SINGAPORE EYE RESEARCH INSTITUTE

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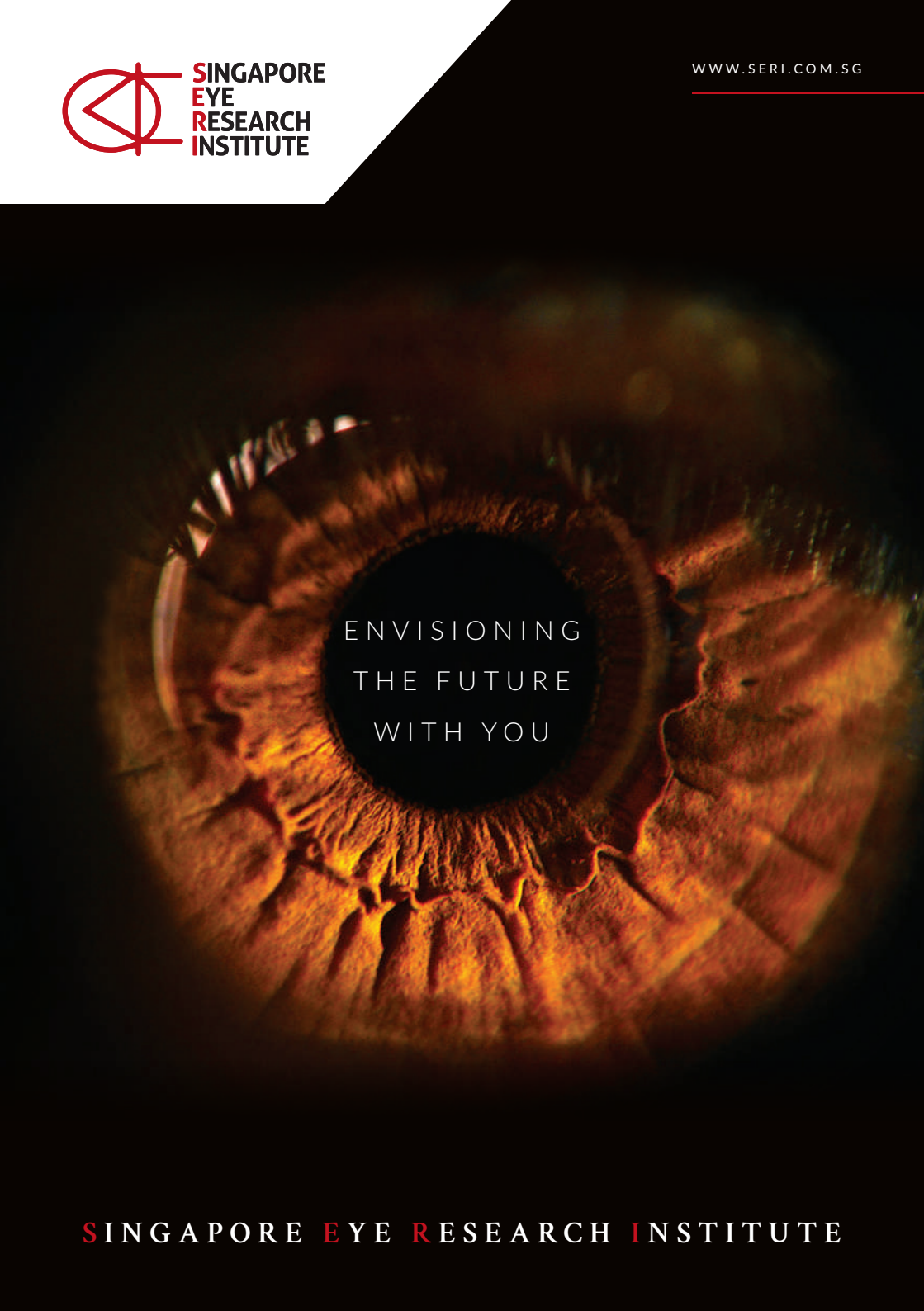


SINGAPORE EYE RESEARCH INSTITUTE

OVERVIEW

The Singapore Eye Research Institute (SERI) is Singapore's premier national research institute for ophthalmic and vision research. Established in 1997 under Prof Arthur Lim's visionary leadership, it is the research arm of Singapore National Eye Centre (SNEC) and is affiliated to the Duke-NUS Medical School.

Over the years, SERI has established a strong reputation for its cutting-edge research in the fields of eye disease and visual science. Its research activities focus on advancing the understanding, diagnosis, and treatment of eye-diseases and include basic, clinical, and translational research. One of the key strengths of SERI is its multidisciplinary approach to research which brings together scientists and clinicians from various fields including ophthalmology, molecular biology, genetics, bioengineering, AI, epidemiology, and population health. This collaborative approach has led to numerous breakthroughs in understanding the causes and progression of eye diseases and has resulted in the development of new diagnostic and therapeutic approaches. Also, SERI's close proximity to SNEC, its clinical arm, allows for a seamless translation of basic research findings into clinical practice, ensuring that the latest treatments and technologies are made available to patients as quickly as possible.

SERI's national mandate drives the organisation to constantly explore areas of synergies and opportunities for multidisciplinary collaborative research partnerships with the various public healthcare eye institutes and other biomedical research institutions in Singapore and throughout the world.

We aim to be at the forefront of ophthalmic research and to translate this knowledge into better patient care. With a strong focus on public health, our research can bring major benefits to people, especially in Southeast Asia and other regions where the burden of eye diseases is high. We are committed to continuing to make breakthroughs in the field of ophthalmology for the betterment of patients and society as a whole.

OUR VISION

To be Asia's global centre of excellence in eye and vision research, renowned internationally for translating basic science to clinical applications for the prevention and treatment of sight threatening disorders.

OUR MISSION

To conduct innovative and world-leading basic science, clinical and translational eye and vision research.

SERI - ENVISIONING THE FUTURE WITH YOU

In over two decades of SERI's presence in the global ophthalmology field, we have built a formidable reputation as the foremost eye research institute in Asia with a focus on incorporating translational research into clinical practice to improve patient outcomes.

Our institute is dedicated to advancing the understanding and treatment of vision disorders through cutting-edge research and collaboration.

A testimony to our research excellence is the recent report that ranks Singapore 1st globally in terms of ophthalmological research with high impact factor points per million inhabitants per year, with SNEC/SERI being the major contributor to this ranking.

The global pandemic has renewed our appreciation for basic and translational research and its boundless potential to support the healthcare needs of our community. The pandemic has given rise to various new challenges including anecdotal reports that suggest ocular infection and damage due to SARS-CoV-2 infection, diagnostics and the need to employ AI and other technologies to reduce the clinicians' dwell time while treating patients and also reducing the exposure risk of patients and staff.

These challenges play to our core strengths at SERI – those of scientific research and clinical improvement, while also broadening our opportunities to serve the public.

SERI has raised the bar in terms of international, multi-institutional, inter-disciplinary collaborations that have led to several milestone discoveries and diversity in our research – from basic to complex, systemic biomedical themes.

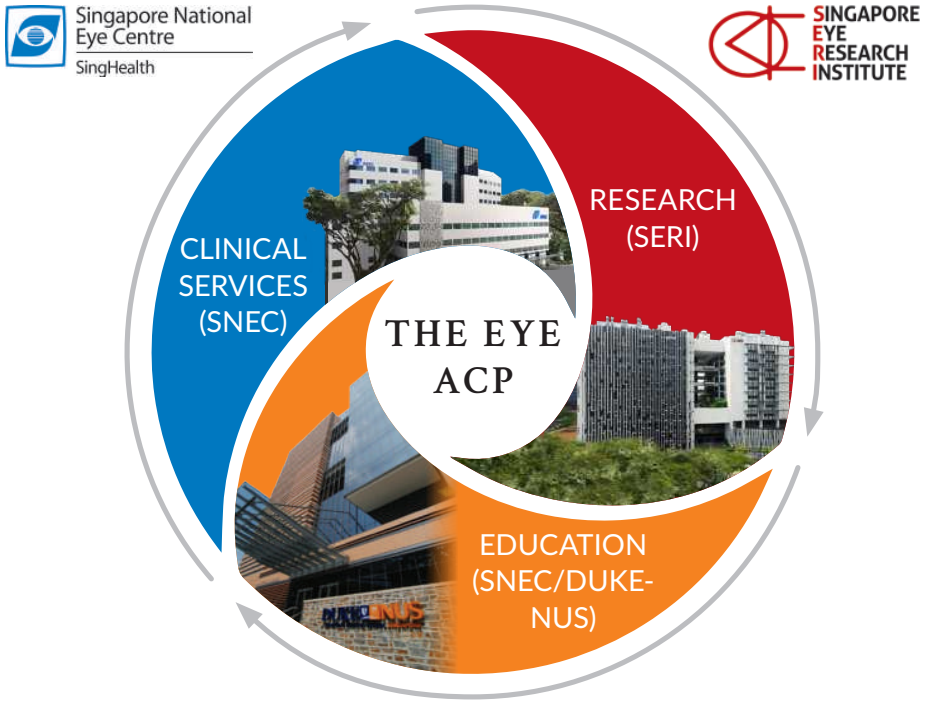
Let's continue to harness on our key strengths i.e. strong partnerships and SERI's people – its talented group of researchers and clinicians who continue to push the boundaries on research excellence while also striving to position us at the forefront of vision research in the world!

SERI's strong mentorship opportunities for young researchers and the constant passion of the SERI faculty and its leadership to develop SERI as the world leader in eye research, has led me to believe that we are well-poised to advance our mission of being a global centre of excellence in eye and vision research.

I invite you to align your vision with that of SERI's and together, we shall work diligently to ensure that SERI is always at the forefront of research and innovation.

Prof Jodhbir Mehta,
Executive Director,
SERI

TRIPARTITE PARTNERSHIP BETWEEN SNEC, SERI AND DUKE-NUS



A virtuous cycle of **clinical care, leveraging on education and research**, with the objective to pursue better patient outcomes.

PUBLICATION HIGHLIGHTS

Singapore ranks no. 1 worldwide in terms of scientific papers published related to ophthalmology based on impact factor points per million inhabitants per year.

According to this data along with the recently published data in *Acta Ophthalmologica*, it is evident that most of the ophthalmology papers are published by our scientists from SERI.

SINGAPORE IS RANKED 1ST GLOBALLY FOR QUANTITY AND QUALITY OF EYE RESEARCH, IN TERMS OF IMPACT POINTS*

Table 2. Top 20 countries of scientific contribution to ophthalmological literature by articles and impact points in relation to worldwide research output and per inhabitants.* Impact factor points is a metric that measures a researcher's published articles multiplied by the journal's impact factor at the time of publication

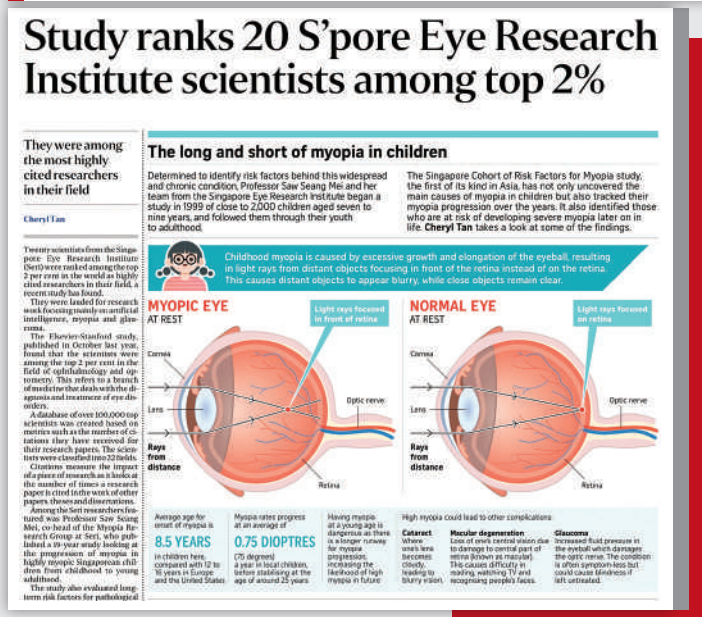
[Bro T. Worldwide ophthalmological research production 2000-2020, with special focus on the Nordic contribution. Acta Ophthalmol. 2022 Dec]

Rank	Country (percentage of worldwide articles)	Country (percentage of worldwide impact points)	Country (articles/million inhabitants/year)	Country (impact points/million inhabitants/year)
1	United States (35.2%)	United States (39.2%)	**Iceland (10)**	Singapore (31)
2	United Kingdom (8.9%)	United Kingdom (8.2%)	Singapore (9)	**Iceland (31)**
3	Japan (7.2%)	Japan (7.2%)	**Denmark (7)**	Australia (20)
4	China (6.0%)	China (5.6%)	Australia (6)	**Denmark (18)**
5	Germany (4.7%)	Germany (4.4%)		
6	Australia (4.5%)	Australia (4.4%)		
7	South Korea (3.2%)	South Korea (3%)		
8		Italy (2.5%)		
9		Spain (2.3%)		
10		France (2.2%)	United Kingdom (4)	Switzerland (13)
11		India (2.1%)	Netherlands (4)	New Zealand (13)
12	Canada (1.9%)	Canada (2%)	**Sweden (4)**	Netherlands (12)
13	Netherlands (1.9%)	Netherlands (2%)	Switzerland (4)	**Sweden (11)**
14	Singapore (1.5%)	Singapore (1.6%)	**Finland (3)**	**Finland (10)**
15	Turkey (1.5%)	Austria (1.2%)	Japan (2)	Japan (6)
16	**Sweden (1.3%)**	Turkey (1.1%)	Germany (2)	South Korea (6)
17	Austria (1.3%)	**Sweden (1.1%)**	South Korea (2)	Canada (6)
18	**Denmark (1.2%)**	**Denmark (1.0%)**	Spain (2)	**Norway (6)**
19	Switzerland (1.1%)	Switzerland (1.0%)	Canada (2)	Germany (5)
20	Israel (1.1%)	Israel (1.0%)	Greece (2)	Spain (5)

Singapore ranks 14th worldwide in number of ophthalmology-related article produced

Singapore ranks 1st worldwide in terms of impact factor points* per million inhabitants per year

*90% of papers are published by SNEC/SERI



Study ranks 20 S'pore Eye Research Institute scientists among top 2%

They were among the most highly cited researchers in their field

Cheryl Tan

The long and short of myopia in children

Determined to identify risk factors behind this widespread and chronic condition, Professor Saw Seang Mei and her team from the Singapore Eye Research Institute began a study in 1999 of close to 2,000 children aged seven to nine years, and followed them through their youth to adulthood.

The Singapore Cohort of Risk Factors for Myopia study, the first of its kind in Asia, has not only uncovered the main causes of myopia in children but also tracked their myopia progression over the years. It also identified those who are at risk of developing severe myopia later on in life. **Cheryl Tan** takes a look at some of the findings.

Childhood myopia is caused by excessive growth and elongation of the eyeball, resulting in light rays from distant objects focusing in front of the retina instead of on the retina. This causes distant objects to appear blurry, while close objects remain clear.

MYOPIC EYE AT REST

NORMAL EYE AT REST

Light rays focused in front of retina

Light rays focused on retina

Cornea

Lens

Optic nerve

Rays from distance

Retina

Average age for onset of myopia is **8.5 YEARS** in children here, compared with 12 to 16 years in Europe and the United States

Myopia rates progress at an average of **0.75 DIOPTRES** (75 degrees) a year in local children, before stabilising at the age of around 25 years

Having myopia at a young age is dangerous as there is a longer runway for myopia progression, increasing the likelihood of high myopia in future

High myopia could lead to other complications:

Cataract Where one's lens becomes cloudy, leading to blurry vision.

Macular degeneration Loss of one's central vision due to damage to central part of retina (known as macular). This causes difficulty in reading, watching TV and recognising people's faces.

Glaucoma Increased fluid pressure in the eyeball which damages the optic nerve. The condition is often symptom-less but could cause blindness if left untreated.

WHERE DOES SERI STAND?

SERI's scientists rank among the top 2% in ophthalmology globally in the Elsevier-Stanford 2022, 2023 and 2024 studies.

COLLABORATIONS

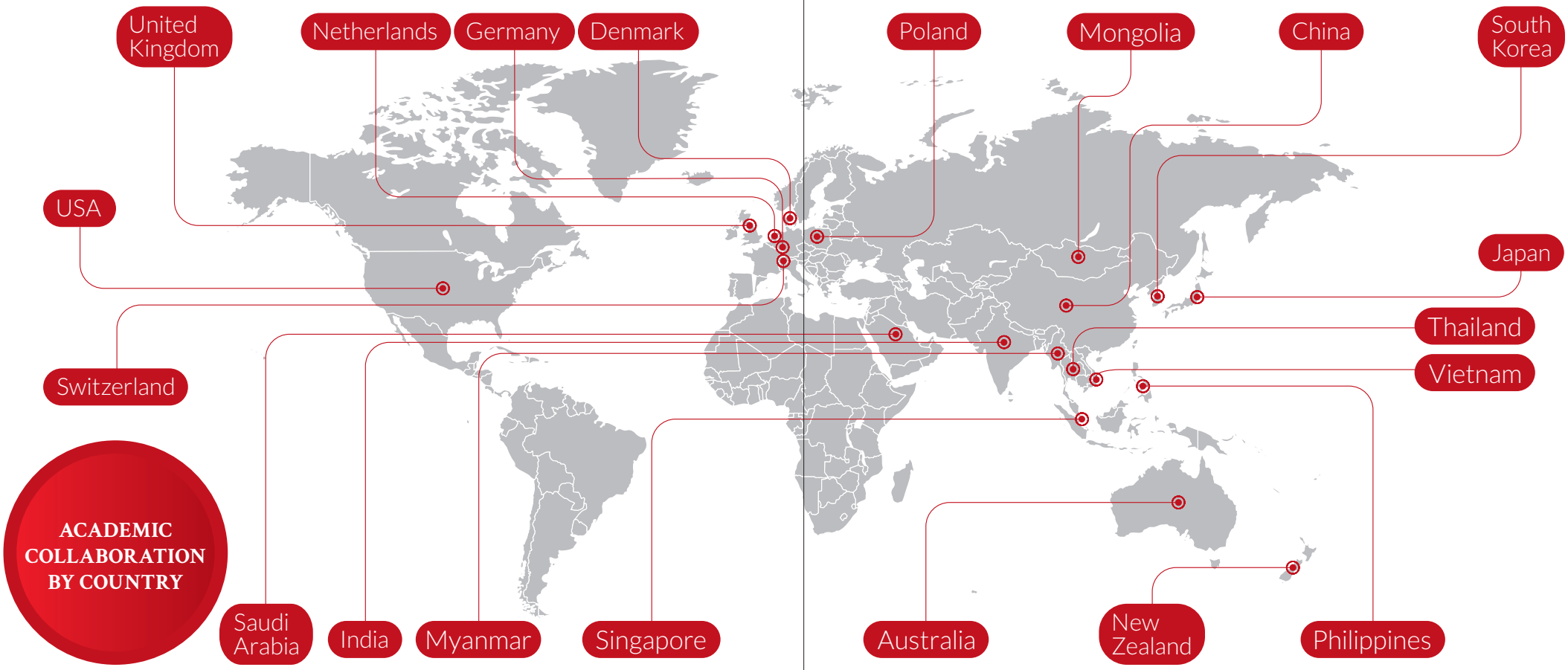
SERI has cultivated a symbiotic network of people including its team of researchers, trial coordinators, optometrists, as well as ophthalmologists from public sector eye hospitals and local institutions. We work together in close collaboration to achieve a common goal – the generation of knowledge and/or technology that can potentially improve the clinical management and treatment of eye diseases. SERI has additionally initiated a steady stream of impactful research collaborations with peers in Singapore.

Today, SERI is recognised as a pre-eminent pacesetter of ophthalmology and vision research in Asia and globally. It is a strong advocate of strategic research alliances and collaborations. The SERI faculty has played key strategic advisory roles in the initiation and conceptualisation of research ideas and technologies with renowned international institutions. This has enabled us to maintain a high level of research competency and skills transference. SERI has also forged important ongoing research alliances with major industry partners.

Academic Collaborators: >140

Industry Collaborators: >90

Scan the QR code to view our collaborations



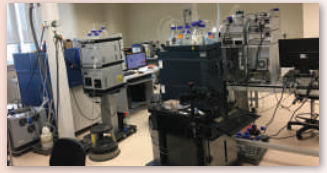
SERI'S RESEARCH STRATEGY

BASIC SCIENCES / LABORATORY PLATFORMS

Experimental Molecular, Cell Biology and Imaging Facility



Proteomics Facility

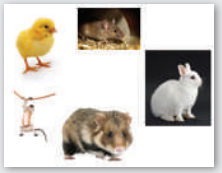


PRE-CLINICAL ANIMAL MODEL PLATFORM

A Multi-disciplinary Team

Consisting of Neuroscientists, Molecular Biologists, Biochemists, Photobiologists, Circadian Biologists, Ophthalmologists and Epidemiologists

Robust Animal Models for Eye Diseases



State-of-the-art Technology

CLINICAL RESEARCH PLATFORM

Co-located within Clinical Arm, SNEC

In-house Trial Pharmacy with State-of-the-art Equipment

>60 GCP Certified Research Team

POPULATION HEALTH PLATFORM

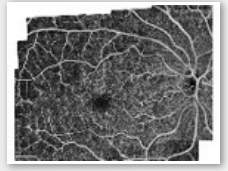
12-year Follow-up Visits for Chinese, Malay and Indian Eye Studies

SEED
SINGAPORE EPIDEMIOLOGY OF EYE DISEASE

Risk Factors, Prevalence & Incidence

Genetic Epidemiology & Biomarkers

Advanced Ocular Imaging



Data Analytics and AI Innovation

TECHNOLOGY DEVELOPMENT & COMMERCIALISATION PLATFORM

Technology Development and Transfer

Industrial Collaboration

Resources & Education for SERI & SNEC staff

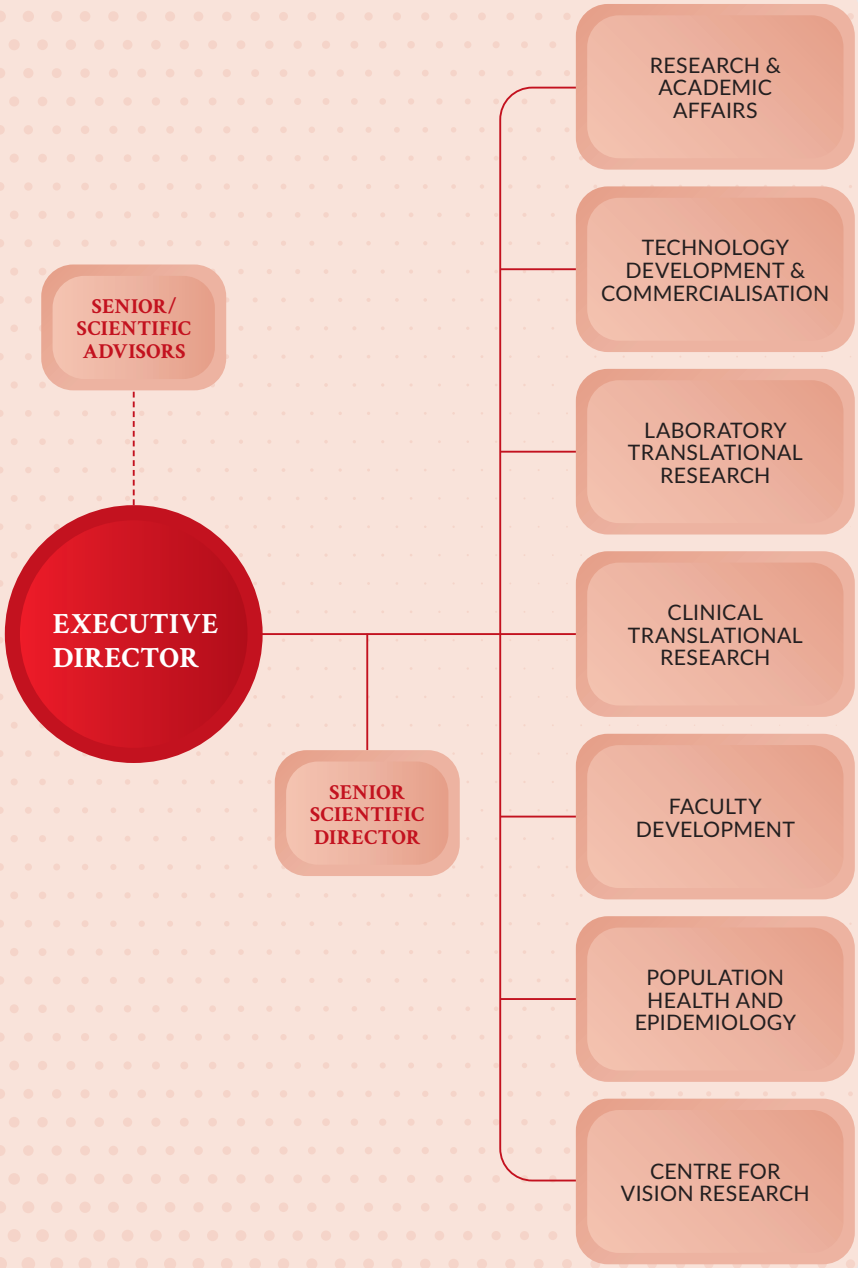
1. We provide a **full suite of research cores** for our researchers to conduct their work from bench to bedside and to population. Our advanced equipment and technology enable us to conduct cutting-edge research, and our spacious and well-equipped labs provide our researchers with the space and resources they need to thrive.

2. Our institute **fosters robust and dynamic interactions between clinicians and scientists**. Clinicians, who are trained in the diagnosis and treatment of eye conditions, provide valuable insights into the real-world challenges and needs of patients, while scientists, with their expertise in research and technology, are able to develop new treatments and therapies. By working together, clinicians and scientists can combine their knowledge and expertise to advance the field of eye care and improve the lives of individuals with vision loss.

3. Our institute has a **systematic research governance structure** that ensures the quality and integrity of our research.

4. Finally, our institute has **a strategic talent development programme** that supports the growth and development of our researchers.

SERI'S ORGANISATIONAL CHART



RESEARCH GROUPS

AI & Digital Health	Bioengineering & Devices	Cataract & Refractive Surgery	Cornea
Glaucoma	Myopia	Ocular Anti Infective & Inflammation	Ocular Epidemiology
Ocular Imaging	Ocular Surface	Ocular Therapeutics & Drug Delivery	Population Health
Regenerative Therapy	Retina	Uveitis	Visual Neuroscience

RESEARCH PLATFORMS

Clinical Research/ Trials	Data Management	Data Science
Experimental & Basic Sciences	Experimental Microscopy, Molecular & Cell Biology	Proteomics
Translational Ophthalmic Pathology & Immunology	Translational Pre-Clinical Model Platform	

To view our latest organisational chart, please scan this QR code.

AI & Digital Health Research Group

Our research group aims to:

- Harness the power of big data analytics and AI to address unmet clinical needs while improving patient care and outcomes.
- Develop AI algorithms for not only eye diseases but also systemic diseases screening, triage and prognostication.
- Facilitate the implementation and commercialisation of these state-of-the-art AI and digital systems/platforms in eye care in a real-world setting.

Bioengineering & Devices Research Group

- Our research group is positioned at the exciting interface between physics (with a focus on biomechanics) and artificial intelligence with applications in ophthalmology.
- We believe that working at such an intersection is crucial for advancing our understanding of a wide range of ophthalmic disorders, developing novel treatments, and improving and simplifying the screening, diagnosis, and prognosis of these conditions.
- Our research focuses on optic neuropathies (including glaucoma) and also covers myopia and corneal disorders.

Cataract & Refractive Surgery Research Group

- Our research group primarily conducts clinician-initiated and industry-initiated studies.
- An example of a clinician-initiated study includes evaluating newer commercially available products used in surgery, such as femtosecond lasers compared to conventional methods, and assessing cataract patient outcomes at SNEC.
- Additionally, we rigorously evaluate new products for safety and efficacy across various trial phases, including intraocular lens implants and phacoemulsification equipment. Furthermore, our research extends to understanding the mechanisms of new surgical procedures in refractive surgery.

Cornea Research Group

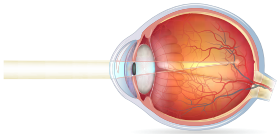
- Our focus is on clinical translational research on the treatment and surgical management of corneal diseases, including corneal transplantation.
- The Singapore Cornea Transplant Registry is an ongoing prospective cohort study of all corneal transplants performed in Singapore, that has contributed to numerous publications and led to evidence-based practices.
- Recent innovation and technological advances have led to the introduction of novel imaging, multimodal evaluation and artificial intelligence in our research to improve outcomes of cornea treatments and transplantation.

Glaucoma Research Group

- To investigate why advancing age predisposes the eye to the major causes of visual impairment in Singapore.
- To develop and translate interventions that reverse age-related susceptibility to the major eye diseases. We have an existing "pipeline" of interventions that will be subject to further experimental and pre-clinical studies with the goal of taking these through to clinical trial.

Myopia Research Group

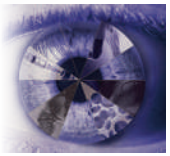
- Our research group aims to better understand the epidemiology, genetics, pathogenesis and public health implications of myopia and to develop and evaluate novel interventions to prevent or slow its progression in young children.
- We conduct large-scale population studies like Singapore Cohort of Risk factors for Myopia (SCORM), Growing Up In Singapore Towards Healthy Outcomes (GUSTO) cohort, SEED-High Myopia as well as Myopic Intervention Studies in children including both pharmacological and optical agents.
- Our team also has several clinical myopia cohorts which span ages from 7 to 70 years.



Ocular Anti Infective & Inflammation Research Group

- Design and development of cell-selective antimicrobial peptides and polymers for combating antimicrobial resistance; generation of antibiograms of new class of antimicrobials and their toxicity and efficacy in animal models.
- Development of drug delivery systems for existing and newly identified therapeutics such as use of contact lenses, core-shell electrospray nanoparticles and electrospun nanofibres as platforms for the sustained release of various drugs.

Ocular Epidemiology Research Group



- Identification and risk stratification of eye diseases, their progression and systemic health outcomes via precision medicine, data science, AI and digital technology with the vision to improve overall population eye health.
- Determining the prevalence, incidence, risk factors and public health significance of blinding eye diseases in Singapore and Asia by conducting the landmark programme, the Singapore Epidemiology of Eye Diseases (SEED) Study.
- A world-leading group for ocular epidemiology and data science in ophthalmology.

Ocular Imaging Research Group

- Produce research and new technologies of translating technological advances into meaningful, robust and validated applications that are clinically useful and becoming an integral part of clinical eye care management in detecting and monitoring various ocular pathologies.
- Develop highly specialised advanced imaging technology that will allow for continuation of cutting-edge research in Singapore in the field of ocular engineering, further strengthening the role of ocular imaging in clinical assessment and monitoring of the eye.

Ocular Surface Research Group

- The main focus of the research group is to improve the diagnosis and treatment of ocular surface diseases such as dry eye, meibomian gland dysfunction and pterygium.
- We are also focused on understanding the molecular basis of these diseases which include inflammation, fibrosis, and epithelial biology. Our translational research ranges from in vitro studies and animal models to epidemiology, health services, biochemistry, immunology, imaging (including artificial intelligence) and human clinical trials.

Ocular Therapeutics & Drug Delivery Research Group

- Development of new therapeutic treatments and the design of sustained delivery systems for glaucoma, retinal and vitreo-retinal disorders.
- Targeting and restraining fibrovascular proliferation in the eye as it leads to impaired wound healings.
- Develop new class of antimicrobials as microbial infections are a major cause of ocular morbidity & blindness.

Population Health Research Group

- The Population Health research group is the translational eye research unit at SERI.
- This unit is focused on the epidemiology and risk factors of age-related sensory decline in Singapore; Patient-Centred Outcomes Research and Patient-Reported Outcome Measurement Development.
- The unit also focuses on translating clinical research into improved real-world management and treatment strategies of major eye diseases, particularly Diabetic Retinopathy (DR), Glaucoma, and Age-related Macular Degeneration (AMD).

Regenerative Therapy Research Group

Our research group aims to understand through translational research and enable innovation in corneal regenerative therapy. Our group focuses on:

- Understanding and investigating regenerative therapy of the cornea, including corneal cells and nerves.
- Investigating corneal nerve degeneration and regeneration associated with diseases or surgical procedures, and developing therapeutic approaches for enhancing corneal nerve regeneration.
- Investigating the principles of corneal cell therapy to improve patients' visual outcomes.

Retina Research Group

- The Retina research group, led by Professor Gemmy Cheung, comprises clinicians, clinician-scientists and scientists with a broad focus and expertise in basic, translational and clinical research.
- We aim to address crucial medical research questions and target clinical gaps in retinal diseases.
- We have established ongoing research programmes in AMD and DR which have attracted funding support from government and industry. We also support individual PIs in other projects related to retinal detachment and low vision.

Uveitis Research Group

- The Uveitis research group conducts clinical trials and translational studies in collaboration with industry leaders to lead the way in uveitis research with focus on ocular inflammation, immunology and oncology masquerades.
- We use cutting-edge in-vitro and in-vivo techniques to bridge gaps in disease pathogenesis and therapeutic strategies.
- Our clinical team of experts plays a vital role in global uveitis consensus committees, shaping international guidelines for uveitis management and pushing the boundaries of medical science.

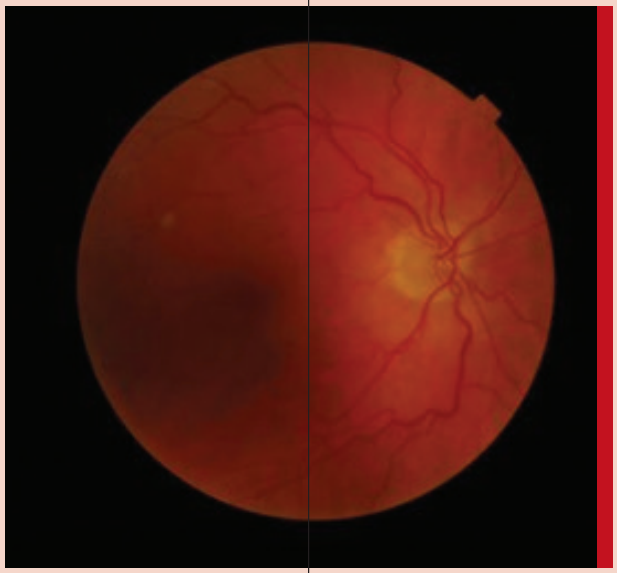
Visual Neuroscience Research Group

- Our research group aims to use the eyes to detect vision- and life-threatening brain conditions by leveraging on artificial intelligence applied to deep analysis of retinal features.
- We also explore the non-visual functions of the eyes (i.e. non-classical photoreception subserving pupillary responses) as a proxy to objectively detect ophthalmic diseases (i.e. glaucoma) and central nervous conditions.

SUCCESS STORIES IN TRANSLATIONAL RESEARCH

CONTROLLING MYOPIA WITH MYOPINE™

Research performed at SERI over the past two decades has shown that low-dose atropine eye drops can be used to slow the progression of myopia by up to 60% without any significant side effects. Our low-dose atropine formulation, marketed as Myopine™, is approved for clinical use in Singapore by HSA on a named patient basis with concentrations of 0.01% and 0.025%, and is already in use in all public hospitals including SNEC Myopia Clinic and private clinics throughout Singapore. It is also available on a similar basis in Japan and Malaysia. It has obtained China NMPA and Malaysia NPRA approval for manufacturing and market at the concentration of 0.01%.



SELENA+: AI-BASED RETINAL IMAGING ANALYSIS FOR DIABETIC RETINOPATHY SCREENING

Early detection of diabetic retinopathy allows for the prevention of diabetes-related visual impairment, reducing the risk of severe visual loss by 57%. SERI researchers developed and validated a novel and robust Artificial Intelligence (AI) system called SELENA+ which uses deep learning to detect referable Diabetic Retinopathy (DR), referable Glaucoma Suspect (GS) and Age-related Macular Degeneration (AMD). Trained and validated over 500,000 retinal images, SELENA+ has shown excellent diagnostic performance in detecting referable DR and has now become an integral part of the Singapore National DR Screening programme (SiDRP). The algorithm has also been licensed to local start-up EyRIS Pte Ltd which is furthering the development, regulatory approval and commercialisation in the region and globally.

VABYSMO: A DUAL-ACTION DRUG TARGETING NEOVASCULAR AMD & DIABETIC MACULAR EDEMA DEVELOPED BY ROCHE IN COLLABORATION WITH SERI

Work done at SERI in collaboration with Roche contributed to the approval of Vabysmo, a novel dual-action drug targeting neovascular AMD & diabetic macular edema. SERI is one of the few research institutions worldwide that has the capabilities and resources to see ophthalmic drug development from pre-clinical stage through to clinical trial phase (end-to-end) all under one roof.

NOTABLE AWARDS & RECOGNITIONS

PSTA AWARD winners — In 2009, Professors Aung Tin, Donald Tan and Roger Beuerman were the inaugural recipients of the prestigious President's Science Award (PSA) for their innovative breakthroughs in "bench-to-bedside" medical research in blinding corneal diseases and glaucoma.

In 2014, SERI received dual honours, winning the highest national research award, the President's Technology Award (PTA), for two cutting-edge research projects. The award went to Prof Wong Tien Yin and his collaborators for an eye image analysis platform to help doctors detect and track the progression of three major eye diseases as well as to Prof Tina Wong for her work with Nanyang Technological University (NTU) on sustained release of glaucoma medications by using a single injection of nanomedicine for the delivery of medication for up to six months.

In 2019, the President's Science & Technology Award (PSTA) was again bestowed on our faculty members Prof Saw Seang Mei, Prof Roger Beuerman, Clin Prof Donald Tan and Assoc Prof Audrey Chia for their exceptional translational research and strategies that have contributed to decreasing the severity of myopia in children.

In 2024, the Young Scientist Award (YSA) was conferred to Assoc Prof Daniel Ting for his significant contributions to AI in ophthalmology and healthcare, and his pioneering work in deep learning, generative AI, and trustworthy AI, advancing global ocular health.

Scan the QR code to get a full list of awards and achievements by our staff.

Other National and International Awards:

- The Association for Research in Vision and Ophthalmology (ARVO) Awards
- The Asia-Pacific Academy of Ophthalmology (APAO) Awards
- The Ophthalmologist's Power List
- The American Academy of Ophthalmology (AAO) Awards
- SingHealth Excellence Awards
- Singapore Health Quality Service Awards (SHQSA)
- The Bernard Gilmartin OPO Awards
- International Society of Refractive Surgery (ISRS) Casebeer Awards
- College of Ophthalmologists Lectureship
- Asia-Pacific Myopia Society (APMS) International Award Lecture
- Top 2% of Researchers in Ophthalmology & Optometry
- World Glaucoma Association (WGA) Founders Award

SERI has also been published in many journals of high impact factors such as the *Journal of the American Medical Association (JAMA)*, the *New England Journal of Medicine (NEJM)*, *Lancet*, etc.

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