Guymer is a world-leading researcher in age-related macular degeneration (AMD), a Professor of Ophthalmology at the University of Melbourne and a senior retinal specialist at the Royal Victorian Eye and Ear Hospital.

Associate Professor van Wijngaarden, Principal Investigator in Ophthalmic Neuroscience, continues to make a valuable contribution to CERA after providing seven months of exemplary leadership as Interim Managing Director from July 2018 to February 2019.

In addition to his research responsibilities he also played a key role in advocacy for the establishment of the national KeepSight program.

In October, Professor Darren Kelly stepped down from his role as Director Enterprise and Innovation. We thank Professor Kelly for his service and congratulate him on his appointment as a new director on CERA's Board.

Our Board

Our Board directors generously volunteer their time and expertise to help us achieve our goal of a world free from vision loss and blindness.

They contribute a wealth of experience in business, finance, law, science, research and philanthropy.

They provide strategic direction and governance, oversee financial and risk management and ensure our organisation remains sustainable and forges partnerships that strengthen our capacity and the impact of our research.

We thank all our 2019 Board directors (from left)

Professor Darren Kelly
BAppSc (MedLabSc) PhD FASN
(Appointed 31 October 2019)

Suwanee Dharmalingam
BCom, LLB
(Appointed 1 September 2019)

Simon Brewin
B Bus, Grad Dip HSM, MBL, GAICD
Royal Victorian Eye and Ear Hospital representative

Wendy Miller
BA, LLB (Hons)

Professor Andrew Cuthbertson AO
BMedSci, MBBS, PhD, FTSE FAHMS

Professor Keith Martin
Managing Director

MA, BM, BCh, DM, MRCP, FRCOphth, FRANZCO, FARVO, ALCM
(Appointed 11 February 2019)

Olivia Hilton
Chairperson

BBus (Mkt) Hons

Andrew Cowlishaw

B Comm (Accounting and Finance), ACA

Christine Edwards

B App Sc, Post Grad Cert Public Sector Management, M Health Admin, GAICD

Professor John Prins

MB, BS, PhD, FRACP, FAHMS
(Appointed 28 February 2019)

We also thank retiring directors Peter Larsen, and Associate Professor Peter van Wijngaarden, who ended their Board terms on 10 September 2019 and 11 February 2019 respectively. Associate Professor van Wijngaarden was a director in a temporary capacity during his time as Interim Managing Director.

We also thank our alternate directors Llewellyn Prain, *BA (Hons), LLB (Hons) GAICD* (for Simon Brewin), Professor Fabienne Mackay, *PhD, FAHMS* (for Professor John Prins) and Associate Professor Peter van Wijngaarden *MBBS (Hons), PhD, FRANZCO* (for Professor Keith Martin).

For full details of the CERA Board visit cera.org.au

Abridged financials

CONSOLIDATED STATEMENT OF FINANCIAL POSITION
as at 31 December 2019

	2019 $'000	2018 $'000
ASSETS		
Current assets		
Cash and cash equivalents	689	2 740
Trade and other receivables	729	727
Other assets	83	52
Total current assets	**1 501**	**3 519**
Non-current assets		
Financial assets	25 194	21 590
Property, plant and equipment	794	850
Right-of-use assets	854	0
Total non-current assets	**26 842**	**22 440**
Total assets	**28 343**	**25 959**
LIABILITIES		
Current liabilities		
Trade and other payables	1 664	3 138
Lease liabilities	298	0
Provisions	1 263	1 133
Total current liabilities	**3 225**	**4 271**
Non-current liabilities		
Lease liabilities	570	0
Provisions	263	178
Total non-current liabilities	**833**	**178**
Total liabilities	**4 058**	**4 449**
Net assets	**24 285**	**21 510**
EQUITY		
Reserves	10 677	8 325
Retained earnings	13 608	13 185
Total equity	**24 285**	**21 510**

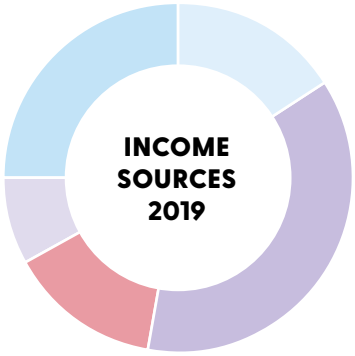
CONSOLIDATED STATEMENT OF PROFIT OR LOSS AND OTHER COMPREHENSIVE INCOME

for the year ended 31 December 2019

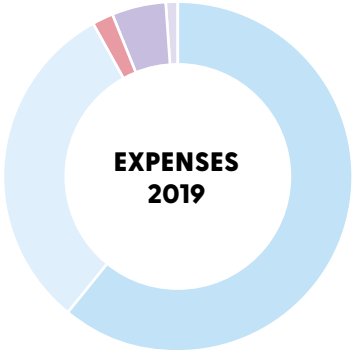
	2019 $'000	2018 $'000
REVENUE		
Federal and State Government grants	2 730	3 318
Clinical trials and contract research	6 508	5 874
Donations and bequests	2 348	3 205
Philanthropic and other grants	1 378	2 046
Investment and other income	4 418	2 342
Total revenue	**17 382**	**16 785**
Expenses		
Research expenses	8 915	10 082
Research support expenses	4 570	3 924
Occupancy expenses	280	688
Depreciation and amortisation	687	500
Finance expenses	155	715
Total expenses	**14 607**	**15 909**
Net surplus	**2 775**	**876**

These abridged audited financial statements have been extracted from the full audited financial statements for CERA and its controlled entity. The full audited financial statements can be extracted from the ACNC (Australian Charities and Not-for-profits Commission) website.

CERA operates as a not-for-profit organisation. Accordingly, accumulated surpluses are held as reserves to support future research projects and operations.



37% Clinical trials and contract research
16% Federal and State Government grants
14% Donations and bequests
25% Investment and other income
8% Philanthropic and other grants



61% Research expenses
31% Research support expenses
2% Occupancy expenses
5% Depreciation and amortisation
1% Finance expenses

2019 Supporters and acknowledgements

We express our heartfelt gratitude to all of our individual donors for their generous contributions to our research, along with the support of philanthropic trusts and foundations, industry, government and our member organisations.

This invaluable support takes us one step closer to a world free from vision loss and blindness – and helps us put hope in sight for people with eye disease and their families.

Major gifts ($10,000+)

Ainslie M Cummins

Andrew Cuthbertson AO

Connie Kimberley and Craig Kimberley AM

Andrew G Michelmore AO

Baillieu Myer AC and Samantha Baillieu AM and a network of generous donors through their support of the Yulgilbar Alzheimer's Research Program (YARP)

Loris Peggie

Margaret S Ross AM

L A Wilson

We would also like to acknowledge the support of other donors who wish to remain anonymous.

Trusts and foundations ($10,000+)

Alzheimer's Drug Discovery Foundation

Angior Family Foundation

Betty Brenda Spinks Charitable Trust

Bill and Jean Henson Charitable Trust*

BrightFocus Foundation

DHB Foundation

GRAS Foundation

Gwenneth Nancy Head Foundation

Harold Mitchell Foundation

Juvenile Diabetes Research Foundation

Lions Ride for Sight - Nina Blyth and Lions District 201V3

Kel & Rosie Day Foundation

Macular Disease Foundation Australia

Marjorie M Kingston Charitable Trust

Myra Stoicesco Charitable Trust

National Foundation for Medical Research and Innovation (NFMRI)

Ophthalmic Research Institute of Australia (ORIA)

Percy Baxter Charitable Trust*

Perpetual IMPACT Philanthropy Program

Retina Australia

The CASS Foundation

The Fred Hollows Foundation

The Lindsay and Heather Payne Medical Research Charitable Foundation*

The Miller Foundation

The Pratt Foundation

Victorian Lions Foundation Inc

Wolf and Dora Rajcher Memorial Fund

Bequests ($10,000+)

Estate of Alice Downey

Estate of Sylvia Gelman

Estate of John Walker Hitch

Estate of Eunice Irene McDonald

* Via the Perpetual IMPACT Philanthropy Program.

* We would also like to acknowledge the support of Equity Trustees, Australian Executor Trustees and Mutual Trust.

Corporate supporters

Eyebank Association of America

Fight for Sight

Genetic Kingdom Pty Ltd

Royal Victorian Eye & Ear Hospital

We gratefully acknowledge the Royal Victorian Eye & Ear Hospital for facilitating support from the following donors for our research:

H & L Hecht Trust

Michael Halprin

The Anne and Eldon Foote Trust

Endowments

Centre for Eye Research Australia Foundation

We would like to acknowledge the University of Melbourne in the ongoing management and direction of the following endowed funds to support our research:

Dorothy Adele Edols Research Fund (managed by Perpetual Ltd)

Hazel Jean Eastham Bequest

Hector MacLean Scholarship Fund

Kathleen Rankin Bequest

Louisa Jean de Bretteville Bequest

Maurice Cantlon Memorial Fund

RB McComas Ophthalmic Research Scholarship

The Annemarie Mankiewicz-Zelkin Fellowship Fund

The Mavis and Ivan Rowe Prize for Retinal Diseases Research

The Ringland Anderson Chair of Ophthalmology Fund

Wiseman Trust

Winifred Hallam Monds Bequest

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Tina McMeckan

Andrew G Michelmore AO

Peter Nankivell

Margaret S Ross AM

Professor Hugh Taylor AC

Professor Bob Williamson AO

Focus on the future

Beryl and Bill Logie hope research today will create a brighter future for people with eye disease.

Beryl Logie first understood the value of eye research when her mother lost her eyesight to glaucoma in her 90s. But it really hit home when Beryl herself was diagnosed with age-related macular degeneration (AMD).

"We decided that CERA was so important that we wanted to become donors."

Beryl and her husband Bill have now donated to CERA for more than 15 years. They regularly attend the Centre's events on eye health, travelling in by train from their outer eastern Melbourne home to hear the latest developments from researchers.

"It's very encouraging to know they are investigating glaucoma and macular degeneration," says Beryl. "Down the track, even if it doesn't help me, it's going to help the next lot of people."

Beryl has lived with AMD for more than a decade. It affects her left eye only.

"At the beginning I lost colour definition in that eye," she says. "Then it was like looking through murky water, intermittently, until central vision was gone."

Beryl is now being monitored by ophthalmologist Professor Robyn Guymer AM who is also a Deputy Director of CERA.

"She's very caring, very friendly and someone you have confidence in," says Beryl. "I am so fortunate to have her looking after me."

Beryl still has good vision, and she can read and drive, but feels that her depth perception is weak.

"I don't have the confidence to know how far down something is."

"I remember Mum putting her foot out to 'feel' her way. It's what I do, getting off the train or changing surfaces, because you don't trust your eyes to gauge it."

Beryl is an active member of a local osteoporosis support group and a strong advocate of regular eye checks for the elderly.

"So many falls and fractures are caused by poor vision," she says.

"It's important people make sure their vision is as good as it can possibly be."

→ **Family support: Bill and Beryl Logie with their daughter Wendy Probert (centre) hope CERA's research will help future generations.**

"It's very encouraging to know they are investigating glaucoma and macular degeneration... Down the track, even if it doesn't help me, it's going to help the next lot of people."

– Beryl Logie

How you can support us

Donate

With your support we can continue our world-leading research and accomplish scientific breakthroughs previously deemed unattainable. Please visit cera.org.au/donate to donate now.

Leave a bequest

Make a gift in your will and create a lasting legacy.

Partnership and funding opportunities

As true innovators, our scientists are on the brink of new discoveries every day. For a confidential conversation about how you can partner with our researchers to help them discover new ways to prevent vision loss, please contact Sarah Rainbird, Head of Philanthropy & Fundraising on srainbird@cera.org.au or +61 3 9929 8796.

Register for a clinical trial

Be part of our research by registering for a clinical trial. Visit the clinical trials section of our website to learn more.

Stay in touch

Visit our website cera.org.au to register for our bi-annual supporter magazine *Visionary* or monthly e-newsletter *Eye-News*.

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