

WESTERN AUSTRALIAN EYE HEALTH SECTOR

SITUATIONAL ANALYSIS

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Preface

The Western Australian (WA) eye health care sector encompasses individuals, organisations and activities which share the goal of improving the diagnosis and management of eye diseases within WA. The aim of this report is to capture a broad snapshot of the WA eye health care sector and provide a basic overview of its mechanics. As such it's organised into seven sections;

- Section 1 – Demographics and Eye Health, describes the demographic characteristics of the WA population, the epidemiology of the main eye conditions, and the influences of non-disease trends (e.g. aging population) on the future populations potential eye health needs.
- Section 2 – Human Resources, describes the demographic features and numbers of the eye health care workforce.
- Section 3 – Services, describes the various eye health care services which exist in WA and the organisations which are involved in delivering them.
- Section 4 – Funding, describes the flow of funds into (funding sources) and out of (expenditure on diseases) the WA eye health care sector.
- Section 5 – Education, describes training pathways for the eye health care workforce and resources available for continuing professional development.
- Section 6 – Health promotion, describes eye diseases from the perspective of the burden they contribute, quantifies avoidable vision loss and blindness, and identifies active health promotional projects.
- Section 7 – Research, describes the ophthalmology specific research which has been produced in WA in the past 10 years. It also describes the individuals and institutions involved in the creation of the literature and the various collaborations that occur state wide, nationally and internationally.

Ultimately the aim of this report is to describe *what is*, in order to take a position on *what isn't*. That is, identify any potential gaps in the sector which, through directed funding may benefit eye health care in Western Australia. To this aim, each report section concludes with an 'Issues and Recommendations' part which describes these potential gaps as well as recommendations for consideration. This summary report contains the complete contents page, executive summaries and 'issues and recommendations' from each section.

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DEMOGRAPHICS
& EYE HEALTH

Section 1 - Demographics and Eye Health

Executive Summary

- Key characteristics of the WA population and an epidemiological overview of WA eye health is presented in this report section.
- The population of WA in 2020 was estimated to be 2,663,561, representing 10.4% of the Australian population. The vast majority (79.8%) live in or near Perth.

Vulnerable populations:

- Demographic features of community segments which may be considered vulnerable from a health outcomes perspective were explored. These included Aboriginal and Torres Strait Islander peoples, lower socioeconomic groups, lower educational attainment groups, regional and remote populations, various cultural and language groups, the aging population and persons with disabilities.
- 75,978 or 11.7% of the Aboriginal Torres Strait Islander population reside in Western Australia with the highest living in Perth (38.3%). There are 2522 registered Indigenous communities in Western Australia.
- The lower a person's socioeconomic status, the greater the risk of poor health, illness, disability, and lower life expectancy. Forty-eight per cent of Aboriginal Torres Strait Islanders live in the bottom fifth most disadvantaged areas in Australia compared to 18 per cent of non-Indigenous people and only 5.4 per cent of Aboriginal and/or Torres Strait Islander peoples live in areas of high relative advantage compared with 22 per cent of non-Indigenous people. Outer metropolitan Perth and regional Western Australia has the greatest disadvantage.
- Adults with higher educational attainment living longer and healthier lives compared to less-educated adults. 67.3% of people in Western Australia had a non-school qualification or were studying one. Aboriginal and Torres Strait Islander peoples in Western Australia have worse educational attainment than the non-Indigenous people; however, the rates are improving. The proportion of Aboriginal and Torres Strait Islander peoples aged 20-24 years, completing year 12 or its equivalent increased from 29% to 40.6% from 2011 – 2016, compared to an increase from 70.8% to 76.4% for non-Indigenous people.
- Living in rural and remote areas can create unique challenges relating to geographical locations resulting in poorer health outcomes. Approximately 79% of the WA population lives in greater Perth, the rest living in regional or remote Western Australia.
- Language differences can create barriers to accessing health care. In Western Australia, 60.3% of people were born in Australia, 3.1% of the population is made up of Aboriginal and Torres Strait Islanders. The majority of people who speak a language other than English at home were proficient in English (86%) while 14% had low proficiency or did not speak English at all.
- The Australian population is ageing due to low fertility and increasing life expectancy. The median age of the Australian population has increased from 35 to 38 years between 2000 and 2020. The median age of the WA population increased from 34.6 to 37.5 years in this period (**Error! Reference source not found.**).
- In WA, the overall prevalence of disability was estimated to be 16.4% in 2018. The rates increased with older age, being 4.3% in children aged 0- 14 years, 2.6% in people aged 15-64 years, and 14.5% in adults aged 65 years and older. Diseases of the eye and adnexa account for 0.3% and 3.1% of disability in the 65-74 year group and 75 years and older age groups, respectively.

Eye examinations:

- Population level eye examination rate can provide insights into access to eye health care. In 2019-2020, 12% of Indigenous Australians (n = 104,300) had an eye examination, compared to 23.5% for non-Indigenous Australians. Across Australia, the examination rates decreased with greater remoteness and were the lowest in the very remote areas. The rates of eye examinations for Indigenous people in WA and the NT were lower than those in other states and territories (8.2%). These results show an increase

in the age-standardised examination rate for Indigenous people from 14% in 2007-2008 to 17% in 2019-2020 and an increase from 19% to 24% for non-Indigenous people.

Vision impairment and blindness:

- The prevalence of eye conditions increases with older age, and affected 93% of people aged 65 years and older, in comparison to 12% of children aged 0-14 years. According to the National Eye Health Survey, refractive error was the main cause of vision impairment for both Indigenous and non-Indigenous Australians (63.39% and 61.69%, respectively). The second leading cause was cataract with a rate of 20.22% in Indigenous Australians and 13.93% in non-Indigenous Australians. The overall age-adjusted prevalence of blindness was 0.36% in Indigenous Australians and 0.12% in non-Indigenous Australians representing a 3-fold increase in Indigenous people. The primary cause of bilateral blindness in non-Indigenous participants was age-related macular degeneration (AMD, 71.42%), while cataracts were the main cause of blindness in Indigenous participants (40%).

Hospitalisations:

- Overall, more non-Indigenous Australians are hospitalised for eye diseases than Indigenous Australians. The age-standardised hospitalisation rate for non-Indigenous people was 14.8 per 1,000 compared to 12.2 per 1,000 for Indigenous Australians. More Indigenous Australians however, are hospitalised with an eye injury than non-Indigenous Australians.

Children:

- The Australian Childhood Vision Impairment Register (ACVIR) was established in Australia in 2008 to report on children diagnosed with permanent visual impairment. More male (57%) than female (43%) children were registered, and the most common primary diagnoses were retinal dystrophy (17%), cortical/cerebral VI (CVI, 15%), and albinism (11%). Families reported that 68% of children received low-vision support by a non-government agency at the time of registration, with 54% reporting the support had commenced prior to the child's first birthday. By comparison, 24% of families reported their child received no such support.
- 747 children were treated for an eye or adnexal injury between 2002 and 2015, including 708 (94.8%) accidental eye injuries and 39 (5.2%) considered highly suspicious for non-accidental or intentional eye injuries. This represents an estimated overall prevalence of 0.17% of eye injuries in children across WA in 2015.
- There is an increasing incidence of early onset type 2 diabetes in Western Australian children with a disproportionate burden on Aboriginal and Torres Strait Islander children. The mean incidence for Aboriginal and Torres Strait Islander children was 18-fold higher than in non-Indigenous children and the incidence increased by an average of 6.2% (95% CI 2.8 – 9.6) per annum in the Aboriginal and Torres Strait Islander children compared 3.9% (95% CI 0.3 – 7.6%) in non-Indigenous children.

Other eye diseases:

- Trachoma and trichiasis - the overall prevalence of active trachoma in children aged 5-9 years was 4.5%, with 0% in SA, 5.2% in the NT, 7.4% in Qld, and 6.4% in WA in 2019. The overall prevalence of active trachoma in children aged 5-9 years varied considerably across regions of WA, ranging from 3.7% in the Pilbara, 4.7% in the Kimberley region, 7.5% in the Midwest, and 12.3% in the Goldfields.
- Myopia - The prevalence of myopia in Western Australia is between 19.6% - 29.9% (n=226) and the prevalence of high myopia between 1.3% - 3.9%.
- Keratoconus – The prevalence rate of keratoconus in Western Australia was found to be 1.2% (95% CI 0.7% – 1.9%), or 1 in 84, one of the highest prevalences reported in the world.
- Amblyopia, strabismus and anisometropia – The Western Australian prevalence of amblyopia was found to be 1.1%, strabismus was 3.5%, and anisometropia was 2.9%.
- Pterygium – The prevalence of pterygium in Western Australia is between 1.2% - 14.1%.

- Ocular Tuberculosis – The 10 year incidence of ocular tuberculosis in Western Australia is estimated to be 1.28 per 100,000 people. The highest incidence was found in males aged 30-39 years and no Indigenous Australians had been diagnosed with ocular tuberculosis.

Issues and Recommendations

<i>Increasing prevalence of eye disease in the context of an aging population</i>
<p>Details:</p> <ul style="list-style-type: none"> • The prevalence of eye conditions increases with age. Ninety-three (93) % of people >65 years are affected by an eye condition in comparison to 12% of children aged 0-14 years (NHS). • The Australian population is ageing due to low fertility and increasing life expectancy. The median age of the Australian population has increased from 35 to 38 years between 2000 and 2020. The median age of the WA population increased from 34.6 to 37.5 years in this period. • Given Australia's aging population, the burden of eye disease is likely to increase in the future. • The prevalence of cataract increases with age. An Ontario, Canada study with a similar aging population to Australia projected the number of cataract operations to increase by 128% between 2007 to 2036 with the proportion provided to patients aged over 85 tripling.⁴²
<p>Recommendations:</p> <ul style="list-style-type: none"> • Key considerations include appropriate economic and disease modelling to inform future eye-health resource planning for Western Australia. A focus on projects, which support this goal may be useful. • Establishing more strict criteria for funding may reduce the future burden on the public health care system.
<i>Uncorrected refractive error is the main cause of vision impairment in Australia</i>
<p>Details:</p> <ul style="list-style-type: none"> • Uncorrected refractive error was reported to be the main cause of vision impairment for both Indigenous and non-Indigenous Australians (63.39% and 61.69%, respectively) (NEHS). • Risk factors for severe uncorrected refractive error in Indigenous and non-Indigenous participants included participants who were older, did not have an eye examination in the previous two years, geographical remoteness and were males. • This represents a high prevalence of reversible vision impairment.
<p>Recommendations:</p> <ul style="list-style-type: none"> • Public awareness of the importance of regular optometric examinations may be required in higher risk groups for severe refractive error. • With the advent of social media, highly targeted campaigns are possible. Health-promotion campaign projects may be an area of interest.
<i>Cataract is the leading cause of blindness in Aboriginal and Torres Strait Islanders</i>
<p>Details:</p> <ul style="list-style-type: none"> • Cataract was the leading cause of blindness (40%) in Indigenous participants of the NEHS. Blinding cataract is 12 times more common among Aboriginal and Torres Strait Islander adults than in non-Indigenous Australians. • Cataracts are reversible; therefore, this is a potentially addressable burden of blindness. • Cataract wait lists are increasing, suggesting the system is at capacity.
<p>Recommendations:</p> <ul style="list-style-type: none"> • Projects that aim to identify undiagnosed cataract in the Indigenous population may be valuable. • This needs to be weighed up against the capacity of the current eye-health system to handle an additional caseload.
<i>There is a significant burden of undiagnosed eye disease in the community</i>
<p>Details:</p> <ul style="list-style-type: none"> • Over 50% of all eye conditions diagnosed in the NEHS were new diagnoses suggesting a significant burden of undiagnosed eye conditions in the community. • The rate of undiagnosed eye conditions in the NEHS was 5.58% of all Indigenous participants and 3.03% of all non-Indigenous participants. In addition, three of the top 4 causes of blindness, AMD (54.6%), glaucoma (8.1%) and DR (5.4%) in WA, have better outcomes for patients when identified early.

<ul style="list-style-type: none"> • This suggests the need for increased regular eye examinations.
<p>Recommendations:</p> <ul style="list-style-type: none"> • Further research to break down the demographic characteristics and risk factors of the population with undiagnosed eye conditions would help to orient any public health campaigns targeted at this issue. • Projects that aim to increase the frequency of eye examinations at a broad population level may create downstream resource issues for the eye health workforce; therefore, projects, which take a more targeted approach, may be preferred.
<p><i>Aboriginal and Torres Strait Islanders in WA have especially high rates of hospitalisations due to eye injuries</i></p>
<p>Details:</p> <ul style="list-style-type: none"> • WA has the second highest rate of hospitalisations for Indigenous people with eye injuries (1.8 per 1000 population). The rates are highest in remote and very remote areas. • The Kimberley has the highest rate (3.2 per 1000 population) and Perth has the lowest rate (0.6 per 1000 population).
<p>Recommendations:</p> <ul style="list-style-type: none"> • Projects that aim to identify upstream causative factors would be beneficial. • In addition, it is important to ensure that emergency services in high prevalence regions are appropriately supported to manage eye trauma.
<p><i>Australia is the only developed country in the world to still have trachoma</i></p>
<p>Details:</p> <ul style="list-style-type: none"> • The overall prevalence of active trachoma in WA in children aged 5-9 years was 6.4% in 2019. These figures have increased since 2017, when the prevalence was 4.1%. • The highest prevalence was 12.3% in the Goldfields. In the 2019 NTSRU, 551 children were examined in 36 of the 38 communities at risk; 66% of them had clean face.
<p>Recommendations:</p> <ul style="list-style-type: none"> • There are active trachoma surveillance and public awareness campaigns in Australia. • One avenue of exploration would be to engage existing organisations to understand the issue and assess the benefits of additional support.
<p><i>Many families of children with vision impairment receive no low-vision support from a non-government agency</i></p>
<p>Details:</p> <ul style="list-style-type: none"> • Twenty-four percent of families of children registered on the Australian Childhood Vision Impairment Register reported they received no low-vision support from a non-government agency.
<p>Recommendations:</p> <ul style="list-style-type: none"> • Explore projects that aim to increase the awareness and uptake of support. • Seek collaboration with low-vision services to understand their current advertising practices, resources, and capacity to increase support of new families.
<p><i>Western Australia has one of the highest prevalence's of keratoconus in the world and has no public funding for hard contact lenses.</i></p>
<p>Details:</p> <ul style="list-style-type: none"> • The Raine Study reports that WA has one of the highest prevalence of keratoconus in the world (1.2%, 95% CI 0.7% – 1.9%). • There is currently no state-wide public funding for hard contact lenses, one of the treatment options for this condition. This is a major gap, as it can leave patients significantly out of pocket.
<p>Recommendations:</p> <ul style="list-style-type: none"> • Seek projects that call for public funding of hard contact lenses.
<p><i>The incidence of early onset type 2 diabetes is increasing in Western Australia affecting Aboriginal Torres Strait Islander children disproportionately.</i></p>
<p>Details:</p> <ul style="list-style-type: none"> • There is a growing incidence of early onset type 2 diabetes in Western Australian Children that disproportionately affects Aboriginal and Torres Strait Islander children. • Early onset T2DM patients are at risk of developing premature retinopathy

Recommendations:

- Consider supporting projects with a focus on preventative measures and screening for early onset T2DM.

HUMAN RESOURCES

Section 2 – Human Resources

Executive Summary

- The Western Australian ophthalmologist workforce comprised of 81 ophthalmologists as of May 2021, has an average annual growth rate of 0.78% per annum, and 1.25% between 2019 and 2020. Workforce size growth is lower than optometrists (2.73% per annum) and Aboriginal Health Workers (11.1% per annum). A recommendation from a recent RANZCO WA Eye Health report was to ‘Ensure a sustainable ophthalmology workforce’. The report highlights planning guidelines of 1 ophthalmologist per 25,000 and 1 trainee per 100,000 population. The population of WA reached approximately 2.6 million in 2020, which according to this calculation, calls for 104 ophthalmologists suggesting the workforce is currently under supplied. However, the population growth of WA was 0.6% from 2019–20. This suggests that despite being undersupplied, the workforce growth rate (1.25%) outstrips the population growth rate (0.6%) pointing towards a correction.
- The proportion of female ophthalmologists has steadily risen from 15% in 2016 to 20% in 2021. This is below the national average of 24% female ophthalmologists in 2020, according to the AIHW NHWD.
- New Zealand and other overseas locations provide a substantial proportion of the ophthalmologist workforce for Western Australia. In 2020, 24% of the WA ophthalmic workforce was trained internationally. Nationally, this figure was 21.3%. The reliance on overseas trainees has been a stable part of the WA ophthalmic workforce for the past 5 years. Special international medical graduates (SIMGs) must apply to RANZCO for registration to practice as an ophthalmologist locally. This is a complex process, including the need to undertake the RACE exit examinations. RANZCO undertook a review of its policy regarding SIMGs, which led to a policy update in May 2019. Given the importance of overseas practitioners in the local workforce, an ongoing balance between supporting applicants through a transparent process as well as maintaining high clinical standards is necessary.
- There are currently no Aboriginal ophthalmologists or optometrists practicing in Western Australia. This represents a clear gap in the workforce, given the considerable needs of the local Aboriginal population.
- Between 2016 and 2020, approximately 4-5% of the optometry workforce capacity remained dormant, i.e. was registered but not clinically active. In 2020, this figure was 7.8% nationally. In 2017, Optometry Australia released a position statement regarding the state of the optometry workforce in Australia: ‘at a national level there are currently sufficient numbers of practicing optometrists to meet community demand for services’ and ‘without change to key determining factors, there is likely to be a substantial excess supply of full time equivalent optometrists in coming decades’. Therefore, this dormant workforce may represent a supply side excess.
- Data availability on ophthalmic nurses in Western Australia was scant. The size, demographic makeup and trends of this workforce are poorly understood.
- Aboriginal health workers (AHWs) represent a fast growing workforce in Western Australia. The average annual growth rate of the youngest age group (20-34 years) was 31.2% between 2016 and 2020, which was 3x the growth of the group as a whole (11.1%). The proportion of female AHWs has also increased from 76-84% females between 2016 and 2020. Young people, and females are the key drivers of workforce growth in this group. The structures that support this growth and promote pathways of education towards eye health would benefit the WA community given the ongoing disparity in eye health measures between Aboriginal and non-Aboriginal Australians.

Issues and Recommendations

<i>The proportion of female ophthalmologists in Western Australia is 20% below the national average.</i>	
Details:	<ul style="list-style-type: none"> • The proportion of female ophthalmologists in Western Australia has steadily risen from 15% in 2016 to 20% in 2021. • This is below the national average of 24% female ophthalmologists in 2020, according to the AIHW NHWD.
Recommendations:	<ul style="list-style-type: none"> • The RANZCO Women in Ophthalmology group represents an avenue of exploring this issue further.

- Collaborative opportunities may exist for incorporating these figures in their strategic plan as well as supporting projects that may aid Western Australian females aspiring, training and qualified ophthalmologists. link - <https://ranzco.edu/home/community-engagement/wio/>

A large proportion of the local Western Australian ophthalmic workforce is trained overseas

Details:

- In 2020, 76% of the workforce was locally trained, 4% trained in New Zealand, and 20% trained overseas. These proportions have remained relatively stable since 2016 where 74% of the workforce was locally trained.
- There does not appear to be recognition or support of this workforce in line with their importance.

Recommendations:

- Explore avenues that recognise and support international medical graduates who contribute to the local ophthalmic workforce. A RANZCO position statement may be an initial avenue to pursue.

There are currently no Aboriginal ophthalmologists or optometrists practicing in Western Australia.

Details:

- There are no current or past Aboriginal and/or Torres Strait Islander ophthalmologists in Western Australia.
- There is currently one nationally.

Recommendations:

- Consider projects with a focus on upstream factors contributing to education and training.

Dormant optometry workforce

Details:

- 4-5% of the optometry workforce remains dormant at any given time.
- This represents a significant and valuable workforce that can be activated to contribute towards other existing WA eye health issues.

Recommendations:

- Consider further research into this phenomenon to understand the reversibility and potential of this workforce, should it be activated.

Data availability on ophthalmic nurses in Western Australia was scant

Details:

- There is limited publicly available data on the size and demographics of the ophthalmic nursing workforce.
- Ophthalmic nurses play an important role in eye health care and there is little insight into the structure and mechanics of the workforce.

Recommendations:

- Consider further research into the Western Australian ophthalmic nursing workforce structure. The ABS Census and AIHW NHWDS is likely to contain further information through professional access.

Aboriginal health workers are the fastest growing eye health care workforce

Details:

- There is substantial growth in the AHW workforce driven by young people and females. This represents an opportunity to promote ophthalmology as a viable area of interest and increase the ophthalmic AHW capacity.

Recommendations:

- Explore promotional activities to encourage AHW interest in ophthalmology as a part of their career progression.
- Explore the AHW national curriculum for eye health from a quality and engagement perspective.

SERVICES

Section 3 – Services

Executive Summary

- This report section outlines the function, size, organisational structure and geographical reach of the various eye health care services available in WA from the perspective of primary, secondary, and tertiary healthcare.
- General practitioners (GPs) are often the first point of contact with the health system for a patient with an eye disorder and represent an important contribution to eye health care in Western Australia.
- In 2020 there were 2,318,554 patients serviced by GPs in WA consuming 2861.3 General Practitioner Full time Equivalent (GPFTE_ over 16,591,524 services. In 2015–16, eye disorders accounted for 1.9% of Australian GP consultations.¹ As a broad estimate, there were approximately 315,239 (1.9% of 2,318,554) eye-related GP consultations in WA in 2020. In 2016, GP referrals to an ophthalmologist represented 4.1% of all allied health and specialist referrals or 6.5% of specialist referrals. This was a rate of 0.6 (95% CI: 0.6-0.7) per 100 encounters, which equates to 99,549 of the 16,591,524 services in 2020.¹
- The emergency department serves as an important site of first presentations of eye conditions, especially those of higher urgency. In WA, 10,940, or 1% of total presentations were classified as diseases of the eye and adnexa. Emergency medicine specialists see approximately 34 eye presentations per clinician per year, compared with 81 for GP's. The majority of eye and adnexa presentations are classified as semi-urgent (52.2%). The redistribution of low-urgency eye patients to optometry or general practice may represent an opportunity to improve patient outcomes, reduce wait times, and reduce the burden on overwhelmed emergency departments.
- In WA, the proportion of Indigenous Australians appropriately screened for diabetic retinopathy was approximately 31%.²² The gap between the recommended and actual screening rates is related to the patients' knowledge of the condition, the need for retinal screening and doctor-patient's communications, travel, operating costs, infrastructure, and time constraints within general practice.³⁻⁵
- On 1 November 2016, two item numbers (12325 and 12326) were launched to support and promote diabetic retinopathy screening in general practice. Pre-introduction modelling suggested that over 400,000 patients with diabetes would be screened for retinal photography, with the new primary health item numbers.⁶ Five years since their introduction, the cumulative national use of these item numbers was 10,598. Barriers to utilisation include the cost of retinal cameras, time constraints, the need for dedicated staff to take the responsibility of diabetic retinopathy (DR) screening, lack of skills to make a DR diagnosis, lack of awareness of Medicare incentives for non-mydriatic retinal photography, optometrists being perceived as ideal for DR screening and limited referral pathways.⁶⁻⁸
- "The Visiting Optometrists Scheme (VOS) is a federal-funded initiative which supports optometrists to deliver outreach optometric services to remote and very remote locations."⁹ In 2019–20, there were 22,089 occasions of service to Indigenous patients and 18,299 to other patients under the VOS with the occasions of service being greatest in very remote and remote areas.¹⁰
- In 2019, Lion's Outback Vision dispensed 1,955 spectacles to Indigenous people (an increase of 714 from 2017): 1,163 in Kimberley, 638 in Pilbara, 120 in Goldfields, and 34 in the Perth Metro areas.
- Cross-sectional data of private optometry advertisements was scraped online from three key platforms, including Healthengine, Healthdirect, and Myhealth1st in November 2021. There were 304 private optometry practices listed in WA, located in 91 different postcodes. WA has 11.41 optometry practices per 100,000 capita.
- In 2021 there were 90 ophthalmologists registered in WA representing 1% of the WA specialist workforce. According to the 2017 RANZCO workforce survey, WA Fellows reported 47.2 hours in an average week, which is higher than the College-wide average of 42.13 hours. The majority of full time equivalent (FTE) between 76.3-84.3% is spent in private practice. Between 20% to 40% of ophthalmologists spend no time in public practice. Between 2014 and 2019, 84% of ophthalmologists remained in Modified Monash Model (MMM)1 and 79% in MMM2 – MMM7.¹¹ There was a trend for an increasing proportion of ophthalmologists to work outside major cities, from 19% in 2014 to 24% in 2019.¹¹ The majority (72%) of the Australian population lives in MM1 areas suggesting that the concentration of ophthalmologists in these areas does not match the population distribution.
- There has been a gradual decline in the number of hospitals in WA, which provide ophthalmology theatre services from 27 in 2011 to 23 in 2019.
- According to data extracted from the AIHW elective surgery activity reports, the number of cataract surgeries performed in public hospitals in Western Australia appears to have declined from 9595 in

2011 to 7539 in 2019 (**Error! Reference source not found.**). The three highest volume public hospitals in 2019 were the Bentley Health Service, Peel Health Campus, and Fremantle Hospital and Health Service reporting 2334, 1017, and 907 cataract surgeries, respectively (**Error! Reference source not found.**). The East Metropolitan Health Service was the busiest network, reporting 3308 cataract surgeries in 2019 (**Error! Reference source not found.**). There was a disparity between public hospital reported trends and the MBS item number trends. Possible issues may be data integrity in the reporting pipeline from the hospitals to AIHW, data storage issues, data analysis issues or could represent a shift from public to private procedures.

- The NEHS¹² reported cataract surgery coverage rates across Australia and the findings (based on self-reported surgery for cataract) indicated significantly higher rates in non-Indigenous (87.63%) participants than in Indigenous (61.47%) participants ($p < 0.001$).
- In WA (2017-2019) the met need for cataract surgery was estimated to be 76% in Ngaanyatjarra (NG) Lands, 57% in the Wheatbelt, 53% in the Kimberley region, 49% in the Goldfields, 44% in the Great Southern region and the Pilbara, 35% in the Mid-West, 29% in Perth, and 25% in the South-West.¹⁰
- Approximately 80% of cataract surgeries for Aboriginal and Torres Strait Islander people and 29% for non-Indigenous people are performed in public hospitals.
- Analysis of the AIHW elective surgery activity data suggests that median wait times for cataract surgery are increasing in Western Australia (**Error! Reference source not found.**). In 2011, the mean median wait time was 80 days, compared to 123 days in 2019. The large increase in average wait times between 2017 and 2019 appears to be driven by the increase in the WA Country Health Service (**Error! Reference source not found.**). In 2019, the three longest wait times were in Derby Hospital, Esperance Hospital, and Katanning Hospital of 328, 308, and 252 days. The longest metropolitan wait time was Joondalup Health Campus, 146 days. Osborne Park Hospital had the lowest wait time of 10 days.
- Wait times captured through AIHW data reflect the time from an addition to a public hospital waiting list to admission. They do not capture the time from the initial diagnosis by a general practitioner or optometrist and referral to an ophthalmologist referred to as the 'hidden waiting list' or the 'wait for the wait'. There is currently no publicly available WA data on this.
- As Indigenous Australians have higher rates of cataracts and predominantly have surgery in public hospitals, they are disproportionately affected by the long wait times.
- A recent RANZCO WA workforce report proposed the 'InReach ophthalmology network,' which combines accredited training posts with private practice as a pathway for Aboriginal and Torres Strait Islander patients to be directly waitlisted for procedures on the public hospital waitlist. The aim is to expedite wait listing of Aboriginal and Torres Strait Islander patients through building relationships with local Aboriginal health service providers and the private sector.
- In November 2021, an analysis of ophthalmologist advertisements on three platforms, including Healthengine, Healthdirect, and Myhealth1st was performed. One hundred and six (106) ophthalmologists had advertisements in Western Australia. The mean (range) number of private clinics listing each ophthalmologist was 2.1 (1-6). There were 72 private clinics advertised in Western Australia. The mean (range) number of ophthalmologists per clinic was 2.3 (1-18). The practices were located in 35 different WA postcodes. WA has 8.3 ophthalmology clinician-clinic instances per 100,000 capita.
- Lions Outback Vision (LOV) currently provides the only official teleophthalmology service in Western Australia, which has been in service since 2011. In 2021, 25% (n=1825) of all LOV ophthalmology appointments were conducted through telehealth. This has increased from 683 teleophthalmology teleconsultations in 2016. An on-call teleophthalmology service was introduced in 2016 to complement the online booking system. A clinical audit showed that the proportion of Indigenous patients in the on-call telehealth cohort was 51.4%, compared to 8.7% in the online-booking telehealth group ($p < 0.01$) representing a 10-fold increase in access for Aboriginal patients.
- There is a broad range of organisations in WA dedicated to disability support for people with low or no vision. Focus areas include advocacy, service providers, entertainment benefits and services, sport, and transport.

Issues and Recommendations

<p><i>Ophthalmology Patients in General Practice</i></p> <p>Details:</p> <ul style="list-style-type: none">• As primary care physicians, GPs are often the first point of contact with the health system for a patient with an eye disorder.• 1.9% of GP consultations in Australia are related to an eye disorder equating to approximately 315,239 services in WA in 2020.• Ophthalmic anti-infectives are amongst the most common medications prescribed, accounting for 0.8% of all prescriptions.• The epidemiology of eye diseases and standard of care is unknown for this patient cohort.• It is important that GPs are resourced appropriately, clinically supported, and have adequate training to ensure patient safety and high standards of care for this large patient volume.
<p>Recommendations:</p> <ol style="list-style-type: none">1) Consider projects that aim to further understand the demographic characteristics and disease epidemiology of this patient cohort.2) Consider projects that aim to understand the level of clinical support and training received by GPs in order to safeguard high standards of care for this patient cohort.
<p><i>The role of general practitioners in the eye health care workforce</i></p> <p>Details:</p> <ul style="list-style-type: none">• GP's are an integral component of the eye health care workforce and commonly refer to ophthalmologists.• Referrals account for 6.5% of all specialist referrals, which is disproportionately higher than the proportion of the specialist workforce (1%) represented by ophthalmology. There were an estimated 99,549 referrals to ophthalmology from GPs in 2020.• GPs are not often recognised as part of the eye health care workforce as is evident by their absence in key government and non-government reports.
<p>Recommendations:</p> <ol style="list-style-type: none">1) Consider projects that aim to further understand the referral patterns of GPs to ophthalmology, which may be useful from a resource planning perspective.
<p><i>Ophthalmic presentations to the emergency departments</i></p> <p>Details:</p> <ul style="list-style-type: none">• Emergency departments are overwhelmed.• In Australia, 65.5% of eye presentations were classified as semi-urgent or and non-urgent urgent and 92% of eye conditions were not admitted in 2019.• In 2019, 65% of eye presentations to a WA emergency department were classified as semi-urgent or non-urgent. This may represent cases, which could be redistributed to other primary health care avenues and reduce this burden.• The relatively modest size of this issue should be recognised; in 2019, 65.5% of low acuity eye presentations representing approximately 7166 cases or 0.8% of the 929,507 total presentations to the WA emergency departments.
<p>Recommendations:</p> <ol style="list-style-type: none">1) Consider projects that aim to address this problem through public health messaging to improve health-seeking behaviour.2) Consider projects that aim to optimize eye-care streams through emergency departments. For example, nurse practitioners specialising in ophthalmology may be well equipped to manage the bulk of these cases.
<p><i>Low proportion of Indigenous and non-Indigenous Australians adhering to guidelines for diabetic retinopathy screening.</i></p> <p>Details:</p> <ul style="list-style-type: none">• 50–77% of non-Indigenous Australians and 20–44% of Indigenous Australians receive appropriate retinal screening.¹⁷• The proportion of people screened decreases with increasing remoteness of locations.
<p>Recommendations:</p>

- 1) Consider projects that explore reducing the potential barriers, including patients' knowledge of the condition and the need for retinal screening, doctor-patient communications, travel, operating costs, infrastructure, and time constraints within general practice.³⁻⁵

Underutilisation of item numbers for diabetic retinopathy screening in primary healthcare.

Issue:

- In 2016, MBS item numbers 12325 and 12326 were introduced to support diabetic retinopathy retinal fundus photography screening in primary care.
- Between the financial years 2016 – 2021, the cumulative use of item numbers 12325 and 12326 nationally was 10,598. WA had the third highest total utilization and second highest per capita utilization.
- The cumulative 10,598 screening episodes over 5 years fell significantly short of the projected 400,000.
- A number of studies have assessed potential factors, which may have contributed to this significant underutilisation.^{5,6,8} These include costs of retinal cameras, time constraints, the need for dedicated staff to take the responsibility for DR screening, lack of skills to make a DR diagnosis, lack of awareness of Medicare incentives for non-mydratic retinal photography, optometrists being perceived as ideal for DR screening, and limited referral pathways.⁶⁻⁸

Recommendations:

- 2) Consider projects that focus on enabling strategies to deliver DR screening within primary care. This may include increasing GPs' access to continuing professional development to improve the GPs' competency in DR detection, awareness campaigns to maximise the use of MBS items, subsidising the cost of retinal cameras particularly for small or rural practices.
- 3) Consider supporting projects that look to outsource DR grading decision making to AI based technology.

Government and peak body future workforce policy for ophthalmology and optometry is based on limited self-reported data collected during AHPRA registration.

Issue:

- The National Health Workforce Dataset is created through a survey, which is completed by AHPRA-accredited health practitioners during annual registration.
- The survey contains questions, which assess the characteristics of the workforce and aim to predict trends such as vocation, retirement, and geographical location of work intentions.
- These data inform a number of key reports such as the Eye Health Workforce In Australia report²⁹ that informs the government and peak-body policy decisions around training and workforce distribution strategy.
- Data is self-reported and missing some granularity in the geographical distribution of the workforce. For example data is postcode-based and does not capture the often multiple places of work for one clinician.
- Greater detail may lead to better policy making.

Recommendations:

- 1) Consider expanding on the optometry and ophthalmology maps presented in this report as a data linkage project. Data could be obtained from the key advertising platforms directly and linked to AHPRA registration data. The key benefit is to have a more granular data set for policymaking. In addition, making the data publicly available may drive market forces to fill the gaps in service delivery.

Indigenous Australians have lower cataract surgery rates and coverage than non-Indigenous Australians

Issue:

- In 2018-19, age-standardised rates of cataract surgeries for Indigenous Australians (8,519 per 1,000,000) remained lower than those of non-Indigenous Australians (9,102 per 1,000,000).
- Cataract surgery coverage rates across Australia are significantly lower in Indigenous (61.47%) Australians compared to non-Indigenous (87.63%) Australians (p<0.001).¹²
- This suggests an ongoing gap in access to eye health care

Recommendations:

- 1) Consider projects that aim to increase awareness and access to timely cataract surgery for Indigenous Australians.

The rate and coverage of cataract surgery for Indigenous Australians is lowest in metropolitan areas.

Issue:

- Results from the AIHW data indicated that across Australia, around 6,100 Indigenous Australians (around 3,655 per 1,000,000) had cataract surgery between 2017 and 2019 with the rate being highest in remote and very remote areas and lowest in major cities.
- In WA, between 2017 and 2019 the met need for cataract surgery was estimated to be 76% in NG Lands, 57% in the Wheatbelt, 53% in the Kimberley region, 49% in the Goldfields, 44% in the Great Sothern region and the Pilbara, 35% in the Mid-West, 29% in Perth, and 25% in the South-West.¹⁰
- Indigenous Australians are more reliant on public hospitals for cataract surgery with approximately 80% of cataract surgeries for Aboriginal and Torres Strait Islander people and 29% for non-Indigenous people are performed in public hospitals.
- A recent report prepared for Vision2020²⁰ concluded that as Indigenous Australians have higher rates of cataracts and predominantly have surgery in public hospitals, they are disproportionately affected by the long wait times, which may be a contributing factor to lower surgery rates and coverage.
- The RANZCO InReach Ophthalmology network offers a pathway for Aboriginal and Torres Strait Islander patients to be wait listed for procedures directly on the public hospital wait list from private practices.

Recommendations:

- 1) Consider service delivery innovation projects, which aim to reduce barriers to access for cataract surgery for Indigenous Australians
- 2) Consider supporting projects such as RANZCO InReach.

Wait times for public cataract surgery are steadily increasing in Western Australia.

Issue:

- Analysis of the AIHW elective surgery activity data suggests that the median wait times for cataract surgery are increasing in Western Australia (**Error! Reference source not found.**).
- In 2011, the mean median wait time was 80 days, compared to 123 days in 2019.
- The large increase in average wait times between 2017 and 2019 appears to be driven by the increase in WA Country Health Service (**Error! Reference source not found.**).
- The longest metropolitan wait time was Joondalup Health Campus, 146 days.
- Volume-weighted wait time was slightly higher in regional sites compared to metropolitan sites for cataract procedures (153.3 vs 64.2 days, $P < 0.001$).

Recommendations:

- 1) Consider advocacy roles to call for increased government funding. Strategies may include increasing public awareness and raising the agenda priority in government.

True cataract surgery wait times are likely higher than reported due to 'the hidden waiting list'.

Issue:

- Wait times captured through the AIHW data do not capture the time from initial diagnosis by a general practitioner or optometrist and referral to an ophthalmologist. This waiting time from initial referral to a public hospital until first visit is referred to as the 'hidden waiting list' or the 'wait for the wait'.
- There are no data available for the 'hidden waiting list' in WA.
- There is some reporting of this figure nationally; however, it is inconsistent and ranges from a median wait time of 3 months in Victoria to 10-20 months in the 90th percentile in Queensland.
- Wait times for cataract surgery have negative health consequences and increased health care costs.²²
- This is an issue from a patient outcome, health, economic, and transparency perspective.

Recommendations:

- 1) Consider projects that aim to increase the transparency of wait lists, which include 'the wait for the wait.' For example, data in the form of publicly available dashboards using publicly available data.
- 2) Consider health systems and innovation projects, which target cataract wait lists. For example, collaborative care models between ophthalmology and optometry for rapid wait listing to reduce the 'wait for the wait'.

There were no eye health specific services available in Western Australia for Culturally and Linguistically Diverse Backgrounds.

- An online search did not reveal any eye health care services specific for people with CALD backgrounds in Western Australia.

- This may represent a gap, given there are services established for other areas, including cancer screening, chronic disease prevention, dental health, immunisation programs, mental health, newborn screening, sexual health, and women's health on the WA Health Multicultural Health Services Directory.
- The Victorian Eye Health promotion website Vision Initiative provides translated eye health resources in 10 languages other than English.

- 1) Consider projects that focus on service or resource development for eye health care in Western Australia for people with CALD backgrounds.

FUNDING

Section 4 – Funding

Executive Summary

- The funding of the Australian Health Care System is complex with multiple sources, directions of flow and ultimate destinations. The goal of this section of the report is to describe the structure of Australian and Western Australian eye health care sector funding.
- The publicly available data was limited in detail, which made it challenging to encompass a complete overview of WA eye health care funding. The overall economics of the Australian health care system has been emphasised and where available, WA eye-health data was extracted.
- Four key databases by the Australian Institute of Health and Welfare (AIHW) informed the majority of this report. The Australian National Health Account (ANHA) describes the national-level health systems funding, the Disease Expenditure in Australia database was used to determine the spending on eye health care specifically, the Philanthropic and Charitable Donations report describes the structure of philanthropic and charitable funding in Australia, and the Health and Medical Research report describes health and medical research funding in Australia.
- In 2019-20, Australia's estimated spending on health was \$202.5 billion. Total health expenditure in WA was \$21.4 billion.
- The average Australia-wide per capita spending in 2019-20 was \$7,926. Per capita spending for WA in 2019-20 was \$7,686.
- The government funds the vast majority (70.4%) of healthcare in Australia. During 2019-20, 42.7% (\$86.4 billion) of the total health spending was federal government funded, 27.7% (\$56.1 billion) was state government funded, and the remaining 29.6% (\$59.9 billion) by non-government sources.
- In 2018-19, the total Australian expenditure for vision disorders was \$3.47 billion. This comprised of spending on cataract (\$1,520M), other vision disorders (\$1,057M), age-related macular degeneration (\$470M), glaucoma (\$287M), and refractive errors (\$134M).
- Philanthropic and charitable donations are made in increasingly complex ways by individuals, through workplace schemes, businesses, and as structured giving.
- In 2018-19, 4.2 million Australian individuals claimed \$3.9 billion as tax deductions for donations, equating to an average of \$922 per person or 0.4% of their taxable income. The highest average donation came from Western Australia with an average donation of \$2,209, or 0.9% of taxable income.¹
- According to Giving Australia's 2016 survey data, Australian businesses gave \$17.5 billion: \$6.2 billion in donations, \$7.7 billion in community partnerships, and \$3.6 billion in non-commercial sponsorships. The education and research sector were the main beneficiaries, receiving 22% of all total business giving, followed by the culture and recreation (19%) and social service and health sectors (12%).
- A significant proportion of Australia's deductible giving occurs through structured giving via a formal structure such as a trust.
- Five of the top 50 philanthropists in 2019 were the Paul Ramsay Foundation, Judith Neilson Foundation, and charitable trusts, Minderoo Foundation, Yajilarra Trust, and Estate of Win Schubert donating a total of \$499.4 million.
- A number of programs initiated by the Federal and State Government have a specific focus on eye health for Aboriginal and Torres Strait Islander and rural populations.
- The National Trachoma Surveillance and Reporting Unit (NTSRU) is responsible for the ongoing data collection, analysis, and surveillance and reporting of trachoma in Australia. In WA, a \$4.95M grant was made to the Lions Eye Institute on 2 June 2020 and a \$660,000 grant to the Western Australian Centre for Rural and Remote Medicine (WACRRM) on 1 July 2019 for 'Ear and Eyes Trachoma'.
- The Visiting Optometrists Scheme (VOS) is a federally funded initiative to support optometrists to deliver outreach services to rural and remote Australia. Fund holders manage the delivery of services in different states. The fund holder for WA is Rural Health West. On 23 March 2020, the Department of Health approved a grant of \$36,020,307 for a further four years of funding from 2020-21 to 2023-24.
- The Rural Health Outreach Fund (RHOF) is a Federal Government-funded program, which supports the delivery of outreach health services for regional and remote Australians. On 25 May 2020, the Australian Government Department of Health committed \$116 million to the RHOF over four years from 2020-21 to 2023-24 (Grant number - GO3236).

- The 2016 National Eye Health Survey was the first national survey to determine the prevalence and major causes of vision impairment and blindness in Australia. The 2016-17 Vision2020 annual report showed a \$1,016,496 expense line for the National Eye Health Survey project.
- The Eye and Ear Surgical Support Program (ESSP) is a Federal Government-funded program, which aims to increase access to surgery for rural and remote Aboriginal and Torres Strait Islander patients. The funding supports the cost of travel and accommodation for the patient and carer to and from the surgery location. Rural Health West administers this service in WA. The Federal Government Department of Health made a \$1,615,435.8 grant (GO3247) to Rural Health West on 3 July 2020 to fund four years of the service from 2020-21 to 2023-24.
- Lions Outback Vision has established an ophthalmology clinic in Broome, Western Australia. The clinic is located in the former Kimberley Klub backpackers, which was donated by the Wen Foundation. The WA State Government has committed \$4.7M towards the clinic project.
- The Australian Institute of Health and Welfare reports on health and medical research and highlights the sources and amounts of funding for Australian research.² Health and medical research in Australia is funded by a number of organisations, including the Federal Government, state and territory governments, not-for-profit organisations, private business and individual philanthropic donations.
- Spending on health and medical research in Australia was \$5.6 billion in 2017-18. The Federal Government (\$4.4 billion) contributed the vast majority (79%) of that amount. State and territory governments spent \$827 million, and non-government sources accounted for \$404 million.
- In 2020-21, 536 new National Health and Medical Research Council (NHMRC) grants were given to a value of \$497.6 million. Balance, eye and hearing diseases received \$22.3 million in funding. Aboriginal and Torres Strait Islander Health received \$57.2 million in funding and 22 grants were given to WA entities to the value of \$36.2 million. There were no WA grants for eye-related conditions.
- In 2020, 543 Medical Research Future Fund (MRFF) grants to the value of \$597.9 million were given and 29 grants (\$84.0 million) were given to WA entities. There were no WA grants for eye-related conditions.
- To date, 22 companies have received funding through the biomedical translational fund. No WA companies received any funding from this fund.
- The CSIRO invested \$63 million on health research in 2020-21 (**Error! Reference source not found.**), which was 4.8% of their \$1.3 billion research budget.
- In 2017-18, the WA state government spent \$72.1 million on health and medical research. A comparison of all the states showed that Queensland spent the most (\$250 million) and Tasmania spent the least (\$6.4 million).

As of 1 Jan 2022, there were 683 charities or groups with ‘health and medical research’ listed as a program classification registered with the Australian Charities and Not-for-Profits Commission², with 50 of these located in WA.

Issues and Recommendations

<i>There is no publicly available database for eye health care funding in Australia</i>	
Details:	<ul style="list-style-type: none"> • The AIHW provides an excellent breakdown of health care expenditure in Australia through the Australian National Health Account, which was produced by compiling data from over 50 sources. • Error! Reference source not found. in the report provides a visual overview of the flow of funds through the healthcare system from source to area of expenditure; however, it was not possible to filter this database by disease sector. • Therefore, achieving a granular analysis of the eye health sector of the Australian health care system was not possible within the constraints of the publicly available data.
Recommendations:	<ol style="list-style-type: none"> 3) Consider projects, which create collaborations with the AIHW to develop an eye health care funding specific study. The output would be a high-level overview of the sector that would give national and state oversight of spending in eye health care from a source, flow, and destination perspective. 4) Consider projects, which utilise similar methodology to the AIHW reports to generate a funding overview of eye health in Australia.

EDUCATION

Section 5 – Education

Introduction

The Western Australian eye health care workforce education sector comprises a distributed network of organisations, each with different priorities, standards, funding, and incentives. Education of the workforce is driven by the peak bodies, which represent specialist eye health care providers at a national level. Although the Western Australian workforce can access these national resources, there are limited local education providers supporting the local workforce. This section of the report considers training and ongoing education as separate educational functions and considers specialist eye-care providers as discrete from generalist eye health care providers.

Issues and recommendations

<p><i>Limited formal training in ophthalmology exists for select specialist and generalist eye health care providers.</i></p>
<p>Details:</p> <ul style="list-style-type: none">• There is no local formal training available for orthoptists, ophthalmic nurses, ophthalmic theatre nurses, and ophthalmic nurse practitioners.• There is no local training for diabetic educators in ophthalmology.• The emergency physician curriculum standards contain ophthalmic outcomes; however, there is no ophthalmic CPD offered through the Australian Collage of Emergency Medicine (ACEM) e-learning platform.• The Australian Collage of Rural and Remote Medicine (ACRRM) have ophthalmic outcomes in their curriculum standards; however, there is no additional CPD offered.• There is a paucity of tailored education available for ophthalmic nurses in Western Australia.
<p>Recommendations:</p> <ul style="list-style-type: none">• Eyeballs Made Easy (EME) is a Western Australian based e-learning hub for medical students, doctors and health care workers, which aims to improve eye care through open access teaching from ophthalmologists. Collaboration opportunities may exist between the PEF and EME to address this issue.• The University of Western Australia Clinical and Training Evaluation Centre (CTEC) offers an opportunity to develop microsurgical skills courses in eye procedures, offered to specialist and generalist providers. There is currently a microsurgical skills course offered to theatre nurses; however, this is not ophthalmology specific.• Existing registered charities provide opportunities for collaboration on the creation of targeted educational content.• Opportunities exist for further collaboration between ophthalmology and education providers for other specialties.

HEALTH PROMOTION

Section 6 – Health Promotion

Executive Summary

- Health promotion refers to a core function of public health that focuses on disease prevention, that is the prevention of the root cause rather than treatment, so the population remains as healthy as possible for as long as possible.
- The burden of disease studies aim to quantify the total impact of living with a disease and dying prematurely in a society. They provide a summary measure of population health by combining mortality and morbidity data into a single number. These studies are important for planning preventative action.
- This report section aims to tell the story of eye-health promotion in Australia. Part 1 highlights the burden of eye disease in the context of the total burden. Part 2 focuses on avoidable vision loss and blindness, which are potential targets for eye-health promotion strategies. Part 3 describes the current eye-health promotion activities and organisations in Australia.

Part 1 – Burden of Disease:

- The Australian Institute of Health and Welfare 2018 Burden of Disease Study is Australia's largest burden of disease study. It calculates burden using the disability adjusted life year or DALY measure.
- In 2018, the total burden of disease in Australia was 5 million DALY, or 5 million healthy years of life lost, which is equivalent to 199 DALY per 1,000 population.
- Hearing and vision loss accounted for 109,241 DALY or 3.7 DALY per 1,000 population representing 2.2% of the total burden (DALY) (**Error! Reference source not found.**).
- The Australian population is getting healthier. The rate of burden fell 13% between 2003 and 2018, from 209 to 182 DALY per 1,000 population; however, burden for all vision disorders increased slightly between 2003 and 2018. Age related macular degeneration (AMD) increased by 2%, cataract and lens disorders increased by 2.5%, glaucoma increased by 0.4%, other vision disorders increased by 0.2% and refractive errors increased by 0.7%.
- Hearing/Vision disorders have 1.6x the burden in remote and very remote areas compared to major cities (**Error! Reference source not found.**), suggesting it is more affected by rurality than the national average for all diseases.
- Hearing/Vision loss had 1.4x the total burden in the lowest socioeconomic strata compared to the highest strata.
- In 2018, Western Australia had a total burden of 490,000 DALY's or 179 per 1,000 as an age standardised rate (**Error! Reference source not found.**). This was the 5th highest rate in the country, above that of Victoria, the ACT, and NSW.
- For all visual disorders except glaucoma, WA has the lowest or equal lowest age standardised rate for disease burden. The ACT had a lower rate for glaucoma (**Error! Reference source not found.**).

Part 2 – Avoidable Vision Loss and Blindness:

- Results from the National Eye Health Survey found that approximately 90% of vision impairment and blindness among both Indigenous and non-Indigenous Australians is preventable or treatable.
- The National Eye Health Survey reports that 57.4% of Indigenous and 51.93% of non-Indigenous participants with one of the five major causes of vision impairment were undiagnosed.
- Refractive error, cataract, age-related macular degeneration, diabetic retinopathy, and glaucoma are the top five conditions responsible for preventable or treatable vision impairment, of which half were undiagnosed in the National Eye Health Survey.

Part 3 – Health Promotion Activities:

- There are a number of organisations responsible for the design and delivery of health promotion activities at a state and national level. The Department of Health and WA Health govern health promotion at the highest level in Western Australia.
- Local organisations support health promotion in Western Australia, including the WA branch of the Australian Health Promotion Association, Healthway, WA health promoting schools, and the Public Health Advocacy association of Western Australia.

- There are limited publicly available data on current health promotion activities.
- WA eye health promotion-specific programs found include those targeting trachoma, diabetes, and smoking cessation.

Issues and Recommendations

<p><i>The National Burden of Vision Disorders is Increasing</i></p> <p>Details:</p> <ul style="list-style-type: none"> • The burden for all vision disorders increased slightly between 2003 and 2018. AMD increased by 2%, cataract and lens disorders increased by 2.5%, glaucoma increased by 0.4%, other vision disorders increased by 0.2% and refractive errors increased by 0.7%. • This is despite a significant reduction in the national fatal burden during the same time period. • This suggests that the overall health of Australians is improving; however, the eye health of Australians remains unchanged or slightly worse during this period. • Despite this, WA had a DALY rate of 3.2 for hearing/vision, which was the lowest in the country. <p>Recommendations:</p> <ol style="list-style-type: none"> 1) Consider projects that aim to increase broad awareness about eye health in Western Australia. The National Eye Health Awareness Campaign 2009 sets an example, which has not been repeated since.
<p><i>Avoidable Vision Loss and Blindness is Prevalent and Undiagnosed</i></p> <p>Details:</p> <ul style="list-style-type: none"> • 90% of vision impairment and blindness among both Indigenous and non-Indigenous Australians is preventable or treatable and approximately 50% of the causes of vision impairment are undiagnosed. • In the NEHS 30% of non-Indigenous, and 50% of Indigenous Australians with intermediate AMD had not accessed optometry or ophthalmology services within the past 12 months. Early diagnosis is important, as presenting VA is a strong predictor of the outcome for anti-VEGF treatment in neovascular AMD. • The NEHS reports that 52.87% of diabetic (self-reported) Indigenous participants adhered to the NHMRC diabetic eye examination guidelines (within the past 12 months) and 77.7% of non-Indigenous participants adhered to the screening guideline (within the past 2 years). • Results from the National Eye Health Survey found that 46.6% of the non-Indigenous population and 72.5% of the Indigenous population who had probable or definite glaucoma did not have a known history of the diagnosis. • In the NEHS, 50% of non-Indigenous and 56% of Indigenous participants with undiagnosed glaucoma had accessed optometry or ophthalmology services within the past 12 months. • This suggests that preventative eye health could reduce the burden of eye disease significantly and there is a large burden of silent, undiagnosed eye disease in the community. <p>Recommendations:</p> <ol style="list-style-type: none"> 1) Consider projects that have a focus on screening and identification of eye diseases, to reduce the burden of preventable vision loss and blindness and uncover undiagnosed eye disease.
<p><i>There is Limited Data About Eye Health Promotional Projects and There Appears to be Limited Focus on Eye Health Promotion in WA</i></p> <p>Details:</p> <ul style="list-style-type: none"> • There was limited publicly available information about eye health-promotion projects nationally or in Western Australia. • There is no centralised organisation, which coordinates eye health promotion in Western Australia. • According to the 2022-26 WA Health Promotion Strategic Framework, there appears to be no focus on preventative eye health in Western Australia. <p>Recommendations:</p> <ol style="list-style-type: none"> 1) Consider projects that increase the states focus on eye health promotion. Consider submitting feedback to the WA Health Promotion Strategic Framework calling for a greater focus. 2) 'Vision Initiative' is a Victorian Government and Vision2020 collaboration, which was established in 2002 as an integrated eye health promotion program. Consider collaboration or consultation from the program leaders to help develop a WA-based eye health-promotion program. https://www.visioninitiative.org.au/

RESEARCH

Section 7 – Research

Executive Summary

- This report section explores the current ophthalmic research activity in Western Australia.
- A literature search was performed on the Scopus database to identify ophthalmic research published by Western Australian researchers within Western Australian institutions between 2011 and 2021.
- There were 974 papers identified with contributions from 6621 individual researchers.
- A total of 8375 institutions were affiliated with identified publications, including Western Australian, national, and international institutions.
- There were 220 Western Australian institutions affiliated with identified publications.
- One collaboration event is considered between each institution that is listed on the same publication. The average number of collaborations per publication was 745.78.
- There may be multiple institutions from Western Australia collaborating with multiple national or international institutions, hence the large number of collaborations.
- The biggest collaboration (538 collaborations) within Western Australia was between the Lions Eye Institute and the Centre for Ophthalmology and Visual Sciences at the University of Western Australia with. Within Australia, Western Australian institutions had maximum collaborations with Victorian institutions (652) and internationally, the most collaborations were with institutions in the United States (1533).

Issues and Recommendations

<i>High research output from few authors and institutions.</i>
<ul style="list-style-type: none">• The majority of research output in Western Australia is generated by the top institutions and researchers.• Sixty-seven (67) % of publications were authored by the top 5 researchers (0.076% of researchers).• Sixty -six (66) % of publications were affiliated with the top institution (The Lions Eye Institute).• There is a long tail of 220 Western Australian research institutions which were affiliated with the research.• This suggests that there are many researchers and institutions producing once off or small volumes of work.
<ul style="list-style-type: none">• Consider identifying and funding smaller researchers in order to diversify the scope of ophthalmic literature produced in Western Australia.

DEMOGRAPHICS
& EYE HEALTH

1 Demographics and Eye Health

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1.4 Executive Summary

- Key characteristics of the WA population and an epidemiological overview of WA eye health is presented in this report section.
- The population of WA in 2020 was estimated to be 2,663,561, representing 10.4% of the Australian population. The vast majority (79.8%) live in or near Perth.

Vulnerable populations:

- Demographic features of community segments which may be considered vulnerable from a health outcomes perspective were explored. These included Aboriginal and Torres Strait Islander peoples, lower socioeconomic groups, lower educational attainment groups, regional and remote populations, various cultural and language groups, the aging population and persons with disabilities.
- 75,978 or 11.7% of the Aboriginal Torres Strait Islander population reside in Western Australia with the highest living in Perth (38.3%). There are 2522 registered Indigenous communities in Western Australia.
- The lower a person's socioeconomic status, the greater the risk of poor health, illness, disability, and lower life expectancy. Forty-eight per cent of Aboriginal Torres Strait Islanders live in the bottom fifth most disadvantaged areas in Australia compared to 18 per cent of non-Indigenous people and only 5.4 per cent of Aboriginal and/or Torres Strait Islander peoples live in areas of high relative advantage compared with 22 per cent of non-Indigenous people. Outer metropolitan Perth and regional Western Australia has the greatest disadvantage.
- Adults with higher educational attainment living longer and healthier lives compared to less-educated adults. 67.3% of people in Western Australia had a non-school qualification or were studying one. Aboriginal and Torres Strait Islander peoples in Western Australia have worse educational attainment than the non-Indigenous people; however, the rates are improving. The proportion of Aboriginal and Torres Strait Islander peoples aged 20-24 years, completing year 12 or its equivalent increased from 29% to 40.6% from 2011 – 2016, compared to an increase from 70.8% to 76.4% for non-Indigenous people.
- Living in rural and remote areas can create unique challenges relating to geographical locations resulting in poorer health outcomes. Approximately 79% of the WA population lives in greater Perth, the rest living in regional or remote Western Australia.
- Language differences can create barriers to accessing health care. In Western Australia, 60.3% of people were born in Australia, 3.1% of the population is made up of Aboriginal and Torres Strait Islanders. The majority of people who speak a language other than English at home were proficient in English (86%) while 14% had low proficiency or did not speak English at all.
- The Australian population is ageing due to low fertility and increasing life expectancy. The median age of the Australian population has increased from 35 to 38 years between 2000 and 2020. The median age of the WA population increased from 34.6 to 37.5 years in this period (Figure 7).
- In WA, the overall prevalence of disability was estimated to be 16.4% in 2018. The rates increased with older age, being 4.3% in children aged 0- 14 years, 2.6% in people aged 15-64 years, and 14.5% in adults aged 65 years and older. Diseases of the eye and adnexa account for 0.3% and 3.1% of disability in the 65-74 year group and 75 years and older age groups, respectively.

Eye examinations:

- Population level eye examination rate can provide insights into access to eye health care. In 2019-2020, 12% of Indigenous Australians (n = 104,300) had an eye examination, compared to 23.5% for non-Indigenous Australians. Across Australia, the examination rates decreased with greater remoteness and were the lowest in the very remote areas. The rates of eye examinations for Indigenous people in WA and the NT were lower than those in other states and territories (8.2%). These results show an increase in the age-standardised examination rate for Indigenous people from 14% in 2007-2008 to 17% in 2019-2020 and an increase from 19% to 24% for non-Indigenous people.

Vision impairment and blindness:

- The prevalence of eye conditions increases with older age, and affected 93% of people aged 65 years and older, in comparison to 12% of children aged 0-14 years. According to the National Eye Health Survey, refractive error was the main cause of vision impairment for both Indigenous and non-

Indigenous Australians (63.39% and 61.69%, respectively). The second leading cause was cataract with a rate of 20.22% in Indigenous Australians and 13.93% in non-Indigenous Australians. The overall age-adjusted prevalence of blindness was 0.36% in Indigenous Australians and 0.12% in non-Indigenous Australians representing a 3-fold increase in Indigenous people. The primary cause of bilateral blindness in non-Indigenous participants was age-related macular degeneration (AMD, 71.42%), while cataracts were the main cause of blindness in Indigenous participants (40%).

Hospitalisations:

- Overall, more non-Indigenous Australians are hospitalised for eye diseases than Indigenous Australians. The age-standardised hospitalisation rate for non-Indigenous people was 14.8 per 1,000 compared to 12.2 per 1,000 for Indigenous Australians. More Indigenous Australians however, are hospitalised with an eye injury than non-Indigenous Australians.

Children:

- The Australian Childhood Vision Impairment Register (ACVIR) was established in Australia in 2008 to report on children diagnosed with permanent visual impairment. More male (57%) than female (43%) children were registered, and the most common primary diagnoses were retinal dystrophy (17%), cortical/cerebral VI (CVI, 15%), and albinism (11%). Families reported that 68% of children received low-vision support by a non-government agency at the time of registration, with 54% reporting the support had commenced prior to the child's first birthday. By comparison, 24% of families reported their child received no such support.
- 747 children were treated for an eye or adnexal injury between 2002 and 2015, including 708 (94.8%) accidental eye injuries and 39 (5.2%) considered highly suspicious for non-accidental or intentional eye injuries. This represents an estimated overall prevalence of 0.17% of eye injuries in children across WA in 2015.
- There is an increasing incidence of early onset type 2 diabetes in Western Australian children with a disproportionate burden on Aboriginal and Torres Strait Islander children. The mean incidence for Aboriginal and Torres Strait Islander children was 18-fold higher than in non-Indigenous children and the incidence increased by an average of 6.2% (95% CI 2.8 – 9.6) per annum in the Aboriginal and Torres Strait Islander children compared 3.9% (95% CI 0.3 – 7.6%) in non-Indigenous children.

Other eye diseases:

- Trachoma and trichiasis - the overall prevalence of active trachoma in children aged 5-9 years was 4.5%, with 0% in SA, 5.2% in the NT, 7.4% in Qld, and 6.4% in WA in 2019. The overall prevalence of active trachoma in children aged 5-9 years varied considerably across regions of WA, ranging from 3.7% in the Pilbara, 4.7% in the Kimberley region, 7.5% in the Midwest, and 12.3% in the Goldfields.
- Myopia - The prevalence of myopia in Western Australia is between 19.6% - 29.9% (n=226) and the prevalence of high myopia between 1.3% - 3.9%.
- Keratoconus – The prevalence rate of keratoconus in Western Australia was found to be 1.2% (95% CI 0.7% – 1.9%), or 1 in 84, one of the highest prevalences reported in the world.
- Amblyopia, strabismus and anisometropia – The Western Australian prevalence of amblyopia was found to be 1.1%, strabismus was 3.5%, and anisometropia was 2.9%.
- Pterygium – The prevalence of pterygium in Western Australia is between 1.2% - 14.1%.
- Ocular Tuberculosis – The 10 year incidence of ocular tuberculosis in Western Australia is estimated to be 1.28 per 100,000 people. The highest incidence was found in males aged 30-39 years and no Indigenous Australians had been diagnosed with ocular tuberculosis.

1.5 Introduction

This section of the report presents selected key characteristics of the WA population and a broad epidemiological overview of WA eye health. The aim is to understand the population served by the WA eye health care sector, the burden of disease, and the most affected and at risk populations.

1.6 Data Sources

1.6.1 Australian Bureau of Statistics 2016 Census

The main data source was the 2016 Census conducted by the Australian Bureau of Statistics (ABS), although some figures (e.g. overall population counts) are more recent.

1.6.2 Regional Insights for Indigenous Communities

Regional Insights for Indigenous Communities is a website created by the Australian Institute of Health and Welfare, it provides detailed information about the Aboriginal Torres Strait Islander population at a community level.

1.6.3 Australian Bureau of Statistics 2018 Survey of Disability

The disability data reported in this survey paper is sourced from the ABS 2018 Survey of Disability, Ageing and Carers, conducted between July 2018 and March 2019. The survey used a stratified multi-stage methodology to select a random sample of Australians with a disability that would be nationally representative. The final sample included responses from 65,805 people including 54,142 living in private households (including retirement villages) and 11,663 people living in cared-accommodation. Data were collected via trained face-to-face interviewers. The ABS defined Disability as ‘any limitation, restriction or impairment, which restricts everyday activities and has lasted, or is likely to last for at least six months.’

1.6.4 The National Eye Health Survey (NEHS)¹ 2015-2016

National Eye Health Survey (NEHS)¹ is an Australia-wide study of the prevalence and incidence of the number of eye conditions across all regions of Australia. It included a nationally representative sample of Indigenous and non-Indigenous Australians from metropolitan, regional, remote, and very remote areas of Australia; data were collected in 2015-2016. Recruitment and assessments were conducted between 2015 and 2016 in a nationally representative sample of Indigenous Australians 40 years or older and non-Indigenous Australians 50 years or older. The NEHS was conducted by investigators at the Centre for Eye Research Australia (CERA) in partnership with Vision 2020 Australia.

1.6.5 The National Health Survey (NHS)² 2017-2018

The National Health Survey was conducted by the ABS in 2017-2018 and included 21,315 Australians in 16,400 randomly selected private dwellings across Australia (other dwelling types were excluded). The survey included urban and rural areas in all Australian state and territories, while very remote areas and discrete Aboriginal and Torres Strait Islander communities were excluded. The sample included 2,168 West Australians or 10.2% of the total. Data were collected by trained interviewers and the data collected in relation to eye conditions is self-reported.

1.6.6 The National Aboriginal and Torres Strait Islander Health Survey (NATSIHS)³ 2018-19

The National Aboriginal and Torres Strait Islander Health Survey (NATSIHS) 2018-19 conducted by the ABS collected a range of data on lifestyle factors and health conditions in a representative sample of Aboriginal and Torres Strait Islander peoples in 2018-2019 across all regions of Australia, including the remote areas. Overall, the sample included 10,579 Aboriginal and Torres Strait Islander peoples of all ages across Australia; of those 1,564 were from WA, representing 14.8% of the total sample.

1.6.7 The Australian Trachoma Surveillance Report 2017⁴

Australia trachoma surveillance is undertaken by the National Trachoma Surveillance and Reporting Unit (NTSRU), who are responsible for collecting and reporting data in relation to the efforts to control trachoma. Key findings from the 2017 report are included in this section.

1.7 Demographics

1.7.1 Population

In 2020, the total population of Australia was estimated to be 25,697,298. Of that number, 2,663,561 (10.4%) were reported to live in WA, with the vast majority (79.8%) living in or near Perth.⁵

Table 1. Selected demographic characteristics for Western Australia and its regions (Part 1)

	Western Australia - Overall	GREATER PERTH (Greater Capital City Statistical Area)^{##}	BUNBURY (SLA^{§4})
Characteristic	Number (%)		
Total population (2020)	2,663,561	2,125,114	186,068
Male (%)	50%	49.6%	49.4%
Female (%)	50%	50.4%	50.6%
Average age (Median) (2019)	37.2 years	36.7 years	41.3 years
0 – 14 years (%)	19.3%	19.1%	20.3%
65 years and older (%)	14.0%	13.8%	17.2%
Number (%) of people born in Australia	1,492,842 (60.3%)	1,113,277 (57.3%)	128,590 (72.9%)
Number of Families	644,189	515,328	46,950
Average number of children per family (in families that have children)	1.9	1.8	1.9
Median employee income (2018)	\$53,956	\$55,007	\$46,328
Median weekly household income	\$1,595	\$1,643	\$1,319
Median monthly mortgage repayments	\$1,993	\$2,000	\$1,733
Aboriginal and Torres Strait Islander peoples			
Number (%)	75,978, (3.1%)	31,214 (1.6%)	4,129 (2.3%)
Male (%)	50%	50.3%	49.3%
Female (%)			
Median Age (years)	23 years	22 years	21 years
Employment Status			
Full-time work	715,287 (57%)	565,148 (56.4%)	44,202 (52.9%)
Part-time work	376,590 (30.0%)	306,272 (30.6%)	28,071 (33.6%)
Away from work	65,859 (5.2%)	48,775 (4.9%)	5,390 (6.5%)
Unemployed	97,966 (7.8%)	81,482 (8.1%)	5,842 (7.0%)
Disability (2018)³			
Number of people with a disability	389,634 (16.4)	314,326 (15.4)	31,736 (17.5)

#Data Sources: ABS 2016 Census^{5,6}; 2020 population counts and 2018 median income are updated with information provided by the Australian Taxation Office; ##Greater Perth is one of 8 Greater Capital City Statistical Areas (GCCSA) in Australia (there is one for each major city in each state/ Territory) and comprises 6 Statistical Area Level (SLA) 4s – Inner Perth, North-East Perth, North-West Perth, South-East Perth, South-West Perth and Mandurah. GCCSA's are designed to represent the functional extent of each major city, and it seemed appropriate to present the data for these SLA4s together (i.e. as Greater Perth) rather than separately.
§SLA4 – Statistical Area Level 4.

Table 2. Selected demographic characteristics for Western Australia and its regions (Part 2)

Characteristic	OUTBACK - NORTH (SLA4)	OUTBACK – SOUTH (SLA4)	WHEATBELT (SLA4)
	Number (%)		
Total population (2020)	98,864	116,006	137,509
% Male (%)	56.8%	51.8%	51%
% Female (%)	43.2%	48.2%	49%
Average age (Median) (2019)	34 years	38.1 years	44.9 years
0 – 14 years (%)	21.8%	20.7%	18.7%
65 years and older (%)	3.9%	13.0%	20.0%
Number of people born in Australia	63,410 (67.5%)	85,264 (71.9%)	98,589 (72.8%)
Number of Families	18,186	28,713	35,016
Average number of children per family (in families that have children)	2.0	1.9	1.9
Median employee income (2018)	\$62,837	\$52,546	\$43,673
Median weekly household income	\$2,202	\$1,487	\$1,192
Median monthly mortgage repayments	\$2,443	\$1,722	\$1,400
Aboriginal and Torres Strait Islander peoples (ATSI)			
Number (%)	22,609 (24.1%)	11,862 (10.0%)	5,565 (4.1%)
ATSI Male (%)	49.7%	49.0%	51.8%
ATSI Female (%)			
ATSI Median Age (years)	25 years	24 years	24 years
Employment Status			
Full-time work	34,164 (70.7%)	34,817 (60.9%)	35,512 (56.8%)
Part-time work	7,832 (16.2%)	14,587 (25.5%)	19,375 (31.0%)
Away from work	3,543 (7.3%)	3,769 (6.6%)	4,168 (6.7%)
Unemployed	2,792 (5.8%)	3,984 (7.0%)	3,412 (5.5%)
Disability (2018)³			
Number of people with a disability	4,343 (9.6)	8,286 (16.5)	26,234 (19.4)

1.8 Vulnerable Community Segments

1.8.1 Aboriginal and Torres Strait Islander Population

According to the 2016 ABS Census there were 649,171 Aboriginal and Torres Strait Islander peoples in Australia, representing 2.8% of the population. This included 75,978 or 11.7% of the Aboriginal Torres Strait Islander population residing in Western Australia (Table 3) representing 3.1% of the population. In 2016, 38.3% of Western Australia's Aboriginal and Torres Strait Islander population lived in the Perth, 15.5% lived in South Western Australia, and 11.0% lived in South Hedland. In the West Kimberley, 64.4% of people identified as being of Aboriginal and/or Torres Strait Islander origin, while the corresponding proportion was 45.7% in the Kununurra region (Table 4). In WA, there are 2522 Indigenous communities registered on the Australian Institute of Health and Welfare Indigenous Communities website. Figure 1 shows the locations of the communities on a screenshot of an interactive map.

Table 3. Aboriginal and Torres Strait Islander peoples by state and territory (2016). Source: ABS 2016.

Aboriginal and Torres Strait Islander people			
	No.	%	(as a proportion of state/territory)
			%
NSW	216 176	33.3	2.9
Vic.	47 788	7.4	0.8
Qld	186 482	28.7	4.0
SA	34 184	5.3	2.0
WA	75 978	11.7	3.1
Tas.	23 572	3.6	4.6
NT	58 248	9.0	25.5
ACT	6 508	1.0	1.6
Australia	649 171	100.0	2.8

Table 4. Aboriginal and Torres Strait Islander people by Indigenous regions (2016). Source: ABS 2016.

	No.	%	(as a proportion of Indigenous Region)
			%
Broome	4 571	6.0	28.2
Geraldton	6 169	8.1	10.3
Kalgoorlie	5 631	7.4	10.1
Kununurra	4 761	6.3	45.7
Perth	29 118	38.3	1.6
South Hedland	8 365	11.0	13.4
South-Western WA	11 795	15.5	2.9
West Kimberley	4 959	6.5	64.4
Western Australia	75 978	100.0	3.1

Figure 1. Screenshot of the interactive map available on the Australian Institute of Health and Welfare Indigenous Communities website.



1.8.2 Socioeconomic Groups

The lower a person’s socioeconomic status, the greater the risk of poor health, illness, disability, and lower life expectancy,⁷ a phenomenon often termed the ‘social gradient of health’. Socioeconomic position can be measured by individual factors, including income, education or occupation, or using a composite measure such as the Index of Relative Socio-Economic Disadvantage (IRSD). As a tool, the IRSD summarises a range of information about the economic and social conditions of people and households within a specific area. It is useful as a broad measure to look for areas of disadvantage. There is clear evidence of a gradient of health running between low and high socioeconomic positions. The ABS uses the IRSD to stratify populations into the lowest and highest socioeconomic groups and measures health outcomes across them. In a snapshot publication using the ABS 2016 data, they found that the lowest socioeconomic group fared worse in almost all measures of health.

Some key differences from the ABS 2016 census between the lowest and highest socioeconomic groups in Australia:

- Those in the lowest socioeconomic group were 3x as likely to smoke daily in the ≥ 14 years age group than those in the highest socioeconomic group.
- In the lowest socioeconomic group, the prevalence of diabetes (2.6x), coronary artery disease (2.2x), and lung cancer (1.6x) was higher than in the highest socioeconomic group.
- Adults from the lowest socioeconomic group were more likely to rate their oral health as ‘fair or poor’ compared to those from the highest socioeconomic group (31% vs 12%).
- Mortality from all health causes was 29% higher in the lowest socioeconomic group compared to the highest socioeconomic group.

Aboriginal and/or Torres Strait Islander peoples are more likely to live in the most disadvantaged areas. Forty-eight per cent live in the bottom fifth most disadvantaged areas in Australia compared to 18 per cent of non-Indigenous people and only 5.4 per cent of Aboriginal and/or Torres Strait Islander peoples live in areas of high relative advantage compared with 22 per cent of non-Indigenous people.

The Socio-Economic Indexes for Areas (SEIFA) product by the ABS ranks areas in Australia according to relative socioeconomic advantage or disadvantage. The tool uses four index measures of socioeconomic position, including the IRSD. The 10 most disadvantaged and advantaged areas in Australia are shown in Table 5 and Table 6. Screenshots of the interactive map tool in Figure 2 visually demonstrate the relative areas of disadvantage. Outer metropolitan Perth and regional areas appear to have larger pockets of disadvantage.

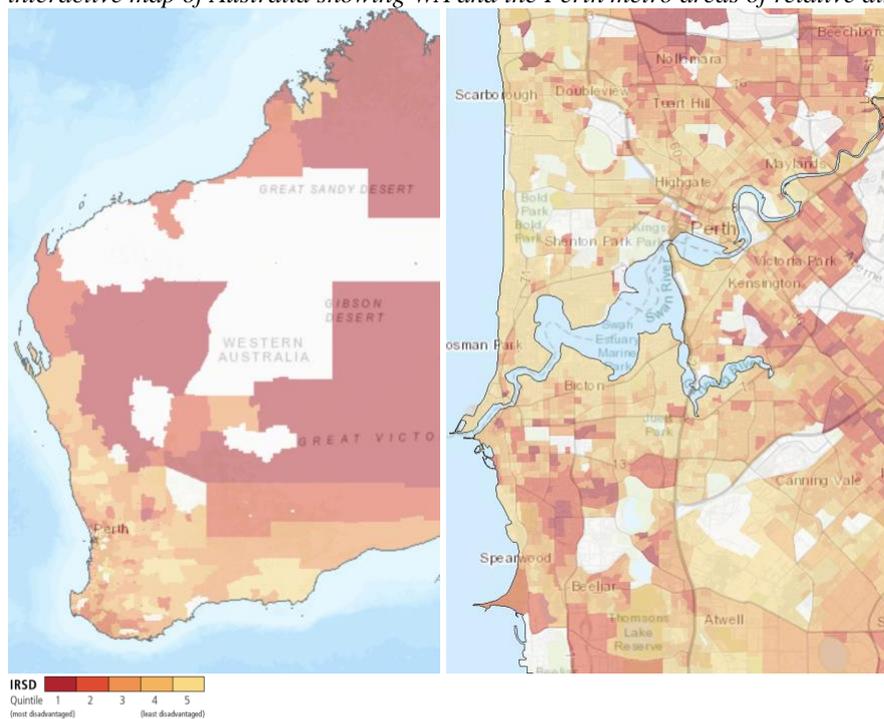
Table 5. The ten most advantaged areas in Australia. Source: ABS 2016 Socio-Economic Indexes for Areas.

Rank	Local Government Area	Usual Resident Population
1	Ku-ring-gai (NSW)	118,053
2	Mosman (NSW)	28,475
3	Woollahra (NSW)	54,240
4	Cottesloe (WA)	7,597
5	Peppermint Grove (WA)	1,636
6	Nedlands (WA)	21,121
7	North Sydney (NSW)	67,658
8	Lane Cove (NSW)	36,051
9	Cambridge (WA)	26,783
10	Hunters Hill (NSW)	13,999

Table 6. The ten most disadvantaged areas in Australia. Source: ABS 2016 Socio-Economic Indexes for Areas.

Rank	Local Government Area	Usual Resident Population
1	Cherbourg (Qld)	1,269
2	West Daly (NT)	3,166
3	Belyuen (NT)	164
4	Woorabinda (Qld)	962
5	Central Desert (NT)	3,677
6	Aurukun (Qld)	1,269
7	Yarrabah (Qld)	2,559
8	Doomadgee (Qld)	1,405
9	Napranum (Qld)	957
10	Palm Island (Qld)	2,446

Figure 2. Screenshots of the Australian Bureau of Statistics Index of Relative Socio-Economic Disadvantage interactive map of Australia showing WA and the Perth metro areas of relative disadvantage.



1.8.3 Educational Attainment

Education is an important social determinant of health and adults with higher educational attainment living longer and healthier lives compared to less-educated adults,⁸ yet the relationship between the two is complex.⁹ A number of mediator variables between education and health have been proposed in the literature. Income and occupation as a result of higher education mediate access to acute and preventative medical care,^{10,11} social, psychological and interpersonal resources allow people with higher education to access coping resources and strategies,¹² social support and problem solving abilities to handle ill health and stress,¹³ and higher education informs healthy behaviours and appropriate health-seeking behaviours.¹⁴

Key statistics from the May 2021 release of the ABS Education and Work data:¹⁵

- Of the Australians aged 15-74 years, 59% were fully engaged in work, study or both. This represents a return to 2019 levels, after decreasing to 57% in May 2020.
- 68% had or were studying a non-school qualification.
- 78% with a non-school qualification were employed, compared to 56% without a non-school qualification.
- Engagement with work or study decreases with age. Sixty-nine percent of people (25-44 years) were fully engaged compared to 43% of people aged 45-74 years.
- 67.3% of people in Western Australia had a non-school qualification or were studying one (Figure 3).

Of the people aged 15 years and over in Western Australia, 16.0% reported having completed Year 12 as their highest level of educational attainment, 17.1% had completed a Certificate III or IV, and 8.9% had completed an Advanced Diploma or Diploma.

The ABS uses the Index of Education and Occupation (IEO) to reflect the educational status and occupational levels of communities. The education variables take into account the level of the qualification achieved or being undertaken. The occupation variables classify the workforce into skill levels according to a standardised classification. The index does not include income variables.¹⁶ An interactive map is available from the ABS and it shows the IEO by geographical area.¹⁷ Figure 4 shows screenshots of this map, demonstrating areas of educational and employment disadvantage, especially in outer metropolitan and regional Western Australia. Aboriginal and Torres Strait Islander peoples in Western Australia have worse educational attainment than the non-Indigenous people; however, the rates are improving. The proportion of Aboriginal and Torres Strait Islander peoples aged 20-24 years, completing year 12 or its equivalent increased from 29% to 40.6% from 2011 – 2016, compared to an increase from 70.8% to 76.4% for non-Indigenous people.¹⁸ Aboriginal and Torres

Strait Islander peoples aged 25 – 64 years were more likely to have left school at year 9 or earlier compared to non-Indigenous people (15% vs 4.7%).

Figure 3. People with or studying towards a non-school qualification, by state/territory (2021). Source: ABS.

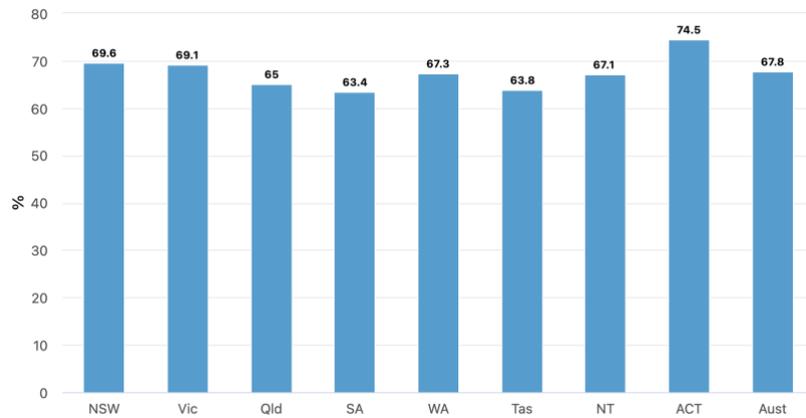
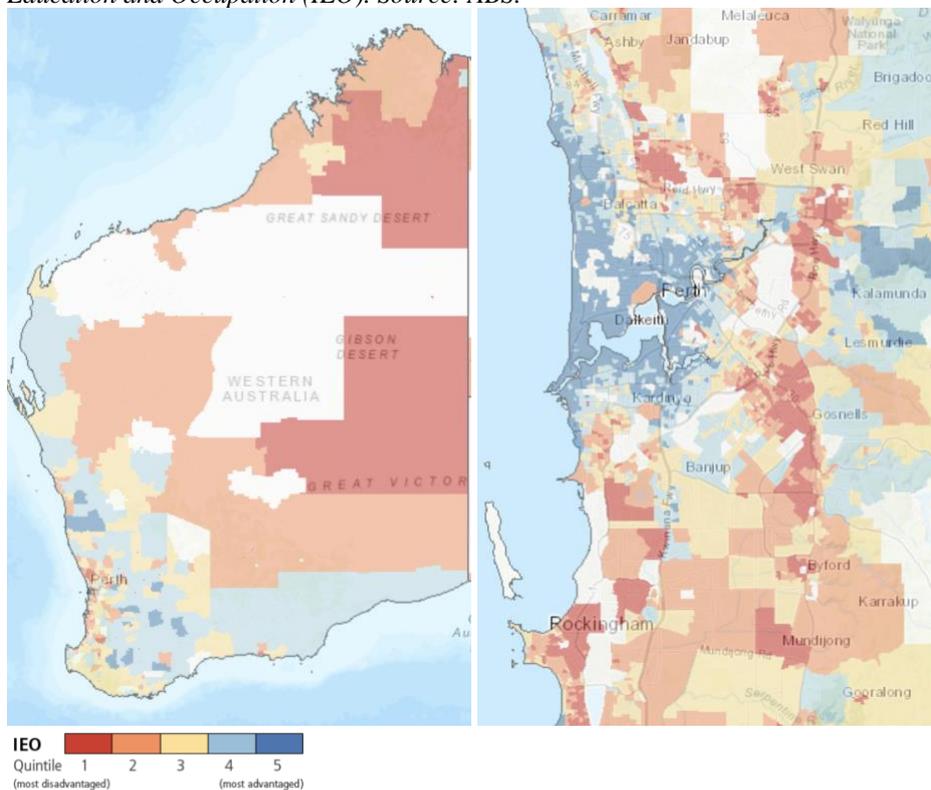


Figure 4. Screenshots of an interactive map representing the geographical distribution of the Index of Education and Occupation (IEO). Source: ABS.



1.8.4 Geographical Location

Living in rural and remote areas can create unique challenges relating to geographical locations resulting in poorer health outcomes. In Australia, people living in rural and remote areas have higher rates of hospitalisations, deaths, injury, and poorer access to primary health care services than those living in major cities.¹⁹

According to the 2016 ABS Census data, approximately 79% of the WA population lives in greater Perth.

Figure 5 shows the population density centred around Perth, Western Australia. Figure 6 shows regional population change for Western Australia. The total population and growth is greater in the capitals compared to regional Australia. In the 2019-20 period, people living in the capitals increased by 245,000 (1.4%) and regional

Australia grew by 86,200 (1.1%). In Western Australia, people living in greater Perth increased by 37,600 (1.8%) and those living in the rest of the state increased by 2,700 (0.5%).

Figure 5. Population grid 2019-20 showing population density in Western Australia. Source: ABS Population Grid screenshots²⁰



Figure 6. Regional population 2019-20: population change. Source ABS screenshots.²¹



1.8.5 Cultural and Language Groups

In Western Australia, 60.3% of people were born in Australia, 3.1% of the population is made up of Aboriginal and Torres Strait Islanders. The most common countries of birth outside Australia were England (7.8%), New

Zealand (3.2%), India (2.0%), South Africa (1.7%), and the Philippines (1.2%). Most people (75.2%) spoke only English at home, although other languages spoken at home included Mandarin 1.9%, Italian 1.2%, Vietnamese 0.8%, Cantonese 0.8%, and Tagalog 0.6%, while 10,103 (13.3%) spoke an Australian Indigenous language at home. The three most common languages were Kriol (23.4%), Ngaanyatjarra (10.7%), and Martu Wangka (7.0%). The majority of people who speak a language other than English at home were proficient in English (86%) while 14% had low proficiency or did not speak English at all.

1.8.6 Aging Population

Like most developed countries, the Australian population is ageing due to low fertility and increasing life expectancy. The median age of the Australian population has increased from 35 to 38 years between 2000 and 2020. The median age of the WA population increased from 34.6 to 37.5 years in this period (Figure 7).²² The proportion of Australians aged 65 years and over has increased from 12.4% to 16.3% in this time period, with projections of an increased rate as the ‘baby boomers’ (born between 1946 and 1964) reach the age of 65 years (Figure 8). The ABS has produced an interactive map showing the number of residents aged 60 years and over per geographical area, which demonstrates a focus around metropolitan Perth (Figure 9).²³

Figure 7. Median age of the Australian population, by state. Source ABS.

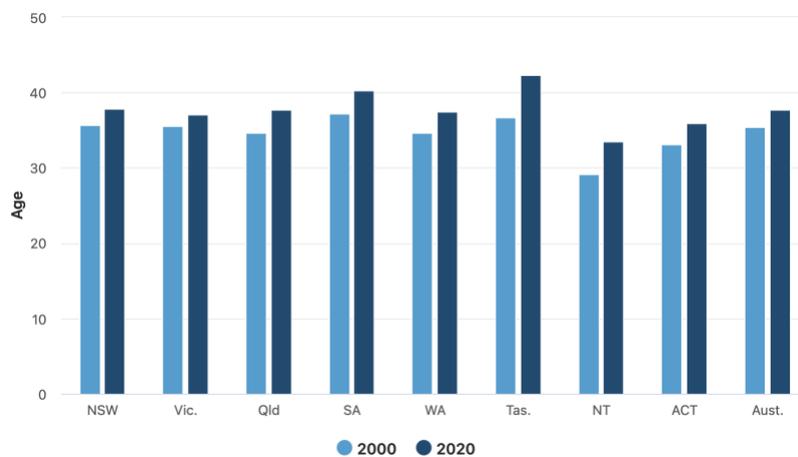


Figure 8. Proportion of Australians aged 65-84 years and 85 years and older. Source ABS.

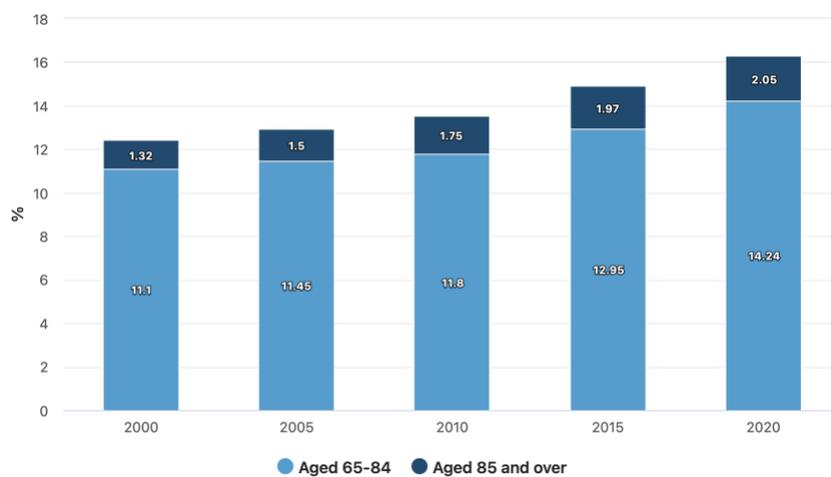


Figure 9. Age distribution by geographical area in Western Australia. Source screenshots taken from ABS.²³



1.8.7 Persons with Disabilities

The disability data reported in this paper was sourced from the ABS 2018 Survey of Disability, Ageing and Carers, conducted between July 2018 and March 2019.²⁴ The survey used a stratified multi-stage methodology to select a random sample of Australians with a disability that would be nationally representative. The final sample included responses from 65,805 people, including 54,142 living in private households (including retirement villages) and 11,663 people living in cared-accommodation. Data were collected via face-to-face trained interviewers. The ABS defined Disability as ‘any limitation, restriction or impairment which restricts everyday activities and has lasted, or is likely to last for at least six months.’

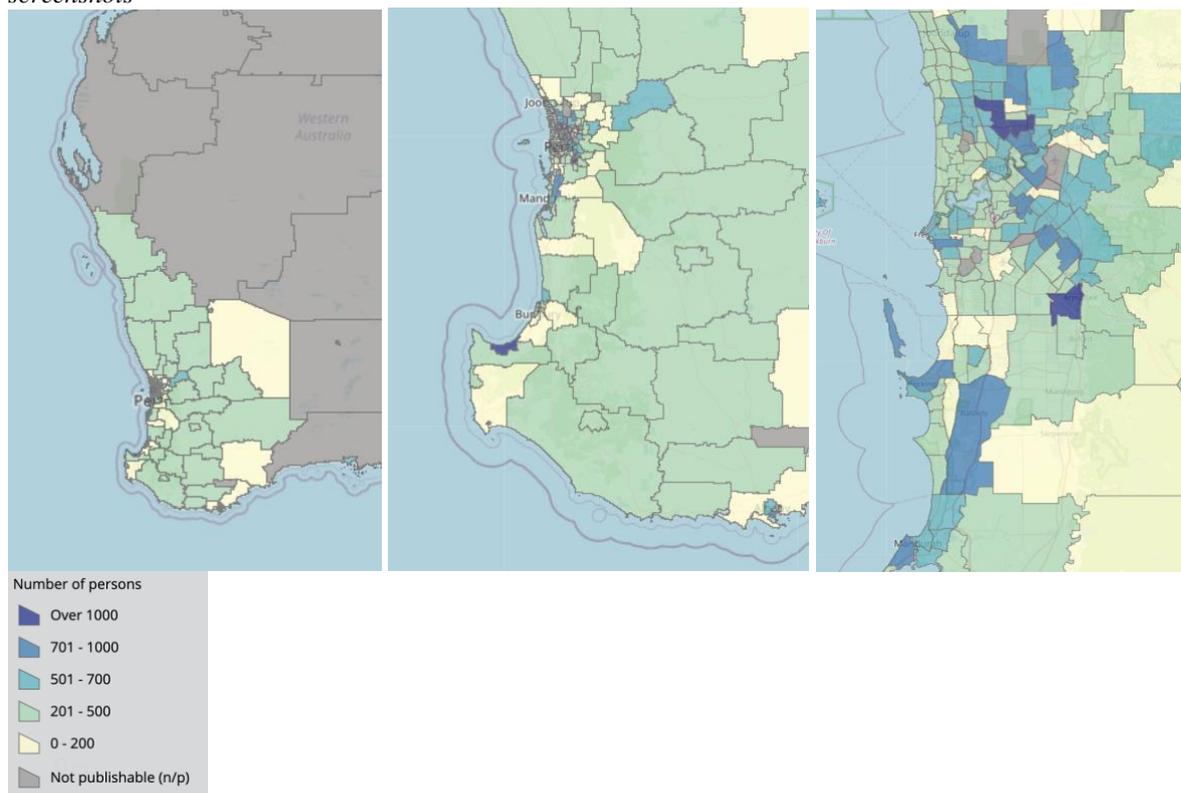
In 2018, the overall prevalence of disability across the whole of Australia was 17.7% with the prevalence being similar for males (17.6%) and females (17.8%). Musculoskeletal problems (arthritis, back problems) were the most commonly reported source of physical disability. In WA, the overall prevalence of disability was estimated to be 16.4% in 2018 with a slightly higher prevalence in females (15.7%) compared to males (15.0%). The rates of disability increased with increasing age, ranging from 3.1% in children aged 0–4 years to 81.4% in people aged 90 years and older. The overall proportion of people in WA with a profound or severe core activity limitation (limitation in being able to perform activities of daily living i.e. being able to mobilise, undertake personal care activities, communicate with others, prepare meals) was 4.4% (age standardised) with the proportion being 5.3% in females and 3.9% in males. The rates increased with older age, being 4.3% in children aged 0- 14 years, 2.6% in people aged 15-64 years, and 14.5% in adults aged 65 years and older. The ABS reported data for a number of specific health conditions for older people (aged 65 years and older) for each state and territory and the data for the main self-reported health conditions by older west Australians are summarised in Table 1. Diseases of the eye and adnexa account for 0.3% and 3.1% of the 65-74 year group and 75 years and older age groups, respectively. Figure 10 shows the WA geographical distribution of disability, demonstrating a focus around outer metropolitan Perth and the south-west of WA.

Table 1. Self-reported main health condition in older age: WA (proportion of total, %).

Condition	Age group	
	65- 74 years %	75 years and older %
Musculoskeletal conditions[#]	28.4	28.9
Hypertension	9.8	8.1
Diseases of the ear and the mastoid process	6.8	9.7
Diabetes	5.0	4.5
Heart disease	3.0	5.2
Dementia and Alzheimer	0.4	6.5
Cancer, lymphomas, and leukaemias	2.1	1.7
Asthma	2.4	2.0
Depression and affective mood disorders	2.0	0.8
Diseases of the eye and adnexa	0.3	3.1
Stroke	0.5	1.9
Total with one or more condition	81.7	95.4

[#] Includes arthritis, back problems, and other conditions.

Figure 10. Persons with a disability in Western Australia by geographical area. Source: ABS Census screenshots²⁵



1.9 Eye Examinations

Although Indigenous Australians have higher rates of vision impairment (VI) and blindness, they access vision services at lower rates than their non-Indigenous counterparts. Reasons for this include financial and cultural concerns, long waiting times and difficulties associated with long distances to the services, especially for those living in remote areas.

The proportion of Indigenous Australians who had an eye examination by an optometrist or ophthalmologist in the previous 12 months, based on Medical Benefits Schemes (MBS) data, was reported by AIHW.²⁶ Results showed that in 2019-2020, 12% of Indigenous Australians (n = 104,300) had such an eye examination, compared to 23.5% for non-Indigenous Australians, and across all age groups, the rates of eye examinations were higher for non-Indigenous Australians than for Indigenous Australians of the same age group. Across Australia, the examination rates decreased with greater remoteness and were the lowest in the very remote areas. The rates of eye examinations for Indigenous people in WA and the NT were lower than those in other states and territories (8.2%).

These results show an increase in the age-standardised examination rate for Indigenous people from 14% in 2007-2008 to 17% in 2019-2020 and an increase from 19% to 24% for non-Indigenous people. All Indigenous Australians are eligible for an annual Indigenous-specific health assessment that includes an eye health assessment. Across Australia, 28% (n=238,700) of Indigenous people had a health assessment in 2019-2020, which was an increase from 11% in 2010-2011.²⁶ In WA, the rate was 25% (n = 26, 978) in 2019-2020 with the highest rate in the Midwest (36.1%) and lowest in the Pilbara (22.1%). In other regions, the rates were Kimberley 22.6%, Wheatbelt 23.4%, Goldfields 25.6%, Perth 24.4%, Great Southern 27.2%, and the South West 29.2%.

Data were also reported for the number and percent of people with self-reported diabetes who had had an eye examination in the timeframe recommended by the NHMRC (within the past 12 months) in the NEHS¹. The overall rate across Australia was 77.7% in the non-Indigenous population and 52.9% in the Indigenous population in 2016, with 22.95% of Indigenous people reporting never having had such an examination. For non-Indigenous people, the eye examination rate was the highest in remote areas (87.2%) and lowest in very remote areas (64.3%) with the rate being intermediate in major cities (74.7%). By comparison, the eye examination rate for Indigenous people was highest in the inner regional areas (61.9%) and lowest in the very remote areas (35.4%), with the rate being 55.2% in major cities.

1.10 Self-reported eye/vision problems in Australia

Participants in the Australian National Health Survey 2017-2018² were asked to self-report a range of eye conditions. The results showed that over 13 million Australians had one or more chronic eye conditions, including:

- 7.2 million with hyperopia (long-sightedness)
- 6.3 million with myopia (short-sightedness)
- 1.4 million with astigmatism
- 687,000 with presbyopia (loss of focusing ability with age)
- 549,000 with colour blindness
- 411,000 with cataract
- 244,000 with macular degeneration
- 131,000 with blindness (complete and partial).

The prevalence of eye conditions increased with older age, and affected 93% of people aged 65 years and older, in comparison to 12% of children aged 0-14 years; the prevalence was also greater in females than males (59% vs 51%). Data were also presented for each state and territory and results for WA are summarized in Table 7.

Table 7 - National Health Survey² 2017-2018 Results: Self-reported eye conditions by Western Australians (Proportion of persons, %).

Diseases of the eye and adnexa	Gender			Age Group (years)			
	Male	Female	Total	0-24	25-44	45-64	65 +
Cataract	0.8	1.2	1.2	0.0	0.0	1.0	5.5
Glaucoma	0.7	0.8	0.9	0.0	0.0	1.4	3.0
Disorders of the choroid and retina (including macular degeneration)	0.9	1.7	1.4	0.0	0.8 [#]	2.1	2.9
Short sightedness/myopia	22.2	28.4	25.2	11.3	26.8	34.4	37.9
Long sightedness/hyperopia	24.9	29.3	27.1	6.0	12.9	56.1	54.8
Other disorders of ocular muscles, binocular	8.2	10.0	9.0	2.2	10.5	14.7	13.8
Visual disturbances/loss of vision or blindness (complete and partial)	1.5	1.7	1.8	0.6 [#]	2.2	1.4	5.3
Other diseases of the eye and adnexa	3.5	1.1	2.3	1.1 [#]	2.5	3.3	2.7
TOTAL diseases of the eye and adnexa	49.7	57.8	53.5	20.7	44.5	87.	88.9

*The proportion has a high standard of error and hence, should be used with caution.

1.11 The National Eye Health Survey

1.11.1 Participants

Overall, the mean (SD) age of non-Indigenous participants in the National Eye Health Survey (NEHS) was 66.6 (9.7) and 55.0 (9.9) years for Indigenous Australians. Almost half of the non-Indigenous participants were male (46.4%) while 41% of Indigenous participants were male. The average (mean) number of years of education was 12.5 years (SD 3.7) for non-Indigenous participants and 10.9 years (SD 3.3) for Indigenous participants. Eight of the 30 randomly selected NEHS sites were from Western Australia (WA) (Table 8) and the WA participants represented 29.5% of the whole sample. They included 888 non-Indigenous people (28.7% of the total non-Indigenous participants) and 536 Indigenous people (30.8% of the total Indigenous participants).

1.11.2 Visual Impairment

The NEHS defined Visual Impairment (VI) as a presenting visual acuity of <6/12 in the better eye. The overall age-adjusted prevalence of VI was 13.60% in Indigenous Australians and 4.57% in non-Indigenous Australians, indicating a 3-fold higher adjusted prevalence in Indigenous Australians ($p < 0.001$). These results indicate that an estimated 453,000 Australians were living with VI or blindness in 2016.

Table 8 - Western Australian sites included in the NEHS¹

WA sites included in the NEHS [#]	Remoteness Category ^{##}	Participants	
		Non-Indigenous	Indigenous
Craigie – Beldon	Major city	110	82
Bassendean - Eden Hill – Ashfield	Major city	106	80
Kalamunda – Maida Vale - Gooseberry Hill	Major city	102	68
Lesmurdie - Bickley – Carmel	Inner regional	101	2
Geraldton	Outer regional	102	17
Katanning	Outer regional	108	105
South Hedland	Remote	42	86
Exmouth	Very remote	101	42
Esperance	Very remote	116	54
TOTAL		888	536

¹In cases where there were insufficient numbers of eligible participants in a region, the region was expanded to include adjacent areas;

^{##}categorised on the basis of accessibility to services

The prevalence of VI increased substantially with the increasing ages of both, Indigenous and non-Indigenous people, with 46% of Indigenous Australians aged 80 years and older having VI while the rate was 15.21% for non-Indigenous Australians (Table 9). There was no significant difference in VI according to gender for both groups of participants. Similarly, there was no difference in the age-adjusted bilateral VI for non-Indigenous Australians, according to the remoteness of an area. By comparison, the rate of bilateral VI (age-adjusted) in Indigenous Australians was significantly higher in the outer regional areas (21.59%, $p < 0.001$), compared to other locations.

Results of VI for Western Australia are presented in comparison to the overall sample in Table 6 and statistical analysis showed no significant difference in the rates between states and territories for non-Indigenous people. By comparison, there was a significant overall difference between the rates of VI for Indigenous Australians across the states and territories. The rates were the highest in the Northern Territory (23.5%) and South Australia (21.36%), lowest in Queensland (9.3%) and Victoria (7.05%), and intermediate in WA (16.0%) and NSW (13.2%). However, the authors warned that these results must be interpreted with caution due to the differing proportions of participants across the states and territories.

Table 9 - Prevalence of visual impairment by age groups for non-Indigenous and Indigenous Australians(2016).

Age Group (years)	Non-Indigenous Australians % (95% CI)	Indigenous Australians % (95% CI)
40-49	--	5.66 (3.93 – 7.86)
50-59	4.42 (3.11 – 6.07)	8.23 (6.21 – 10.65)
60-60	4.37 (3.27 – 5.71)	16.85 (13.14 – 21.11)
70-79	7.87 (6.06 – 10.02)	18.52 (12.36 – 26.11)
80+	15.21 (11.64 – 19.38)	46.15 (26.59 – 66.62)

1.11.3 Causes of Visual Impairment

The NEHS¹ reported the uncorrected refractive error was the main cause of VI for both, Indigenous and non-Indigenous Australians (63.39% and 61.69%, respectively), while cataract was the second leading cause in both groups, the rate of cataract was 20.22% in Indigenous Australians and 13.93% in non-Indigenous Australians. Age-related macular degeneration (AMD) accounted for a higher proportion of VI in non-Indigenous Australians compared to Indigenous Australians (8.96% vs. 1.09%). By comparison, diabetic retinopathy contributed to a higher proportion of VI in Indigenous Australians with self-reported diabetes than for non-Indigenous Australians (5.46% vs. 1.49%).

1.11.4 Blindness

The NEHS¹ defined blindness as presenting visual acuity of <6/60 in the better eye. The overall age-adjusted prevalence of blindness was 0.36% in Indigenous Australians and 0.12% in non-Indigenous Australians representing a 3-fold increase in Indigenous people. However, there was no significant difference in the rates of blindness according to gender for either group. The rates for blindness in the whole sample compared to the WA sample are summarized in Table 10. Comparisons between the states and territories for blindness were not conducted due to their small sample sizes.

Table 10 - Prevalence of vision impairment in Western Australians and the total sample.

	Western Australia				The Total Sample	
	Non-Indigenous (n = 888)		Indigenous (n = 590)		Non-Indigenous (n = 3,098)	Indigenous (n = 1738)
	n % (95% CI)	OR ² (95% CI)	n % (95% CI)	OR ² (95% CI)	n % (95% CI)	n % (95% CI)
Prevalence of bilateral presenting vision impairment (VA<6/12-6/60) (Age adjusted)	75 5.88 (4.52-7.61)	1.32 (0.93 – 1.87)	74 16.0 (12.88-19.70)	1.25 (0.87 – 1.81)	201 4.57 (3.88-5.37)	183 13.6 (11.84 – 15.58)
Prevalence of bilateral presenting blindness (VA<6/60) (Age adjusted)	1 0.11 (0.002 – 0.63)		4 0.68 (0.18-1.74)		7 0.12 (0.06 – 0.25)	5 0.36 (0.14 – 0.92)

² The Odds Ratio (OR) shows the association between the state and visual impairment (VI)

Prior to the NEHS, the prevalence of blindness in WA had been explored in a study using a mathematical modelling approach to estimate the extent of legal blindness in the state.²⁷ Data were collected from three different lists of people who were determined to be legally blind (i.e. blind registers, hospital lists) in 2008-2009. After excluding duplicate entries and deaths, 1,771 people, aged between 1 and 106 years were identified as legally blind. Those results allowed the authors to estimate the prevalence of legal blindness across WA, which they determined to be 3,384 people (0.15%) of the population. This was slightly higher than the age-adjusted prevalence rate of 0.12% reported by the NEHS for non-Indigenous people in WA.

1.11.5 Causes of Blindness

The NEHS¹ reported the primary cause of bilateral blindness in non-Indigenous participants was age-related macular degeneration (AMD, 71.42%), while cataracts were the main cause of blindness in Indigenous participants (40%), followed by diabetic retinopathy (20%), optic atrophy (20%), and a combination of causes (20%).

1.11.1 Undiagnosed Major Eye Diseases

The proportion of undiagnosed major eye diseases or uncorrected refractive error was estimated in the NEHS¹ sample as a whole. Of the Indigenous participants with VI or blindness due to one of the five main causes of vision loss (refractive error, cataract, AMD, diabetic retinopathy, glaucoma), 57.40% were not previously diagnosed, representing 5.58% of all Indigenous participants. In non-Indigenous participants for whom VI or blindness was due to one of the five main causes, 51.93% reported that the condition had not been diagnosed previously, i.e. 3.03% of the total non-Indigenous sample.

1.11.1 Refractive Error Correction

The NEHS¹ collected data on the rates of refractive error correction (distance glasses or contact lens prescription), and the results showed higher rates of refractive error correction in non-Indigenous (93.65%) people than in Indigenous people (83.28%) in 2016. Treatment rates for refractive error for Indigenous Australians in the outer regional (70%) and very remote (75%) areas were significantly lower than in the major cities (87%). The treatment rate for non-Indigenous Australians was significantly higher than for Indigenous Australians in inner regional, outer regional and very remote areas. However, the authors cautioned that as the refractive error was not assessed in participants without VI or blindness, these percentages may be underestimated.

1.12 Causes of Blindness in Western Australia

Additional data regarding specific causes of blindness in WA was more recently reported by Heath and colleagues.²⁸ They conducted a retrospective analysis of the reasons for low-vision or blindness-only certificates issued to patients registered with the Association for the Blind Western Australia (ABWA) / Visibility Blind and Vision Impaired Registry in WA. The results showed that 11,824 low-vision certificates were issued between July 1995 and January 2017. Inherited retinal disease (IRD) was the reason for vision loss in 679 (5.7%) cases, with retinitis pigmentosa as the most common form. In patients who were blind (n=4,919), AMD was the most common cause (54.6%, 2,684/4,919) followed by IRD (8.3%, 406/4,919). IRD was the second most common reason for low-vision certification in children aged 0-15 years (11.6%), and the most common in adults aged 15-64 years (23.3%). The mean age for IRD-related blindness-only certification was 46±20 years. The authors also reported the most common reasons for blindness in patients by age group, Table 11 is a replication of that table.

The annual incidence of blindness due to AMD in WA adults aged 50 years and older was examined in another study by Heath and colleagues.²⁹ Records from the ABWA/Visibility Blind and Vision Impaired Registry were searched from 1996 to 2016 to identify new registrations for blindness, assess the incidence and the primary reasons for blindness. The results indicated that 3,060 registrations were issued for blindness over the 21-year period, with the majority attributable to AMD (60%; n = 1,828). In 2016, the age-standardised annual incidence of blindness was 8.2 cases per 100,000 person-years with higher registrations for females (4.9 per 100,000) than males (3.3 per 100,000); the mean age at registration in 2016 was 86.8 years. The 2016 rate represents a significant decline from 2004 and 2006 when the annual age-standardized rate of AMD-related blindness was highest and rates were 28.7 and 44.0 per 100,000 people in males and females, respectively. The decline in rates coincided with the increased use of intravitreal therapy from 2009.

Table 11 - Frequency of the 20 most common causes of blindness in WA (n = 4,919) by gender and age group²⁸

Diagnosis	Number and % of cases n (%)	Female (% of total)	Age at certification (years; mean ± SD)	Children 0-15 years [#] (% of total diagnosis)	Adults 16-64 years ^{##} (% of total diagnosis)	Adults 65 years and older [§] (% of total diagnosis)
AMD	2,684 (54.6)	64.7	84 ± 7	0.0	1.3	98.7
IRD	406 (8.3)	50.5	47 ± 20	7.9	73.8	18.3
Glaucoma	398 (8.1)	49.7	79 ± 13	0.0	13.9	86.1
Diabetic Retinopathy	264 (5.4)	53.0	65 ± 14	0.0	41.4	58.6
Optic Atrophy	237 (4.8)	47.9	55 ± 23	8.0	54.0	38.0
Retinal Vascular Disease	153 (3.1)	55.6	79 ± 11	0.0	10.5	89.5
Cerebral Defect	88 (1.8)	53.4	56 ± 27	14.9	37.9	47.1
Retina Surgical	85 (1.7)	38.8	64 ± 22	3.6	38.1	58.3
Retina Congenital	73 (1.5)	49.3	17 ± 20	63.0	31.5	5.5
Corneal Scar	41 (0.8)	46.3	66 ± 20	2.4	34.1	63.4
Uveitis	38 (0.8)	50.0	59 ± 21	2.8	61.1	36.1
Cataract Adult	35 (0.7)	60.0	80 ± 9	0.0	5.7	94.3
Myopic Macular Disease	34 (0.7)	52.9	67 ± 15	0.0	41.2	58.8
Amblyopia	27 (0.5)	48.1	38 ± 30	25.9	55.6	18.5
Corneal Dystrophy	21 (0.4)	76.2	61 ± 22	4.8	42.9	52.4
Optic Nerve Tumour	21 (0.4)	61.9	39 ± 23	23.8	57.1	19.0
Optic Nerve Congenital	21 (0.4)	57.1	19 ± 22	61.9	33.3	4.8
Cataract Congenital	13 (0.3)	30.8	26 ± 17	30.8	69.2	0.0
Hereditary Optic Neuropathy	10 (0.2)	30.0	36 ± 22	0.0	80.0	20.0
Retinal Trauma	8 (0.2)	37.5	56 ± 25	0.0	75.0	25.0

[#]n = 174; ^{##}n = 943; [§]n = 3772

1.13 Hospitalisations

1.13.1 Hospitalisations for treatment of eye conditions

In 2017–19, around 9,700 Indigenous Australians (age-standardised rate of 12.2 per 1,000 population) were hospitalised for diseases of the eye, while the rate for non-Indigenous people was 14.8. The Indigenous hospitalisation rate was an increase from the age-standardised rate of 8.3 per 1,000 population in 2011–12.¹²

The most common reason for hospitalisation of Indigenous people for an eye condition were disorders of the lens (see cataract surgery), disorders of the choroid and retina (1,260 hospitalisations or 0.8 per 1,000 population), disorders of the conjunctiva (0.4 per 1,000 population), and disorders of the eyelid, lacrimal system and orbit (0.4 per 1,000 population). In 2017-2019, the hospitalisation rates for eye conditions increased with older age and were greatest for people aged 75 years and older. The age-standardised hospitalisation rates for eye diseases increased with remoteness, higher rates of hospitalisation for Indigenous Australians in remote and very remote areas compared to major cities.

Of all the Australian states and territories, WA had the highest hospitalisation rates (12.6 per 1,000 population), although the overall crude hospitalisation rate of Indigenous people varied from 4 per 1,000 population in the South-West to 12.3 per 1,000 population in the Pilbara. The rates (per 1,000 population) for other regions were 4.2 in Perth, 5.9 in the Mid-West, 6.6 in the Goldfields, 7.4 in the Great Southern area, 7.7 in the Wheatbelt, 8.4 in the Kimberley, and 11.1 in Ngaanyatjarra Lands (NG Lands) in Central WA.

1.13.2 Hospitalisations for eye injuries

In 2017-2019, approximately 2,000 (1.2 per 1,000) Indigenous Australians were hospitalised with an eye injury (no change since 2011-12).¹² The age-standardisation rate (1.4 per 1,000) of such hospitalisations for Indigenous people was higher than for their non-Indigenous peers (0.5 per 1,000), with the most common principal diagnosis being an open wound to the eyelid and periorcular area (0.4 per 1,000). Of the Indigenous people, males aged 35-44 years had the highest rates of hospitalisations (age-standardised rate = 2.5 per 1,000), and females in the 25-34 and 35-44 year age groups, both had 2.2 per 1,000).

Across Australian states and territories, age-standardisation rates for Indigenous people with eye injuries was highest in the NT (3.8 per 1,000) and WA (1.8 per 1,000) with rates being higher in remote and very remote areas compared to the inner and outer regional areas and major cities. In WA, the highest rate (crude rate) was 3.2 per 1,000 in the Kimberley and lowest in Perth (0.6 per 1,000). The rates (per 1,000) for other regions were 2.3 in the Pilbara, 2.0 in the Mid-West and Goldfields, 1.9 in NG Lands, 1.6 in the Wheatbelt, 1.0 in the Great Southern area, and 0.8 in the South-West.

1.14 Visual Impairment in children

1.14.1 Australian Childhood Vision Impairment Register (ACVIR)

The Australian Childhood Vision Impairment Register (ACVIR) was established in Australia in 2008 to report on children diagnosed with permanent visual impairment (VI). To be eligible for registration on the ACVIR, a child must be aged between 0 and 18 years and have permanent VI in both eyes diagnosed by an ophthalmologist. The ACVIR includes the child's demographic details and details of their eye condition(s) provided by their ophthalmologist. Researchers recently reported the results of the register's first ten years of operation.³⁰ Of the 1,336 children registered on the ACVIR, complete records were available for 904 children, which were included in the report. More male (57%) than female (43%) children were registered, and the most common primary diagnoses were retinal dystrophy (17%), cortical/cerebral VI (CVI, 15%), and albinism (11%). A secondary diagnosis of infantile nystagmus was reported in 33% of children. Additional disabilities and/or developmental delays were reported for 44% of children. While these results provide important information regarding the prevalence of these conditions in this sample, the ACVIR data cannot be used to provide accurate population-level prevalence data regarding permanent VI in Australian children, as it is highly likely that many children eligible for registration are not listed on the ACVIR.

Families reported that 68% of children received low-vision support by a non-government agency at the time of registration, with 54% reporting the support had commenced prior to the child's first birthday. By comparison, 24% of families reported their child received no such support.

1.14.2 Prevalence of eye injuries amongst children in WA

The prevalence of accidental and non-accidental eye injuries amongst children <16 years old was recently reported by researchers in WA.³¹ The authors conducted a retrospective review of all the cases admitted with any eye or adnexal injury to Princess Margaret Hospital (PMH) for children in WA, from January 2002 to December 2015. PMH was the only tertiary referral hospital in WA for the treatment of serious conditions in children; hence, the authors were confident they would capture all such cases. The results showed that 747 children were treated for an eye or adnexal injury between 2002 and 2015, including 708 (94.8%) accidental eye injuries (AEI) and 39 (5.2%) considered highly suspicious for non-accidental or intentional eye injuries (NAI). The children with AEI were significantly older (mean age 7 years) than those with NAI (mean age 5.8 months; $p = 0.001$), while no child aged over 24 months was found to have an NAI. Males were more likely than females to have sustained either type of injury (AEI: males = 68.2%; NAI: males 57.8%).

The most common finding in AEIs was a closed-globe injury (306/694; 44%), adnexal injuries (297/694; 42.7%) and open-globe injuries (91/694; 13.1%) with retinal injuries were rare (2.1%). By comparison, retinal injuries, including retinal haemorrhages in all the retinal layers, including optic disc haemorrhages were found in all the NAI cases. The authors also found that children with NAI were more likely to present with additional traumatic injuries, including a head injury and this was an important predictor of NAI.

According to the ABS census data, the estimated number of children aged 0-14 years living in WA was 440,072 in 2016.⁶ This information together with the results reported by Clark and colleagues²⁶ was used as a rough estimate of the overall prevalence of eye injuries in children across WA in 2015, which was approximately 0.17% (747/440,072).

1.14.1 Early onset type 2 diabetes in WA

Type 2 diabetes mellitus (T2DM) was once considered a disease of adults but the age of diagnosis is falling and increasing numbers of adolescents and young adults are being diagnosed.³² Early onset T2DM carries with it increased risks of developing macrovascular and microvascular complications, often at an earlier stage and greater frequency than seen in type 1 diabetes.³² Early onset T2DM patients are at risk of developing premature retinopathy,³³ the chief microvascular complication.

A recently published (2021) retrospective analysis of early onset T2DM patients in Western Australia determined the incidence of T2DM in youth aged <16 years from 2000-2019, using the Western Australian Children's Diabetes Database (WACDD).³⁴ There were 224 cases identified, 128 (58%) of which were Aboriginal and Torres Strait Islander children. The mean age of diagnosis of diabetes was 13.2 years with no difference by Aboriginal and Torres Strait Islander status. The overall mean incidence was 2.3/100,000

population (95%CI 2.1 – 2.7). There was an average annual increase in the incidence of 5.2% (95% CI 2.8 – 7.8%). The mean incidence for Aboriginal and Torres Strait Islander children was 18-fold higher than in non-Indigenous children. The incidence increased by an average of 6.2% (95% CI 2.8 – 9.6) per annum in the Aboriginal and Torres Strait Islander children compared 3.9% (95% CI 0.3 – 7.6%) in non-Indigenous children.³⁴ This study highlights the increasing incidence of early onset type 2 diabetes in Western Australian children with a disproportionate burden on Aboriginal and Torres Strait Islander children.

1.15 Other Eye Diseases

1.15.1 Trachoma and Trichiasis

Results from the National Trachoma Surveillance and Reporting Unit (NTSRU)⁴ showed the overall prevalence of active trachoma in children aged 5-9 years was 4.5%, with 0% in SA, 5.2% in the NT, 7.4% in Qld, and 6.4% in WA in 2019. These figures indicate an increased prevalence of trachoma in Australia and WA since 2017 when the prevalence was 3.8% and 4.1%, respectively.

The overall prevalence of active trachoma in children aged 5-9 years varied considerably across regions of WA, ranging from 3.7% in the Pilbara, 4.7% in the Kimberley region, 7.5% in the Midwest, and 12.3% in the Goldfields. Results showing the numbers screened for trachoma and the prevalence of the condition in WA and in Australia are presented in Table 12.

Table 12 - Trachoma screening and prevalence in Western Australia and Australia (2019).

	Western Australia	Australia
Number of communities at risk	38	115
Number of communities screened	36	111
Children aged 5-9 years examined for clean face	551	23,236
Children aged 5-9 years with a clean face	363	2,418
Clean face prevalence (%)	66	75
Children screened for trachoma	545	3,154
Children with active trachoma, n (%)	82	263
Estimated prevalence of active trachoma (%)	15.0	8.3
Overall prevalence of active trachoma (%)	6.4	4.5

The NTSRU also reported the results of their screening and reporting efforts for trichiasis. Overall, 12,977 Australian adults aged ≥ 15 years were screened for trichiasis in 127 at-risk and previously at-risk communities in 2019. Of those screened, 11 active cases were identified with the overall prevalence of trichiasis being 0.08% in Australia and 0.8% in WA (Table 13).

Table 13 - Trichiasis screening, prevalence and treatment in adults in Western Australia and Australia (2019).

	Western Australia	Australia
Number of communities screened	36	127
Estimated population in trachoma endemic region	9,357	39,027
Number of adults (aged 15 years and older), examined	654	12,977
Number of adults positive for trichiasis (%)	4 (0.8)	11 (0.08)
Surgery in past 12 months	1	6

1.15.1 Myopia

The prevalence of myopia in middle-aged adults (49-70 years) of European descent in WA was recently reported by Mackey et al.³⁵ Data were extracted from two longitudinal studies conducted in WA (the Busselton Healthy Ageing Study [BHAS] and the Raine Study). The BHAS was conducted between 2010 and 2015 and the data for 2,987 adults (mean age = 58.2 years; SD = 5.4) were included in the analysis; all the participants had undergone an eye examination, including autorefractometry and autokeratometry. The Raine Study (see page 13 of this document for additional details of the study methods) was conducted and data from 756 adults (mean age = 57.1 years; SD = 4.6), who had all undergone an eye examination and non-cycloplegic autorefractometry were included in this analysis.

Results showed the prevalence of myopia to be 19.6% (n=586) in the BHAS and 29.9% (n=226) in the Raine Study. The prevalence of high myopia was 1.3% (n=39) in the BHAS and 3.9% (n=30) in the Raine Study. High myopia was defined as the mean spherical equivalent of both eyes ≤ 5.00 dioptres. Being younger and having a post-secondary school qualification were significantly associated with an increased risk of myopia and high myopia while being female was associated with an increased risk of high myopia (OR = 1.94; 95% CI 1.29-

2.93, $p=0.002$). The authors concluded that although the prevalence of myopia in WA has increased since World War II, it has remained relatively low.

1.15.2 Keratoconus

Only one study of the prevalence of keratoconus has been reported in an Australian population (Raine Study).³⁶ The cross-sectional prevalence study included 1,259 adults aged 20 years from Perth, WA. The study was undertaken between 2010-2012. The participants were considered to be generally representative of the wider WA population and underwent an ophthalmic examination and completed a health questionnaire. Keratoconus was defined as a Belin/Ambrósio enhanced ectasia display score of ≥ 2.6 in either eye, based on Pentacam imaging.

The study participants were predominantly Caucasian (85.6%), 50.8% were females and 49.2% were males. The results showed that 15 participants had keratoconus in at least one eye, although it had only been previously diagnosed in two participants. This represented a prevalence rate of 1.2% (95% CI 0.7% – 1.9%), or 1 in 84, one of the highest prevalences reported in the world. The authors attributed the increased prevalence to advances in corneal topography and tomography making the condition easier to diagnose.

Keratoconus was found to be significantly associated with regular cigarette smoking ($p=0.04$), although there was no association with gender, race, body mass index, use of spectacles or contact lenses, history of allergic eye disease, and pregnancy.

1.15.3 Amblyopia, Strabismus and Anisometropia

The prevalence of amblyopia, strabismus, and anisometropia was also investigated in the Raine study.³⁷ Complete data for 1,125 participants with northern European ancestry were available and included in this sub-study. This final sample included 551 participants (49% females and 51% males) with an average age of 20.1 years (range 18.3-22.1 years), who underwent a comprehensive eye examination, including visual acuity and a detailed orthoptic assessment. The results showed the prevalence of amblyopia was 1.1% ($n = 12$), strabismus was 3.5% ($n=39$), and anisometropia was 2.9% ($n=33$). Of the participants with amblyopia, one had bilateral amblyopia and 11 had unilateral amblyopia. From the 11 participants with unilateral amblyopia, two had strabismus, three had anisometropia, and one had both strabismus (microtropia) and anisometropia. The prevalence of the three conditions was similar to previously reported rates.

1.15.4 Pterygium

The prevalence of pterygium was also investigated in the Raine Study.³⁸ Of the total sample, data were available for 1,344 participants with an average age of 20.0 years, males ($n = 684$; 51.5%) and who were predominantly Caucasian (85.5%). Pterygium was assessed using high-resolution ultraviolet photographs of the nasal and temporal conjunctiva and the results showed the prevalence of pterygium to be 1.2% ($n = 15$; 95% CI 0.6–1.8%); one participant had bilateral pterygium while 13 participants had unilateral pterygium. The prevalence of pterygium was 2% in males (1 in 50) and 0.3% in females (1 in 330), it was significantly higher in males ($p=0.004$).

The prevalence of pterygium was also assessed in another group of the Raine Study participants (Gen1 Raine Study participants). Data for this cohort was collected in 2017-2019 and data from 994 participants were included in the analysis.³⁹ The mean age of participants was 56.7 years ($SD = 5.8$) and 57.4% were female ($n=571$). The presence of pterygium was assessed by examining colour photographs of both eyes and the results indicated the lifetime prevalence of pterygium to be 8.4% ($n= 83$), including 14 bilateral and 52 unilateral cases. Pterygium was more common in males than females; the lifetime prevalence was 11.3% ($n = 48$) vs 6.1% ($n = 35$), (OR 1.95, 95% CI [1.24–3.08], p -value = 0.004), point prevalence was 9.6% ($n = 40$) vs 4.8% ($n = 27$) (OR 2.10, 95% CI [1.23–3.63], p -value = 0.005), respectively. The reported pterygium prevalence rate was the second highest out of seven studies conducted in Australia. The authors considered that the higher number of hours of sunshine per day in WA, compared to the eastern states might be a factor.

The authors of the study also assessed the Medicare claims data for privately funded pterygium surgery from 1994 to 2017. The results showed that the Australia-wide surgery rates decreased 47% from 46 to 25 surgeries per 100,000 people across that timeframe. The rates in WA decreased 11%, which was a substantially lower decrease than observed in the other Australian states.

The prevalence of pterygium was assessed in another WA study that examined clinical data from the WA Visiting Optometry Service (VOS) in 2017.⁴⁰ Records from 2,072 patients were examined, the majority were female (n=1,221, 58.9%), identified as being Aboriginal (n= 1,754, 84.7%), and most were from Northern WA (the Kimberley and the Pilbara; 97%). Overall, pterygium was found in 14.1% (n = 293) of patients. The mean age of those with pterygium was 57.1 (SD = 11.9-years), most were female (n = 188; 64.1%), and most identified as Aboriginal (n = 260, 88.7%). There were more males than females with pterygium in the non-Aboriginal group (18.0% vs 6.4%); however, the reverse was true in the Aboriginal group (11.7% vs 17.0%).

Astigmatism was also present in 66.9% of patients (n=176) in at least one eye and 35.0% (n = 92) of patients had bilateral astigmatism (n=92).

1.15.5 Ocular Tuberculosis (TB)

The incidence of ocular tuberculosis in Australia was assessed over a 10-year period from 2006-2015.⁴¹ A retrospective analysis of the individual state and territory health records was undertaken, and results indicated 162 cases reported over the timeframe. Of those, 30 (18.5%) were reported in WA, equating to a 10-year incidence of 1.28 per 100,000 people. The mean patient age at the time of notification to the health authority was 42.93 years (SD 15.5; range 7–87 years) and 53.7% were male (n=87). The highest incidence was found in males aged 30-39 years and no Indigenous Australians had been diagnosed with ocular tuberculosis. Most of the cases were classified as non-specific (40.7%, n=66) while 27.8% (n = 45) were classified as uveitis and an increase in the annual incidence of ocular TB was noted, although remaining low overall. It increased from 0.02 per 100,000 in 2006 to 0.13 per 100,000 in 2015.

1.16 Issues and Recommendations

<p><i>1.16.1 Increasing prevalence of eye disease in the context of an aging population</i></p>	
<p>Details:</p> <ul style="list-style-type: none"> • The prevalence of eye conditions increases with age. Ninety-three (93) % of people >65 years are affected by an eye condition in comparison to 12% of children aged 0-14 years (NHS). • The Australian population is ageing due to low fertility and increasing life expectancy. The median age of the Australian population has increased from 35 to 38 years between 2000 and 2020. The median age of the WA population increased from 34.6 to 37.5 years in this period. • Given Australia's aging population, the burden of eye disease is likely to increase in the future. • The prevalence of cataract increases with age. An Ontario, Canada study with a similar aging population to Australia projected the number of cataract operations to increase by 128% between 2007 to 2036 with the proportion provided to patients aged over 85 tripling.⁴² 	
<p>Recommendations:</p> <ul style="list-style-type: none"> • Key considerations include appropriate economic and disease modelling to inform future eye-health resource planning for Western Australia. A focus on projects, which support this goal may be useful. • Establishing more strict criteria for funding may reduce the future burden on the public health care system. 	
<p><i>1.16.2 Uncorrected refractive error is the main cause of vision impairment in Australia</i></p>	
<p>Details:</p> <ul style="list-style-type: none"> • Uncorrected refractive error was reported to be the main cause of vision impairment for both Indigenous and non-Indigenous Australians (63.39% and 61.69%, respectively) (NEHS). • Risk factors for severe uncorrected refractive error in Indigenous and non-Indigenous participants included participants who were older, did not have an eye examination in the previous two years, geographical remoteness and were males. • This represents a high prevalence of reversible vision impairment. 	
<p>Recommendations:</p> <ul style="list-style-type: none"> • Public awareness of the importance of regular optometric examinations may be required in higher risk groups for severe refractive error. • With the advent of social media, highly targeted campaigns are possible. Health-promotion campaign projects may be an area of interest. 	
<p><i>1.16.3 Cataract is the leading cause of blindness in Aboriginal and Torres Strait Islanders</i></p>	
<p>Details:</p> <ul style="list-style-type: none"> • Cataract was the leading cause of blindness (40%) in Indigenous participants of the NEHS. Blinding cataract is 12 times more common among Aboriginal and Torres Strait Islander adults than in non-Indigenous Australians. • Cataracts are reversible; therefore, this is a potentially addressable burden of blindness. • Cataract wait lists are increasing, suggesting the system is at capacity. 	
<p>Recommendations:</p> <ul style="list-style-type: none"> • Projects that aim to identify undiagnosed cataract in the Indigenous population may be valuable. • This needs to be weighed up against the capacity of the current eye-health system to handle an additional caseload. 	
<p><i>1.16.4 There is a significant burden of undiagnosed eye disease in the community</i></p>	
<p>Details:</p> <ul style="list-style-type: none"> • Over 50% of all eye conditions diagnosed in the NEHS were new diagnoses suggesting a significant burden of undiagnosed eye conditions in the community. • The rate of undiagnosed eye conditions in the NEHS was 5.58% of all Indigenous participants and 3.03% of all non-Indigenous participants. In addition, three of the top 4 causes of blindness, AMD (54.6%), glaucoma (8.1%) and DR (5.4%) in WA, have better outcomes for patients when identified early. • This suggests the need for increased regular eye examinations. 	
<p>Recommendations:</p> <ul style="list-style-type: none"> • Further research to break down the demographic characteristics and risk factors of the population with undiagnosed eye conditions would help to orient any public health campaigns targeted at this issue. • Projects that aim to increase the frequency of eye examinations at a broad population level may create 	

<p>downstream resource issues for the eye health workforce; therefore, projects, which take a more targeted approach, may be preferred.</p>
<p><i>1.16.5 Aboriginal and Torres Strait Islanders in WA have especially high rates of hospitalisations due to eye injuries</i></p>
<p>Details:</p> <ul style="list-style-type: none"> • WA has the second highest rate of hospitalisations for Indigenous people with eye injuries (1.8 per 1000 population). The rates are highest in remote and very remote areas. • The Kimberley has the highest rate (3.2 per 1000 population) and Perth has the lowest rate (0.6 per 1000 population).
<p>Recommendations:</p> <ul style="list-style-type: none"> • Projects that aim to identify upstream causative factors would be beneficial. • In addition, it is important to ensure that emergency services in high prevalence regions are appropriately supported to manage eye trauma.
<p><i>1.16.6 Australia is the only developed country in the world to still have trachoma</i></p>
<p>Details:</p> <ul style="list-style-type: none"> • The overall prevalence of active trachoma in WA in children aged 5-9 years was 6.4% in 2019. These figures have increased since 2017, when the prevalence was 4.1%. • The highest prevalence was 12.3% in the Goldfields. In the 2019 NTSRU, 551 children were examined in 36 of the 38 communities at risk; 66% of them had clean face.
<p>Recommendations:</p> <ul style="list-style-type: none"> • There are active trachoma surveillance and public awareness campaigns in Australia. • One avenue of exploration would be to engage existing organisations to understand the issue and assess the benefits of additional support.
<p><i>1.16.7 Many families of children with vision impairment receive no low-vision support from a non-government agency</i></p>
<p>Details:</p> <ul style="list-style-type: none"> • Twenty-four percent of families of children registered on the Australian Childhood Vision Impairment Register reported they received no low-vision support from a non-government agency.
<p>Recommendations:</p> <ul style="list-style-type: none"> • Explore projects that aim to increase the awareness and uptake of support. • Seek collaboration with low-vision services to understand their current advertising practices, resources, and capacity to increase support of new families.
<p><i>1.16.8 Western Australia has one of the highest prevalence's of keratoconus in the world and has no public funding for hard contact lenses.</i></p>
<p>Details:</p> <ul style="list-style-type: none"> • The Raine Study reports that WA has one of the highest prevalence of keratoconus in the world (1.2%, 95% CI 0.7% – 1.9%). • There is currently no state-wide public funding for hard contact lenses, one of the treatment options for this condition. This is a major gap, as it can leave patients significantly out of pocket.
<p>Recommendations:</p> <ul style="list-style-type: none"> • Seek projects that call for public funding of hard contact lenses.
<p><i>1.16.9 The incidence of early onset type 2 diabetes is increasing in Western Australia affecting Aboriginal Torres Strait Islander children disproportionately.</i></p>
<p>Details:</p> <ul style="list-style-type: none"> • There is a growing incidence of early onset type 2 diabetes in Western Australian Children that disproportionately affects Aboriginal and Torres Strait Islander children. • Early onset T2DM patients are at risk of developing premature retinopathy
<p>Recommendations:</p> <ul style="list-style-type: none"> • Consider supporting projects with a focus on preventative measures and screening for early onset T2DM.

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HUMAN RESOURCES

2. Human Resources

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2.3 Executive Summary

- The Western Australian ophthalmologist workforce comprised of 81 ophthalmologists as of May 2021, has an average annual growth rate of 0.78% per annum, and 1.25% between 2019 and 2020. Workforce size growth is lower than optometrists (2.73% per annum) and Aboriginal Health Workers (11.1% per annum). A recommendation from a recent RANZCO WA Eye Health report was to ‘Ensure a sustainable ophthalmology workforce’. The report highlights planning guidelines of 1 ophthalmologist per 25,000 and 1 trainee per 100,000 population. The population of WA reached approximately 2.6 million in 2020, which according to this calculation, calls for 104 ophthalmologists suggesting the workforce is currently under supplied. However, the population growth of WA was 0.6% from 2019–20. This suggests that despite being undersupplied, the workforce growth rate (1.25%) outstrips the population growth rate (0.6%) pointing towards a correction.
- The proportion of female ophthalmologists has steadily risen from 15% in 2016 to 20% in 2021. This is below the national average of 24% female ophthalmologists in 2020, according to the AIHW NHWD.
- New Zealand and other overseas locations provide a substantial proportion of the ophthalmologist workforce for Western Australia. In 2020, 24% of the WA ophthalmic workforce was trained internationally. Nationally, this figure was 21.3%. The reliance on overseas trainees has been a stable part of the WA ophthalmic workforce for the past 5 years. Special international medical graduates (SIMGs) must apply to RANZCO for registration to practice as an ophthalmologist locally. This is a complex process, including the need to undertake the RACE exit examinations. RANZCO undertook a review of its policy regarding SIMGs, which led to a policy update in May 2019. Given the importance of overseas practitioners in the local workforce, an ongoing balance between supporting applicants through a transparent process as well as maintaining high clinical standards is necessary.
- There are currently no Aboriginal ophthalmologists or optometrists practicing in Western Australia. This represents a clear gap in the workforce, given the considerable needs of the local Aboriginal population.
- Between 2016 and 2020, approximately 4-5% of the optometry workforce capacity remained dormant, i.e. was registered but not clinically active. In 2020, this figure was 7.8% nationally. In 2017, Optometry Australia released a position statement regarding the state of the optometry workforce in Australia: ‘at a national level there are currently sufficient numbers of practicing optometrists to meet community demand for services’ and ‘without change to key determining factors, there is likely to be a substantial excess supply of full time equivalent optometrists in coming decades’. Therefore, this dormant workforce may represent a supply side excess.
- Data availability on ophthalmic nurses in Western Australia was scant. The size, demographic makeup and trends of this workforce are poorly understood.
- Aboriginal health workers (AHWs) represent a fast growing workforce in Western Australia. The average annual growth rate of the youngest age group (20-34 years) was 31.2% between 2016 and 2020, which was 3x the growth of the group as a whole (11.1%). The proportion of female AHWs has also increased from 76-84% females between 2016 and 2020. Young people, and females are the key drivers of workforce growth in this group. The structures that support this growth and promote pathways of education towards eye health would benefit the WA community given the ongoing disparity in eye health measures between Aboriginal and non-Aboriginal Australians.

2.4 Introduction

This section of the report summarises currently available data on the status of the Western Australian eye health workforce with a focus on key demographic features. Further insights into the workforce distribution characteristics and a needs perspective are addressed in the subsequent Service Delivery section.

The Western Australian eye health workforce is multidisciplinary and diverse, comprising a number of health care professionals with both, distinct and overlapping roles. The Australian Institute of Health and Welfare (AIHW) sets out definitions of the various contributors as detailed in Box 1 below.

Table 1 - Eye Health Workforce (extracted from the AIHW 2016 Eye Health Workforce Report).¹

Role	Function
Ophthalmologist	Provides diagnostic, treatment and preventative medical services related to diseases, injuries and deficiencies of the human eye and its associated structures.
Optometrist	Performs eye examinations and vision tests to determine the presence of visual, ocular and other abnormalities, ocular diseases, and systemic diseases with ocular manifestations. They also prescribe lenses, other optical aids, therapy, and medication to correct and manage vision problems and eye diseases.
Orthoptists	Diagnose and manage eye movement disorders and associated sensory deficiencies
Ophthalmic nurses	Have completed general nurse training as well as specialist training in the nursing care of patients with eye problems, whether in hospital, clinics or the community. These nurses test vision and perform other eye tests under medical direction.
Ocularists	Fit, shape, and paint ocular prostheses and show patients how to handle and care for them.
Orientation and mobility specialists	Assist people who are experiencing difficulties in moving about due to vision loss.
Occupational therapists specialise in eye health	Assess the functional limitations of people resulting from eye illnesses and disabilities, and provide therapy to enable people to perform their daily activities and occupations.
Optical dispensers	Fit and service optical appliances such as spectacle frames and lenses.
Optical mechanics	Operate machines to grind, polish, and surface optical lenses to meet prescription requirements and to fit lenses to spectacle frames.
Ophthalmic assistants	Undertake tasks such as visual acuity tests.
Optometric assistants	Support optometrists within private clinics. They assist clients in selecting spectacle frames and appropriate sunglasses and undertake receptionist functions

Because of the multidisciplinary nature of the workforce, there are multiple peak bodies and differing regulatory jurisdictions that encompass it. There was no single data source, which captured the entire workforce. In order to maximise detail, various sources of data have been compiled and summarised. It is important to exercise caution when interpreting these results as the sources have different cross-sectional time points and acquisition methodologies. It should be noted that for many practitioners, as Western Australian-specific data were not available they have been omitted from the final results.

A literature search was performed using the PubMed database to identify relevant workforce survey data. The Australian Institute of Health and Welfare National Health Workforce Dataset (NHWDS)² was explored using the publicly available data tool.³ The Australian Bureau of Statistics 2016 Census Table builder⁴ was used to explore the available census data. A search of the peak bodies of relevant organisations was conducted for data pertaining to their registered practitioners. A summary of data sources for each eye health provider are available in Table 1.

2.5 Data sources

2.5.1 National Health Workforce Dataset (NHWDS)

This dataset comes from the AHPRA practitioner registration data as well as self-reports from a workforce survey filled out by practitioners at time of registration. The latest data from 2020² are included in this report. Data were extracted using the health workforce data tool.³ Data were available for ophthalmologists, optometrists, nurses, and Aboriginal health workers who had organisational boards affiliated with AHPRA.

2.5.2 Australian Bureau of Statistics 2016 Census Data

The 2016 ABS Census dataset⁴ on employment, income and education provides self-reported data on a number of healthcare professionals. Wherever NHWDS data were available, it was the preferred source, as it forms part of the professional board registration process and is likely to be more reliable. Limited information about optometrists and orthoptists was extracted from this database.

2.5.3 Orthoptics Australia Workforce Survey

Orthoptics Australia published a workforce survey in 2017.⁵ Three hundred and twenty eight orthoptists responded. This represents approximately 40.1% of the total workforce when compared to the 814 self-reported professionals from the 2016 ABS Census.

2.5.4 Orthoptics Board of Australia

The Orthoptics Board of Australia maintains registration for orthoptists and publishes details online.⁶ State-specific details were not available on their registry; however, the board was directly contacted for further information.

2.5.5 Ocularists Association of Australia

This is the national peak body for ocularists in Australia.⁷ There are currently 14 members nationally, and three of them are in Western Australia.

Table 2 - Accessed data sources for the Western Australian eye health workforce.

Workforce	Data source
Ophthalmologists	AIHW NHWDS
Optometrists	AIHW NHWDS, ABS 2016 Census
Orthoptists	ABS 2016 Census, Orthoptics Australia Workforce Survey
Ophthalmic nurse	AIHW NHWDS
Aboriginal health workers	AIHW NHWDS
Ocularists	Ocularists Association of Australia
Orientation and mobility specialists	No WA data available
Occupational therapists specialising in eye health	No WA data available
Optical dispensers	No WA data available
Optical mechanics	No WA data available
Optometric assistant	No WA data available
Ophthalmic assistant	No WA data available

2.6 Ophthalmologists

According to the 2020 National Health Workforce Data, there were 81 registered practicing ophthalmologists in Western Australia.² This is in line with RANZCO Registration data as of May 2021, showing 81 active ophthalmologists. The number of registered practitioners has been relatively stable over the past five years as demonstrated in Table 2. The average growth rate of the workforce from 2016–20 was 0.78% per annum. The growth rate from 2019–20 was 1.25%.

Table 3 - Number of ophthalmologists in WA from 2016–20 (Extracted from the AIHW NHWDS).

	Year	2016	2017	2018	2019	2020
Professions						
Ophthalmologists		78	78	77	80	81
Total		78	78	77	80	81

The average age could not be extracted from the 2020 AIHW NHWDS; however, to the 2017 RANZCO workforce survey states the average age of WA Ophthalmologists was 52.4. Table 3 shows the age distribution in 2020, where 60% of ophthalmologists were under 55 years, 40% were 55 years and older.

Table 4 - Age distribution of WA ophthalmologists in 2020, n (%) (Extracted from the AIHW NHWDS).

Age 20-34 (years)	Age 35-44(years)	Age 45-54(years)	Age 55-64(years)	Age 65-74(years)	Age 75-99(years)
0 (0)	21 (25.6)	28 (34.1)	23 (28.0)	7 (8.5)	3 (3.7)

*Note total number = 82, which contradicts the 81 reported. The source of this disparity is unclear.

The age demographics of ophthalmologists were relatively stable over the past five years. The average age was 52.4 years in 2017 and is currently 53.57 years, based on the RANZCO registration data. The age distribution also appears to be stable as seen in Table 4.

Table 5 - Age distribution of WA ophthalmologists (2016–20) (Extracted from the AIHW NHWDS).

	Professions	Age	Year	2016	2017	2018	2019	2020
	Ophthalmologists	75-99		0	3	3	3	3
		65-74		5	7	4	9	7
		55-64		21	22	25	22	23
		45-54		28	29	28	29	28
		35-44		24	19	18	18	21
		20-34		0	0	3	0	0

As of May 2021, according to the RANZCO registration data, there are 16 (20%) female ophthalmologists in Western Australia. The proportion of female ophthalmologists has steadily risen from 12 (15%) since 2016, as evident from Table 5.

Table 6 - Gender distribution of ophthalmologists in Western Australia 2016–20, n (%) (Extracted from the AIHW NHWDS).

	Professions	Sex	Year	2016	2017	2018	2019	2020
	Ophthalmologists	Male		66 (85)	66 (85)	64 (83)	65 (81)	64 (79)
		Female		12 (15)	12 (15)	13 (17)	15 (19)	17 (21)

	Female	12 (15)	12 (15)	13 (17)	15 (19)	17 (21)
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In 2020, 76% of the workforce was locally trained, 4% trained in New Zealand, and 20% trained overseas. These proportions have remained relatively stable since 2016 where 74% of the workforce was locally trained (Table 6).

Table 7 - Initial country of qualification of WA ophthalmologists (2016–2020), n (%) (Extracted from the AIHW NHWDS).

		<i>Year</i>				
		2016	2017	2018	2019	2020
Professions	Initial Country of Qualifications					
Ophthalmologists	Australia	57 (74)	59 (75)	58 (77)	59 (76)	62 (76)
	New Zealand	3 (4)	3 (4)	0	0	3 (4)
	Other overseas	17 (22)	17 (22)	17 (33)	19 (34)	16 (20)

Currently, there are no ophthalmologists in Western Australia who identify as Indigenous Australians and none have registered in the past five years.

2.7 Optometrists

In 2020, there were 480 optometrists registered with AHPRA in Western Australia, 455 (95%) were active in the labour force. The number of optometrists in Western Australia has been increasing since 2016 as outlined in Table 7. The average growth rate of the total workforce from 2016–20 was 2.73% per annum.

Table 8 - AHPRA-registered optometrists in Western Australia, by labour force participation (2016–2020) (Extracted from the AIHW NHWDS).

	Year	2016	2017	2018	2019	2020
Workforce Status						
In labour force in Australia		412 (95)	403 (96)	429 (96)	447 (96)	455 (95)
Not in labour force in Australia		20 (5)	18 (4)	17 (4)	18 (4)	25 (5)
Total		432	421	446	465	480

The 2016 ABS Census data states that the national average age of the optometry workforce was 41.5 years. WA-specific data on the average age could not be extracted. The optometry workforce is young with 79% below the age of 55 years in 2020. The age distributions for 2016–20 are represented in Table 8.

Table 9 - Number of optometrists in WA, by age group (2016–20) (Extracted from the AIHW NHWDS).

Year	2016	2017	2018	2019	2020
Age					
20-34	123	118	135	143	154
35-44	116	115	112	111	107
45-54	108	105	112	117	119
55-64	64	61	66	72	76
65-74	17	17	19	18	20
75-99	4	5	0	4	4
Total	432	421	446	465	480

The proportion of female optometrists in Western Australia has remained stable (46-48%) from 2016–20 (Table 9). This is lower than the national figure (51.6% females) from the 2016 Census data.

Table 10 - Male and female optometrists (n[%]) in WA from 2016–20 (Extracted from the AIHW NHWDS).

Year	2016	2017	2018	2019	2020
Sex					
Male	232 (54)	224 (53)	235 (53)	241 (52)	253 (53)
Female	200 (46)	197 (47)	211 (47)	224 (48)	227 (47)
Total	432	421	446	465	480

The Western Australian optometry workforce is made up of a significant proportion of international graduates, 36-38% of the workforce from 2016–20 (Table 10). According to the 2016 Census, 361 people who studied optometry, reside in WA as their primary place of work.

Table 11 - Optometrists in WA by their initial country of qualification (n[%]).

	Year	2016	2017	2018	2019	2020
Initial Country of Qualifications						
Australia		266 (63)	256 (62)	276 (64)	283 (62)	288 (62)
New Zealand		36 (9)	38 (9)	44 (10)	54 (12)	55 (12)
Other overseas		119 (28)	118 (29)	114 (26)	116 (26)	119 (26)
Total		421	412	434	453	462

Currently, there are currently no Aboriginal optometrists in Western Australia. Historically, there were three Aboriginal optometrists registered in 2016 and 2017, respectively (Table 11).

Table 12 - Number of Indigenous and Non-Indigenous optometrists in Western Australia from 2016–20 (Extracted from the AIHW NHWDS).

	Year	2016	2017	2018	2019	2020
Australian Born Indigenous						
Indigenous (and Australian born)		3	0	0	0	0
Indigenous (not Australian born)		0	3	0	0	0
Not Indigenous		429	420	446	464	480
Total		432	421	446	465	480

2.8 Orthoptists

There were 814 self-reported orthoptists in the 2016 Census. There are 17 Western Australian orthoptists registered with the Orthoptic Board of Australia in 2021. According to the 2017 Orthoptics Australia Workforce Survey, 88.7% of orthoptists are female, 98.7% have Australian nationality, and 1.3% New Zealand nationality. Table 12 shows the age distribution of the national Australian orthoptic workforce.

Table 13 - Age distribution of the national Australian orthoptic workforce (Extracted from the 2017 Orthoptics Australia Workforce Survey [OWS]).

	2017 OWS (n = 327)
20 to 29 years	84 (25.7%)
30 to 39 years	79 (24.2%)
40 to 49 years	65 (19.9%)
50 to 59 years	56 (17.1%)
60 years and older	43 (13.2%)

Table 14 - Orthoptists by state or territory (n[%]) (Extracted from the 2017 Orthoptics Australia Workforce Survey).

	2017 OWS (n = 293)
NSW	135 (46%)
Victoria	90 (31%)
Queensland	23 (7.8%)
South Australia	14 (4.7%)
Western Australia	14 (4.7%)
Australian Capital Territory	10 (3.4%)
Tasmania	6 (2%)
Northern Territory	1 (0.3%)

2.9 Ophthalmic nurses

There are currently 95 members of the Australian Ophthalmic Nurses Association of Western Australia. According to the AIHW NHWD, in 2020 there were 40,890 nurses registered in Western Australia. Table 14 and Table 15 show the WA nursing workforce by division and job area respectively.

Table 15 - WA nursing workforce in 2020 by their qualifications (Extracted from the AIHW NHWDS).

	Year	2020
Nurse Division		
Registered Nurse Only		31030
Enrolled Nurse Only		5613
Registered and Enrolled Nurse		705
Midwife Only		465
Registered Nurse and Midwife		2596
Enrolled Nurse and Midwife		3
Registered and Enrolled Nurse and Midwife		14
Non-practising Only		465
Total		40890

Table 16 - Western Australian nursing workforce in 2020 by job areas of work (Extracted from the AIHW NHWDS).

	Year	2020
Job Area as a Nurse		
Critical care		1874
Emergency		2809
Medical		3904
Mixed medical/surgical		2407
Surgical		3150
Peri-operative		2687
Paediatrics		911
Maternity care		933
Child and family health		716
Practice nursing		1711
Rehabilitation and disability		1055
Mental health		3062
Aged care		4102
Drug and Alcohol		101
Community nursing		1727
Palliative care		422
Health promotion		101
Management		816
Education		717
Policy		56
Research		215
Other		2192
Neonatal care		713
Not stated		4509
Total		40890

2.10 Aboriginal health workers

There were 143 Aboriginal Health Workers registered in 2020 with 130 (91%) employed in Western Australia, according to the National Health Workforce Data. Their proportion in the labour force has fluctuated by year from 2016–20 (Table 16) The workforce’s average annual growth rate from 2016–20 was 11.1%. The average annual growth rate by age was 31.2%, 13.3%, 7.3%, 6.6%, and -3.75% for the age groups (years) of 20-34, 35-44, 45-54, 55-64 and 65-74, respectively (Table 17). 120 (84%) of workers are female. The proportion of female AHW’s has increased from 76% in 2016 as seen in Table 18.

Table 17 - Number of Aboriginal health workers in Western Australia, by labour force activity (2016–20)
(Extracted from the AIHW NHWDS).

	Year	2016	2017	2018	2019	2020
Workforce Status						
In labour force in Australia		85 (89)	86 (89)	106 (95)	118 (94)	130 (91)
Not in labour force in Australia		10 (11)	11 (11)	6 (5)	7 (6)	13 (9)
Total		95	97	112	125	143

Table 18 - Western Australian-registered Aboriginal health workers by age (Extracted from the AIHW NHWDS).

	Year	2016	2017	2018	2019	2020
Age						
20-34		15	16	21	31	43
35-44		25	28	25	31	33
45-54		24	25	33	27	30
55-64		27	24	29	31	34
65-74		4	4	4	5	3
Total		95	97	112	125	143

Table 19 - Western Australian-registered Aboriginal health workers by sex (2016–20) (Extracted from the AIHW NHWDS).

	Year	2016	2017	2018	2019	2020
Sex						
Male		23 (24)	22 (23)	23 (21)	21 (17)	23 (16)
Female		72 (76)	75 (77)	89 (79)	104 (83)	120 (84)
Total		95	97	112	125	143

2.11 Ocularists

Currently, there are 12 ocularists registered with the Ocularists Association of Australia, three of them are located in Western Australia. All three ocularists work for a single family business.

2.12 Issues and Recommendations

<p><i>2.12.1 The proportion of female ophthalmologists in Western Australia is 20% below the national average.</i></p> <p>Details:</p> <ul style="list-style-type: none"> The proportion of female ophthalmologists in Western Australia has steadily risen from 15% in 2016 to 20% in 2021. This is below the national average of 24% female ophthalmologists in 2020, according to the AIHW NHWD. <p>Recommendations:</p> <ul style="list-style-type: none"> The RANZCO Women in Ophthalmology group represents an avenue of exploring this issue further. Collaborative opportunities may exist for incorporating these figures in their strategic plan as well as supporting projects that may aid Western Australian females aspiring, training and qualified ophthalmologists. link - https://ranzco.edu/home/community-engagement/wio/
<p><i>2.12.2 A large proportion of the local Western Australian ophthalmic workforce is trained overseas</i></p> <p>Details:</p> <ul style="list-style-type: none"> In 2020, 76% of the workforce was locally trained, 4% trained in New Zealand, and 20% trained overseas. These proportions have remained relatively stable since 2016 where 74% of the workforce was locally trained. There does not appear to be recognition or support of this workforce in line with their importance. <p>Recommendations:</p> <ul style="list-style-type: none"> Explore avenues that recognise and support international medical graduates who contribute to the local ophthalmic workforce. A RANZCO position statement may be an initial avenue to pursue.
<p><i>2.12.3 There are currently no Aboriginal ophthalmologists or optometrists practicing in Western Australia.</i></p> <p>Details:</p> <ul style="list-style-type: none"> There are no current or past Aboriginal and/or Torres Strait Islander ophthalmologists in Western Australia. There is currently one nationally. <p>Recommendations:</p> <ul style="list-style-type: none"> Consider projects with a focus on upstream factors contributing to education and training.
<p><i>2.12.4 Dormant optometry workforce</i></p> <p>Details:</p> <ul style="list-style-type: none"> 4-5% of the optometry workforce remains dormant at any given time. This represents a significant and valuable workforce that can be activated to contribute towards other existing WA eye health issues. <p>Recommendations:</p> <ul style="list-style-type: none"> Consider further research into this phenomenon to understand the reversibility and potential of this workforce, should it be activated.
<p><i>2.12.5 Data availability on ophthalmic nurses in Western Australia was scant</i></p> <p>Details:</p> <ul style="list-style-type: none"> There is limited publicly available data on the size and demographics of the ophthalmic nursing workforce. Ophthalmic nurses play an important role in eye health care and there is little insight into the structure and mechanics of the workforce. <p>Recommendations:</p> <ul style="list-style-type: none"> Consider further research into the Western Australian ophthalmic nursing workforce structure. The ABS Census and AIHW NHWDS is likely to contain further information through professional access.
<p><i>2.12.6 Aboriginal health workers are the fastest growing eye health care workforce</i></p> <p>Details:</p> <ul style="list-style-type: none"> There is substantial growth in the AHW workforce driven by young people and females. This represents an opportunity to promote ophthalmology as a viable area of interest and increase the ophthalmic AHW capacity. <p>Recommendations:</p> <ul style="list-style-type: none"> Explore promotional activities to encourage AHW interest in ophthalmology as a part of their career

progression.

- Explore the AHW national curriculum for eye health from a quality and engagement perspective.

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SERVICES

3. Services

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3.4 Executive Summary

- This report section outlines the function, size, organisational structure and geographical reach of the various eye health care services available in WA from the perspective of primary, secondary, and tertiary healthcare.
- General practitioners (GPs) are often the first point of contact with the health system for a patient with an eye disorder and represent an important contribution to eye health care in Western Australia.
- In 2020 there were 2,318,554 patients serviced by GPs in WA consuming 2861.3 General Practitioner Full time Equivalent (GPFTE_ over 16,591,524 services. In 2015–16, eye disorders accounted for 1.9% of Australian GP consultations.¹ As a broad estimate, there were approximately 315,239 (1.9% of 2,318,554) eye-related GP consultations in WA in 2020. In 2016, GP referrals to an ophthalmologist represented 4.1% of all allied health and specialist referrals or 6.5% of specialist referrals. This was a rate of 0.6 (95%CI: 0.6-0.7) per 100 encounters, which equates to 99,549 of the 16,591,524 services in 2020.¹
- The emergency department serves as an important site of first presentations of eye conditions, especially those of higher urgency. In WA, 10,940, or 1% of total presentations were classified as diseases of the eye and adnexa. Emergency medicine specialists see approximately 34 eye presentations per clinician per year, compared with 81 for GP's. The majority of eye and adnexa presentations are classified as semi-urgent (52.2%). The redistribution of low-urgency eye patients to optometry or general practice may represent an opportunity to improve patient outcomes, reduce wait times, and reduce the burden on overwhelmed emergency departments.
- In WA, the proportion of Indigenous Australians appropriately screened for diabetic retinopathy was approximately 31%.²² The gap between the recommended and actual screening rates is related to the patients' knowledge of the condition, the need for retinal screening and doctor-patient's communications, travel, operating costs, infrastructure, and time constraints within general practice.³⁻⁵
- On 1 November 2016, two item numbers (12325 and 12326) were launched to support and promote diabetic retinopathy screening in general practice. Pre-introduction modelling suggested that over 400,000 patients with diabetes would be screened for retinal photography, with the new primary health item numbers.⁶ Five years since their introduction, the cumulative national use of these item numbers was 10,598. Barriers to utilisation include the cost of retinal cameras, time constraints, the need for dedicated staff to take the responsibility of diabetic retinopathy (DR) screening, lack of skills to make a DR diagnosis, lack of awareness of Medicare incentives for non-mydratic retinal photography, optometrists being perceived as ideal for DR screening and limited referral pathways.⁶⁻⁸
- "The Visiting Optometrists Scheme (VOS) is a federal-funded initiative which supports optometrists to deliver outreach optometric services to remote and very remote locations."⁹ In 2019–20, there were 22,089 occasions of service to Indigenous patients and 18,299 to other patients under the VOS with the occasions of service being greatest in very remote and remote areas.¹⁰
- In 2019, Lion's Outback Vision dispensed 1,955 spectacles to Indigenous people (an increase of 714 from 2017): 1,163 in Kimberley, 638 in Pilbara, 120 in Goldfields, and 34 in the Perth Metro areas.
- Cross-sectional data of private optometry advertisements was scraped online from three key platforms, including Healthengine, Healthdirect, and Myhealth1st in November 2021. There were 304 private optometry practices listed in WA, located in 91 different postcodes. WA has 11.41 optometry practices per 100,000 capita.
- In 2021 there were 90 ophthalmologists registered in WA representing 1% of the WA specialist workforce. According to the 2017 RANZCO workforce survey, WA Fellows reported 47.2 hours in an average week, which is higher than the College-wide average of 42.13 hours. The majority of full time equivalent (FTE) between 76.3-84.3% is spent in private practice. Between 20% to 40% of ophthalmologists spend no time in public practice. Between 2014 and 2019, 84% of ophthalmologists remained in Modified Monash Model (MMM)1 and 79% in MMM2 – MMM7.¹¹ There was a trend for an increasing proportion of ophthalmologists to work outside major cities, from 19% in 2014 to 24% in 2019.¹¹ The majority (72%) of the Australian population lives in MM1 areas suggesting that the concentration of ophthalmologists in these areas does not match the population distribution.
- There has been a gradual decline in the number of hospitals in WA, which provide ophthalmology theatre services from 27 in 2011 to 23 in 2019.
- According to data extracted from the AIHW elective surgery activity reports, the number of cataract surgeries performed in public hospitals in Western Australia appears to have declined from 9595 in 2011 to 7539 in 2019 (Figure 10). The three highest volume public hospitals in 2019 were the Bentley Health Service, Peel Health Campus, and Fremantle Hospital and Health Service reporting 2334, 1017, and 907 cataract surgeries, respectively (Figure 11). The East Metropolitan Health Service was the

busiest network, reporting 3308 cataract surgeries in 2019 (Figure 12). There was a disparity between public hospital reported trends and the MBS item number trends. Possible issues may be data integrity in the reporting pipeline from the hospitals to AIHW, data storage issues, data analysis issues or could represent a shift from public to private procedures.

- The NEHS¹² reported cataract surgery coverage rates across Australia and the findings (based on self-reported surgery for cataract) indicated significantly higher rates in non-Indigenous (87.63%) participants than in Indigenous (61.47%) participants ($p < 0.001$).
- In WA (2017-2019) the met need for cataract surgery was estimated to be 76% in Ngaanyatjarra (NG) Lands, 57% in the Wheatbelt, 53% in the Kimberley region, 49% in the Goldfields, 44% in the Great Southern region and the Pilbara, 35% in the Mid-West, 29% in Perth, and 25% in the South-West.¹⁰
- Approximately 80% of cataract surgeries for Aboriginal and Torres Strait Islander people and 29% for non-Indigenous people are performed in public hospitals.
- Analysis of the AIHW elective surgery activity data suggests that median wait times for cataract surgery are increasing in Western Australia (Figure 14). In 2011, the mean median wait time was 80 days, compared to 123 days in 2019. The large increase in average wait times between 2017 and 2019 appears to be driven by the increase in the WA Country Health Service (Figure 15). In 2019, the three longest wait times were in Derby Hospital, Esperance Hospital, and Katanning Hospital of 328, 308, and 252 days. The longest metropolitan wait time was Joondalup Health Campus, 146 days. Osborne Park Hospital had the lowest wait time of 10 days.
- Wait times captured through AIHW data reflect the time from an addition to a public hospital waiting list to admission. They do not capture the time from the initial diagnosis by a general practitioner or optometrist and referral to an ophthalmologist referred to as the 'hidden waiting list' or the 'wait for the wait'. There is currently no publicly available WA data on this.
- As Indigenous Australians have higher rates of cataracts and predominantly have surgery in public hospitals, they are disproportionately affected by the long wait times.
- A recent RANZCO WA workforce report proposed the 'InReach ophthalmology network,' which combines accredited training posts with private practice as a pathway for Aboriginal and Torres Strait Islander patients to be directly waitlisted for procedures on the public hospital waitlist. The aim is to expedite wait listing of Aboriginal and Torres Strait Islander patients through building relationships with local Aboriginal health service providers and the private sector.
- In November 2021, an analysis of ophthalmologist advertisements on three platforms, including Healthengine, Healthdirect, and Myhealth1st was performed. One hundred and six (106) ophthalmologists had advertisements in Western Australia. The mean (range) number of private clinics listing each ophthalmologist was 2.1 (1-6). There were 72 private clinics advertised in Western Australia. The mean (range) number of ophthalmologists per clinic was 2.3 (1-18). The practices were located in 35 different WA postcodes. WA has 8.3 ophthalmology clinician-clinic instances per 100,000 capita.
- Lions Outback Vision (LOV) currently provides the only official teleophthalmology service in Western Australia, which has been in service since 2011. In 2021, 25% (n=1825) of all LOV ophthalmology appointments were conducted through telehealth. This has increased from 683 teleophthalmology teleconsultations in 2016. An on-call teleophthalmology service was introduced in 2016 to complement the online booking system. A clinical audit showed that the proportion of Indigenous patients in the on-call telehealth cohort was 51.4%, compared to 8.7% in the online-booking telehealth group ($p < 0.01$) representing a 10-fold increase in access for Aboriginal patients.
- There is a broad range of organisations in WA dedicated to disability support for people with low or no vision. Focus areas include advocacy, service providers, entertainment benefits and services, sport, and transport.

3.5 Introduction

Currently, there is a broad range of eye-care services available in Western Australia (WA) and can be considered from the perspective of primary healthcare, secondary healthcare, and disability support services (Table 1). Primary healthcare is typically a person's first encounter and therefore, an entry-point into the health care system. Secondary health care is typically medical care provided by a specialist or facility upon referral by a primary care physician. Tertiary healthcare encompasses a range of services, which aim to support persons with disability, secondary to vision impairment in the community. The aim of this section of the report is to describe the function, size, organisational structure, and geographical reach of the various eye health care services available in WA.

Table 1. Eye health care services available in WA.

Primary Health Care Services General practitioners Emergency services Optometry – public Optometry – private
Secondary Health Care Services Ophthalmology outpatients Ophthalmology theatres Teleophthalmology
Tertiary Health Care Services Advocacy Service providers Entertainment benefits and services Sport Transport

3.6 Data Sources and Methodology

There is no overarching body that governs eye health care services in Western Australia; therefore, multiple sources of data were used to capture the relevant activity. A number of 'sub-studies' were conducted to acquire and analyse publicly available data. The methodologies are described in the relevant sections below.

3.6.1 Private Optometry and Ophthalmology Clinics

Data was scraped from three leading online health-service advertisement platforms, including Healthengine, Healthdirect, and Myhealth1st. Records were manually de-duplicated by the practice name and address. Duplicates with different practice names with the same addresses were de-duplicated by keeping the most recent advertisement, assuming that the previous practice was taken over. The ophthalmologists were linked to their practicing clinic(s) and therefore, the analysis was based on the unique instances of a clinician-clinic combination. The optometrists could not be linked to their practicing clinic(s), so the analysis was based on unique clinics only. The addresses were plotted by latitude and longitude coordinates on a geographical map of Western Australia. The map was geometrically divided for the postcode analysis. ABS Census data on postcodes was used for per-capita analysis.

3.6.2 Ophthalmologists

The AIHW Health Workforce data were used to analyse the clinical public and private hours worked by ophthalmologists. The raw data were exported and analysed. The total clinical, public, and private hours for all clinicians were calculated for each year between 2013 and 2020. Summary statistics were calculated for each year and presented in tabular form.

3.6.3 Public Hospital Surgery

The AIHW publishes annual data on public hospital elective surgery activity. The full dataset was downloaded from the AIHW website on 8 December 2021. It included all the operating theatre activity organised by the state,

local health networks, hospitals, specialties, and procedures for the 2011-2019 reporting years. For this analysis, a public hospital ophthalmic theatre was defined as any WA hospital, which reported a procedure being performed by an ophthalmologist. Past reporting periods were analysed to determine the trends in service delivery. Waiting times were analysed for the ophthalmic specialty as a whole as well as for cataract extraction. The active services in a reporting year were compared across the years to identify the opening and closure of theatres. A volume-weighted waiting time variable was created to compare regional and metropolitan hospital wait times. This took into account the differences in surgery numbers between hospitals to reduce the effect of low-volume hospitals with high wait times and vice versa.

3.6.4 Private Hospital Surgery

Private hospitals are required to report data on separations to the Department of Health which is collated as the Private Hospitals Data Bureau (PHDB). This data includes patient demographics, hospital episode, clinical information (ICD-10-AM) and hospital charges for all patients in private hospitals. A separation is defined as a single episode of care from admission to discharge, or transfer. Each separation is assigned an Australian Refined Diagnosis Related Group (AR-DRG) which summarises the primary reason for the admission under a single identifier. The Independent Hospital Pricing Authority (IHPA), an independent government agency, sets a national efficient price, and weightings for each type of hospital admission based on complexity and resources required. The PHDB has data pertaining to specific admission reasons for private hospitals including cataract surgery. The data is granular to the state, but not hospital level.

3.6.5 Medicare Benefits Schedule (MBS) Item Reports

MBS item numbers were analysed using the item report function on the department website.¹³ Australian Bureau of Statistics (ABS) Census data were used to link population data.

3.6.6 Disability support services

Publicly available annual reports were accessed for the most up-to-date service activity information.

3.7 Primary Healthcare Services

3.7.1 General practitioners

General practitioners (GP's) are often the first point of contact with the health system for a patient with an eye disorder. The workforce represents an important contribution to eye health care in Western Australia.

Key statistics:

- GP full-time Equivalent (GPFTE) is a workforce specific method to estimate the workload of GPs providing primary care services. One GPFTE represents a 40-hour week per week for 46 weeks of the year. In 2020, there were 3882 GPs working 2870.4 GPFTE in Western Australia. This equates to a 109.5 GPFTE per 100,000 population. Since 2014, the average growth of GP numbers and GPFTE was 3.0% and 4.9%, respectively.¹⁴
- In 2020, there were 2,318,554 patients serviced by GPs in WA, consuming 2861.3 GPFTE over 16,591,524 services. In 2015–16, eye disorders accounted for 1.9% of Australian GP consultations.¹ As a broad estimate, there were approximately 315,239 services (1.9% of 2,318,554) eye-related GP consultations in WA in 2020.
- In 2016, ophthalmic anti-infective drugs accounted for 0.8% of all GP prescriptions at a rate of 0.7 (95% CI 0.6–0.7) per 100 encounters and 0.4 (0.4–0.5) per 100 problems. Most (87.5%) of the prescribed ophthalmic anti-infectives were chloramphenicol.¹
- In 2016, GP referrals to an ophthalmologist represented 4.1% of all allied health and specialist referrals, or 6.5% of specialist referrals. This was a rate of 0.6 (95% CI 0.6–0.7) per 100 encounters, which as a broad equates to 99,549 of the 16,591,524 services in 2020.¹

3.7.2 Emergency Services

The emergency department serves as an important site of first presentation of eye conditions, especially those of higher urgency. In an ophthalmic context, it can be considered a primary healthcare service.

Key statistics:

- In 2019, there were 24 emergency departments (EDs) in WA, 8.2% of the 292 nationally. The number of EDs has increased by 26% from 19 in 2015. In 2021, there were 319 emergency medicine specialists registered in Western Australia.¹⁵
- In 2019, there were 929,507 ED presentations in WA, 355.8 per 1000 population. There has been a 2.9% average annual growth since 2015.
- In WA, 10,940, or 1% of total presentations were classified as diseases of the eye and adnexa. This represents approximately 3.5% of the volume of eye presentations to GPs.
- Emergency medicine specialists see approximately 34 eye presentations per clinician, per year compared with 81 seen by GPs. This equates to 42% of the number of eye presentations seen per clinician by emergency medicine specialists compared with the GPs.

The majority of eye and adnexa presentations are classified as semi-urgent (52.2%) (

- *Table 2). There were 8% of eye and adnexa presentations that were subsequently admitted in 2019.¹⁵*

Table 2. Diseases of the eye and adnexa, national Australian emergency department presentations by urgency category (2019).¹⁵

	Resuscitation	Emergency	Urgent	Semi-urgent	Non-urgent	Total
n	45	5,760	34,845	61,588	15,695	117,936
%	0.04	4.9	29.5	52.2	13.3	

The RACGP posits that GPs are well-placed to manage low-urgency cases, which can often overwhelm the EDs.¹⁶ Low-urgency ED care is defined by the AIHW as presentations where the person was assessed as needing semi-urgent (triage category 4) or non-urgent care (category 5), did not arrive by ambulance, police or correctional vehicle, was not admitted to the hospital, was not referred to another hospital, and did not die. In Australia, 65.5% of eye presentations were classified as semi-urgent or and non-urgent and 92% of eye conditions were not admitted in 2019. The redistribution of low-urgency eye patients to optometry or general practice may represent an opportunity to improve patient outcomes, reduce wait times and reduce the burden on overwhelmed emergency departments. It should be recognised; however, that the size of the problem is

relatively modest. The 65.5% of low-acuity eye presentations represent approximately 7166 cases, or 0.8% of the 929,507 total presentations to WA EDs in 2019.¹⁵

3.7.3 Diabetic Retinopathy Screening

Diabetic retinopathy screening in Western Australia is fragmented and without a centralised source of responsibility.

Key statistics:

- Across Australia, between 50% and 77% of non-Indigenous Australians and 20–44% of Indigenous Australians receive appropriate retinal screening.¹⁷ The proportion was highest in the inner regional areas and major cities and decreased with increasing remoteness.
- In WA, the proportion of Indigenous Australians screened for diabetic retinopathy was approximately 31%.²
- The gap between the recommended and actual screening rates is thought to be related to the patients' knowledge of the condition and the need for retinal screening, doctor-patient's communications, travel, operating costs, infrastructure, and time constraints within general practice.^{3–5}
- Across Australia, 506 Indigenous Australians who underwent screening for diabetic retinopathy received treatment in 2019–2020 (3.8% of the total number screened), increasing slightly from 3.5% in 2010–11.12. The age-standardised rate was similar for Indigenous (2.6%) and non-Indigenous (2.9%) Australians.¹⁸
- Treatment rates for Indigenous Australians increased with increasing age and were highest in those aged 65 years and older (females 4.8%; males 4.0%). In terms of geographical differences, the proportion of Indigenous Australians who received treatment for diabetic retinopathy was highest in major cities and outer regional areas (4.2%) and lowest in the very remote areas.

3.7.3.1 MBS Reimbursement for Primary Care Screening

On 1 November 2016, two item numbers were launched to support and promote diabetic retinopathy screening in general practice. Items 12325 for patients of Aboriginal and Torres Strait Islander descent, and 12326 for non-Aboriginal and Torres Strait Islander patients provide reimbursement for the assessment of visual acuity and bilateral non-mydratic fundus photography, including the analysis and reporting of the images. Any element of this service can be delegated to appropriately trained or qualified personnel (including registered nurses, Aboriginal or Torres Strait Islander health practitioners or workers, diabetes educators) under the direction of the medical practitioner co-ordinating the patient's care, who retains the overall responsibility for claiming the service.

MBS item number reports between 2016 and 2021 for item numbers 12325 and 12326 were analysed. The cumulative use of these numbers in this period was 10,598. The utilisation in WA, the third highest state (Figure 1) was 2308. WA was the second highest utiliser of these item numbers per capita (Figure 2). 84.1% of screening was for patients of Aboriginal and Torres Strait Islander descent in WA, compared to 52.8% nationally (Figure 3). WA has the highest use per capita for the Aboriginal Torres Strait Islander population (Figure 4). Usage of both item numbers is steadily increasing in WA from 141 uses in 2016–17 to 583 in 2020–21 (Figure 5). The average growth in this period was 64%, which was comparable to the national average growth of 60% (P = 0.95).

Figure 1. National cumulative use of the MBS item numbers 12325 and 12326, by state.

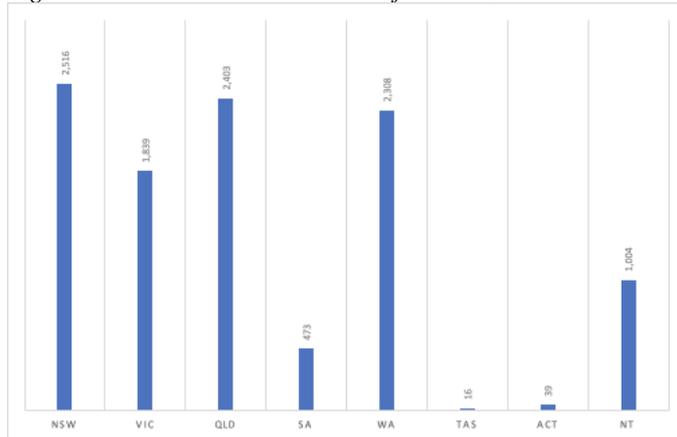


Figure 2. National per capita use of MBS item numbers 12325 and 12326 by state (per 1000 population).

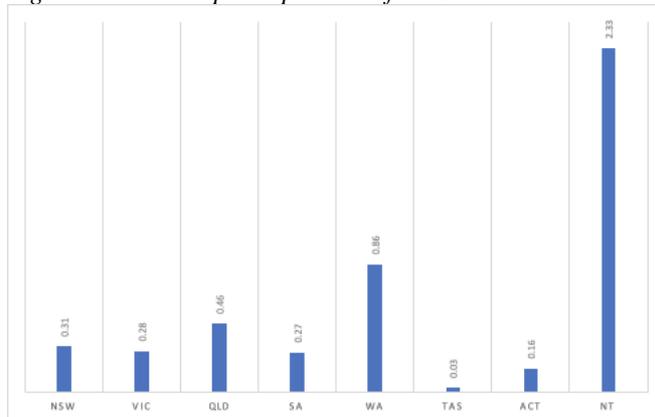


Figure 3. Proportion of item numbers 12325 (Aboriginal Torres Strait Islander specific) of the total (items 12325 and 12326 combined), by state.

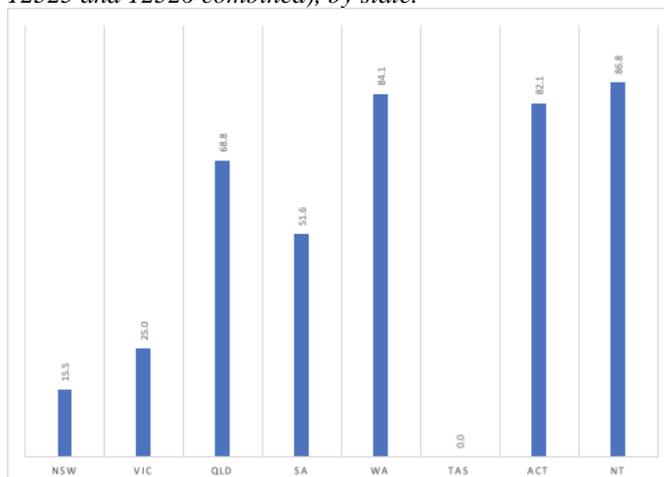


Figure 4. Item number 12325 used per capita in the Aboriginal Torres Strait Islander population (Source: ABS Census) (per 1000 population)

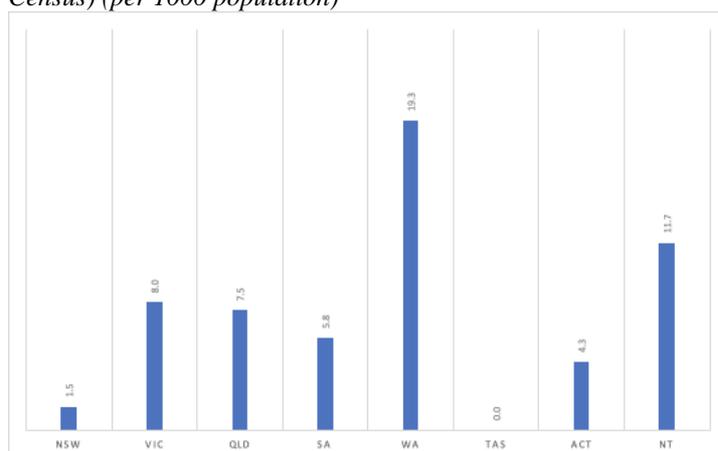
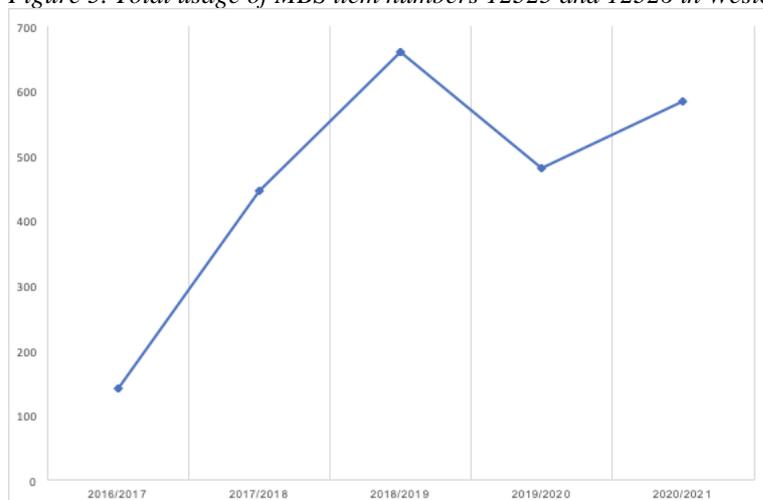


Figure 5. Total usage of MBS item numbers 12325 and 12326 in Western Australia.



Pre-introduction modelling suggested that over 400,000 patients with diabetes would be screened with the new primary health item numbers for retinal photography.⁶ Five years since introduction, the national figure of cumulative item number use was 10,598. A number of studies have assessed potential factors, which may have contributed to this significant underutilisation.^{5,6,8} A key theme in these studies was that GPs have a strong belief in their role in managing chronic diseases, yet there are a number of barriers to utilising retinal screening in practice. These include the costs of retinal cameras, time constraints, the need for dedicated staff to take the responsibility of DR screening, lack of skills to make a DR diagnosis, unawareness of Medicare incentives for non-mydratic retinal photography, optometrists being perceived as ideal for DR screening, and limited referral pathways.⁶⁻⁸

3.7.4 Public Optometry

3.7.4.1 Visiting Optometrists Scheme (VOS)

“The Visiting Optometrists Scheme (VOS) is a federal-funded initiative which supports optometrists to deliver outreach optometric services to remote and very remote locations, and other communities with an identified need for optometric services. A portion of VOS funding is earmarked specifically to provide increased optometry services to Aboriginal and Torres Strait Islander people.”⁹

Key statistics:

- In 2019–20, there were 22,089 occasions of service for Indigenous patients and 18,299 for other patients under the VOS with the occasions of service being greatest in very remote and remote areas.¹⁰
- By comparison, there were around 8,298 occasions of service by the VOS to Indigenous people in 2010–11.

- Of all the Australian states and territories, the rate of Indigenous occasions of service by the VOS was highest in the NT (56 per 1,000), and WA (38 per 1,000) in 2019–2020.
- Country WA Primary Health Network (PHN) recorded the second highest rate (65 per 1,000) of PHNs while the rate for Perth's North PHN was the lowest (0.7 per 1,000).¹⁰

3.7.4.2 Subsidised spectacles

The NEHS¹² reported that no data were available in WA for the number of spectacles dispensed to Indigenous Australians through their subsidised scheme(s). However, in 2019, Lion's Outback Vision provided 2,528 consultations in WA, 91% of those were for Indigenous Australians. They also dispensed 1,955 spectacles to Indigenous people (an increase of 714 from 2017): 1,163 in the Kimberley, 638 in the Pilbara, 120 in the Goldfields, and 34 in the Perth Metro areas.

3.7.5 Private Optometry

Cross-sectional data about private optometry advertisements was scraped from three key platforms, including Healthengine, Healthdirect, and Myhealth1st in November 2021.

There were 304 private optometry practices in WA with listed advertisements on three platforms, including Healthengine, Healthdirect, and Myhealth1st. Each practice was plotted on a geographical map of WA (Figure 6). An interactive map was developed to explore the location of specific optometry practices (Available online: <https://public.tableau.com/app/profile/joos.meyer/viz/Optometry/DotsPolyOPT>)

The number of optometry practices within each postcode were plotted (Figure 7). Practices were located in 91 different WA postcodes. The postcodes with the highest number of practices were postcode 6018 (Churchlands, Doubleview, Gwelup, Innaloo, Karrinyup, and Woodlands) with 18 practices and postcode 6000 (Perth city) with 18 practices. WA has 11.41 optometry practices per 100,000 capita. The practices per capita varied between postcodes and can be visualised in Figure 8.

Figure 6. Private optometry practices in WA. Each point represents a single practice. An interactive version is available online: <https://public.tableau.com/app/profile/joos.meyer/viz/Optometry/DotsPolyOPT>.

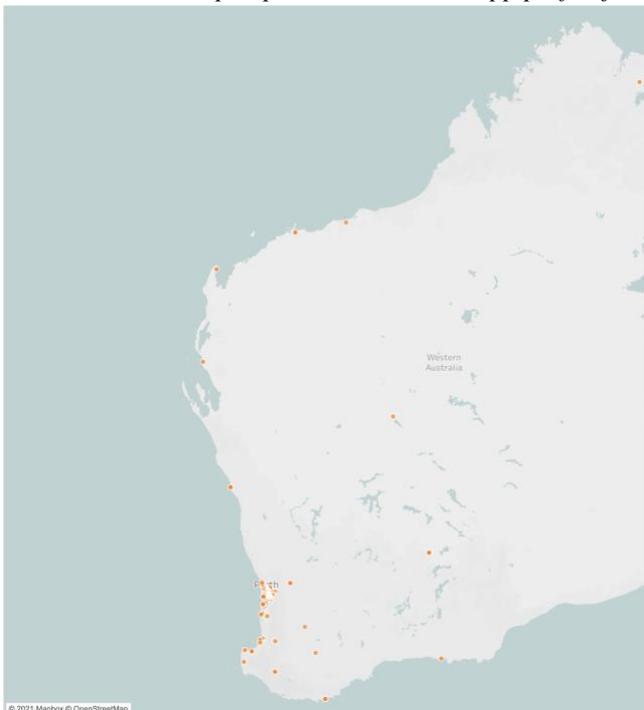


Figure 7. Number of optometry practices in WA by postcode.

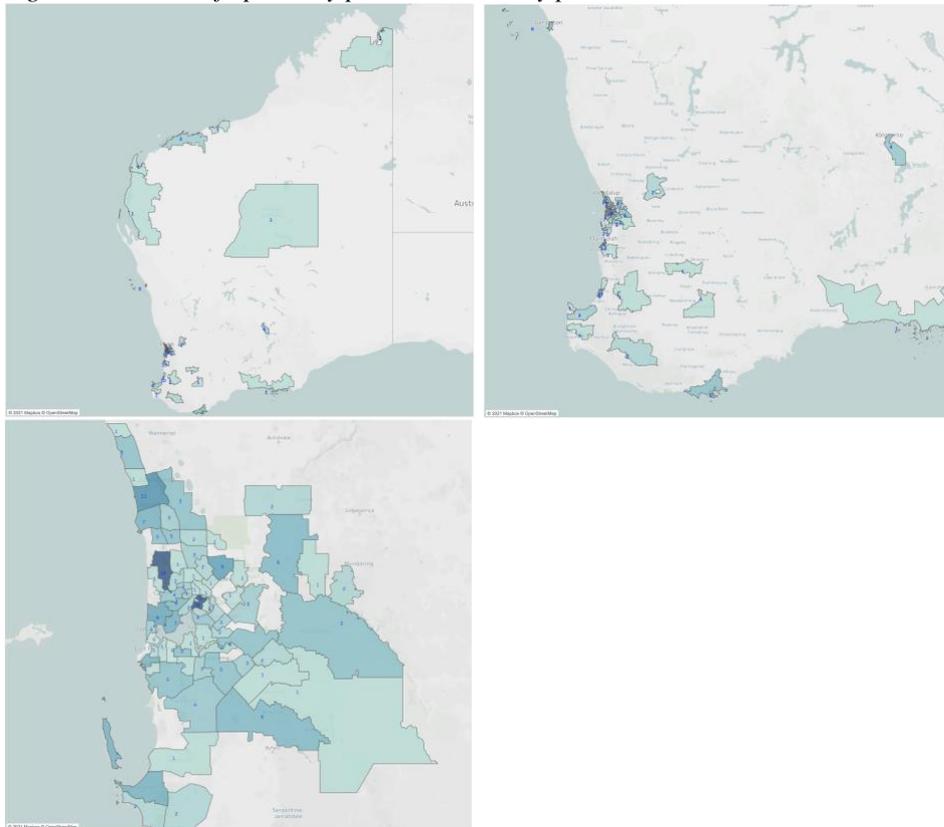
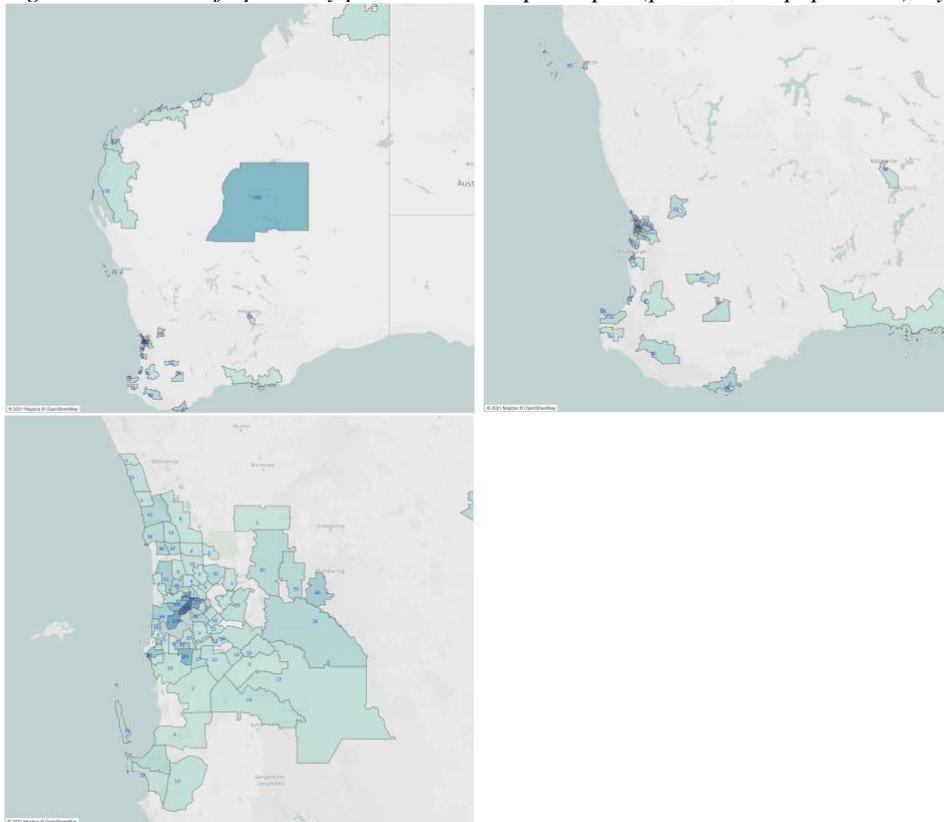


Figure 8. Number of optometry practices in WA per capita (per 100,000 population), by postcode.



3.8 Secondary Healthcare Services

3.8.1 Ophthalmology

The Medical Board publishes quarterly statistics on the Medical Practitioner Registrant Data. In 2021, there were 8,364 specialist medical practitioners registered in WA. In 2021 there were 90 ophthalmologists registered in WA. Therefore, Ophthalmology represents 1% of the WA specialist workforce. Full time equivalent

Key statistics:

- According to the 2017 RANZCO workforce survey, WA Fellows reported 47.2 hours of work in an average week, which is higher than the College-wide average of 42.13 hours.
- Table 3 highlights the trends in public and private clinical hours spent by ophthalmologists in Western Australia compiled from the NHWDS data. The proportion of time spent in public vs private practice is relatively stable year on year.
- The majority of FTE (76.3–84.3) is spent in private practice. Between 20% and 40% of ophthalmologists spend no time in public practice. Public practice accounts for approximately 15-24% of FTE from 2013–20 and 80-90% of clinicians spent less than 10 hours per week in public practice.

Table 3. Summary statistics of public and private hours worked by ophthalmologists in WA 2013–2020. Data source: NHWDS¹⁹

Year	2013	2014	2015	2016	2017	2018	2019	2020
Number of ophthalmologists	68	71	68	78	78	77	80	81
Public FTE	21.8	20.8	23.4	30.9	31.1	30.2	25.6	33.1
Private FTE	51.1	55.6	57.6	57.3	66.7	62.8	63.3	67.8
Total FTE	72.9	76.4	81	88.2	97.8	93	88.9	100.9
Mean public hours per clinician/per week	6.4	5.8	6.9	9.5	8.0	7.8	6.4	8.2
Mean private hours per clinician/per week	30.0	31.3	33.9	30.5	30.0	30.0	30.0	30.0
Total clinical hours per clinician/per week	36.4	37.2	40.7	40.0	38.0	37.9	36.4	38.2
Proportion of public hours (%)	17.6	15.7	16.9	23.7	21.0	20.7	17.5	21.4
Proportion of private hours (%)	82.4	84.3	83.1	76.3	79.0	79.3	82.5	78.6
Proportion of persons <=10 hours public	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8
Proportion of persons 0 hours public	0.2	0.3	0.3	0.2	0.3	0.2	0.4	0.3

In 2019, there were about 965 ophthalmologists employed in Australia (4.0 FTE per 100,000). Between 2013 and 2019, the number of ophthalmologists increased slightly, while the rate remained fairly constant. In 2019, major cities had the highest number (818) and rate (4.9 FTE per 100,000) of employed ophthalmologists, followed by the inner regional areas (121, 2.9 FTE per 100,000) and outer regional areas (23, or 1.3 FTE per 100,000).

3.8.1.1 Regional distribution

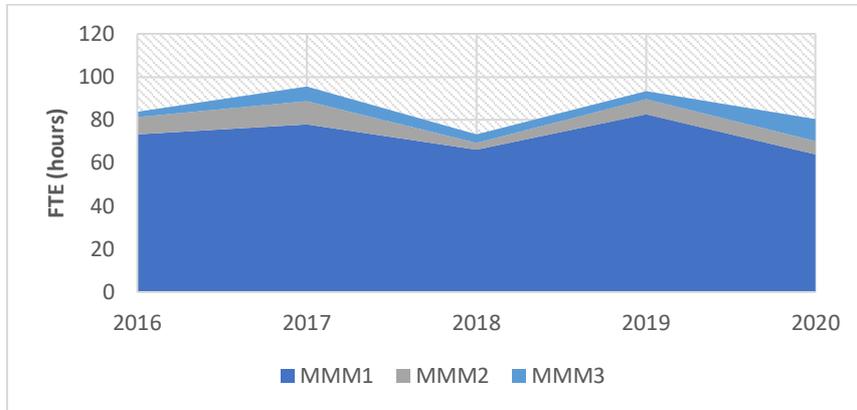
Allen et al. recently published an Australia-wide ophthalmology-workforce analysis study using AHPRA data. They found that ophthalmologists have a high level of location stability and are concentrated in the metropolitan areas.

Key statistics:

- Between 2014 and 2019, 84% of ophthalmologists remained in MMM1, 79% in MMM2 – MMM7.¹¹
- There was a trend for an increasing proportion of ophthalmologists to work outside the major cities, from 19% in 2014 to 24% in 2019.¹¹ The majority (72%) of the Australian population lives in MM1 areas suggesting that the concentration of ophthalmologists in these areas does not match the population distribution.
- According to the NHWDS data, no ophthalmologist in WA reported working in a >MMM3 area between 2016 and 2020. The majority of the ophthalmology FTE is within MMM1 areas (Figure 9). This data does not appear to capture the FTE from the ophthalmology outreach clinics.

- According to the 2017 RANZCO workforce survey, 25.58% of WA Fellows worked more than once a month in rural or remote areas compared to 24.4% of Fellows College-wide and 14.8% of total average work hours were spent in rural or remote areas, compared to the national rate of 16.95%.

Figure 9. A stacked area chart of Western Australian ophthalmologists' FTE by the Modified Monash Model. Data source: NHWDS¹⁹



3.8.2 Public Ophthalmology Theatres

The AIHW publishes annual data on public hospital elective surgery activity. The full dataset between 2011 and 2019 reporting years was downloaded and analysed. In 2019 there were 23 hospitals within five local hospital networks, which reported surgeries performed by an ophthalmologist in Western Australia (Table 4). There has been a gradual decline in the number of hospitals in WA, which provide ophthalmology theatre services from 27 in 2011 to 23 in 2019.

Table 5 highlights the opening and closure activity resulting in this net decline. Opening is defined as a new hospital reporting ophthalmic procedures. Closing is defined as a hospital no longer reporting ophthalmic procedures in the given year. The increase in procedure numbers and reduction in active public hospitals has resulted in a net rise in the caseload per hospital.

Table 4. Hospitals with surgeries performed by an ophthalmologist in WA, by local hospital network (2019).

Local hospital network	Hospital
Child Adolescent Health Service	Perth Children's Hospital
East Metropolitan Health Service	Bentley Health Service Royal Perth Hospital St John of God Midland
North Metropolitan Health Service	Sir Charles Gairdner Hospital Osborne Park Hospital Joondalup Health Campus (Public)
South Metropolitan Health Service	Fremantle Hospital Peel Health Campus
WA Country Health Service	Albany Hospital Broome Hospital Bunbury Hospital Busselton Health Campus Carnarvon Hospital Derby Hospital Esperance Hospital Geraldton Hospital Hedland Health Campus Kalgoorlie Health Campus Karratha Health Campus Katanning Hospital Kununurra Hospital Northam Hospital

Table 5. WA hospitals that opened and closed between 2011 and 2019.

Year	Hospitals opened	Hospitals closed
2011		Nil
2012		Nil
2013		Geraldton Hospital
2014		Armadale-Kelmscott Memorial Hospital
2015	Geraldton Hospital St John of God Midland Public Hospital	Kaleeya Hospital Swan District Hospital
2016		Rockingham General Hospital
2017	Perth Children's Hospital	Geraldton Hospital
2018	Geraldton Hospital Karratha Health Campus	Merredin Hospital Princess Margaret Hospital for Children
2019		Nickol Bay Hospital

3.8.3 Public Hospital Cataract surgery

Key statistics:

- According to data extracted from the AIHW elective surgery activity reports, the number of cataract surgeries performed in public hospitals in Western Australia appears to have declined from 9595 in 2011 to 7539 in 2019 (Figure 10).
- 2015 was the busiest year with 11,059 cataract surgeries reported.
- The three highest volume public hospitals in 2019 were the Bentley Health Service, Peel Health Campus, and Fremantle Hospital and Health Service reporting 2334, 1017, and 907 cataract surgeries, respectively (Figure 11). The East Metropolitan Health Service was the busiest network, reporting 3308 cataract surgeries in 2019 (Figure 12).
- The trend of total number of cataract surgeries was increased to 10626 in 2016, then there was a 30% decline to 7451 in 2017 (Figure 10). The hospitals with the three greatest reductions in cataract surgeries reported in this same period and the proportion drop in service (%) were the Bentley Health Service -661 (23%), Osborne Park Hospital -610 (41%), and Busselton Health Campus -608 (59%) (Appendix 3).
- A recent report prepared for Vision2020 regarding the current and future demand for cataract surgery in Australia indicated that the demand for surgery will likely increase in the coming decades due to ageing population.²⁰

Figure 10. Number of cataract surgeries performed in Western Australia (2011–2019). Data source: AIHW elective surgery activity.

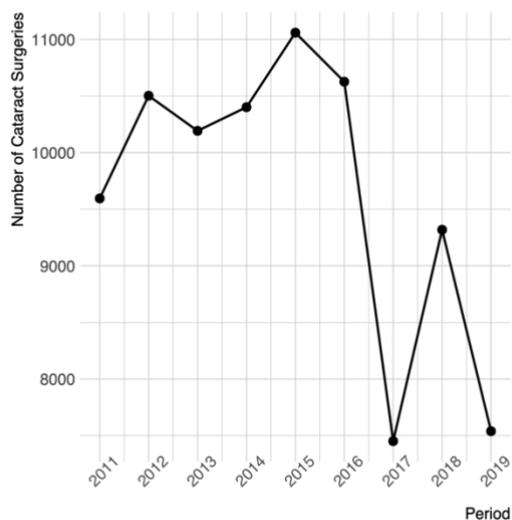


Figure 11. Number of cataract surgeries performed in Western Australia, by hospital (2019). Data source: AIHW elective surgery activity.

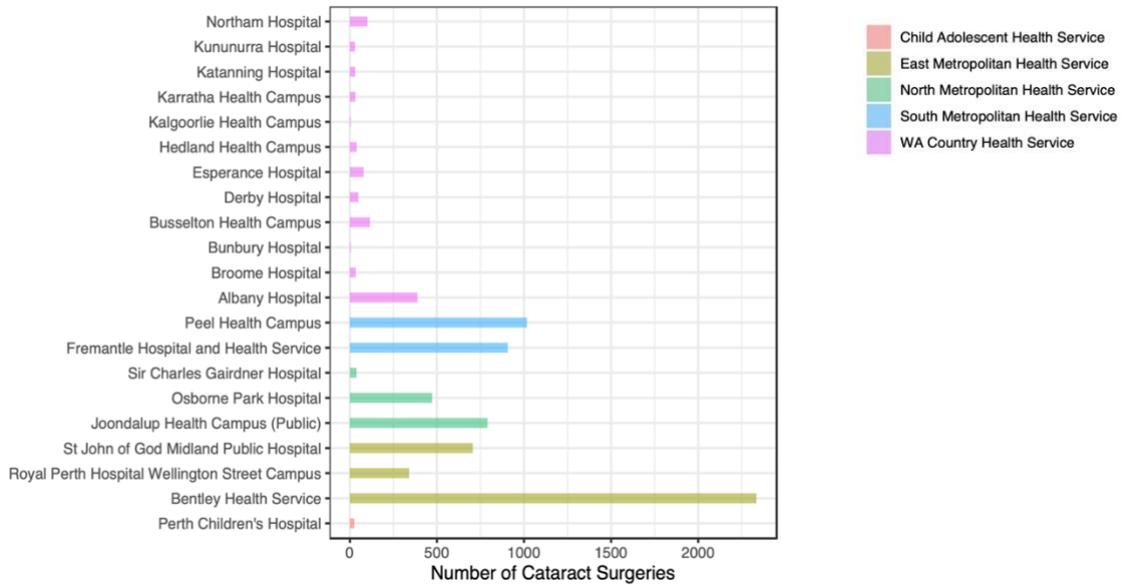
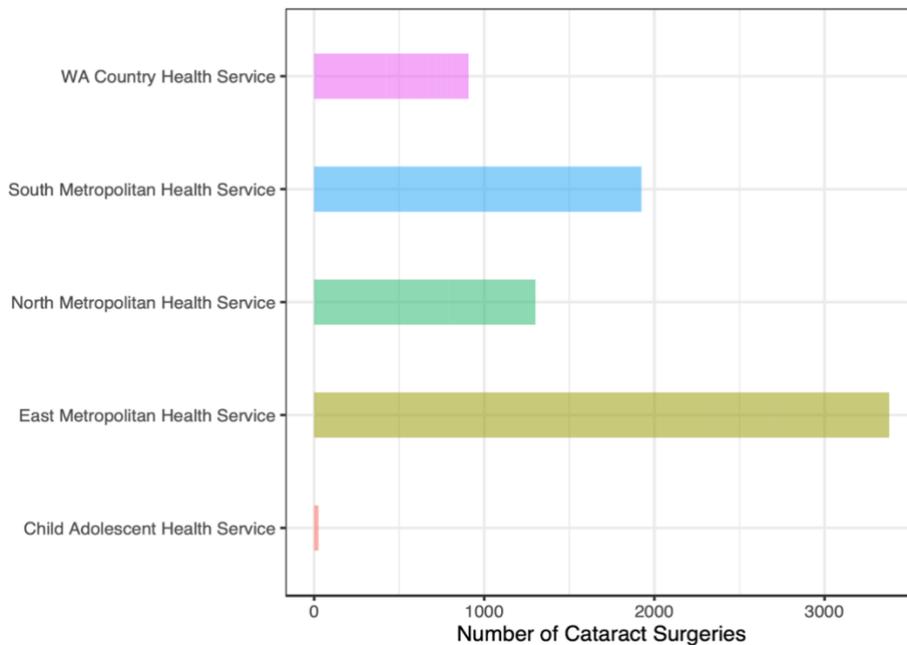
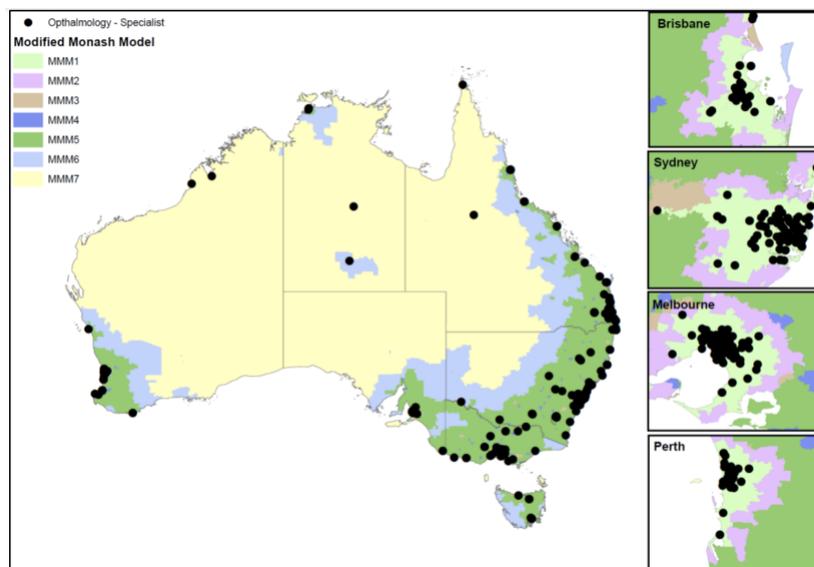


Figure 12. Number of cataract surgeries by local health network (2019). Data source: AIHW elective surgery activity.



However, when comparing these figures to the MBS data on item 42702 (Lens extraction/cataract), there was a steady increase from 16,362 to 17,162 (public and private practice) from the 2016 – 2017 reporting year. Possible issues may be data integrity in the reporting pipeline from the hospitals to AIHW, data storage issues, and data analysis issues. It may also represent a shift from public to private cataract procedures, although this is unlikely, given the proportion of total hours worked in public and private practice appear to be stable across the years for ophthalmologists (Table 3). The source of this reduction warrants further investigation.

Figure 13. Ophthalmology workforce (clinicians) by the Modified Monash Model (2016).²¹



3.8.3.1 Cataract Surgery Rates

The NEHS¹² reported cataract surgery coverage rates across Australia and findings (based on self-reported surgery for cataract) indicated significantly higher rates in non-Indigenous (87.63%) participants than in Indigenous (61.47%) participants ($p < 0.001$). The rate did not differ by the remoteness category.

Results from AIHW data indicated that across Australia, around 6,100 Indigenous Australians (around 3,655 per 1,000,000) had cataract surgery in 2017–2019, with the rate being the highest in remote and very remote areas and lowest in major cities. These numbers represent an increase in the age-standardised rate of 63.8% from 2008–2010. However, the age-standardised rates of cataract surgeries in 2018–2019 for Indigenous Australians (8,519 per 1,000,000) remained lower than that of non-Indigenous Australians (9,102 per 1,000,000).

To better understand the extent to which the need for cataract surgery was met across Australia and its states and territories, the Indigenous Eye Health Unit (IEHU) at the University of Melbourne calculated the met need for cataract surgery in Indigenous Australians. The results showed that in WA in 2017–2019 the met need for cataract surgery was estimated to be 76% in the NG Lands, 57% in the Wheatbelt, 53% in the Kimberley region, 49% in the Goldfields, 44% in the Great Sothorn region and the Pilbara, 35% in the Mid-West, 29% in Perth, and 25% in the South-West.¹⁰

Approximately 80% of cataract surgeries for Aboriginal and Torres Strait Islander people and 29% for non-Indigenous people were performed in public hospitals.

3.8.4 Private Hospital Cataract Surgery

The Private Hospital Data Bureau (PHDB) contains private hospital data organised by separation (admission to discharge). Data is granular to the state but not hospital level. The Australian Refined Diagnosis Group Version 9 (AR-DRG) code C16Z ‘Lens interventions’ specifies separations related to cataract surgery. In the 2019-20 financial year (latest data) there were 16,618 separations coded as C16Z ‘Lens interventions’ in Western Australia. 8,463 were from ‘Private – Day’ hospitals and 8,155 were from ‘Private – Other’ hospitals. Explanatory notes from the data set suggest that ‘Private – Other’ relate to private hospitals with overnight facilities. There were 17,390 C16Z ‘Lens interventions’ in WA in 2017-18 and 18,817 in 2018-19. Previous data formats were not compatible.

3.8.5 Public Hospital Wait Times

3.8.5.1 Surgery

Key statistics:

- Analysis of the AIHW elective surgery activity data suggests that median wait times for cataract surgery are increasing in Western Australia (Figure 14).
- In 2011, the mean median wait time was 80 days, compared to 123 days in 2019. The large increase in average wait times from 2017–2019 appears to be driven by the increase wait times in the WA Country Health Service (Figure 15).
- In 2019, the three longest wait times were at Derby Hospital, Esperance Hospital, and Katanning Hospital of 328, 308, and 252 days. The longest metropolitan wait time was at the Joondalup Health Campus, 146 days. Osborne Park Hospital had the lowest wait time of 10 days.
- As the volume of procedures varies substantially between hospitals (Figure 16), volume-weighted wait times were calculated by taking into account the size of the service by the number of procedures performed. Volume-weighted wait time was slightly higher in regional sites compared to metropolitan sites for cataract procedures (153.3 vs 64.2 days, $P < 0.001$).

Figure 14. Median cataract surgery wait times across all WA hospitals (2011 – 2019). Data source: AIHW elective surgery activity.

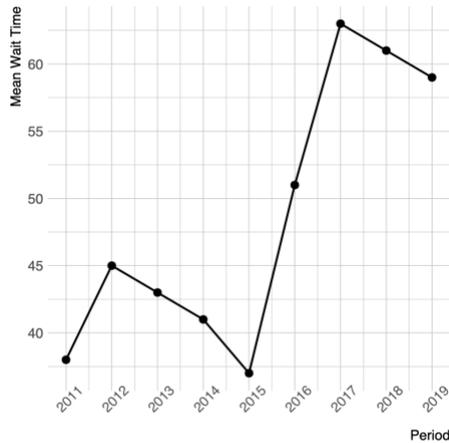


Figure 15. Cataract surgery wait times in WA, by network. Data source: AIHW elective surgery activity.

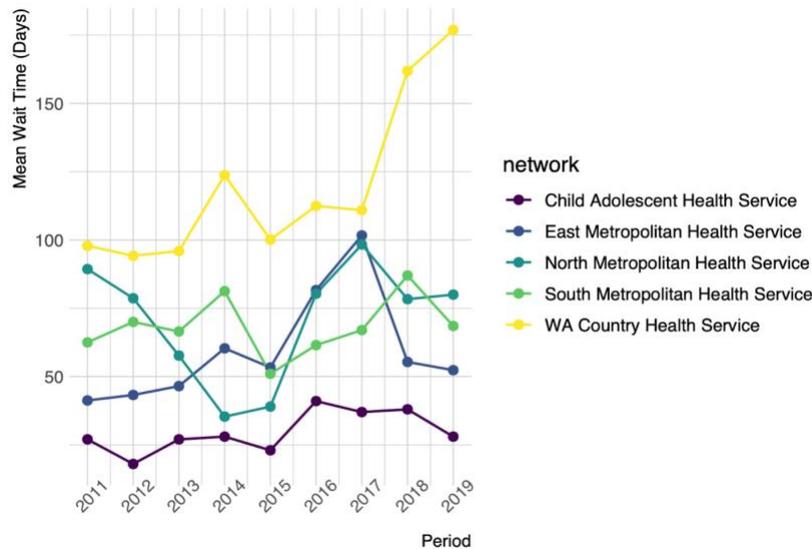
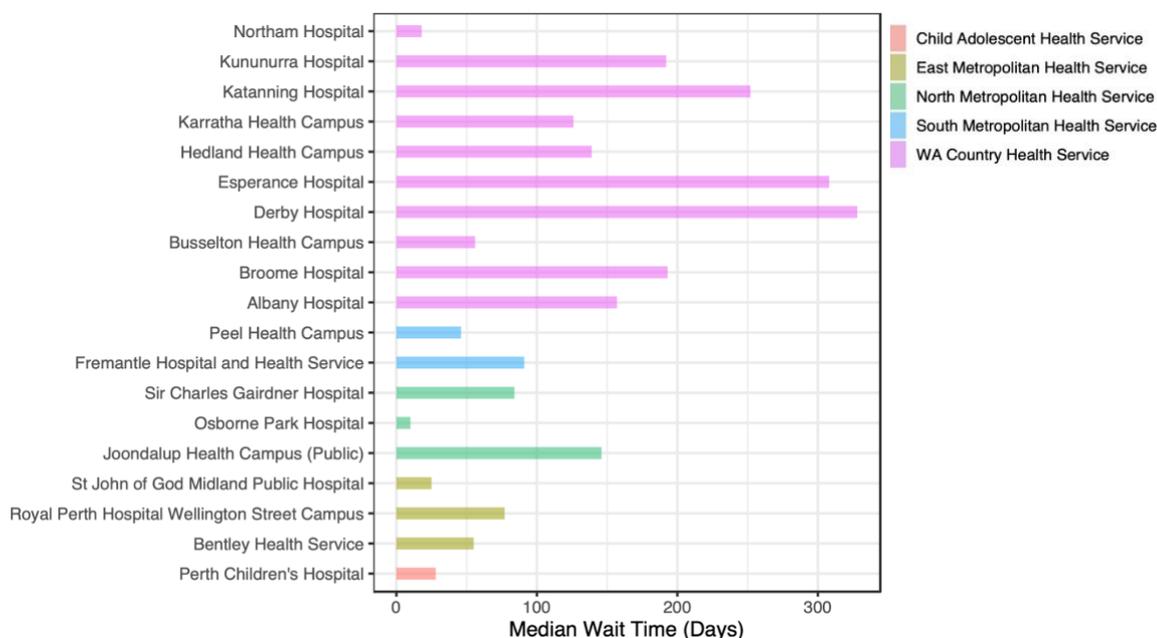


Figure 16. Median wait time (days) for cataract surgery by hospital (2019). Data source: AIHW elective surgery activity



*No data available for Bunbury Hospital or Kalgoorlie Health Campus.

3.8.5.2 Outpatients - The 'Wait for the Wait'

Wait times captured through the AIHW data reflect the time from addition to a public hospital waiting list to admission. They do not capture the time from initial diagnosis by a general practitioner or optometrist and referral to an ophthalmologist. This waiting time from the initial referral to a public hospital is referred to as the 'hidden waiting list' or the 'wait for the wait'. There is some reporting of this figure nationally; however, it is inconsistent and ranges from a median wait time of 3 months in Victoria to 10-20 months in the 90th percentile in Queensland.

A 2021 report on Australian cataract surgery wait times estimated a \$6.6m reduction in the health system costs, 50,679 falls avoided, and an increase of 141 motor vehicle crashes (because of a higher crash rate after second eye surgery compared with the period after first eye surgery) when reducing a wait from 12 months to 3 months.²² The authors report that reasons for this include increased age and increased exposure to more risky driving after surgeries for both eyes. There are no data available for the 'hidden waiting list' in WA.

A recent report prepared for Vision2020²⁰ found that once patients are assessed, around 50% wait an average of 1-2 months for surgery while 90% of patients have surgery within 6-11 months. It was concluded that as Indigenous Australians have higher rates of cataracts and predominantly have surgery in public hospitals, they are disproportionately affected by the long wait times.

3.8.6 Private Hospital Wait Times

There is no official central source of data for private hospital wait times. A 2018 HBF wait-times report determined private hospital waiting times in Western Australia using a mix of qualitative and quantitative data provided by the national private hospital networks Ramsay Healthcare and St John of God (SJOG). The 'wait for the wait' in private hospitals was reported to be 2-3 weeks.²³ The average wait time for ophthalmological procedures was 8.24 days (Table 6).

Table 6. Average waiting times in Western Australian private hospitals by surgical speciality.

Surgical Speciality	Average waiting time from notification from Specialist ('Doctor's rooms') "decision to admit for treatment" to admission to hospital for non-emergency care (Days)
Cardiology (e.g. Heart treatment)	5.55
Cardiothoracic surgery (e.g. Heart surgery)	6.68
Chemotherapy cancer treatment	No wait
Ear, nose and throat surgery	9.97
Endocrinology (e.g. Diabetes, thyroid problems)	4.93
Gastroenterology (e.g. Colonoscopy)	8.65
General surgery (e.g. Hernia repair, appendectomy)	8.24
Gynaecology (e.g. Hysterectomy)	8.5
Obstetrics (e.g. Childbirth)	No wait
Ophthalmology (e.g. Cataract surgery, glaucoma treatment)	8.41
Oral faciomaxillary (e.g. Complex dental surgery, jaw surgery)	9.89
Orthopaedics (e.g. Hip and knee replacement surgery, knee cartilage repair)	9.54
Pain management (e.g. Chronic pain management)	6.57
Plastic surgery (e.g. Removal of skin cancers, breast cancer reconstruction)	7.94
Respiratory medicine (e.g. Sleep studies, chronic breathing disorders)	4.82
Spinal surgery (e.g. Laminectomy, spinal fusion, "slipped disc")	7.05
Thoracic surgery (e.g. Lung surgery)	4.2
Urogynaecology (e.g. Management of urinary/prolapse problems)	9
Urology (e.g. Prostatectomy, cystoscopy)	10.36
Vascular surgery (e.g. Peripheral vascular disease, varicose veins)	10.62

Source: Booking module, Patient Administration System 'WebPAS'. Quantitative data analysis of 48,500 episodes admitted to WA SJOG hospitals from January to June in 2018 (SJOG Murdoch, Mt Lawley and Subiaco hospitals).²³

3.8.7 Private Ophthalmology

In November 2021, an analysis of ophthalmologist advertisements on three platforms including Healthengine, Healthdirect, and Myhealth1st was performed. Advertisements from one hundred and five (105) clinicians were found in Western Australia. Thirty (30) clinicians were removed as they were not ophthalmologists or were duplicate entries. There were 75 ophthalmologists with advertisements on these platforms. Four (4) known WA ophthalmologists did not have advertisements listed, making a total of 79 active ophthalmologists in Nov 2021. The mean (range) number of private clinics that listed each ophthalmologist is 2.1 (1-6). There were 72 private clinics advertised in Western Australia. The mean (range) number of ophthalmologists per clinic was 2.3 (1-18). The full list of ophthalmologists and clinics can be found in Appendix 1 and Appendix 2, respectively. Figure 17 shows each clinic plotted on a geographical map of WA (Online access: https://public.tableau.com/app/profile/joos.meyer/viz/Ophthalmology_16400489206400/DotsPoly#1).

The number of unique clinician-clinic instances within each postcode was plotted (Figure 18). For example, one clinician working in two practices in separate postcodes is counted as a unique clinician-clinic instance in each location. The practices were located in 35 different WA postcodes. The postcodes with the highest number of clinicians were 6009 (Crawley, Dalkeith, Nedlands) with 37 clinicians and 6151 (Kensington, South Perth) with 23 clinicians. WA has 8.3 ophthalmology clinician-clinic instances per 100,000 capita. Clinician-clinic instances per capita varied between the postcodes and can be visualised in Figure 19.

Figure 17. Advertised private ophthalmology clinics in WA. Each point represents a single clinic and the size of the point is relative to number of clinicians. Interactive version available online: https://public.tableau.com/app/profile/joos.meyer/viz/Ophthalmology_16400489206400/DotsPoly#1

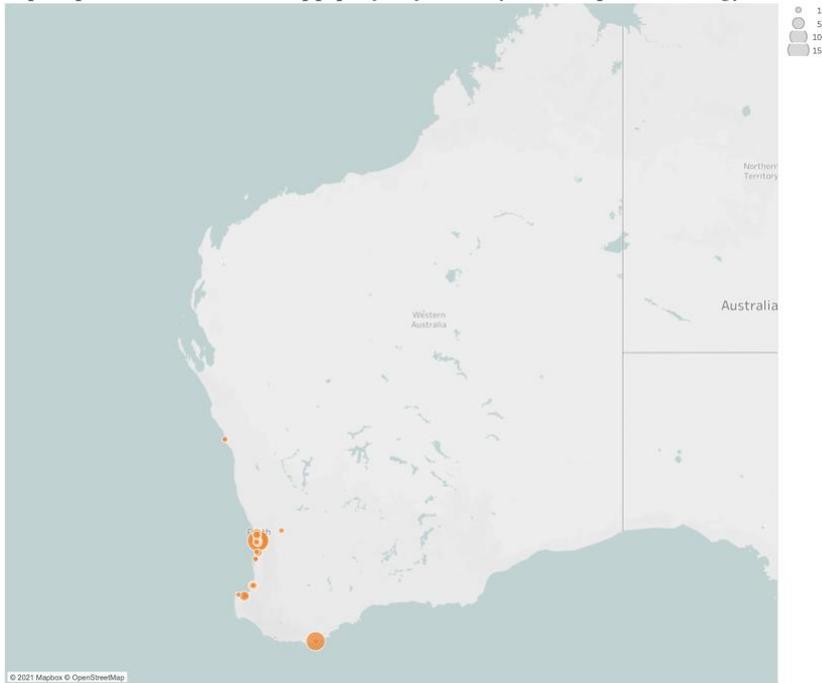


Figure 18. Number of ophthalmology clinician-clinic instances by postcode.



Figure 19. Number of ophthalmology clinician-clinic instances per capita (per 100,000 population), by postcode.



3.8.8 RANZCO ‘InReach Ophthalmology Network’

A recent RANZCO WA workforce report proposed the ‘InReach ophthalmology network,’ which combines the accredited training posts with private practice as a pathway for Aboriginal and Torres Strait Islander patients to be directly wait listed for procedures on the public hospital wait list. The affiliated private clinics would be seen as outreach clinics from affiliated public hospital ophthalmology departments. The aim is to expedite wait listing of Aboriginal and Torres Strait Islander patients through building relationships with local Aboriginal health service providers and the private sector. Doctors and support staff would all receive and maintain appropriate cultural competency training. The key recommendation from the RANZCO WA workforce report was for WA health to support the development and funding of innovative urban clinical-care pathways for Aboriginal and Torres Strait Islander peoples.

3.8.9 Telehealth

3.8.9.1 What is teleophthalmology

Telehealth services use information technology to provide health care to patients over a distance. Ophthalmology is particularly suited to this technology due to its high reliance on visual information for the diagnosis and management of disease.²⁴ Synchronous and asynchronous types of telehealth differ in the time when an assessment is made by a clinician. Synchronous telehealth, or ‘real time’ telehealth, involves a live connection between clinician and referrer with the aim of mimicking an in-person consultation. Asynchronous, or ‘store and forward’ telehealth involves the capturing of clinical images with assessment by a clinician in a different geographical location and later time.²⁵ Diabetic retinopathy is perhaps the most-recognised application of asynchronous telehealth in ophthalmology. A systematic review of 12 studies comparing real-time teleophthalmology with face-to-face consultations found that real-time teleophthalmology was found to be superior to face-to-face consultations in one study and comparable in six.²⁵

3.8.9.2 Teleophthalmology in Western Australia

Lions Outback Vision (LOV) currently provides the only official teleophthalmology service in Western Australia, which has been in service since 2011. The program provides a combination of both synchronous and asynchronous types with imaging and test results being sent to the treating ophthalmologist prior to a real-time virtual consultation taking place.²⁶ Referrals originate from regional and remote optometrists (59%), hospital district medical officers (23%), and GPs (18%). The scale of the service is vast with the closest location to Perth being 416 km away and the most distant being 3215 km away. The main sites in 2015 were Karratha (41%), Albany (20%), and Broome (14%). The main equipment used included digital retinal cameras (56%), smartphones (25%), and digital slit lamps (13%).²⁷

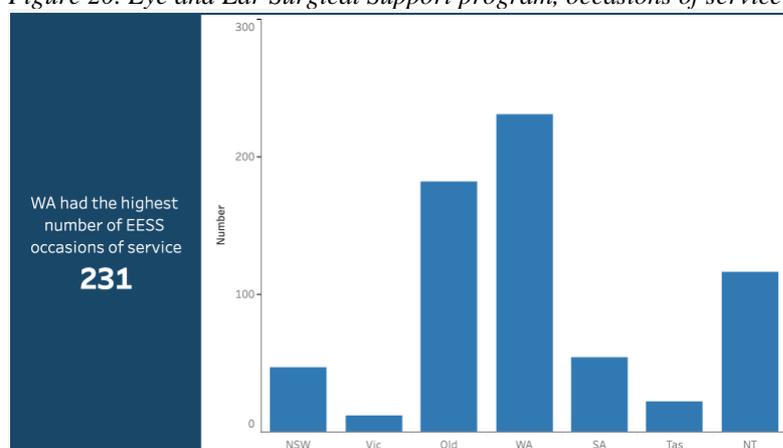
In 2021, 25% (n=1825) of all LOV ophthalmology appointments were conducted through telehealth. This has increased from 683 teleophthalmology teleconsultations in 2016. A 2016 audit found that cataract was the most frequent diagnosis (n = 287, 42.7%), followed by glaucoma (n = 77, 11%), age-related macular degeneration (n = 30, 4.4%), and diabetic retinopathy (n = 26, 3.8%). From the patients who had teleconsultations, 98.6% were from outer regional, remote or very remote Australia. A 2017 study assessed patient satisfaction with the WA teleophthalmology service and found the majority of the participants were either 'Very satisfied' (69.1%) or 'Satisfied' (24.5%) with the service. No one reported being either 'Dissatisfied' or 'Very dissatisfied'.²⁶

An on-call teleophthalmology service was introduced in 2016 to complement the online booking system. A clinical audit showed that the proportion of Indigenous patients in the on-call telehealth cohort was 51.4%, compared to 8.7% in the online-booking telehealth group (p< 0.01) representing a 10-fold increase in access for Aboriginal patients. Of all telehealth consultations in 2018, 27.8% made use of the on-call service, demonstrating high demand for the more flexible booking arrangement.²⁸ According to the 2017 RANZCO workforce survey, telehealth utilisation rate by WA Fellows is slightly higher (10.26%) than the national rate (8.11%).

3.8.9.3 Eye and Ear Surgical Support Program (EESP)

In 2019–20, a total of 664 occasions of service for Indigenous patients were provided by eye health professionals under the Eye and Ear Surgical Support (EESP) program (Figure 20).

Figure 20. Eye and Ear Surgical Support program, occasions of service (2019–20). Source: AIHW.



3.8.10 Outreach Services

3.8.10.1 Lions Outback Vision

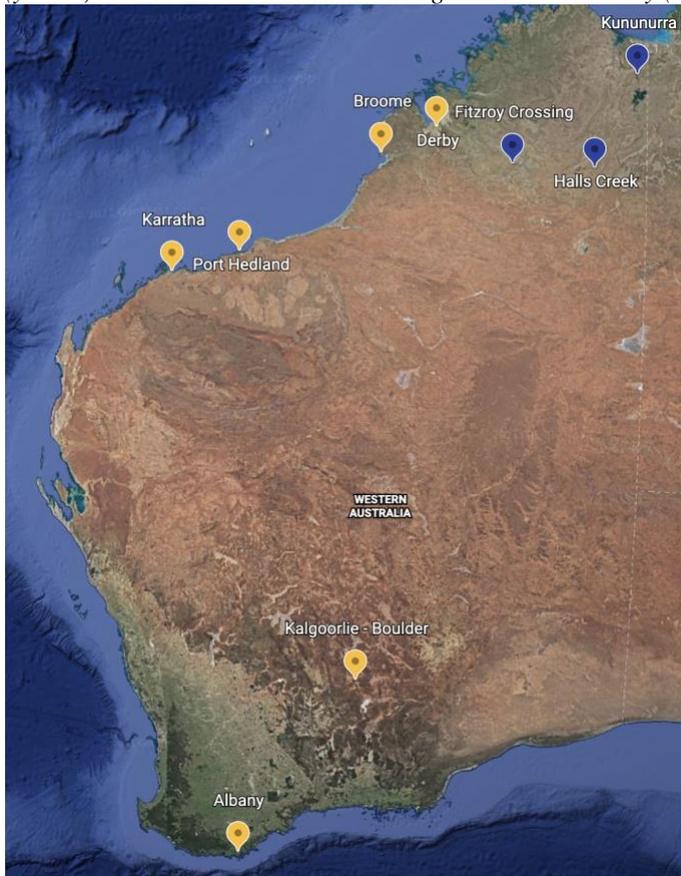
Lions Outback Vision (LOV) is an outreach ophthalmology service run through the Lions Eye Institute. The service has headquarters in Perth, Western Australia at the Harry Perkins Medical Institute. The Broome regional hub was recently built as a second headquarters to service the north west of WA. The service includes outreach outpatient clinics, operating theatre, a mobile clinic (the ‘Vision Van’), and a telehealth ophthalmology service.

The Lions Outback Vision ‘Vision Van’ visits 22 locations in regional Western Australia (Figure 21) over an approximate 6-month schedule. Visiting ophthalmology outpatient clinics are held in nine regional locations and has operating theatres in six locations (Figure 22). In addition, LOV runs a monthly Aboriginal Medical Service outpatient clinic at Derbarl Yerrigan Health Service in the Perth metro.

Figure 21. Twenty-two regional locations covered by the Lions Outback Vision ‘Vision Van.’



Figure 22. Six regional locations with combined visiting ophthalmology outpatient clinic and theatre services (yellow) and three locations with visiting clinic services only (blue).



3.8.11 Regional Ophthalmology Clinics

There are a number of private ophthalmology clinics, which operate in regional centres. In November 2021, an analysis was performed on the ophthalmologist advertisements on three platforms, including Healthengine, Healthdirect, and Myhealth1st. Clinics located in any postcode outside the Perth metro area were included in the analysis of regional ophthalmology clinics. There were 26 clinicians working in 13 clinics, in seven regional centres. One clinician worked in three different clinics, four clinicians worked in two, and the other 21 clinicians worked in one clinic each. The number of clinicians working in each location and clinic is summarised in Table 7 below.

Table 7. Number of ophthalmologists per regional clinic.

Postcode – Location, Clinic Name	Count of Clinician
6210 - Mandurah	3
Mandurah Eye Centre	1
Murdoch Ophthalmology	1
Peel Vision	1
6230 - Bunbury	6
Bunbury and Busselton Eye Doctors	3
Southwest Eye Surgeons	3
6280 - Busselton	6
Bunbury and Busselton Eye Doctors	3
Southwest Eye Surgeons	3
6281 - Dunsborough	1
Dunsborough Eye Clinic	1
6330 - Albany	13
Dr David Offerman, Ophthalmologist - Albany	1
Great Southern Specialist Centre	12
6401 - Northam	1
Perth Eye Clinic	1
6530 - Geraldton	2
Geraldton Eye Surgery	1
St John Of God Visiting Specialists - Dr Nigel Morlet	1
Grand Total	32

3.9 Tertiary Healthcare Services

Tertiary health care refers to disability support for people with low or no vision and covers a broad range of service activities. Organisations are categorised by the type of service delivered, which includes advocacy, service providers, entertainment benefits and services, sport, and transport. The following is a summary of the key organisations identified and their activities.

3.9.1 Advocacy

Organisation	Description
Disability Services Commission	<p>Disability Services Commission works in partnership with service providers and other government departments to provide information, supports and services to people with disability, their families and carers.</p> <p>Phone: (08) 9426 9200 Email: dsc@dsc.wa.gov.au Web: www.disability.wa.gov.au</p>
Equal Opportunities Commission	<p>The Western Australian Commissioner for Equal Opportunity is responsible for the administration of the Equal Opportunity Act 1984. The Commissioner carries out this role by conducting community education and training, investigating and conciliating complaints of discrimination and providing information to the community about equal opportunity.</p> <p>Phone: (08) 9216 3900 Website: www.eoc.wa.gov.au</p>
Ethnic Disability Advocacy Centre	<p>Ethnic Disability Advocacy Centre (EDAC) is the peak advocacy organisation for people (from WA) with disabilities who are from culturally and linguistically diverse backgrounds. EDAC provides individual and systemic advocacy services for people with all types of disabilities, including physical, sensory, intellectual, and psychiatric conditions.</p> <p>Phone: (08) 9388 7455 Email: admin@edac.org.au Website: www.edac.org.au</p>
People with Disabilities WA Inc.	<p>People With Disabilities WA (PWdWA) is the peak consumer organisation for people with disabilities in Western Australia. PWdWA offers individual and systemic advocacy to all Western Australians with disabilities.</p> <p>Phone: (08) 9485 8900 Free call: 1800 193 331 Email: info@pwdwa.org Website: http://pwdwa.org</p>
Blind Citizens WA Inc.	<p>Blind Citizens WA Inc is the public voice of Western Australians who are blind or vision impaired. Members offer peer support and advocate for themselves and others who are blind or vision impaired.</p> <p>Phone: (08) 9355 5113 Email: bcwa@westnet.com.au Website: www.bcwa.org.au</p>

3.9.2 Service providers

Organisation	Description
Deafblind Information – By Senses Australia	<p>A website with accessible web-based resources for individuals living with a combination of vision and hearing impairments, their families and support members, professionals, and service providers.</p> <p>Phone: (08) 9473 5400 Email: admin@deafblindinformation.org.au Website: www.deafblindinformation.org.au</p>
EverAbility Group	<p>The EverAbility Group owns and operates a number of disability support services, including VisAbility, Guide Dogs WA, Guide Dogs Tasmania, Kites Children’s Therapy, and Perron Place. Their 2020–21 annual report states they have 178 employees, 373 volunteers, 30 allied-health student placements, and had \$16.4 million in revenue, \$2.7 million less than the previous year due to reduced government funding, resulting in a loss of \$0.5 million.</p> <p>Phone: (08) 9311 8202 Email: info@everabilitygroup.org.au Website: https://www.everabilitygroup.org.au/</p>
VisAbility	<p>Owned and operated by the EverAbility Group. The therapies offered include a dietician, exercise physiology, occupational therapy, orientation and mobility, orthoptics, physiotherapy, positive behaviour support, physiotherapy, speech therapy, and social work. Specialist services include accessible information, assistive technology, disability employment services, guide dogs, and a library. VisAbility offers both adult and children’s group programs for education and community building. The topics include night orientation and mobility, dining skills, look good feel confident, and cooking skills for beginners. Their annual 2020–21 annual report states that they delivered 51,920 service hours in WA and 2,440 people accessed the service across WA.</p> <p>Phone: (08) 9311 8202 Email: info@visability.com.au Website: https://www.visability.com.au/</p>
Guide Dogs WA	<p>Owned and operated by the EverAbility Group. Their 2020–21 annual report states they had 58 working dogs in WA, 19 new puppies entering the program, 118 volunteers, 14 dogs matched in new partnerships, and \$4,142,775 as their total fundraising income.</p> <p>Phone: 1800 847 466 Email: info@guidedogswa.com.au Website: https://www.guidedogswa.com.au/</p>
Senses WA	<p>Offers a broad range of disability support services, which includes sensory services for people living with a combination of vision and hearing impairment. Sensory services include communication skills, orientation and mobility, Dual Sensory Loss/Usher Syndrome Support Group, Assistive Technology, Deafblind Awareness Training, Communication Guide Training. Their 2020-21 annual report states they had \$29.8 million revenue and 10 Service centres in WA.</p> <p>Phone: 1300 111 881 Website: https://www.senseswa.com.au/</p>
Vision Australia	<p>Vision Australia offers a broad range of blindness and low vision support services across Australia, including Western Australia. Their 2020–21 annual report states they had 35,285 people access their services and 201,943 hours of service delivered. They had 25,500 clients, 35 centres nationally, including Western Australia and got \$119 million as revenue in the 2020–21 financial year. They had a \$2.2</p>

	<p>million surplus in the 2020–21 financial year and a \$28.3 million surplus in the 2019–20 financial year.</p> <p>Phone: 1300 84 74 66 Email: info@visionaustralia.org Website: https://www.visionaustralia.org/</p>
Retina Australia (WA)	<p>Retina Australia (WA) raises funds for local and national research into retinal disease and organises regular community events for patients and support networks.</p> <p>Phone: (08) 9388 1488 Email: info@rawa.com.au Website: http://rawa.com.au</p>

3.9.3 Entertainment benefits and services

Organisation	Description
Disability in the Arts, Disadvantage in the Arts WA (DADAA)	<p>DADAA is a not-for-profit community arts and cultural development organisation, which focuses on positive social change and opportunities for people with a disability or a mental illness. Based in Fremantle, DADAA offers targeted arts and cultural programs that include a broad range of traditional and new media projects in almost 50 Western Australian communities.</p> <p>Phone: (08) 9430 6616 Website: www.dadaa.org.au</p>
BookShare	<p>Bookshare is an online collection of Braille and Daisy books open to Australians who are blind or have print disabilities.</p> <p>Website: www.bookshare.org</p>
VisAbility Library Services	<p>VisAbility offers membership to their digital library, for anyone who is blind or has a print disability worldwide, audiobooks are delivered via post statewide, a selection of Braille books, described movies, and tactile games and toys are available at the Dr Geoff Gallop Library Resource Centre in Victoria Park.</p> <p>Phone: 1800 847 466</p>
His Majesty's Theatre Perth	<p>An Audio Description Service is offered for blind or vision-impaired persons for certain performances.</p> <p>Phone: (08) 9265 0900 Website: http://ptt.wa.gov.au/venues/his-majestys-theatre</p>
Perth Concert Hall	<p>An Audio Description Service is offered for blind or vision-impaired persons for some performances.</p> <p>Phone: (08) 9231 9900 Email: info@perthconcerthall.com.au Website: www.perthconcerthall.com.au</p>
State Theatre Centre of WA	<p>An audio description service is offered for blind or vision-impaired persons for some performances.</p> <p>Phone: (08) 6212 6200 Website: http://ptt.wa.gov.au/venues/state-theatre-centre-of-wa/your-visit/accessibility</p>
WA Companion Card	<p>The WA Companion Card is available to assist people to access ticketed events – including movies, live performances, and concerts. The Companion Card Scheme recognises the need for some people to have an attendant or carer accompany them to such events and allows the cardholder to have their companion attend free of charge.</p> <p>Phone: 1800 617 337 Website: www.wa.companioncard.org.au</p>

3.9.4 Sport

Organisation	Description
Blind Sports WA	<p>Promotes sports amongst people who are blind and vision impaired in Western Australia.</p> <p>Website: https://www.blindsportsaustralia.com.au/wa Email: blindsportswa@gmail.com</p>
Western Australian Blind Golf Association	<p>Supports playing and teaching golf for people with visual impairment in Western Australia.</p> <p>Website: www.wabga.org.au</p>
Horse Riding	<p>Riding for the Disabled Association of Western Australia (RDWA) is a voluntary, not for profit organisation that provides opportunities for people with disabilities to develop their abilities in horse riding.</p> <p>Phone: (08) 9296 4655 Email: info@rdawa.org.au Website: www.rdawa.org.au</p>
Judo	<p>The University of Western Australia Judo Club makes mainstream judo accessible to people who are blind and vision impaired.</p> <p>Phone: 0409 290 385 Email: info@judouwa.com.au Website: www.judouwa.com.au</p>
Surfing	<p>The Disabled Surfers Association is a not-for-profit organisation, which aims to give people with disabilities the opportunity to have a safe, happy and dignified surfing experience.</p> <p>Website: http://disabledsurfers.org/wa/</p>
Swish	<p>Swish is a game for people who are blind or vision impaired, it is played on a modified table-tennis table.</p> <p>Phone: (08) 9355 5113 Email: bcwa@westnet.com.au</p>
Tandem Cycling	<p>Promotes the integration of blind and vision-impaired cyclists into cycling mainstream. Organises regular rides for fun and fitness, and participates in community cycling events.</p> <p>Phone: 0410 499 464 Email: info@watcac.org Website: www.watcac.org</p>
Ten Pin Bowling	<p>Blind and Vision Impaired Ten Pin Bowling Australia BVIT supports blind and vision-impaired people in the sport of ten pin bowling.</p> <p>Email: scotteileen700@gmail.com Website: www.bvit.asn.au</p>

3.9.5 Transport

Organisation	Description
Transperth WA	<p>Transperth offers free travel to persons with vision impairment and their accompanying guide. A Western Australian and interstate vision-impairment travel pass is required, which can be granted through VisAbility, SensesWA or Vision Australia.</p> <p>Website: https://www.transperth.wa.gov.au/tickets-fares/concession-guide</p>
WA Department of Transport Taxi User Subsidy Scheme	<p>50-75% subsidies on taxis are available to certain eligible people with disabilities, travelling in on-demand rank or hail (taxi) vehicles. The subsidy is available for people with a vision disability.</p> <p>Website: https://www.transport.wa.gov.au/aboutus/taxi-user-subsidy-scheme.asp</p>
Mobility Allowance	<p>The Mobility Allowance is paid to people with a disability, who experience difficulty accessing public transport.</p> <p>Phone: 13 23 00 Website: www.humanservices.gov.au/customer/services/centrelink/mobility-allowance</p>
Qantas Carer Concession Card	<p>The Carer Concession Card is issued to people with a disability who require the assistance of a carer while travelling.</p> <p>Website: https://www.qantas.com/au/en/travel-info/specific-needs/travelling-with-specific-needs/travelling-with-a-carer.html</p>
Special Assistance at Stations	<p>Transperth provides special assistance at train stations for anyone who has a vision or mobility impairment.</p> <p>Website: www.transperth.wa.gov.au/Using-Transperth/Disability-Assistance/Train-Accessibility</p>
Vision-Impaired Persons Pass	<p>This pass entitles the pass-holder to free transport on Perth train services, Transwa regional bus and train services, regular bus routes (government and private) and Perth ferry services.</p> <p>Website: www.transperth.wa.gov.au/Tickets-Fares/Concession-Guide</p>
Mail for the blind	<p>Australia Post will deliver eligible items identified as being used to aid the blind for free or at concessional rates to blind people.</p> <p>Website: https://auspost.com.au/sending/check-sending-guidelines/mail-for-the-blind</p>

3.10 Services for Specific Community Groups

3.10.1 Aboriginal and Torres Strait Islander Services

Western Australia has a number of currently active Aboriginal and Torres Strait Islander-specific eye health services. The following is a list of active services and organisations.

Service / Organisation(s)	Description
Derbarl Yerrigan Eye Health Program/Derbarl Yerrigan Health Service, Lions Outback Vision	This program aims to coordinate and deliver eye health services to Aboriginal people in the Perth metropolitan, Great Southern, Wheatbelt, and Peel regions of WA. Lions Outback Vision runs a monthly ophthalmology outpatient and optometry clinic through the East Perth Derbarl Yerrigan rooms.
Eye and Ear Surgical Support Service (EESS)/Rural Health West https://www.ruralhealthwest.com.au/outreach	This program aims to increase access to surgical interventions for Aboriginal and Torres Strait Islander Australians living in rural and remote locations with diagnosed eye and ear conditions, who have been placed on a waiting list for surgery.
Lions Outback Vision https://www.outbackvision.com.au/	Lions Outback Vision provides outreach eye health clinics, surgical services, and telemedicine for rural, remote, and Aboriginal and Torres Strait Islanders, WA.
Outreach in the Outback/Rural Health West https://www.ruralhealthwest.com.au/outreach	Outreach in the Outback is a visiting medical outreach service. The program operates in >50 locations in WA ranging from Kununurra to Albany and as far east as Tjuntjuntjarra. The program is run by Rural Health West and funded by the Australian Government Department of Health under the Medical Specialist Outreach Assistance Program (MSOAP). Health professionals can apply for funding for outreach visits.
The Visiting Optometry Scheme (VOS) Expansion for Indigenous Australians https://www1.health.gov.au/internet/main/publishing.nsf/Content/optometry_eye_health	Under the VOS Expansion for Indigenous Australians element, optometrists are funded to provide new and increased numbers of optometric services to Indigenous Australians in remote and very remote communities.
VisAbility: Kimberley Program https://healthinonet.ecu.edu.au/key-resources/programs-and-projects/1068/?title=VisAbility%3A+Kimberley+Program&contentid=1068_4	The program provides specialist services to Aboriginal and Torres Strait Islander people living in major towns and remote communities in the Kimberley region of WA

3.10.2 culturally and linguistically diverse (CALD) backgrounds

The Western Australian population is culturally and linguistically diverse, 14% of the population speak a language other than English at home, and have little or no English proficiency. The following outlined services are available in Western Australia for CALD background people accessing health services. There were no eye health-specific services found.

Service	Description
The Humanitarian Entrant Health Service (HEHS) Phone: (08) 9222 8500 Email: ACCadmin@health.wa.gov.au Website: http://ww2.health.wa.gov.au/Articles/F_I/Humanitarian-Entrant-HealthService	This service provides a holistic health assessment service for all refugees and humanitarian entrants who are resettled in Western Australia under the Australian Government's Humanitarian Program and Special Humanitarian Program.
Perth Children's Hospital Refugee Health Service (PCHRHS) Phone: (08) 93407649 Email RefugeeHealth.PMH@health.wa.gov.au Website: http://www.pmh.health.wa.gov.au/services/r	The PCHRHS aims to coordinate and manage the complex care needs of recently settled refugee and asylum seeker children (under 16 years of age). Both inpatient and outpatient care is provided depending on the clinical needs of the patient.

efugee_clinic/index.htm	
<p>Refugee health nursing from Child and Adolescent Community Health (CACH) - Refugee Health Team</p> <p>Email: CACH.RefugeeHealthReferrals@health.wa.gov.au</p>	<p>Community Health Nurses in the Refugee Health Team act as advocates in empowering individuals and families to take responsibility for their own health and well-being. They identify health concerns and direct families via referral processes to appropriate services.</p>

3.11 Issues and Recommendations

<p><i>3.11.1 Ophthalmology Patients in General Practice</i></p> <p>Details:</p> <ul style="list-style-type: none"> • As primary care physicians, GPs are often the first point of contact with the health system for a patient with an eye disorder. • 1.9% of GP consultations in Australia are related to an eye disorder equating to approximately 315,239 services in WA in 2020. • Ophthalmic anti-infectives are amongst the most common medications prescribed, accounting for 0.8% of all prescriptions. • The epidemiology of eye diseases and standard of care is unknown for this patient cohort. • It is important that GPs are resourced appropriately, clinically supported, and have adequate training to ensure patient safety and high standards of care for this large patient volume. <p>Recommendations:</p> <ol style="list-style-type: none"> 1) Consider projects that aim to further understand the demographic characteristics and disease epidemiology of this patient cohort. 2) Consider projects that aim to understand the level of clinical support and training received by GPs in order to safeguard high standards of care for this patient cohort.
<p><i>3.11.2 The role of general practitioners in the eye health care workforce</i></p> <p>Details:</p> <ul style="list-style-type: none"> • GP's are an integral component of the eye health care workforce and commonly refer to ophthalmologists. • Referrals account for 6.5% of all specialist referrals, which is disproportionately higher than the proportion of the specialist workforce (1%) represented by ophthalmology. There were an estimated 99,549 referrals to ophthalmology from GPs in 2020. • GPs are not often recognised as part of the eye health care workforce as is evident by their absence in key government and non-government reports. <p>Recommendations:</p> <ol style="list-style-type: none"> 1) Consider projects that aim to further understand the referral patterns of GPs to ophthalmology, which may be useful from a resource planning perspective.
<p><i>3.11.3 Ophthalmic presentations to the emergency departments</i></p> <p>Details:</p> <ul style="list-style-type: none"> • Emergency departments are overwhelmed. • In Australia, 65.5% of eye presentations were classified as semi-urgent or and non-urgent urgent and 92% of eye conditions were not admitted in 2019. • In 2019, 65% of eye presentations to a WA emergency department were classified as semi-urgent or non-urgent. This may represent cases, which could be redistributed to other primary health care avenues and reduce this burden. • The relatively modest size of this issue should be recognised; in 2019, 65.5% of low acuity eye presentations representing approximately 7166 cases or 0.8% of the 929,507 total presentations to the WA emergency departments. <p>Recommendations:</p> <ol style="list-style-type: none"> 1) Consider projects that aim to address this problem through public health messaging to improve health-seeking behaviour. 2) Consider projects that aim to optimize eye-care streams through emergency departments. For example, nurse practitioners specialising in ophthalmology may be well equipped to manage the bulk of these cases.
<p><i>3.11.4 Low proportion of Indigenous and non-Indigenous Australians adhering to guidelines for diabetic retinopathy screening.</i></p> <p>Details:</p> <ul style="list-style-type: none"> • 50–77% of non-Indigenous Australians and 20–44% of Indigenous Australians receive appropriate retinal screening.¹⁷ • The proportion of people screened decreases with increasing remoteness of locations. <p>Recommendations:</p> <ol style="list-style-type: none"> 1) Consider projects that explore reducing the potential barriers, including patients' knowledge of the

condition and the need for retinal screening, doctor-patient communications, travel, operating costs, infrastructure, and time constraints within general practice.³⁻⁵

3.11.5 Underutilisation of item numbers for diabetic retinopathy screening in primary healthcare.

Issue:

- In 2016, MBS item numbers 12325 and 12326 were introduced to support diabetic retinopathy retinal fundus photography screening in primary care.
- Between the financial years 2016 – 2021, the cumulative use of item numbers 12325 and 12326 nationally was 10,598. WA had the third highest total utilization and second highest per capita utilization.
- The cumulative 10,598 screening episodes over 5 years fell significantly short of the projected 400,000.
- A number of studies have assessed potential factors, which may have contributed to this significant underutilisation.^{5,6,8} These include costs of retinal cameras, time constraints, the need for dedicated staff to take the responsibility for DR screening, lack of skills to make a DR diagnosis, lack of awareness of Medicare incentives for non-mydratic retinal photography, optometrists being perceived as ideal for DR screening, and limited referral pathways.⁶⁻⁸

Recommendations:

- 2) Consider projects that focus on enabling strategies to deliver DR screening within primary care. This may include increasing GPs' access to continuing professional development to improve the GPs' competency in DR detection, awareness campaigns to maximise the use of MBS items, subsidising the cost of retinal cameras particularly for small or rural practices.
- 3) Consider supporting projects that look to outsource DR grading decision making to AI based technology.

3.11.6 Government and peak body future workforce policy for ophthalmology and optometry is based on limited self-reported data collected during AHPRA registration.

Issue:

- The National Health Workforce Dataset is created through a survey, which is completed by AHPRA-accredited health practitioners during annual registration.
- The survey contains questions, which assess the characteristics of the workforce and aim to predict trends such as vocation, retirement, and geographical location of work intentions.
- These data inform a number of key reports such as the Eye Health Workforce In Australia report²⁹ that informs the government and peak-body policy decisions around training and workforce distribution strategy.
- Data is self-reported and missing some granularity in the geographical distribution of the workforce. For example data is postcode-based and does not capture the often multiple places of work for one clinician.
- Greater detail may lead to better policy making.

Recommendations:

- 1) Consider expanding on the optometry and ophthalmology maps presented in this report as a data linkage project. Data could be obtained from the key advertising platforms directly and linked to AHPRA registration data. The key benefit is to have a more granular data set for policymaking. In addition, making the data publicly available may drive market forces to fill the gaps in service delivery.

3.11.7 Indigenous Australians have lower cataract surgery rates and coverage than non-Indigenous Australians

Issue:

- In 2018-19, age-standardised rates of cataract surgeries for Indigenous Australians (8,519 per 1,000,000) remained lower than those of non-Indigenous Australians (9,102 per 1,000,000).
- Cataract surgery coverage rates across Australia are significantly lower in Indigenous (61.47%) Australians compared to non-Indigenous (87.63%) Australians ($p < 0.001$).¹²
- This suggests an ongoing gap in access to eye health care

Recommendations:

- 1) Consider projects that aim to increase awareness and access to timely cataract surgery for Indigenous Australians.

3.11.8 The rate and coverage of cataract surgery for Indigenous Australians is lowest in

<i>metropolitan areas.</i>
<p>Issue:</p> <ul style="list-style-type: none"> • Results from the AIHW data indicated that across Australia, around 6,100 Indigenous Australians (around 3,655 per 1,000,000) had cataract surgery between 2017 and 2019 with the rate being highest in remote and very remote areas and lowest in major cities. • In WA, between 2017 and 2019 the met need for cataract surgery was estimated to be 76% in NG Lands, 57% in the Wheatbelt, 53% in the Kimberley region, 49% in the Goldfields, 44% in the Great Sothern region and the Pilbara, 35% in the Mid-West, 29% in Perth, and 25% in the South-West.¹⁰ • Indigenous Australians are more reliant on public hospitals for cataract surgery with approximately 80% of cataract surgeries for Aboriginal and Torres Strait Islander people and 29% for non-Indigenous people are performed in public hospitals. • A recent report prepared for Vision2020²⁰ concluded that as Indigenous Australians have higher rates of cataracts and predominantly have surgery in public hospitals, they are disproportionately affected by the long wait times, which may be a contributing factor to lower surgery rates and coverage. • The RANZCO InReach Ophthalmology network offers a pathway for Aboriginal and Torres Strait Islander patients to be wait listed for procedures directly on the public hospital wait list from private practices.
<p>Recommendations:</p> <ol style="list-style-type: none"> 1) Consider service delivery innovation projects, which aim to reduce barriers to access for cataract surgery for Indigenous Australians 2) Consider supporting projects such as RANZCO InReach.

<i>3.11.9 Wait times for public cataract surgery are steadily increasing in Western Australia.</i>
<p>Issue:</p> <ul style="list-style-type: none"> • Analysis of the AIHW elective surgery activity data suggests that the median wait times for cataract surgery are increasing in Western Australia (Figure 14). • In 2011, the mean median wait time was 80 days, compared to 123 days in 2019. • The large increase in average wait times between 2017 and 2019 appears to be driven by the increase in WA Country Health Service (Figure 15). • The longest metropolitan wait time was Joondalup Health Campus, 146 days. • Volume-weighted wait time was slightly higher in regional sites compared to metropolitan sites for cataract procedures (153.3 vs 64.2 days, P < 0.001).
<p>Recommendations:</p> <ol style="list-style-type: none"> 1) Consider advocacy roles to call for increased government funding. Strategies may include increasing public awareness and raising the agenda priority in government.

<i>3.11.10 True cataract surgery wait times are likely higher than reported due to 'the hidden waiting list'.</i>
<p>Issue:</p> <ul style="list-style-type: none"> • Wait times captured through the AIHW data do not capture the time from initial diagnosis by a general practitioner or optometrist and referral to an ophthalmologist. This waiting time from initial referral to a public hospital until first visit is referred to as the 'hidden waiting list' or the 'wait for the wait'. • There are no data available for the 'hidden waiting list' in WA. • There is some reporting of this figure nationally; however, it is inconsistent and ranges from a median wait time of 3 months in Victoria to 10-20 months in the 90th percentile in Queensland. • Wait times for cataract surgery have negative health consequences and increased health care costs.²² • This is an issue from a patient outcome, health, economic, and transparency perspective.
<p>Recommendations:</p> <ol style="list-style-type: none"> 1) Consider projects that aim to increase the transparency of wait lists, which include 'the wait for the wait.' For example, data in the form of publicly available dashboards using publicly available data. 2) Consider health systems and innovation projects, which target cataract wait lists. For example, collaborative care models between ophthalmology and optometry for rapid wait listing to reduce the 'wait for the wait'.

<i>3.11.11 There were no eye health specific services available in Western Australia for Culturally and Linguistically Diverse Backgrounds.</i>

- An online search did not reveal any eye health care services specific for people with CALD backgrounds in Western Australia.
- This may represent a gap, given there are services established for other areas, including cancer screening, chronic disease prevention, dental health, immunisation programs, mental health, newborn screening, sexual health, and women's health on the WA Health Multicultural Health Services Directory.
- The Victorian Eye Health promotion website Vision Initiative provides translated eye health resources in 10 languages other than English.

- 1) Consider projects that focus on service or resource development for eye health care in Western Australia for people with CALD backgrounds.

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3.13 Appendices

3.13.1 Appendix 1 – Ophthalmologists in Western Australia with advertisements listed on Healthengine, Healthdirect, and Myhealth1st. Clinicians and number of associated private clinics.

Clinician	Number of clinics
Adam Gajdatsy	5
Alasdair Jackson	2
Alexandra Taylor	1
Andrea Ang	4
Angus Turner	2
Anita Tandon	3
Antonio Giubilato	5
Antony Clark	3
Blasco D'Souza	3
Boon Ham	4
Brad Johnson	3
Chandra Balaratnasingam	2
Charlotte McKnight	2
Chathri Amaratunge	2
Chee Khong	2
Chee Yiong Kang	1
Christopher Kennedy	2
Christopher Low	4
Con Anastas	2
David de la Hunty	3
David Greer	3
David Mackey	2
David Offerman	2
Dimitri Yellachich	1
Dr Tze Lai	1
Dru Daniels	1
Edward Mele	1
Fred Chen	1
Frederick Nagle	2
Geoffrey Lam	1
Graeme Chester	1
Graham Barrett	1
Graham Furness	5
Hannah Clark	3
Hessom Razavi	3
Ian Chan	1
Ian Constable	1
Ian McAllister	2
Jane Khan	4
Jason Lim	6
Jean-Louis de Sousa	1
Jeremy Raiter	2
Jo Richards	4
Johnny Wu	4
Jonathon Ng	1
Joshua Yuen	4

Kai Goh	4
Lasitha Jayasinghe	1
Lourens Van Zyl	5
Malcolm Burvill	2
Marina Rayside	1
Mei-Ling Tay-Kearney	2
Michael Brown	1
Michael Wertheim	5
Neil Sinclair	2
Nigel Morlet	3
Olivia Macvie	2
Peter Heyworth	4
Peter Richardson	2
Phillip McGeorge	6
Rhiju Mehta	1
Richard Gardner	1
Robert Paul	4
Ross Agnello	3
Ross Littlewood	2
Russell Townsend	3
Siew-YIn Then	2
Stephen Colley	4
Steven Wiffen	1
Stuart Ross	2
Tim Isaacs	3
Tze Lai	2
Vignesh Raja	2
William Morgan	1
William Ward	1
Geoffrey Chan	No advertisement
Caroline Lim	No advertisement
Jane Lock	No advertisement
XiaNi Wu	No advertisement

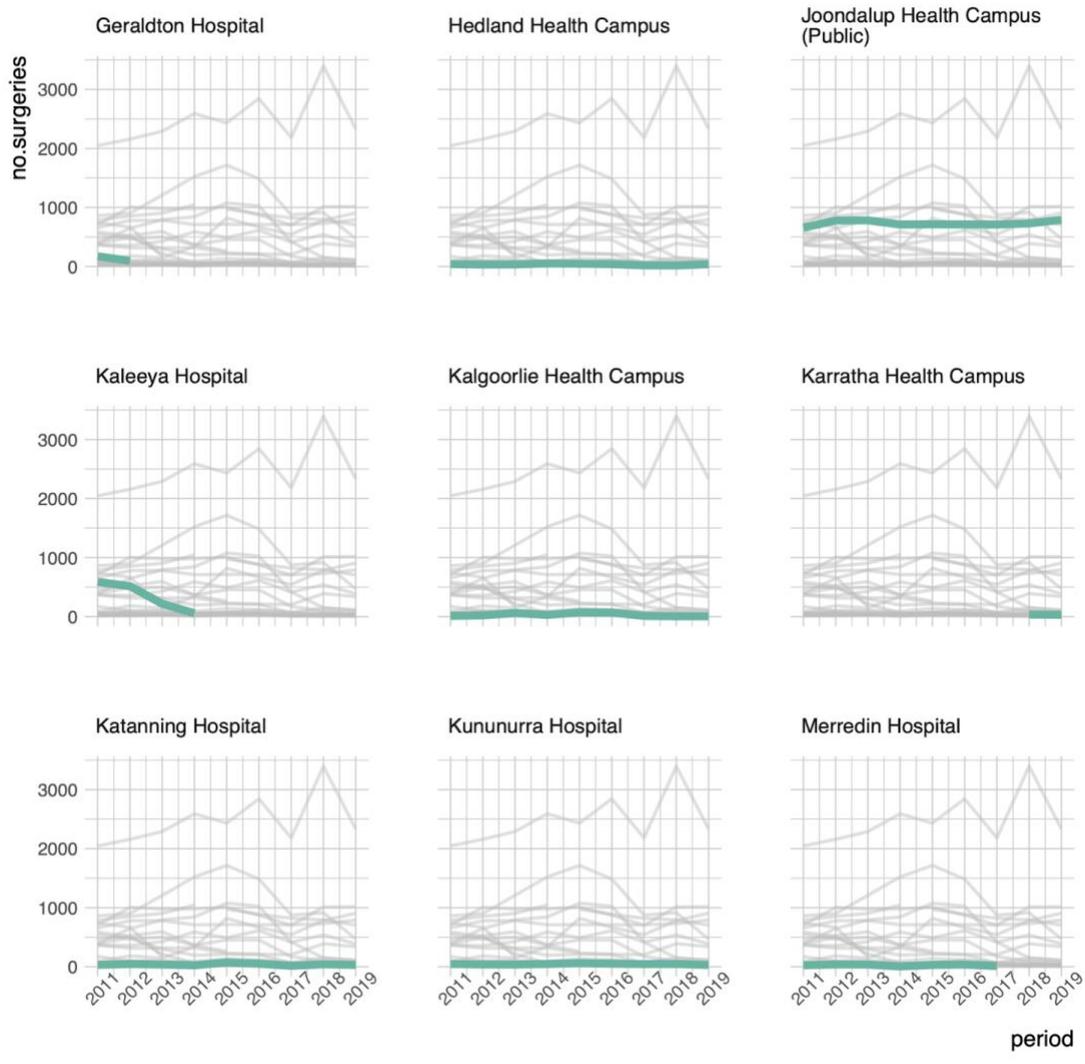
3.13.2 Appendix 2 – Private ophthalmology clinics in Western Australia with advertisements listed on Healthengine, Healthdirect, and Myhealth1st. Clinic names and numbers of associated ophthalmologists for each clinic.

Clinic name (as advertised)	Number of associated ophthalmologists
158 Cambridge Street	1
Aculase Laser Eye Surgery	1
Applecross Eye Clinic	2
Bunbury and Busselton Eye Doctors	6
Cambridge Eye Clinic	1
Canning Eye Clinic	1
Centro Eye Clinic	1
Claremont Eye Clinic	1
Clear Vision Laser Clinic	1
Colin Benson	1
Crystal Eye & Laser Centre	4
Dr Alexandra Taylor Specialist Ophthalmologist	1
Dr Boon Ham, Ophthalmologist	1
Dr Boon Ham, Ophthalmologist - Kelmscott	1
Dr David Greer Ophthalmic Surgeon	1
Dr David Offerman, Ophthalmologist - Albany	1
Dr Dru Daniels, Ophthalmologist	1
Dr Frederick J Nagle Refractive Eye Surgeon	1
Dr G C Lam Paediatric Ophthalmologist	1
Dr G Raad Specialist Practice	1
Dr John O'Shea Ophthalmologist	1
Dr L Taylor Specialist Practice	1
Dr Lourens Van Zyl, Ophthalmologist - Armadale	1
Dr Lourens Van Zyl, Ophthalmologist - Joondalup	1
Dr Lourens Van Zyl, Ophthalmologist - Midland	1
Dr Michael Wertheim	1
Dr Nigel Morlet - Western Eye, Ophthalmologist - Mosman Park, WA	1
Dr Richard Gardner - Ophthalmology	1
Dr Robert Paul, Ophthalmologist - Nedlands	1
Dr Ross Littlewood, Ophthalmologist	1
Dr Wham Specialist Practice	1
Duncraig Eye Surgeons	2
Dunsborough Eye Clinic	1
Emerald Terrace Ophthalmologist	2
Geraldton Eye Surgery	1
Great Southern Specialist Centre	12
Hollywood Medical Centre	1
Insight Eye Clinic	1
Insight Eye Clinic Subiaco	1
Jeremy Raiter Ophthalmology	1
Joondalup Eye Clinic	2
Kishorn Road Ophthalmologist	1
Kookaburra Eye Clinic	1
LASERSIGHT - Subiaco	1
Lions Eye Institute	18

Lions Eye Institute: Laser Vision Centre	4
Mandurah Eye Centre	1
Midland Eye Clinic	1
Midland Swan Valley Eye Clinic	1
Morley Eye Clinic	1
Mount Lawley Eye Clinic	1
Murdoch Eye Clinic	1
Murdoch Ophthalmology	5
New Vision - Dr Nigel Morlet	1
Northern Eye Surgeons	2
Peel Vision	1
Perth Eye Clinic	9
Perth Eye Hospital	12
Perth Eyes: Paediatric & Adult Specialist Ophthalmology Centre	1
Perth Laser Vision	1
Perth Laser Vision at Murdoch	1
Perth Retina	2
Rockingham Eye Clinic	1
South Street Eye Clinic	2
Southwest Eye Surgeons	6
St John of God Eye Clinic	2
St John Of God Visiting Specialists - Dr Nigel Morlet	1
The Claremont Eye Clinic	1
The Old Fire Station	1
WA Eye Specialists	8
WA Laser Eye Centre	5
Western Eye	9
Grand Total	166

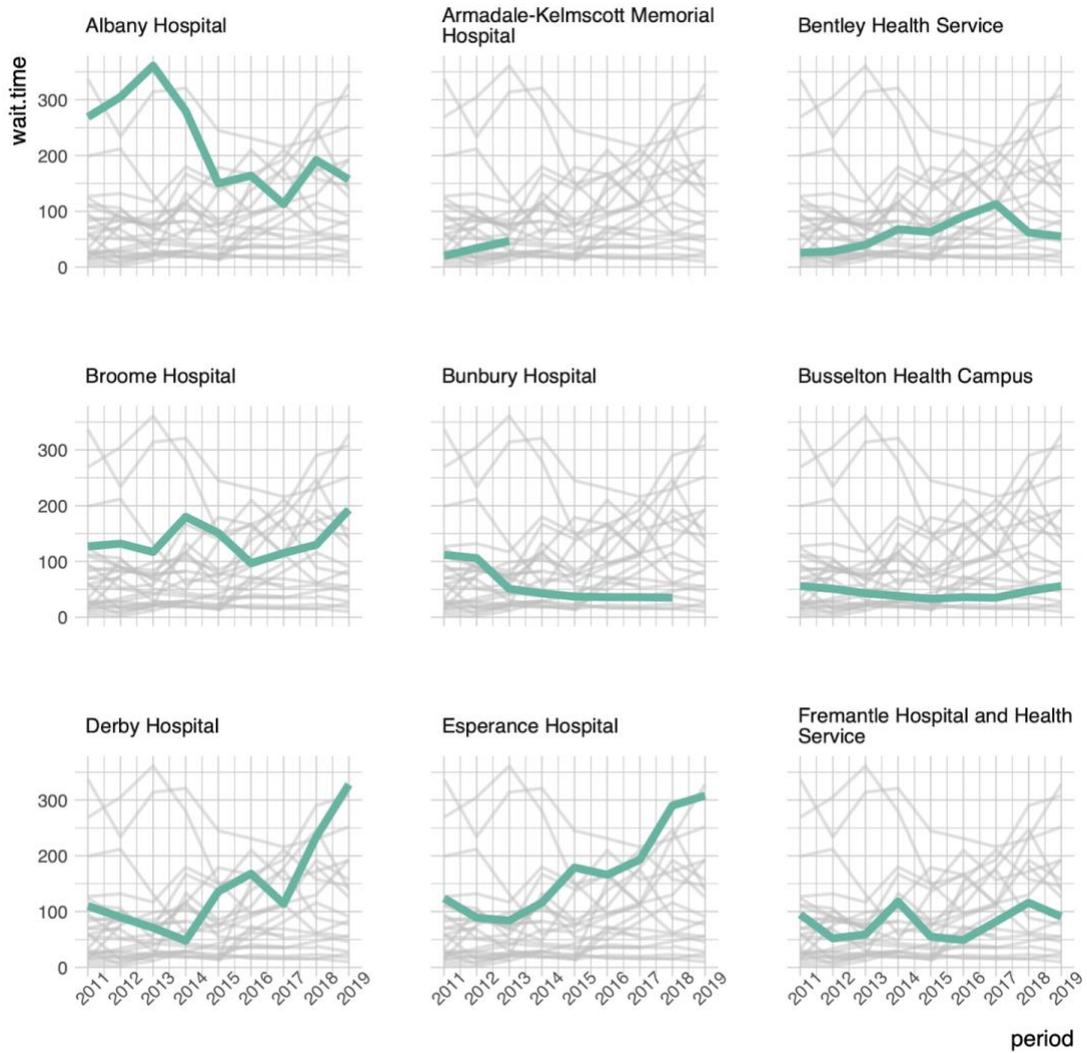
3.13.3 Appendix 3– Public hospital cataract surgeries, 2011–2019, by hospital. Data source: AIHW elective surgery data.

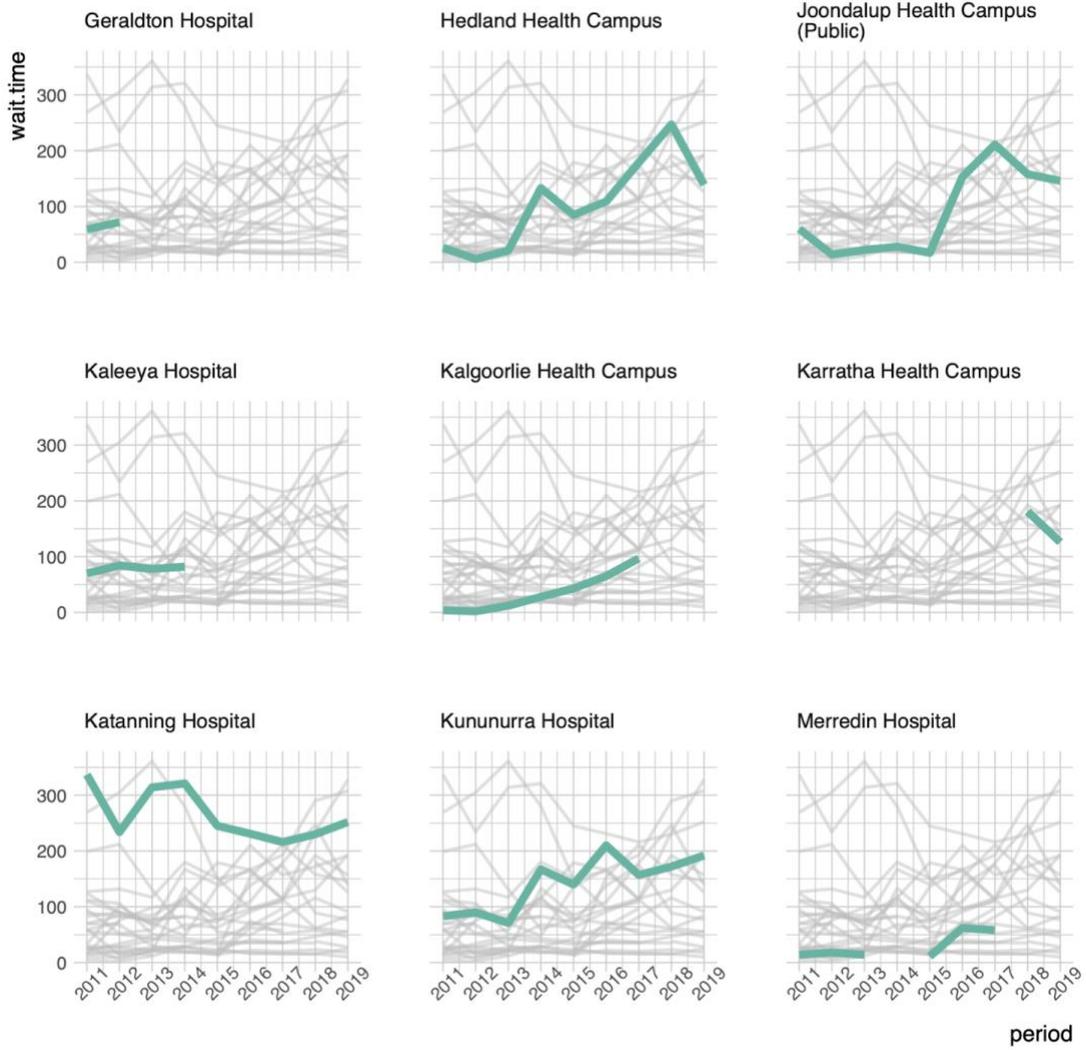


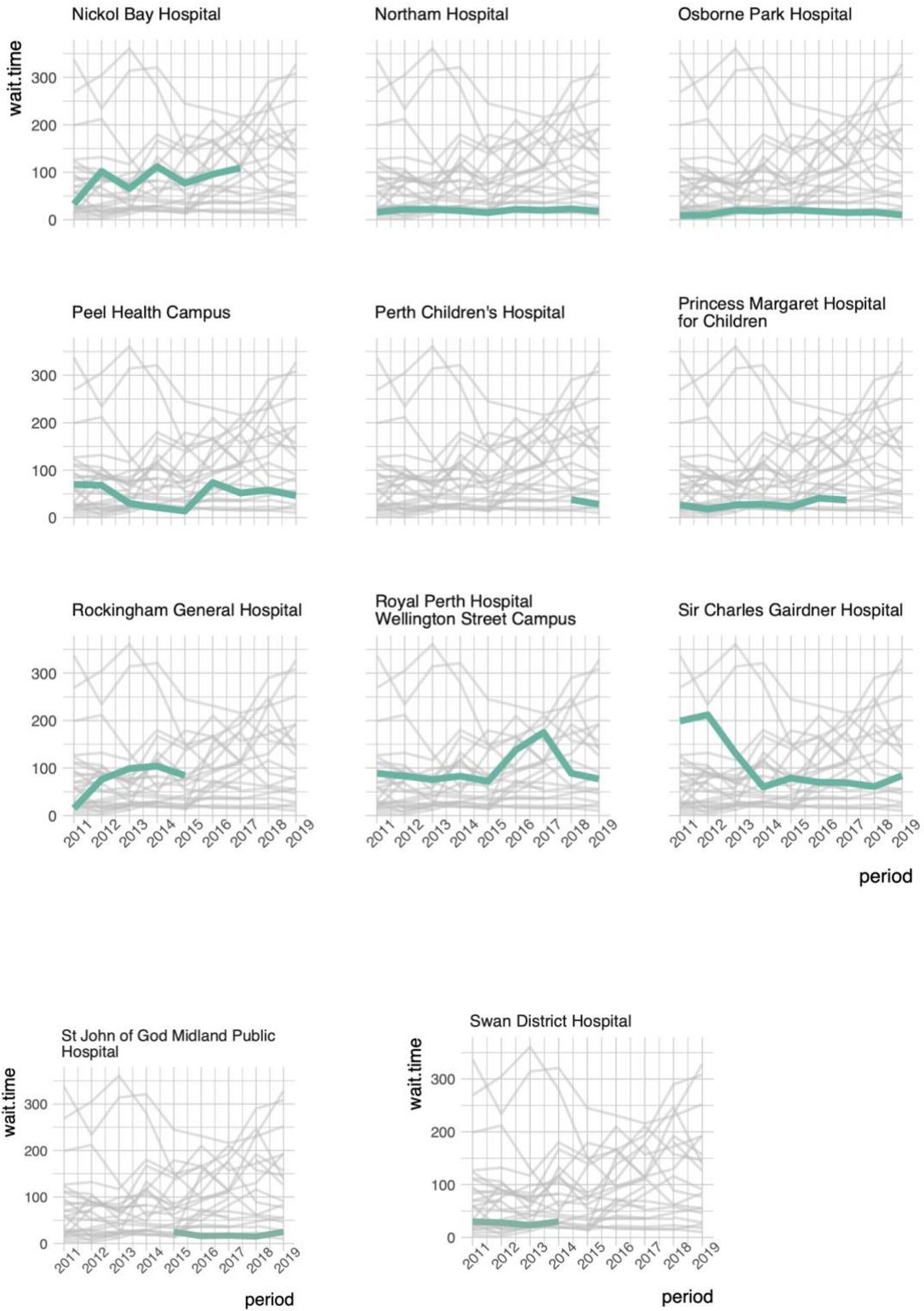




3.13.4 Appendix 3– Public hospital cataract surgery wait times, 2011–2019, by hospital. Data source: AIHW elective surgery data.







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4.4 Executive Summary

- The funding of the Australian Health Care System is complex with multiple sources, directions of flow and ultimate destinations. The goal of this section of the report is to describe the structure of Australian and Western Australian eye health care sector funding.
- The publicly available data was limited in detail, which made it challenging to encompass a complete overview of WA eye health care funding. The overall economics of the Australian health care system has been emphasised and where available, WA eye-health data was extracted.
- Four key databases by the Australian Institute of Health and Welfare (AIHW) informed the majority of this report. The Australian National Health Account (ANHA) describes the national-level health systems funding, the Disease Expenditure in Australia database was used to determine the spending on eye health care specifically, the Philanthropic and Charitable Donations report describes the structure of philanthropic and charitable funding in Australia, and the Health and Medical Research report describes health and medical research funding in Australia.
- In 2019-20, Australia's estimated spending on health was \$202.5 billion. Total health expenditure in WA was \$21.4 billion.
- The average Australia-wide per capita spending in 2019-20 was \$7,926. Per capita spending for WA in 2019-20 was \$7,686.
- The government funds the vast majority (70.4%) of healthcare in Australia. During 2019-20, 42.7% (\$86.4 billion) of the total health spending was federal government funded, 27.7% (\$56.1 billion) was state government funded, and the remaining 29.6% (\$59.9 billion) by non-government sources.
- In 2018-19, the total Australian expenditure for vision disorders was \$3.47 billion. This comprised of spending on cataract (\$1,520M), other vision disorders (\$1,057M), age-related macular degeneration (\$470M), glaucoma (\$287M), and refractive errors (\$134M).
- Philanthropic and charitable donations are made in increasingly complex ways by individuals, through workplace schemes, businesses, and as structured giving.
- In 2018-19, 4.2 million Australian individuals claimed \$3.9 billion as tax deductions for donations, equating to an average of \$922 per person or 0.4% of their taxable income. The highest average donation came from Western Australia with an average donation of \$2,209, or 0.9% of taxable income.¹
- According to Giving Australia's 2016 survey data, Australian businesses gave \$17.5 billion: \$6.2 billion in donations, \$7.7 billion in community partnerships, and \$3.6 billion in non-commercial sponsorships. The education and research sector were the main beneficiaries, receiving 22% of all total business giving, followed by the culture and recreation (19%) and social service and health sectors (12%).
- A significant proportion of Australia's deductible giving occurs through structured giving via a formal structure such as a trust.
- Five of the top 50 philanthropists in 2019 were the Paul Ramsay Foundation, Judith Neilson Foundation, and charitable trusts, Minderoo Foundation, Yajilarra Trust, and Estate of Win Schubert donating a total of \$499.4 million.
- A number of programs initiated by the Federal and State Government have a specific focus on eye health for Aboriginal and Torres Strait Islander and rural populations.
- The National Trachoma Surveillance and Reporting Unit (NTSRU) is responsible for the ongoing data collection, analysis, and surveillance and reporting of trachoma in Australia. In WA, a \$4.95M grant was made to the Lions Eye Institute on 2 June 2020 and a \$660,000 grant to the Western Australian Centre for Rural and Remote Medicine (WACRRM) on 1 July 2019 for 'Ear and Eyes Trachoma'.
- The Visiting Optometrists Scheme (VOS) is a federally funded initiative to support optometrists to deliver outreach services to rural and remote Australia. Fund holders manage the delivery of services in different states. The fund holder for WA is Rural Health West. On 23 March 2020, the Department of Health approved a grant of \$36,020,307 for a further four years of funding from 2020-21 to 2023-24.
- The Rural Health Outreach Fund (RHOF) is a Federal Government-funded program, which supports the delivery of outreach health services for regional and remote Australians. On 25 May 2020, the Australian Government Department of Health committed \$116 million to the RHOF over four years from 2020-21 to 2023-24 (Grant number - GO3236).
- The 2016 National Eye Health Survey was the first national survey to determine the prevalence and major causes of vision impairment and blindness in Australia. The 2016-17 Vision2020 annual report showed a \$1,016,496 expense line for the National Eye Health Survey project.
- The Eye and Ear Surgical Support Program (ESSP) is a Federal Government-funded program, which aims to increase access to surgery for rural and remote Aboriginal and Torres Strait Islander patients.

The funding supports the cost of travel and accommodation for the patient and carer to and from the surgery location. Rural Health West administers this service in WA. The Federal Government Department of Health made a \$1,615,435.8 grant (GO3247) to Rural Health West on 3 July 2020 to fund four years of the service from 2020-21 to 2023-24.

- Lions Outback Vision has established an ophthalmology clinic in Broome, Western Australia. The clinic is located in the former Kimberley Klub backpackers, which was donated by the Wen Foundation. The WA State Government has committed \$4.7M towards the clinic project.
- The Australian Institute of Health and Welfare reports on health and medical research and highlights the sources and amounts of funding for Australian research.² Health and medical research in Australia is funded by a number of organisations, including the Federal Government, state and territory governments, not-for-profit organisations, private business and individual philanthropic donations.
- Spending on health and medical research in Australia was \$5.6 billion in 2017-18. The Federal Government (\$4.4 billion) contributed the vast majority (79%) of that amount. State and territory governments spent \$827 million, and non-government sources accounted for \$404 million.
- In 2020-21, 536 new National Health and Medical Research Council (NHMRC) grants were given to a value of \$497.6 million. Balance, eye and hearing diseases received \$22.3 million in funding. Aboriginal and Torres Strait Islander Health received \$57.2 million in funding and 22 grants were given to WA entities to the value of \$36.2 million. There were no WA grants for eye-related conditions.
- In 2020, 543 Medical Research Future Fund (MRFF) grants to the value of \$597.9 million were given and 29 grants (\$84.0 million) were given to WA entities. There were no WA grants for eye-related conditions.
- To date, 22 companies have received funding through the biomedical translational fund. No WA companies received any funding from this fund.
- The CSIRO invested \$63 million on health research in 2020-21 (Figure 11), which was 4.8% of their \$1.3 billion research budget.
- In 2017-18, the WA state government spent \$72.1 million on health and medical research. A comparison of all the states showed that Queensland spent the most (\$250 million) and Tasmania spent the least (\$6.4 million).
- As of 1 Jan 2022, there were 683 charities or groups with 'health and medical research' listed as a program classification registered with the Australian Charities and Not-for-Profits Commission², with 50 of these located in WA.

4.5 Introduction

Funding of the Australian healthcare system is complex, with multiple sources, directions of flow, and final destinations. The goal of this section of the report is to describe the funding structure of the Australian and Western Australian eye-health care sector. Publicly available data was limited in detail, which made it challenging to encompass a complete and detailed funding overview. An emphasis has been placed on the overall economics of the Australian health care system and where available, WA eye health-specific data was extracted.

4.6 Data Sources and Methodology

A number of key sources of data were assessed and compared for inclusion in this report. The Australian National Health Account (ANHA) by the Australian Institute of Health and Welfare (AIHW) provides the most relevant and detailed data set for a national health care funding overview. The AIHW Disease Expenditure in Australia database provides funding data from a disease perspective and was used to examine the spending on eye health care specifically.

4.6.1 *The Australian National Health Account (ANHA)*

The AIHW produces an annual financial year estimate of health spending in Australia. It is derived from over 50 sources of data and captures spending by governments, individuals, insurance providers, and other private sources, including some private hospital spending and research spending. The data is stored in the Health Expenditure Database and reported as the Australian National Health Account. This database was found to be the most comprehensive source of national health care funding data.

4.6.2 *Australian System of National Accounts (ASNA)*

The Australian Bureau of Statistics (ABS) produces government financial statistics, which include the overall spending on the health portfolio. The data comes from the government financial systems, which record ledger transactions from different government agencies, including the health department. The database uses a ‘purpose’ classification that captures the purpose rather than the nature of activity. For example, remote housing for doctors would be treated as health expenditure in this model. The classifications of expenses also differ. For example, private insurance is reported in the insurance sector rather than in the health sector. Unconsolidated statistics are included, which is an issue for double counting of expenses. For example, expenditures at a state level, which are financed by transfers from Federal Government, are still included in the state’s spending accounts. These features made it less fit-for-purpose than the ANHA for this report, and therefore, was not included.

4.6.3 *Western Australia Health*

WA health publishes a range of reports, including financial reports, budget papers, annual reports and specific program data. These reports generally use the same sources of data provided to the AIHW for the ANHA; however, they vary in their scope and methodology of reporting. The ANHA removes federal transfers from state and territory spending and considers them as a different source. The state reports show the federal transfers as an income source but does not differentiate where the spending occurs. Therefore, it was difficult to obtain a clear picture of the sources and destinations of funding from the WA health budget papers. As the same data is included in the ANHA, the WA health budget papers were not included in this report.

4.6.4 *Disease Expenditure in Australia*

The Australian Institute of Health and Welfare publishes a disease expenditure database, comprised of data from nine separate government databases, which describes health care funding by various disease groups. The findings are based on estimates rather than actual observations. Expenditure is estimated for admitted patients, emergency departments, outpatient hospital services, primary health care (general practitioners, allied health, pharmaceuticals, and dental) and referred medical services (specialists, pathology, and diagnostic imaging). As it is not feasible to allocate some health expenditure (e.g. administration or capital expenditure) to specific diseases, the estimates from the disease expenditure database are not directly comparable to the AIHW.

4.6.5 Philanthropic and Charitable Donations

The AIHW published a report in August 2021, which summarised the philanthropic and charitable donations in Australia, wherever possible, information pertaining to eye health-related funding was extracted.

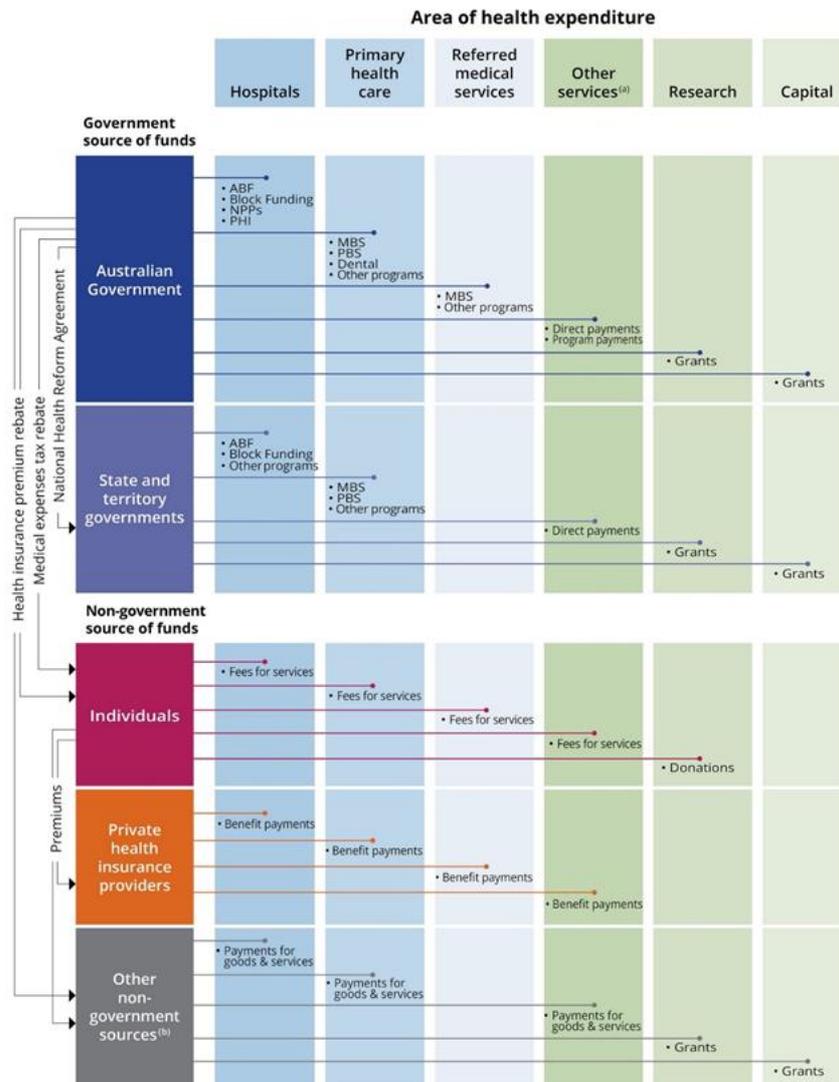
4.6.6 Health and Medical Research

The AIHW published a report on Health and Medical Research in July 2021. This report describes the broad sources of funding for health and medical research in Australia and Western Australia, wherever possible, eye-health research-related funding information was extracted.

4.7 Structure of Australia's Health Care System Funding

ANHA produced by the AIHW serves as the primary source of data for describing the structure of health care funding in Australia. Australia's health care funding arrangements are complex. Health care is funded by all levels of government as well as out-of-pocket expenses by individuals, private health insurers, and non-government organisations. Figure 1 shows the various sources of funding, the programs instituted and the destination of funds as an area of health expenditure.

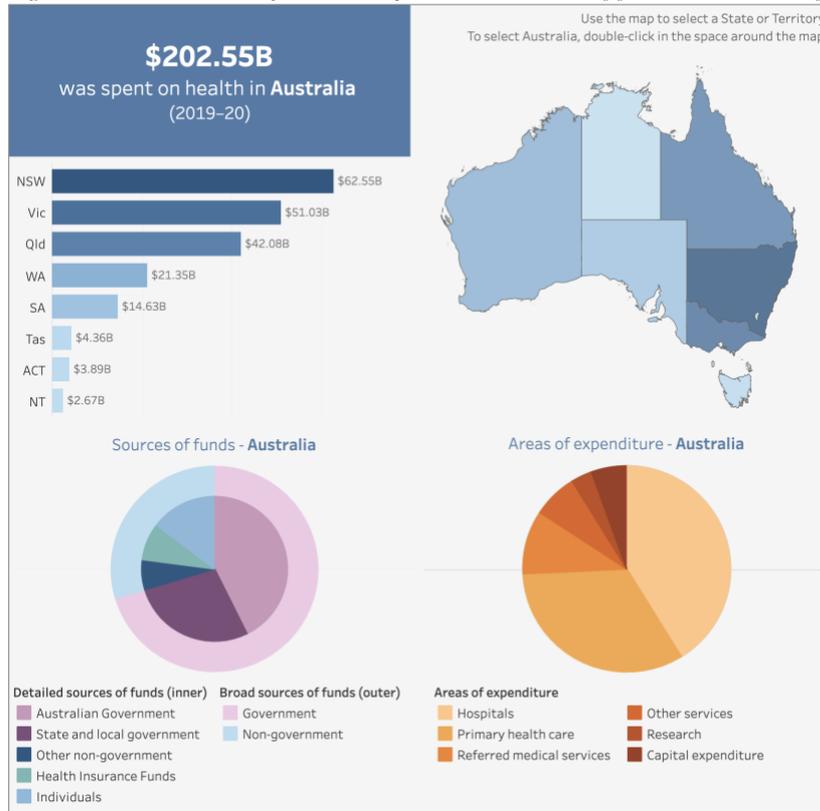
Figure 1. Structural flow of health care funding by source to the area of expenditure.



4.7.1 Total Health Spending

In 2019-20, Australia's estimated spending on health was \$202.5 billion (Figure 2). This was \$3.5 billion more than 2018-19, representing a 1.8% growth (Figure 3).

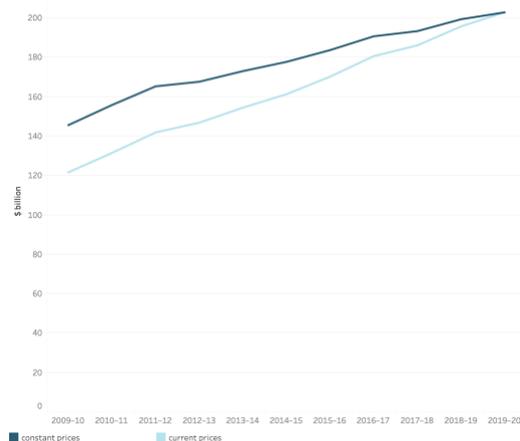
Figure 2. Total health expenditure by location, source of funds, and areas of expenditure in Australia, 2019-20.



Key statistics:

- Total health expenditure in WA in 2019-20 was \$21.4 billion (**Error! Reference source not found.**).
- Health inflation was 0.16% above the general inflation of 1.70%, indicating a faster rise in the price of health goods and services.
- Average Australia-wide per capita spending in 2019-20 was \$7,926. Per capita spending for WA in 2019-20 was \$7,686.

Figure 3. Nominal and real total health expenditure* in Australia, 2009–10 to 2019–20.



*Nominal (constant) prices are adjusted for inflation, real (current) prices reflect the value of currency for that particular year.

4.7.2 Spending Trends by Source

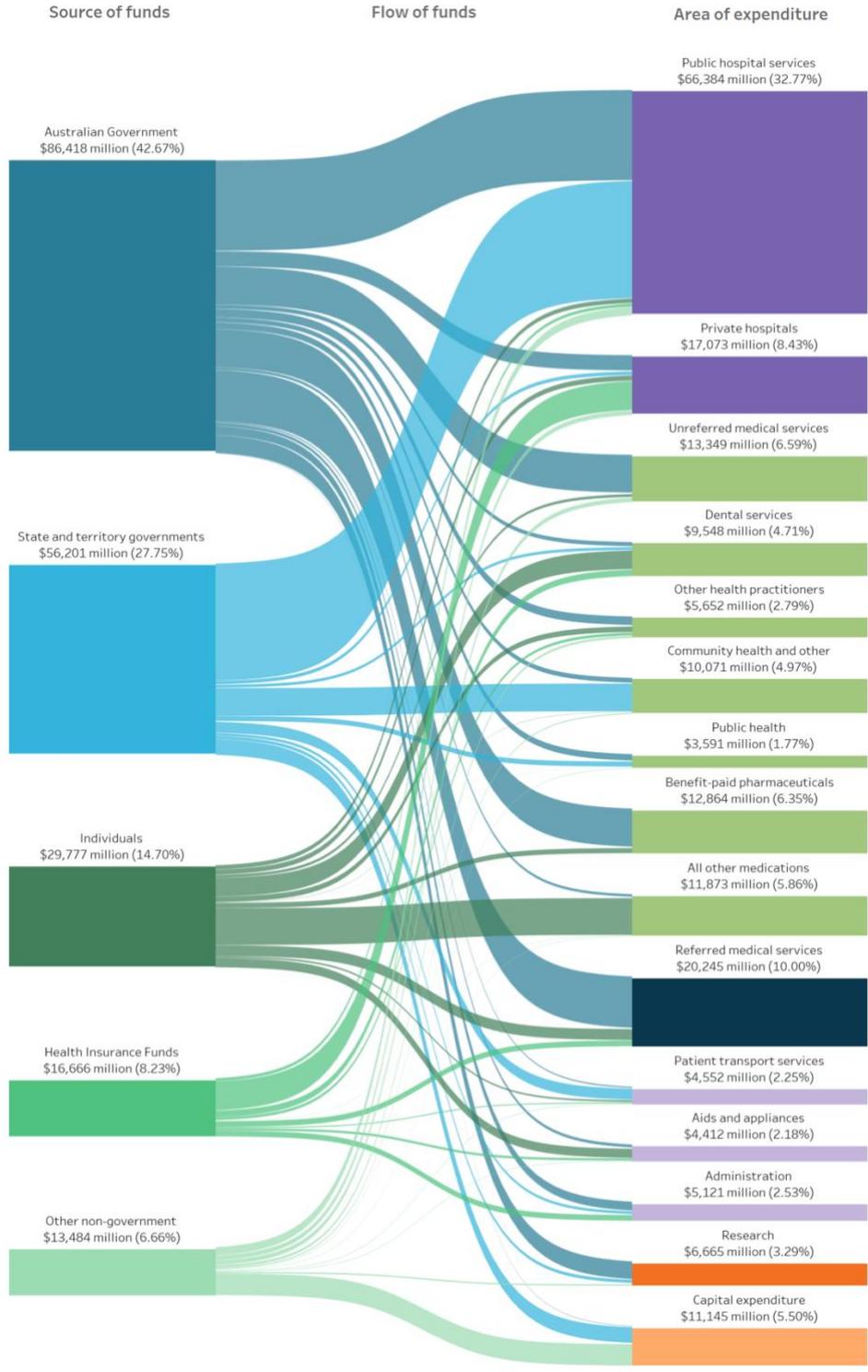
In Australia, the vast majority of health care funding comes from the government. During 2019-20, 42.7% (\$86.4 billion) of total health spending was federal government funded, 27.7% (\$56.1 billion) was state government funded, and the remaining 29.6% (\$59.9 billion) was funded by non-government sources (Figure 4

). Of the government funding sources, the Federal Government contributes 61% and state and territory governments contribute 39%. Table 1 shows the breakdown of the spend into the various government health care programs and Figure 4 details the flow of funds from the source to the area of expenditure. There is currently no publicly available database, which breaks down this information by disease category.

Table 1. Breakdown of health care spending by source (2019-20).

Source	Spending breakdown
Federal Government – \$86.4 billion	<p>Spending Programs:</p> <ol style="list-style-type: none"> 1) Direct Australian government spending through the Department of Health programs, such as MBS, PBS and health research is \$50.7 billion (58.7%); this includes some health spending by the Department of Defence. 2) Grants to states and territories, include National Health Reform Funding, the National Partnership on COVID-19 Response, other National Partnership Payments and highly specialised drug funding in public hospitals is \$26.8 billion (31.0%). 3) Rebates and subsidies for privately insured people under the National Private Health Insurance Act 2007 is \$6.1 billion (7.0%) 4) DVA funding \$2.9 billion (3.3%). 5) Medical expense tax rebate was \$4 million; however, this has been phased out. <p>Area of Spending:</p> <ol style="list-style-type: none"> 1) Primary Health Care – \$30.5 billion (35.3%) <ol style="list-style-type: none"> a) Pharmaceuticals subsidised through PBS \$11.4 billion b) Unreferred medical services (mainly visits to GPs) – \$11.3 billion c) Spending on other health practitioners – \$2.5 billion 2) Public Hospitals –\$26.8 billion 3) Referred Medical Services –\$15.3 billion 4) Research - \$5.3 billion 5) Private Hospitals - \$4.5 billion 6) Other Services - \$3.9 billion
State and Territory Government – \$56.2 billion	<p>Area of Spending:</p> <ol style="list-style-type: none"> 1) Public Hospitals – \$34.9 billion 2) Primary Health Care – \$10.6 billion (18.9%) 3) Capital Expenditure – \$4.6 billion 4) Private Hospitals – \$1.1 billion 5) Research – \$0.9 billion
Non-government sources – \$59.9 billion	<ol style="list-style-type: none"> 1) Individuals – \$29.8 billion <ol style="list-style-type: none"> a) \$11.0 billion (36.8%) on medications not subsidised through the PBS (includes over-the-counter medications, vitamins and health-related products) b) \$5.5 billion (18.5%) on dental services c) \$4.1 billion (13.7%) on both referred and unreferred medical services 2) Private health insurance – \$16.7 billion 3) Other non-government – \$13.5 billion

Figure 4 - Detailed flow of funds from the source to the area of expenditure in Australia (2019-20).



4.8 Funding by Disease Group – Vision Disorders

The Australian Institute of Health and Welfare disease expenditure database provides estimates of the spending on various disease categories in Australia. Hearing and vision disorders are considered in the same category; however, it was possible to extract data pertaining to specific eye-related diseases. In 2018-19, the Australian expenditure for vision disorders was \$3.47 billion. This comprised of spending on cataract (\$1,520M), other vision disorders (\$1,057M), age-related macular degeneration (\$470M), glaucoma (\$287M), and refractive errors (\$134M) (Figure 5). The spending for cataract has a bell-curve distribution peaking in the 70-74 year age group with a higher spend for females (\$193.4M) than males (\$152.0M) in this age group (Figure 6). Spending for other vision disorders is bimodally distributed (Figure 8). The spending on AMD and glaucoma increases with age and is higher for women for both conditions (Figure 8 and Figure 9). Refractive error spending is bimodally distributed with a peak at age 5-9 years and increasing again at a later age (Figure 10). It was not possible to filter the spending on eye conditions to include only WA.

Figure 5. Expenditure by Australian Burden of Disease Conditions (2018-19).

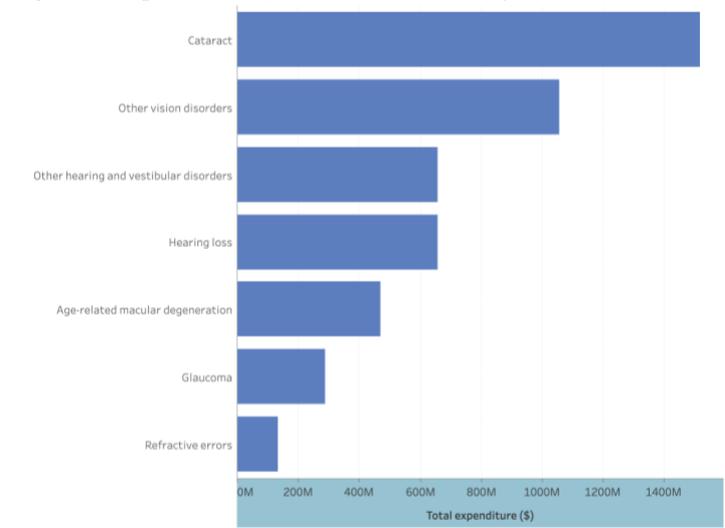


Figure 6. Expenditure on cataract, by sex and age group (2018-19).

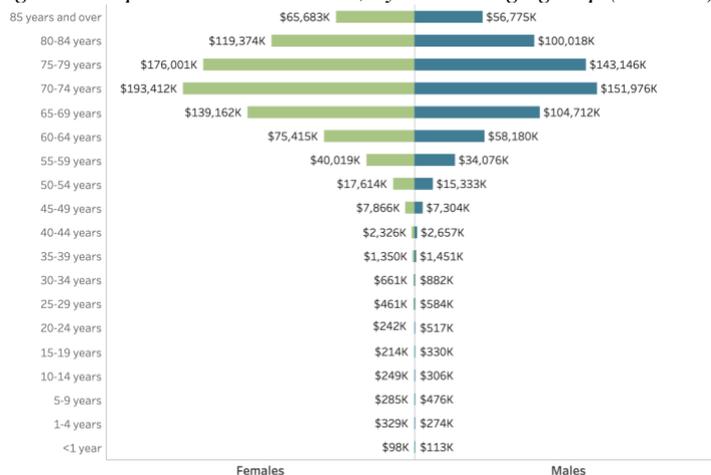


Figure 7. Expenditure on vision disorders (other than cataract), by sex and age group (2018-19).

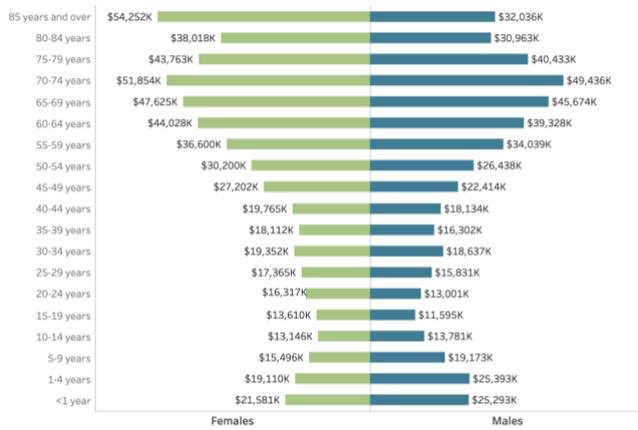


Figure 8. Expenditure on age-related macular degeneration by sex and age group (2018-19).

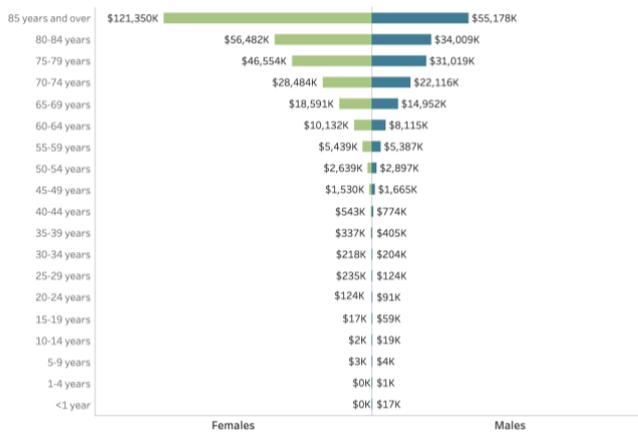


Figure 9. Expenditure on glaucoma, by sex and age group (2018-19).

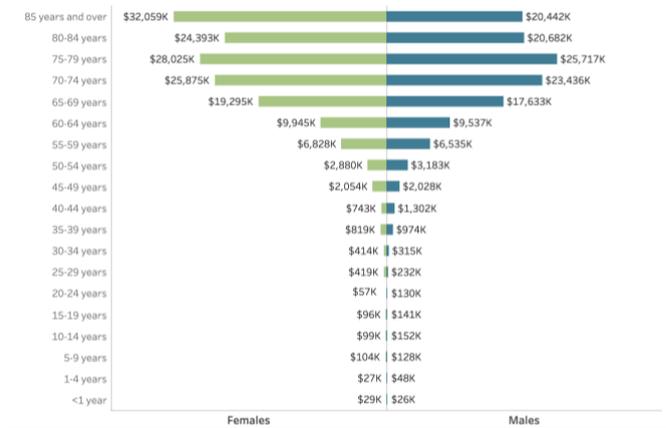
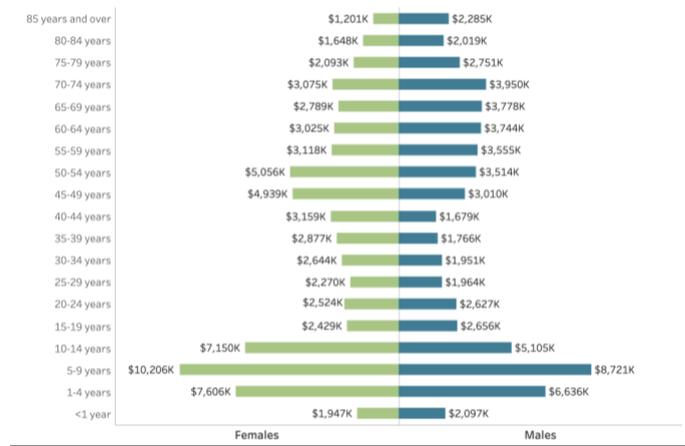


Figure 10. Expenditure on refractive errors, by sex and age group (2018-19).



4.9 Philanthropic and Charitable Donations

Donations are made in increasingly complex ways. Philanthropy and charity represent distinct mechanisms but the terms are frequently used interchangeably. Philanthropy has been defined as the ‘planned and structured giving of time, information, goods and services, influence and voice as well as money to improve the wellbeing of humanity and the community’.³ Charity is a broader term about giving, usually to those in need. In legal terms, charity is a non-profit organisation defined by the *Charities Act 2013* for the purpose of public benefit.

4.9.1 Individual Giving

Individual giving refers to donations made by individuals, usually as once-off smaller amounts. Donations of cash over \$2 or property over \$5000 in value to a Deductible Gift Recipient (DGR) are tax deductible in Australia and therefore, individual tax returns provide some insight into individual giving. However, they do not show the recipient so it was not possible identify eye health-specific donations. The ABS Household Expenditure Survey provides some insight into giving, that was not claimed as a tax deduction.

Key statistics:

- Australia ranks 8th from more than 140 countries in the World Giving Index by the Charitable Aid Foundation (CAF).⁴
- The majority of individual donors gave to non-profit organisations without intending to make regular or ongoing donations to the organisation.³
- A 2018 survey by the Australian Community Trends Report, of individual donors who gave to charity in 2018 found that Australian givers prefer to support charities with a local or national focus (61%) rather than a global focus, and generally prefer traditional charities rather than social enterprises.⁵
- In 2018-19, the total amount claimed by individual taxpayers was \$3.9 billion and 4.2 million Australians claimed an average tax deduction of \$922, which equated to 0.4% of their taxable income on average.
- Over half (52%) of those earning over \$250,000 made a tax-deductible donation.
- The highest average donation came from Western Australia with an average donation of \$2,209 or 0.9% of taxable income.¹
- In 2015-16 according to the ABS Household Expenditure Survey, Australians reported donating \$557 per household on average, equating to approximately \$5 billion.⁶ This compares with \$2.9 billion claimed as a tax deductible gift in the same year.

4.9.2 Workplace Giving

Workplace giving enables giving a proportion of the employees’ pre-tax salary to charity. Employers often match the donation.

Key statistics:

- In 2018-19, there were 5,382 employers in Australia, who offered payroll giving and 201,237 workplace donations resulted in \$43 million donated. With employers matching the employees’ donations, this figure was approximately \$66 million.¹
- In 2020 JB Hi-Fi was awarded the best overall workplace-giving program. Of the 8,500 staff, 75% took part in their workplace-giving program. Since launching the program in 2008, \$23 million have been donated. The program allows employees to choose from one of their nine charity partners, which include AWLA, Bush Heritage, Médecins Sans Frontières, Oxfam, ReachOut, Redkite, Sunrise Cambodia, The Song Room, and The Fred Hollows Foundation.

4.9.3 Business Giving

Corporate philanthropy differs from individual giving in that larger businesses are more likely to partner with charitable organisations over a cash donation, while small and medium business’ primarily make monetary donations.⁷

Key statistics:

- According to Giving Australia’s 2016 survey data, Australian businesses gave \$17.5 billion: \$6.2 billion in donations, \$7.7 billion in community partnerships, and \$3.6 billion in non-commercial sponsorships.

- Over half (51%, \$9 billion) was given by large businesses even though these represented 0.2% of all Australian businesses.
- The education and research sector benefited the most, receiving 22% of the total business giving, followed by the culture and recreation (19%), and social service and health sectors (12%).

4.9.4 Structured Giving

Structured giving involves charitable donations through a formal structure such as a trust. A significant proportion of Australia's deductible giving occurs through this mechanism. A survey of 105 philanthropists found the most common structures used were private ancillary funds (33%), charitable trusts (18%), sub-funds, and as a part of a public ancillary fund (12%).⁸

A list of the top 50 philanthropists (Table 2) was compiled by JBWere Philanthropic Services and published in the Australian Financial Review. The amounts reflect the total given to the end recipients in the 2019-20 financial year, by Australian individuals, families, and bequests, directly and through various foundations.⁹

Public Ancillary Funds (PuAFs) and Private Ancillary Funds (PAFs) represent two other common philanthropic trust fund structures. These structures play a supporting role by linking those who want to donate to eligible Deductible Gift Recipients (DGRs). PuAFs raise money from the public while PAFs were introduced by the Australian government in 1999 as a way to offer tax incentives to the wealthy for philanthropic giving. In 2018-19, there were 1,359 PuAFs and 1,731 PAFs, which received donations of around \$850 million and \$550 million, respectively. PuAFs distributed around \$400 million and PAFs distributed around \$560 million. Of the PAF distributions, \$43.1 million were distributed within the health sector and \$15.2 million distributed within the research sector. Of the PuAF distributions, \$91.7 million were distributed within health sector and \$4.6 million were distributed within the research sector.¹⁰

Table 2. Top 50 philanthropists in Australia, by donation amount (2019-20).

Rank	Name	Value (\$m)	Causes
1	Paul Ramsay Foundation*	168.9	Breaking the cycle of disadvantage through early childhood and school learning, transition to employment for young people
2	Judith Neilson Foundation and Charitable Trusts	125.5	Arts including Phoenix Cultural Centre, Judith Neilson Institute for Journalism and Ideas
3	Minderoo Foundation	88.7	Research, cancer, modern slavery, building community, early childhood, oceans, Indigenous disparity, bushfires, COVID-19
4	Yajilarra Trust	81.3	Australia's First Nations people, climate change, disability, Christian faith
5	Estate of Win Schubert	35.0	Queensland Art Gallery
6	Ian Potter Foundation	30.3	Environment and freshwater, homelessness, Indigenous community, medical and public health research, mental health
7	Terry Snow and Snow Foundations	26.8	Canberra Grammar School, homelessness, domestic violence, disadvantage, Indigenous health, ageing, disability
8	Pratt Philanthropies	23.3	Food security, mental health, arts, education, cancer care, Jewish life, Aboriginal advancement, environment, bushfires, COVID-19
9	Lowy family	23.2	Lowy Medical Research Institute and Lowy Institute for International Policy
10	Estate of Margaret Caroline Reid	22.5	Ian Potter Foundation, \$5m to fund the Water Policy Centre
11	Kinghorn Foundation	20.5	Medical research, poverty, and Australian youth
12	Graham and Louise Tuckwell	20.0	Part of \$100m for two halls of residence at the Australian National University, partners the Tuckwell Scholarship Program
13	Valerie and John Ryan bequest	20.0	Hunter Medical Research Institute and Newcastle Art Gallery Foundation

14	Stan Perron Charitable Trust	15.5	Disadvantage, particularly in Western Australia, improving children's health, cultural enrichment
15	Gandel Philanthropy	15.5	Arts, education, COVID-19, health and medical research, youth at risk, Jewish identity, Indigenous, poverty and disadvantage
16	Myer Foundation and Sidney Myer Fund	12.6	Arts, sustainability and environment, water security, poverty and disadvantage, mental health, rights and justice, education
17	Peter and Lyndy White Foundation	12.5	Homelessness and disadvantage, youth, family and aged care
18	Susan and Isaac Wakil Foundation	12.0	School of Nursing and Midwifery at the University of Sydney and Art Gallery of NSW
19	Neilson Foundation	11.9	Arts, universities, and welfare
20	Planet Wheeler Foundation	11.1	International development focused on health, education, and human rights, refugees, and climate change
21	Vincent Fairfax Family Foundations	10.5	Education and jobs, Christian organisations particularly supporting youth
22	Packer Family Foundations	10.0	Arts, education, bushfires
23	Lang Walker Family Foundation	9.1	Macarthur Medical Research Centre with Western Sydney University and Chris O'Brien Lifehouse
24	Eldon and Anne Foote Trust and subfund - Lord Mayor's CF	8.5	Education, social causes, environment, health, medical research, arts
25	Sylvia and Charles Viertel Charitable Foundation	8.2	Health and medical research
26	Kerry Stokes	8.2	Bushfires, WA Telethon, Australian War Memorial
27	Miller Foundation	8.1	Health and medical research, social services, environment
28	Stafford Fox Medical Research Foundation	7.1	Medical research, public hospitals, and universities
29	Trevor Kennedy	7.0	Artworks to National Museum of Australia
30	Sarah and Lachlan Murdoch	7.0	Murdoch Children's Research Institute, bushfires
31	William Buckland Foundation	6.8	Vulnerable Victorians through housing, health, employment and education, and regional communities
32	Shine On Foundation	6.5	Social services, economic, social and community development
33	Scanlon Foundation	6.5	Improving social cohesion, particularly for the transition of migrants into Australian society
34	Tim Fairfax Family Foundation	6.1	Arts, education and community initiatives in rural, remote and regional areas in Queensland and the Northern Territory
35	Collier Charitable Fund	6.1	Welfare, public hospitals, education, and religion
36	Hansen Little Foundation	6.0	Tertiary education, arts, and medical research
37	Susan McKinnon Foundation	5.8	Effective government, international leadership, and obesity prevention
38	McCusker Charitable Foundation	5.1	Medical research and advancement of science, conservation/environment, education, arts
39	Baker Foundation	5.0	Predominantly medical research, and also education, welfare, and children
40	Michael Hintze	5.0	Australian Museum
41	Andrew Thyne Reid Charitable Trust	4.9	Arts, higher education, medical research, welfare
42	Noel and Carmel O'Brien Family Foundation	4.9	International aid and education, migrants, refugees or asylum seekers, homelessness
43	JO and JR Wicking Trust	4.8	Wellness and quality of life for the aged and those with or at risk of Alzheimer
44	Ernest Heine Family Foundation	4.5	Medical research and social services
45	R E Ross Trust	4.4	Educational opportunities for vulnerable young Victorians, sustainability/environment in Victoria, crisis support
46	Percy Baxter Charitable	4.4	Education, medical research and other Victorian charities

	Trust		
47	Peter Weiss and Foundation	4.2	University of Sydney's Westmead Institute for Medical Research
48	The Charitable Foundation	4.1	International aid
49	Wyatt Benevolent Institution	4.1	Challenging inequality and poverty in South Australia
50	Estate of Donald Counter Cooper	4.0	Medical research

4.10 Government Funded Aboriginal and Torres Strait Islander and Rural Eye Health programs

A number of programs initiated by the Federal and State Government have a specific focus on eye health for Aboriginal and Torres Strait Islander and rural populations.

4.10.1 The National Trachoma Surveillance and Reporting Unit (NTSRU)

The NTSRU is responsible for the ongoing data collection, analysis, surveillance and reporting of trachoma in Australia. It is a Federal Government-funded initiative, which is based on agreements with the four states and territories where trachoma still occurs. It is managed by the Kirby Institute at the University of New South Wales. A number of government grants for 'Ear and Eyes Trachoma' from the Department of Health to various institutions were found in the grant.gov.au portal (Table 3). In WA, a \$4.95M grant was made to the Lions Eye Institute on 2 June 2020 and a \$660,000 grant made to the WACRRM on 1 July 2019.

Table 3. Health Department grants for 'Ear and Eyes Trachoma' extracted from grants.gov.au.

Date	Grant number	Amount	State	Organisation
7/6/2021	GA169586	786,330.6	National	Vanguard Consulting & Services Pty Ltd
1/7/2021	GO4648	2,550,000	VIC	University of Melbourne
2/6/2020	GA80282-V1	4,950,000	WA	Lions Eye Institute Limited
1/6/2021	GA168170	511,733.2	NT	Ngaanyatjarra Health Service (Aboriginal Corporation)
18/7/2019	GA56274	660,000	NT	Northern Territory of Australia
18/7/2019	GA56275	660,000	SA	Rural Doctors Workforce Agency Incorporated
1/7/2019	GA55756	660,000	WA	Western Australian Centre for Remote and Rural Medicine (WACRRM) Ltd
1/7/2019	GA55757	660,000	VIC	Rural Workforce Agency; Victoria Limited
1/7/2019	GA55758	660,000	TAS	State of Tasmania acting through the Department of Health
1/7/2019	GA55759	660,000	QLD	General Practice Queensland Limited
1/7/2019	GA55760	660,000	NSW	NSW Rural Doctors Network Ltd
2/10/2018	GA22414-V1	946,000	QLD	Diamond Jubilee Partnerships Limited
21/11/2018	GA25454-V1	2,200,000	Nat	Vanguard Consulting & Services Pty Ltd

4.10.2 The Visiting Optometrists Scheme (VOS)

The VOS is a federally funded initiative to support optometrists deliver outreach services to rural and remote Australia. Fund holders manage the delivery of services in different states. The fund holder for WA is Rural Health West. On 23 March 2020, the Department of Health approved a grant of \$36,020,307 for a further four years of funding from 2020-21 to 2023-24. The 2020-21 Rural Health West annual report did not detail the expenditure on the VOS.

4.10.3 The Rural Health Outreach Fund (RHOF)

The RHOF is a Federal Government-funded program, which supports the delivery of outreach health services to regional and remote Australians. There are five programs under the RHOF, which include:

- The Medical Specialist Outreach Assistance Program (MSOAP)
- MSOAP – Ophthalmology expansion
- MSOAP – Maternity services expansion
- Rural Women's GP Service Program
- National Rural and Remote Health – Kimberley Paediatric Outreach Program.

On 25 May 2020, the Australian Government Department of Health committed \$116 million to the RHOF over four years from 2020-21 to 2023-24 (Grant number - GO3236).

4.10.4 National Diabetes Services Scheme (NDSS)

The NDSS is a federal-funded scheme, which provides subsidies for diabetes-related products, including syringes and needles, blood glucose test strips, urine test strips, insulin pump consumables, continuous glucose monitoring (CGM) products.

On 11 March 2021, the Australian Government Department of Health committed \$140,490,000 to the NDSS from 2020-21 to 2023-24 (Grant no. GO4707). The scheme is run by sub-contractors, including the State and Territory Diabetes Organisations, the Australian Diabetes Educators Association, and the Australian Diabetes Society.

4.10.5 National Eye Health Survey

The 2016 National Eye Health Survey was the first national survey to determine the prevalence and major causes of vision impairment and blindness in Australia. It was conducted by investigators at the Centre for Eye Research Australia (CERA) in collaboration with Vision2020 and funded by the Australian Government with contributions coming from CERA, OPSM, Novartis, Zeiss, the Brien Holden Vision Institute, Optometry Australia, the National Aboriginal Community Controlled Health Organisation (NACCHO), and the Royal Flying Doctor Service. The 2016-17 Vision2020 annual report showed a \$1,016,496 expense line for the National Eye Health Survey project.

The Australian Department of Health released a request for tender for the second national eye health survey on the 23 March 2020. The Westmead Institute for Medical Research (WIMR) Centre for Vision Research won the tender and announced the Australian Eye and Ear health survey.

4.10.6 Indigenous Eye Health Unit

Prof Hugh R Taylor established the Indigenous Eye Health Unit at the University of Melbourne, School of Population and Global Health in 2008. It aims to Close the Gap for Vision for the Aboriginal and Torres Strait Islander peoples through research, policy formation, advocacy and implementation. No publicly available funding information was found from university annual reports or government grants; however, their website states they receive Federal Government funding as well as sponsorship from Minum Bareng, BB&A Miller Foundation, Paul Ramsay Foundation, The Cybec Foundation, Minderoo Foundation, and Metal Manufacturers Limited.

4.10.7 Eye and Ear Surgical Support Program

The Eye and Ear Surgical Support Program (ESSP) is a Federal Government-funded program, which aims to increase access to surgery for rural and remote Aboriginal and Torres Strait Islander patients. The funding supports the cost of travel and accommodation for the patient and carer to and from the surgery location.

Rural Health West administers this service in WA. The Federal Government Department of Health made a \$1,615,435.8 grant (GO3247) to Rural Health West on 3 July 2020 to fund four years of the service from 2020-21 to 2023-24.

Other states have received the following grants:

- Tasmania – 5 May 2021, \$385,550, Rural Health Tasmania Inc
- NSW – 4 July 2020, \$709,500, NSW Rural Doctors Network Ltd
- Victoria - 4 July 2020, \$307,450, Rural Workforce Agency; Victoria Limited
- Queensland – 16 June 2021, \$380,988.3 General Practice Queensland Limited
- Queensland – 3 July 2020, \$1,439,900 General Practice Queensland Limited
- South Australia – 6 July 2020, \$605,000 Rural Doctors Workforce Agency Incorporated

4.10.8 The Lions Eye Institute Northwest Hub

Lions Outback Vision has an established ophthalmology clinic in Broome, Western Australia. The clinic is located in the former Kimberley Klub backpackers, which was donated by the Wen Foundation. The WA State Government has committed \$4.7M towards the clinic project. The aim of the clinic is to deliver eye care services to people of northern Western Australia.

4.10.9 Rural Health West and WACHS

The WA Country Health Service (WACHS) is one of WA's six local health networks. It is part of, and funded by, the State Government of Western Australia's Department of Health. WACHS operates a network of health facilities, including regional hospitals, integrated district hospitals, nursing posts, and community health centres. They operate 12 hospitals over seven WA regions as well as administer the state-funded Patient Assisted Transport Scheme.

Rural Health West is a not-for-profit organisation, which operates as a workforce agency. Their focus is on recruitment and support of medical professionals to rural Western Australia. Their services include recruitment services for locum general practitioners, nurses, midwives, dentists, and allied health professionals, professional development (regional workshops and conferences to rural health professionals), encouraging medical and allied health university graduates to consider a rural career, business support to rural practices, personal and family support to rural medical and health practitioners, and conducting needs-assessment planning. They are funded by the Australian Government Department of Health and WACHS.

4.11 Research Funding

The Australian Institute of Health and Welfare reports on health and medical research and highlights the sources and amounts of funding for Australian research.² Health and medical research in Australia is funded by a number of organisations, including the Federal Government, state and territory governments, not-for-profit organisations, and private business and individual philanthropic donations.

Spending on health and medical research in Australia was \$5.6 billion in 2017-18. The majority (79%) was contributed by the Federal Government (\$4.4 billion). State and territory governments spent \$827 million and non-government sources accounted for \$404 million.

4.11.1 Federal Government Funding

The Federal Government funds health and medical research directly through three main programs, which include the National Health and Medical Research Council (NHMRC), Medical Research Future Fund (MRFF) and the Biomedical Translation Fund. In addition, it funds health and medical research indirectly through block grants to Universities, Research and Development Tax incentive program and grants to both, public and private research institutions and organisations, such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Cancer Australia.

4.11.1.1 The National Health and Medical Research Council (NHMRC)

The NHMRC is Australia's national health and medical research funding body. It was the eighth largest research funding body in the world in 2016.¹¹

Key statistics:

- In 2020-21, the NHMRC received 1678 funding applications from female chief investigators and 2154 funding applications from male CIAs.
- In 2020-21, 536 new grants were given to a value of \$497.6 million.
- Balance, eye and hearing diseases received \$22.3 million in funding.
- Aboriginal and Torres Strait Islander Health received \$57.2 million in funding.
- 22 grants were given to WA entities to the value of \$36.2 million.
- There were no grants for eye-related conditions in WA.

4.11.1.2 Medical Research Future Fund (MRFF)

The MRFF is a sovereign fund established by the Australian Government in 2015, which is designed to provide ongoing funds for medical research through dividends.

Key statistics:

- The Federal Government funded \$3.2 billion into the fund as per its election promise on 21 July 2020, which brought it to the capital target of \$20 billion.
- The fund aims to distribute \$650 million per year.
- In 2020, 543 grants were given to the value of \$597.9 million.
- 29 grants (value of \$84.0 million) were given to WA entities.
- There were no grants for eye-related conditions in WA.

4.11.1.3 Biomedical Translation Fund

The Biomedical Translation Fund (BTF) provides companies with venture capital through licensed private sector fund managers.

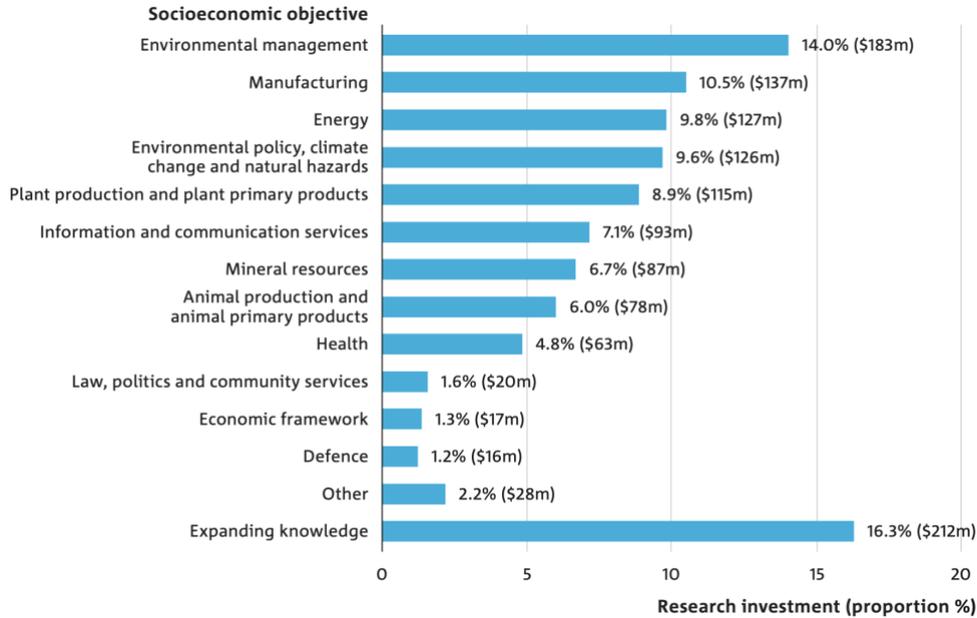
Key statistics:

- A total of \$501.25 million is available through the Biomedical Translation Fund.
- \$250 million is from the Commonwealth capital and \$251.25 million is from the private sector capital.
- To date, 22 companies have received funding.
- Polyactiva (Melbourne) was funded \$8.2 million for development of an ocular implant in its glaucoma program.
- No companies in WA or other eye health-related companies have received funding through this fund.

4.11.1.4 Commonwealth Scientific and Industrial Research Organisation (CSIRO)

The CSIRO is an independent government agency, which operates as Australia’s national science research institution. The CSIRO invested \$63 million on health research in 2020-21 (Figure 11), which was 4.8% of their \$1.3 billion research budget.

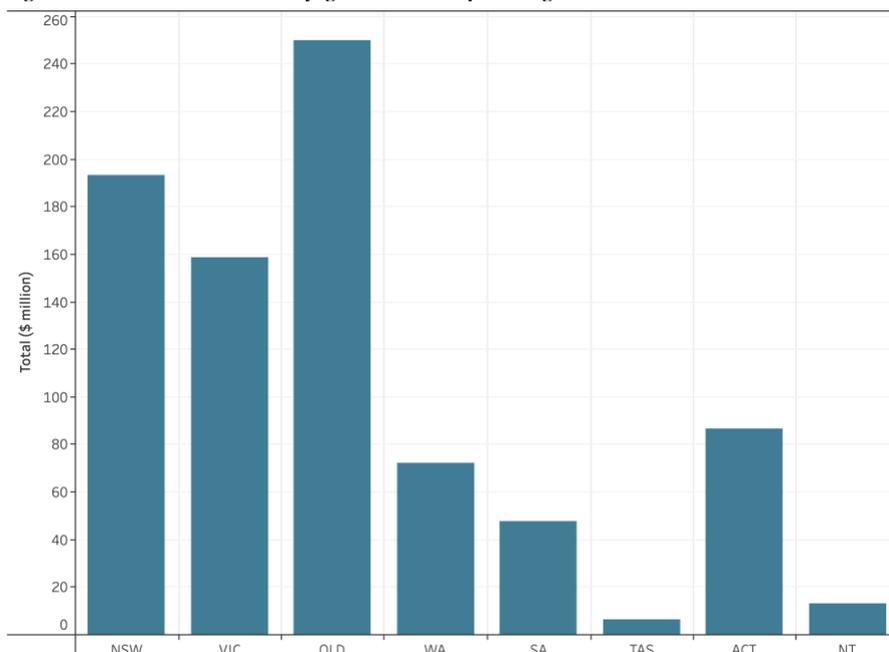
Figure 11. CSIRO research investment: proportion (%) and amount spent (\$) by socioeconomic objectives.



4.11.2 State and Territory Government Funding

In 2017-18, the WA state government spent \$72.1 million on health and medical research. Queensland spent the most (\$250 million) and Tasmania spent the least (\$6.4 million). Healthway, which supports health promotion research among other areas and the WA future health research and innovation fund, which supports health and medical research directly, are two mechanisms of project funding by the WA state government.

Figure 12. State and territory government spending on health and medical research (2017-18).²



4.11.2.1 WA Future Health Research and Innovation Fund

In 2021, \$5.03 million was awarded as part of the WA near miss awards, to help researchers obtain nationally competitive NHMRC grants. The following grants were awarded to WA eye health-related projects:

- Dr Fred Chen - \$688,577, Preventing blindness from retinal degeneration: from clinic to bench to trials.
- Dr Livia Carvalho - \$74,000, Validating novel treatments for cone-mediated vision loss.

Additionally, the Lions Eye institute researchers received \$274,278 as part of the Medical Health Research Infrastructure Fund (MHRIF) and \$166,871 Research Institute Support (RIS) program.

4.11.2.2 HealthyWA

Healthway is the WA state government funding body focused on health promotion. They fund community initiatives, programs, research and partnerships across sports, arts, racing, community events, and health research organisations. For more than 30 years they have funded over 5600 organisations to the value of \$470 million. There were no grants for eye-health promotion in the 1446 listed approved grants.

4.11.3 Non-government funding

Data pertaining to individuals and charities contributions to health and medical research is difficult to obtain. In 2017–18, individuals in Australia spent approximately \$3 million on medical research.²

As of 1 Jan 2022, there were 683 charities or groups with ‘health and medical research’ listed as a program classification registered with the Australian Charities and Not-for-Profits Commission.² Fifty of these were located in WA.

4.12 Issues and Recommendations

4.12.1 There is no publicly available database for eye health care funding in Australia

Details:

- The AIHW provides an excellent breakdown of health care expenditure in Australia through the Australian National Health Account, which was produced by compiling data from over 50 sources.
- Figure 4 in the report provides a visual overview of the flow of funds through the healthcare system from source to area of expenditure; however, it was not possible to filter this database by disease sector.
- Therefore, achieving a granular analysis of the eye health sector of the Australian health care system was not possible within the constraints of the publicly available data.

Recommendations:

- 1) Consider projects, which create collaborations with the AIHW to develop an eye health care funding specific study. The output would be a high-level overview of the sector that would give national and state oversight of spending in eye health care from a source, flow, and destination perspective.
- 2) Consider projects, which utilise similar methodology to the AIHW reports to generate a funding overview of eye health in Australia.

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EDUCATION

5. Education

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5.3 Introduction

The Western Australian eye health care workforce education sector comprises a distributed network of organisations, each with different priorities, standards, funding, and incentives. Education of the workforce is driven by the peak bodies, which represent specialist eye health care providers at a national level. Although the Western Australian workforce can access these national resources, there are limited local education providers supporting the local workforce. This section of the report considers training and ongoing education as separate educational functions and considers specialist eye-care providers as discrete from generalist eye health care providers.

5.4 Specialist Eye Care Providers

Specialist eye-care providers are providers whose vocation is solely dedicated to eye health care (shown in Table 1).

Table 1. Specialist and generalist eye health care providers in Western Australia.

Specialist	Generalist
<ul style="list-style-type: none">• Ophthalmologist• Optometrist• Orthoptists• Ophthalmic nurse• Ophthalmic theatre nurse• Ophthalmic nurse practitioner• Optical dispenser	<ul style="list-style-type: none">• General practitioner• Emergency physician• Paediatrician• Pharmacist• Diabetic educator• Aboriginal health worker

5.4.1 Training

5.4.1.1 Training Organisations

Specialist medical colleges, universities, and registered training organisations train the Western Australian eye health care specialist workforce. The Australian Medical Council (AMC) accredits specialist medical colleges to provide specialist medical training and their specialist training programs, which lead to qualifications for practice in recognised medical specialties. Australian universities are higher education providers registered with the Australian Government Tertiary Education Quality and Standards Agency, who evaluate providers against the Higher Education Standards Framework 2021. Registered training organisations (RTOs) are private training providers registered with the Australian Government Australian Skills Quality Authority, to deliver nationally recognised courses (certificates and diplomas). Table 2 shows the organisations responsible for the training of the specialist eye health care workforce in WA.

Table 2. Western Australian specialist eye-care workforce training organisations.

Specialist	Training organisation(s)	Type
<i>Ophthalmologist</i>	RANZCO*	Specialist medical college
	RANZCO* WA	Specialist medical college
<i>Optometrist</i>	The University of Western Australia	University
	Curtin University together with Flinders University	University
<i>Orthoptist</i>	No local training available	
<i>Ophthalmic nurse</i>	No local training available	
<i>Ophthalmic theatre nurse</i>	No local training available	
<i>Ophthalmic nurse practitioner</i>	No local training available	
<i>Optical dispenser</i>	Australasian College of Optical Dispensing	RTO*
	Community Skills WA	RTO*
<i>Medical student</i>	The University of Western Australia	University
	Notre Dame University	University
	Curtin University	University
	Eyeballs Made Easy	Private organisation

*RANZCO = Royal Australian College of Ophthalmologists = RTO, Registered training organisation.

5.4.1.2 Training pathways

5.4.1.2.1 Ophthalmology

Ophthalmologists are trained and accredited by a national vocational training program (VTP), which is provided by the Royal Australian and New Zealand College of Ophthalmologists (RANZCO). Each state or territory has its own RANZCO branch. The WA branch provides training for the WA trainees. Fellows of the college can register with Australian Health Practitioner Regulation Agency (AHPRA) as a specialist ophthalmologist.

5.4.1.2.2 Optometry

Tertiary education providers offer optometry training. Until 2021, there was no tertiary-level optometry training provider in Western Australia. The University of Australia has created the first which opened in 2021. Previously, a pathway allowed students to commence study at Curtin University and transfer to Flinders University to complete a Bachelor of Medical Science (Vision Science) / Master of Optometry. Graduates with an accredited degree could register with the Optometry Board AHPRA as an optometrist.

5.4.1.2.3 Orthoptist

Orthoptists graduate from a recognised university degree program and then register with the Australian Orthoptic Board (the registration body for orthoptists in Australia). Currently, there are only two such recognised programs, and neither is based in Western Australia. Recognized programs are offered by LaTrobe University (Victoria) and University of Technology, Sydney (NSW). There are currently no orthoptic education providers in Western Australia.

5.4.1.2.4 Ophthalmic nurse

Enrolled nurses (ENs) complete a 2-year Diploma of Nursing through a vocational education provider. Registered nurses (RNs) complete a 3-year Bachelor of Nursing through a university. Nurse practitioners (NPs) are RNs who are endorsed as NPs by the Nursing and Midwifery Board of Australia (NMBA). NPs practice independently in an advanced and extended clinical role and can prescribe some medicines. There is no independent registration body for ophthalmic nurses. There are no certification or registration requirements to

practice as an ophthalmic nurse. A nurse may develop a special interest in eye care and develop skills through vocational experience. Nationally, there are a number of university degrees in ophthalmic nursing; however, none are offered in Western Australia. Continuing professional development for ophthalmic nurses is provided by the Australian Ophthalmic Nurses Association of WA.

5.4.1.2.5 Optical dispenser

No formal qualification is needed to work as an optical dispenser; however, a Certificate IV in optical dispensing is available.

5.4.1.2.6 Aboriginal health worker

To gain registration as an Aboriginal health worker, practitioners must complete a minimum 12-month Certificate IV program of study approved by the Aboriginal and Torres Strait Islander Health Practice Board of Australia.

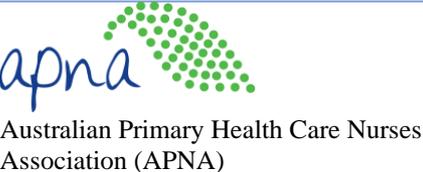
5.4.2 Ongoing Education

5.4.2.1 Peak bodies

Peak bodies are not-for-profit non-government organisations, whose activities are funded by a range of sources, including states and territories, the Australian Government, bequests, donations, and fundraising activities. A peak organisation or peak body is an Australian term for an advocacy group or trade association, an association of industries or groups with allied interests. They are generally established for the purposes of developing standards and processes, or to act on behalf of all members when lobbying the government or promoting the interests of the members.

Ongoing education for eye health care specialist providers in Western Australia is driven at the top by the various representative peak bodies (Table 1). In an educational context, they are accredited and provide ongoing professional education for their representative professions. Many have continuing professional development (CPD) point systems for professional members to track and maintain their educational requirements. Peak bodies are national; however, they often have state branches, which provide for local education needs. Local practitioners can access the national resources.

Table 1 - Education provided by peak bodies representing eye health professionals

Profession	Peak body	Ongoing education
Ophthalmology		<ul style="list-style-type: none"> • CPD program • Congress • Eye2Eye magazine • Clinical Experimental Ophthalmology Journal
Optometry		<ul style="list-style-type: none"> • CPD program • Annual conference • Optometry Connection magazine • Clinical and Experimental Optometry Journal • Podcast
Orthoptics		<ul style="list-style-type: none"> • Online paid education • Journal club • Annual conference • Australian Orthoptic Journal
Ophthalmic nurse		<ul style="list-style-type: none"> • An introduction to eyes
		<ul style="list-style-type: none"> • Seminars
Optical dispenser		<ul style="list-style-type: none"> • CPD program • Practice management diploma

5.4.2.2 Registered charities

Registered charities, which support eye health care in Australia often provide ongoing education targeted at various eye health care providers (Table 2). These online CPD activities are accessible by Western Australian practitioners.

Table 2 - Ongoing education provided by registered charities

Registered charity	Ongoing education
	<ul style="list-style-type: none"> • Glaucoma Now publication -CME publication targeted at ophthalmologists, ophthalmology residents, and glaucoma specialists. • Optometry CPD • Collaboration with MiVision Australia for content
	<ul style="list-style-type: none"> • Myopia education program for optometrists
	<ul style="list-style-type: none"> • CPD for optometrists • Macular research update email list • Webinars • Fact sheets
	<ul style="list-style-type: none"> • Publications and reports • Fact sheets

5.5 Generalist Eye Care Providers

5.5.1 Ongoing Education

Several resources exist for generalist health care providers involved in Western Australian eye health care. The majority are provided by respective medical colleges and peak bodies, with some collaboration with registered charities in certain areas (Table 3).

Table 3 - Eye health related ongoing education provided by medical colleges

<i>Generalist eye care provider</i>	Organisation	Ongoing education
<i>General practitioner</i>	 RACGP Royal Australian College of General Practitioners	<ul style="list-style-type: none"> • Ophthalmology presentations • Curriculum material
	 Australian College of Rural & Remote Medicine WORLD LEADERS IN RURAL PRACTICE	<ul style="list-style-type: none"> • CPD • Curriculum material
	 ThinkGP www.thinkgp.com.au	<ul style="list-style-type: none"> • CPD
<i>Emergency Medicine</i>	 Australasian College for Emergency Medicine	<ul style="list-style-type: none"> • CPD • Curriculum material
<i>Pharmacist</i>	 Pharmaceutical Society of Australia	<ul style="list-style-type: none"> • Eye health for pharmacists course
<i>Diabetic educator</i>	 Australian Diabetic Educators Association Your trusted partner in diabetes care	<ul style="list-style-type: none"> • Optometry for Diabetes Educators course
<i>Aboriginal health worker</i>	 Brien Holden FOUNDATION	<ul style="list-style-type: none"> • Provision of eye-health equipment and training (PEHET) program. Retinal camera training for diabetic retinopathy screening in Aboriginal and Torres Strait Islander people.

5.6 Medical students

The body of knowledge in medicine is ever expanding, which puts increasing pressure on university medical curricula to sufficiently cover all specialties.^{1,2} In most medical schools, ophthalmology comprises a small component of the curricula,³ and surveys in Australia, the UK and Canada have revealed that it is diminishing further.³⁻⁵ In Western Australia, this lack of ophthalmic exposure is continued post medical, with minimal ongoing ophthalmic education and support provided for generalist eye health care providers. The potential consequence is the misdiagnosis of ocular conditions, leading to permanent vision loss in some cases.⁶

5.7 Issues and recommendations

5.7.1 *Limited formal training in ophthalmology exists for select specialist and generalist eye health care providers.*

Details:

- There is no local formal training available for orthoptists, ophthalmic nurses, ophthalmic theatre nurses, and ophthalmic nurse practitioners.
- There is no local training for diabetic educators in ophthalmology.
- The emergency physician curriculum standards contain ophthalmic outcomes; however, there is no ophthalmic CPD offered through the Australian Collage of Emergency Medicine (ACEM) e-learning platform.
- The Australian Collage of Rural and Remote Medicine (ACRRM) have ophthalmic outcomes in their curriculum standards; however, there is no additional CPD offered.
- There is a paucity of tailored education available for ophthalmic nurses in Western Australia.

Recommendations:

- Eyeballs Made Easy (EME) is a Western Australian based e-learning hub for medical students, doctors and health care workers, which aims to improve eye care through open access teaching from ophthalmologists. Collaboration opportunities may exist between the PEF and EME to address this issue.
- The University of Western Australia Clinical and Training Evaluation Centre (CTEC) offers an opportunity to develop microsurgical skills courses in eye procedures, offered to specialist and generalist providers. There is currently a microsurgical skills course offered to theatre nurses; however, this is not ophthalmology specific.
- Existing registered charities provide opportunities for collaboration on the creation of targeted educational content.
- Opportunities exist for further collaboration between ophthalmology and education providers for other specialties.

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HEALTH PROMOTION

6. Health Promotion

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6.4 Executive Summary

- Health promotion refers to a core function of public health that focuses on disease prevention, that is the prevention of the root cause rather than treatment, so the population remains as healthy as possible for as long as possible.
- The burden of disease studies aim to quantify the total impact of living with a disease and dying prematurely in a society. They provide a summary measure of population health by combining mortality and morbidity data into a single number. These studies are important for planning preventative action.
- This report section aims to tell the story of eye-health promotion in Australia. Part 1 highlights the burden of eye disease in the context of the total burden. Part 2 focuses on avoidable vision loss and blindness, which are potential targets for eye-health promotion strategies. Part 3 describes the current eye-health promotion activities and organisations in Australia.

Part 1 – Burden of Disease:

- The Australian Institute of Health and Welfare 2018 Burden of Disease Study is Australia's largest burden of disease study. It calculates burden using the disability adjusted life year or DALY measure.
- In 2018, the total burden of disease in Australia was 5 million DALY, or 5 million healthy years of life lost, which is equivalent to 199 DALY per 1,000 population.
- Hearing and vision loss accounted for 109,241 DALY or 3.7 DALY per 1,000 population representing 2.2% of the total burden (DALY) (Figure 1).
- The Australian population is getting healthier. The rate of burden fell 13% between 2003 and 2018, from 209 to 182 DALY per 1,000 population; however, burden for all vision disorders increased slightly between 2003 and 2018. Age related macular degeneration (AMD) increased by 2%, cataract and lens disorders increased by 2.5%, glaucoma increased by 0.4%, other vision disorders increased by 0.2% and refractive errors increased by 0.7%.
- Hearing/Vision disorders have 1.6x the burden in remote and very remote areas compared to major cities (Table 2), suggesting it is more affected by rurality than the national average for all diseases.
- Hearing/Vision loss had 1.4x the total burden in the lowest socioeconomic strata compared to the highest strata.
- In 2018, Western Australia had a total burden of 490,000 DALY's or 179 per 1,000 as an age standardised rate (
- Table 3). This was the 5th highest rate in the country, above that of Victoria, the ACT, and NSW.
- For all visual disorders except glaucoma, WA has the lowest or equal lowest age standardised rate for disease burden. The ACT had a lower rate for glaucoma (Figure 6).

Part 2 – Avoidable Vision Loss and Blindness:

- Results from the National Eye Health Survey found that approximately 90% of vision impairment and blindness among both Indigenous and non-Indigenous Australians is preventable or treatable.
- The National Eye Health Survey reports that 57.4% of Indigenous and 51.93% of non-Indigenous participants with one of the five major causes of vision impairment were undiagnosed.
- Refractive error, cataract, age-related macular degeneration, diabetic retinopathy, and glaucoma are the top five conditions responsible for preventable or treatable vision impairment, of which half were undiagnosed in the National Eye Health Survey.

Part 3 – Health Promotion Activities:

- There are a number of organisations responsible for the design and delivery of health promotion activities at a state and national level. The Department of Health and WA Health govern health promotion at the highest level in Western Australia.
- Local organisations support health promotion in Western Australia, including the WA branch of the Australian Health Promotion Association, Healthway, WA health promoting schools, and the Public Health Advocacy association of Western Australia.
- There are limited publicly available data on current health promotion activities.
- WA eye health promotion-specific programs found include those targeting trachoma, diabetes, and smoking cessation.

6.5 Introduction

Health promotion refers to a core function of public health that focuses on disease prevention, that prevents the root cause rather than treatment, so the population remains as healthy as possible for as long as possible. It moves beyond an individual perspective, towards broader educational, organisational, economic, and political interventions.¹ The World Health Organization's Ottawa Charter for Health Promotion defines it as:

“The process of enabling people to increase control over and improve their health. It involves the population as a whole in the context of their everyday lives, rather than focusing on people at risk for specific diseases, and is directed toward action on the determinants or causes of health.”²

Burden of disease studies aim to quantify the total impact of living with a disease and dying prematurely in a society. Loss of healthy life is called burden of disease in epidemiological literature and is recognised as the best method to measure the impact of different diseases or injuries in a population. It provides a summary measure of population health by combining mortality and morbidity data into a single number. These studies are important for a number of reasons, including assessing the performance of healthcare systems, comparing action and health gain, identifying high risk populations, setting health research priorities, planning for future needs, and in the health promotion context, for planning of preventative action.

The Australian Institute of Health and Welfare conducts the largest national burden of disease study in the country. The latest study was completed in 2018, reported in 2021 and included data from 219 diseases.³ It found that 38% of the burden could have been avoided or reduced, being due to modifiable risk factors, including tobacco use and excess body weight (overweight, including obesity). Reducing this preventable burden is the target of health promotion.

This report section aims to tell the story of eye health promotion in Australia. Part 1 highlights the burden of eye disease in the context of the total burden. Part 2 focuses on avoidable vision loss and blindness, which are potential targets for eye health promotion strategies. Part 3 describes the current eye health promotion activities and organisations in Australia.

6.6 Data Sources and Methodology

6.6.1 *Australian Burden of Disease Study 2018*

The 2018 Australian Burden of Disease Study³ is a national study by the Australian Institute of Health and Welfare (AIHW), which estimates the total, non-fatal and fatal burden of disease for the Australian population, using the disability adjusted life years (DALY) measure. The study estimates DALY for 219 diseases as well as the burden, which is attributable to specific risk factors. Vision disorders in the study include glaucoma, refractive errors, age-related macular degeneration, cataracts, and other vision disorders.

6.7 Part 1 – Burden of Disease

Burden of disease studies use data from a range of sources to construct an internally consistent measure of deaths and living with illness. The major benefit is that the impact of a fatal disease can be compared with a disease that is non-fatal but can cause great suffering in a large number of people.³ As such, they provide the best summary measures of a population's health.³

The Australian Institute of Health and Welfare 2018 Burden of Disease Study is Australia's largest burden of disease study. It calculates burden using the disability adjusted life year or DALY measure. One disability adjusted life year (or 1 DALY) represents 1 year of healthy life lost, either through premature death ('years of life lost' or YLL) or from living with an illness or injury ('years lived with disability' or YLD). It represents the gap between the health status of the population and some ideal reference status.

The YLL is calculated as the number of deaths multiplied by the life expectancy, at the age when the death occurs. The YLD aggregates the time lived with a disability, it is calculated by multiplying the number of disability cases by the duration of the disease and taking a disease weight, which takes into account the severity of the disease.⁴ The total burden is a combination of the fatal and non-fatal burden of disease. Eye diseases are comprised of only the non-fatal burden of disease.

6.7.1 Australian Disease Burden

Key statistics:

- In 2018, the total burden of disease in Australia was 5 million DALY, or 5 million healthy years of life lost, which is equivalent to 199 DALY per 1,000 population. Fifty-two percent of the total burden was from living with an illness (non-fatal), and 48% was premature death (fatal).
- The five disease groups that caused the most burden in 2018 were cancer, musculoskeletal conditions, cardiovascular disease, mental health conditions and substance use disorders, and injuries accounted for cumulative 65% of the burden.
- Males (52% of total burden) experienced more burden than females (47%).
- The overall health of the Australian population has improved between 2003 and 2018. Total DALY has reduced by 13% from 208.6 per 1,000 population in 2003 to 181.8 per 1,000 population in 2018. This was driven by reductions in the fatal burden, although there were no reductions in the non-fatal burden.
- In 2018, 38% of the burden of disease was potentially preventable by avoiding exposure to one or more risk factors. The top risk factors (percent of total burden) contributing to total burden were tobacco use (8.6%), overweight/obesity (8.4%), all dietary risks (5.4%), high blood pressure (5.1%), and alcohol use (4.5%).
- Coronary artery disease had the highest burden of disease at 10 DALY per 1,000 population.
- Hearing and vision loss accounted for 109,241 DALY or 3.7 DALY per 1,000 population representing 2.2% of the total burden (DALY) (Figure 1).
- Hearing and vision loss is the only disease group that is comprised completely of non-fatal burden (Figure 2).
- In 2018, the burden of non-fatal disease in Australia was 2.6 million years of healthy life lost, which equates to 98.1 YLD per 1,000 population. This is 17% higher than the rate of fatal burden.
- Females (53%) experience slightly more fatal burden than males (47%).
- Because the hearing and vision loss burden is non-fatal, the years lost to the total burden are all attributed to years lost to disability. In 2018, vision and hearing diseases accounted for 109,241 years lost to disability (YTD), or 3.7 age-adjusted years per 1,000 population, equating to 4.2% of the non-fatal burden.

Figure 1. Proportion (%) of total burden (DALY), by disease group and sex (2018).
 Source: AIHW Australian Burden of Disease Study.

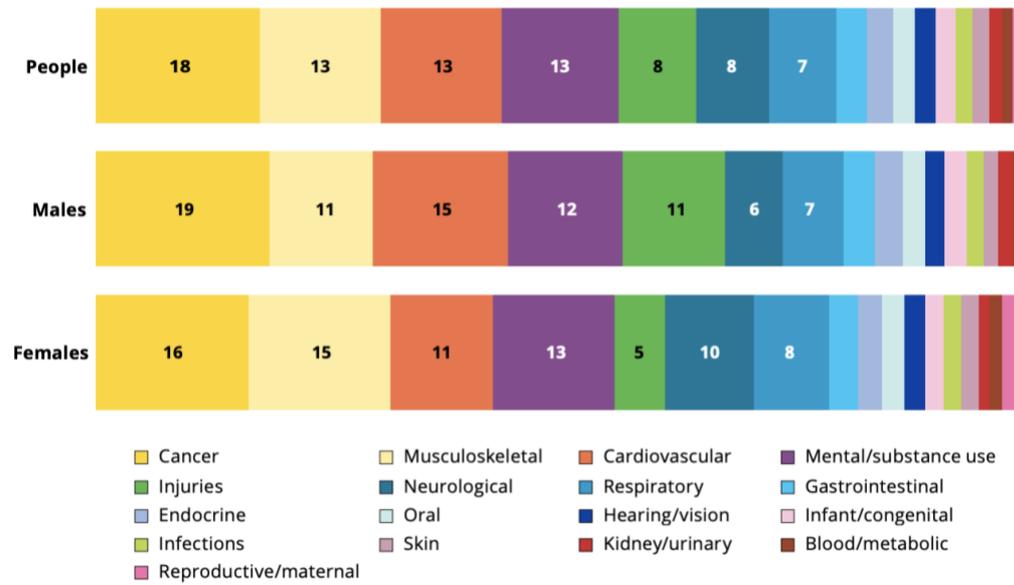


Figure 2. Proportion (%) of total burden (DALY) by fatal burden (years of life lost) versus non-fatal burden (years lived with disability), by disease group (2018).
 Source: AIHW Australian Burden of Disease Study.

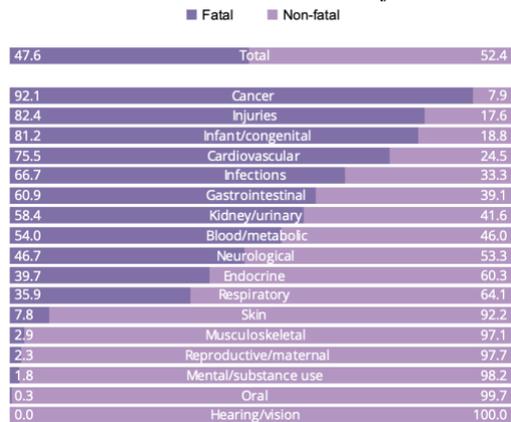
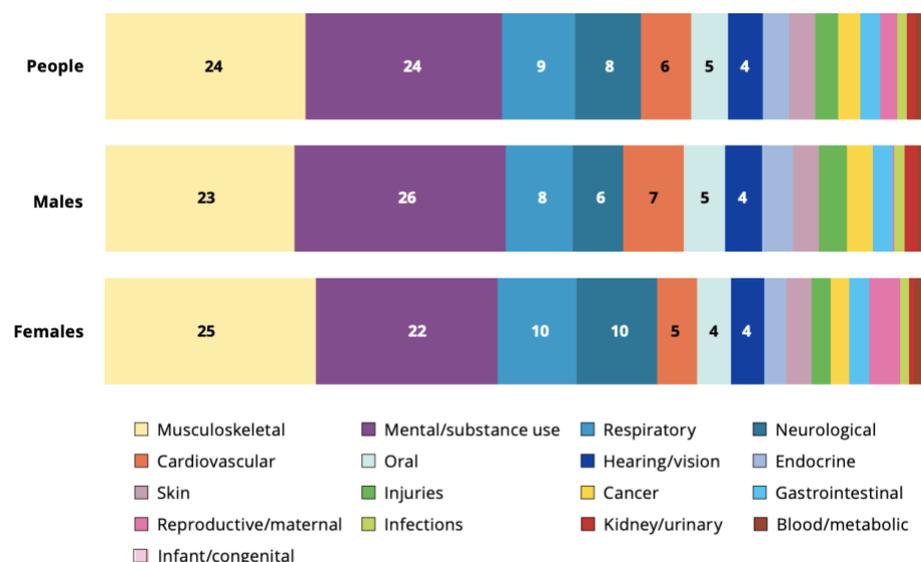


Figure 3. Proportion (%) of non-fatal burden (years lived with disability), by disease group and sex (2018). Source: AIHW Australian Burden of Disease Study.



6.7.2 Burden from Vision Diseases

The 109,241 DALY or 3.7 per 1,100 population rate, from hearing/vision disorders accounted for the following diseases in the 2018 AIHW Australian Burden of Disease Study (Table 1).

Table 1. Disease specific DALY and rate for hearing/vision disorders (2018). Data source: AIHW

Disease	DALY ('000s)	Rate
Age-related macular degeneration	8,225	0.2
Refractive errors	7,470	0.2
Cataract and other lens disorders	4,210	0.1
Other vision disorders	3,232	0.1
Glaucoma	2,550	0.1
Hearing loss	78,569	2.7
Other hearing and vestibular disorders	4,985	0.2
Total	109,241	3.7

6.7.2.1 Changes over time

- The rate of burden decreased by 13% between 2003 and 2018, from 209 to 182 DALY per 1,000 population. The non-fatal burden rates remained similar in this time period (97.9 in 2003 and 98.1 in 2018 YLD per 1,000 population) while fatal burden decreased 24% from 111 to 84 YLL per 1,000 population.
- The burden for all vision disorders increased slightly between 2003 and 2018. AMD increased by 2%, cataract and lens disorders increased by 2.5%, glaucoma increased by 0.4%, other vision disorders increased by 0.2%, and refractive errors increased by 0.7%.

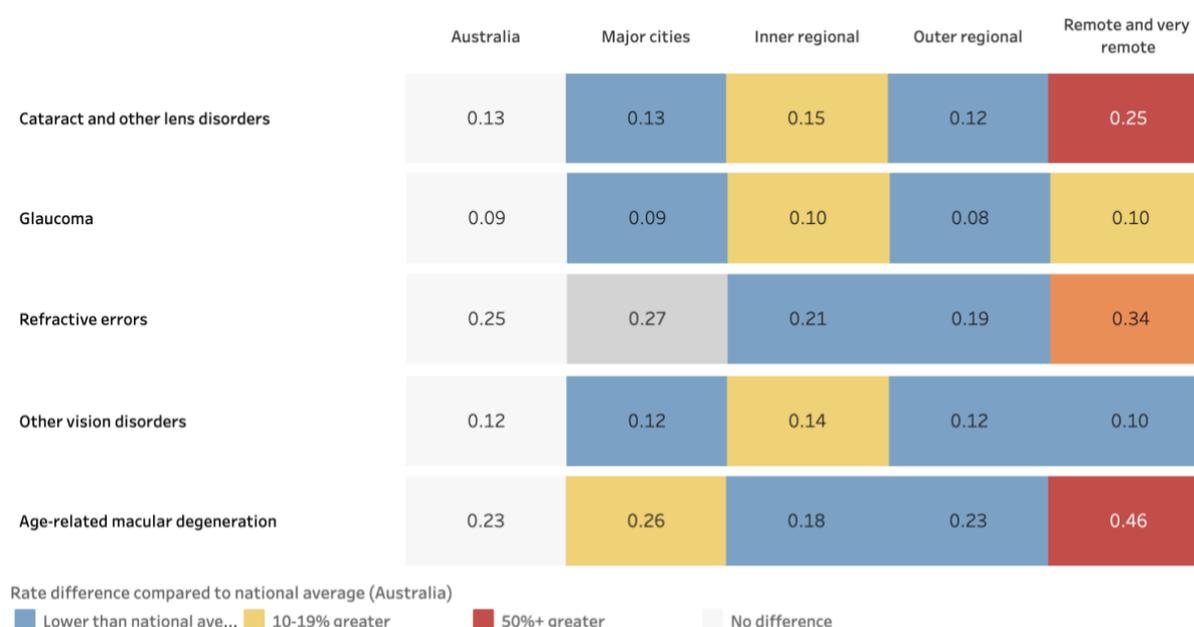
6.7.2.2 Variations across geographic areas

- Remote and very remote areas carry 1.4x the total burden of the major cities. A 4.4% reduction in total burden could be achieved, if all Australians had the disease burden of those in major cities.
- Hearing/Vision disorders have 1.6x the burden in remote and very remote areas compared to major cities (Table 2), suggesting it is more affected by rurality than the national average for all diseases.
- Of the vision disorders, AMD and cataract, and other lens disorders are most affected by rurality with the remote and very remote areas rates being 50% greater than the national average (Figure 4).

Table 2. Age-standardised DALY rates, by disease group and area remoteness (2018). Source: AIHW.

Disease group	Remoteness area				Australia	Rate ratio	Rate difference
	Major cities	Inner regional	Outer regional	Remote and very remote			
Blood/metabolic	2.1	2.2	2.8	3.5	2.2	1.7	1.4
Cancer	28.7	33.7	34.6	37.1	30.5	1.3	8.4
Cardiovascular	20.2	23.8	25.7	37.9	21.7	1.9	17.7
Endocrine	4.6	4.9	6.1	8.6	4.8	1.9	4.0
Gastrointestinal	5.7	6.3	6.6	8.5	5.9	1.5	2.8
Hearing/vision	3.6	4.0	4.1	5.6	3.7	1.6	2.1
Infant/congenital	4.4	4.8	5.5	6.7	4.6	1.5	2.3
Infections	3.1	3.5	4.2	7.2	3.3	2.3	4.1
Injuries	14.4	21.1	24.3	34.5	16.6	2.4	20.1
Kidney/urinary	2.1	2.1	2.6	5.8	2.2	2.7	3.7
Mental/substance use	26.6	24.7	22.5	25.3	25.9	1.0	-1.3
Musculoskeletal	23.1	27.8	24.6	19.6	24.0	0.9	-3.4
Neurological	13.1	14.9	13.7	12.6	13.3	1.0	-0.5
Oral	4.1	5.2	5.8	6.5	4.5	1.6	2.4
Reproductive/maternal	2.0	2.6	2.2	2.1	2.1	1.0	0.1
Respiratory	12.3	14.6	15.0	18.0	13.0	1.5	5.8
Skin	3.5	3.7	3.4	4.2	3.5	1.2	0.7
All diseases	173.7	200.0	203.6	243.9	181.8	1.4	70.2

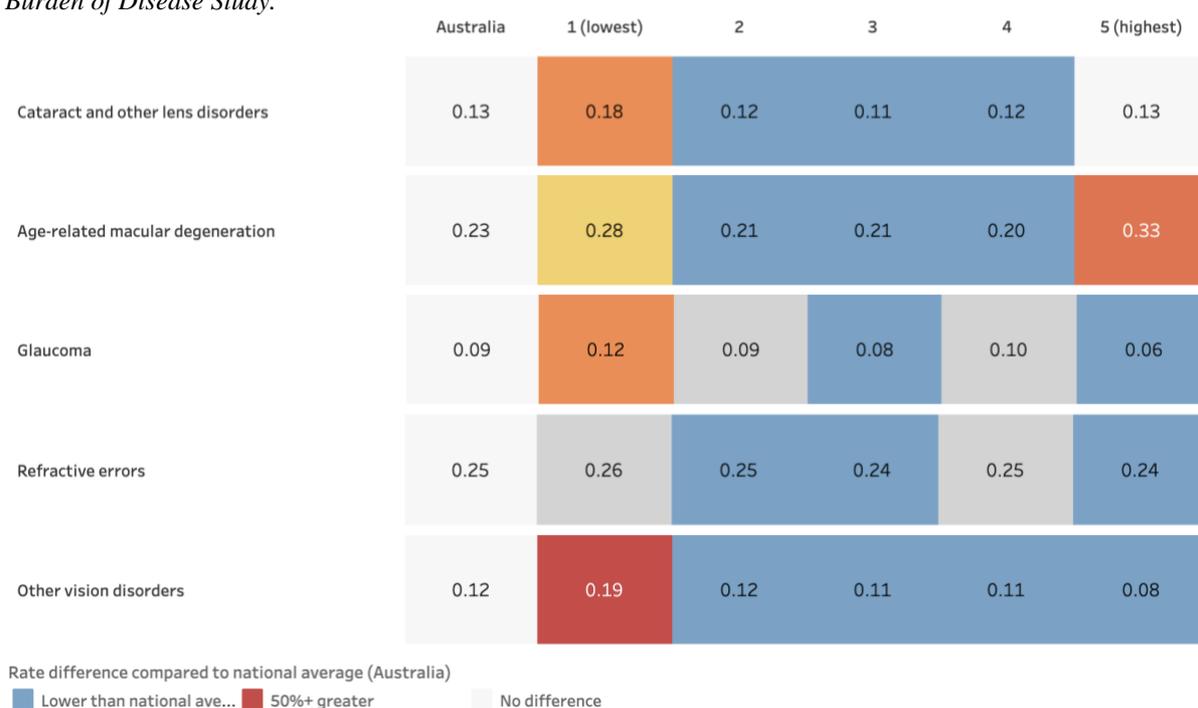
Figure 4. Comparison of age-standardised DALY rate by disease: Persons (2018). Source: AIHW Burden of Disease Study.



6.7.2.3 Variations by Socioeconomic Group

- The lowest socioeconomic group carries 1.6x the burden of the highest socioeconomic group.
- A 21% reduction in total burden could be achieved, if all Australians had the disease burden of the highest socioeconomic group.
- Hearing/vision loss had 1.4x the total burden in the lowest socioeconomic group compared to the highest socioeconomic group.
- Cataract, glaucoma, and 'other vision disorders' were the most affected by the socioeconomic group (Figure 5).

Figure 5. Age-standardised DALY rate by disease and socioeconomic group: Persons, 2018. Source: AIHW Burden of Disease Study.



6.7.2.4 By State and Territory

- In 2018, Western Australia had a total burden of 490,000 DALYs or 179.0 per 1,000 population as an age-standardised rate (Table 3). This was the 5th highest rate in the country above Victoria, the ACT, and NSW.
- In 2018, WA had a non-fatal burden of 254,000 YLD or 94.3 age standard rate. This was the lowest rate in the country (Table 3).
- In terms of total burden by disease group, WA had a DALY rate of 3.2 for hearing/vision, which was the lowest in the country.
- For all visual disorders except glaucoma, WA has the lowest, or equal lowest age-standardised rate for disease burden. ACT had a lower rate for glaucoma (Figure 6).

Table 3. Total (DALY), non-fatal (YLD) and fatal (YLL) burden, burden rates and rate ratios, by state and territory (2018).

Jurisdiction	Total burden			Non-fatal burden			Fatal burden		
	DALY ('000s)	Rate	Rate ratio	YLD ('000s)	Rate	Rate ratio	YLL ('000s)	Rate	Rate ratio
NSW	1,586	178.3	1.0	828	96.4	1.0	758	81.9	1.0
Vic	1,248	177.3	1.0	681	99.4	1.0	567	77.8	0.9
Qld	1,021	189.6	1.0	531	100.7	1.0	491	88.8	1.1
WA	490	179.0	1.0	254	94.3	1.0	236	84.7	1.0
SA	388	189.7	1.0	197	101.7	1.0	191	87.9	1.1
Tas	122	192.8	1.1	59	97.9	1.0	63	94.9	1.1
ACT	75	177.9	1.0	42	98.5	1.0	33	79.4	0.9
NT	54	254.8	1.4	22	105.4	1.1	31	149.4	1.8
Australia	4,984	181.8	—	2,613	98.1	—	2,370	83.7	—

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and are expressed per 1,000 population.
2. Rate ratios compare the state/territory rate of burden with the Australian rate of burden.
3. Non-fatal burden by state/territory may not add up to the Australian total due to modelling and rounding.

Figure 6. Vision disorders, burden of disease, DALY age-standardised rate by state/territory for 2018. (A) Cataract and other lens disorders. (B) Age-related macular degeneration. (C) Glaucoma. (D) Refractive errors. (E) Other vision disorders. Source: AIHW Burden of Disease Study

(A) Cataract and other lens disorders.



(B) Age-related macular degeneration.



(C) Glaucoma.



(D) Refractive errors.



(E) Other vision disorders.



6.8 Part 2 – Avoidable Vision Loss and Blindness

The International Agency for the Prevention of Blindness (IAPB) Vision Atlas and the Lancet Global Health Commission on Global Eye Health report that globally, 90% of vision loss can be prevented or treated.⁵ This was calculated by combining major global causes of preventable or reversible vision loss, which include uncorrected refractive errors that can be treated with spectacles or contact lenses, cataracts that can be treated with surgery, and near vision impairment due to uncorrected presbyopia that can be treated with spectacles.

Similarly, in Australia, results from the National Eye Health Survey found that approximately 90% of vision impairment and blindness among both Indigenous and non-Indigenous Australians is preventable or treatable. This was calculated by combining the five major conditions responsible for preventable or reversible vision loss in Australia (age-related macular degeneration, cataract, diabetic retinopathy, glaucoma, and uncorrected refractive error) as a percentage of all vision loss.

The National Eye Health Survey reports on the proportion of undiagnosed participants with one of the five major causes of vision impairment. The participants who were diagnosed with one of these conditions were asked to self-report whether a doctor had diagnosed the condition. A total of 57.4% of Indigenous participants and 51.93% of non-Indigenous had not previously had that condition diagnosed (Table 4).

Table 4. Undiagnosed major eye diseases and conditions in participants with vision impairment. Source: National Eye Health Survey

Major disease or condition ¹	Indigenous			Non-Indigenous		
	N ²	n ³	%	N	n	%
Refractive error ⁴	116	64	55.17	124	79	63.71
Cataract	39	27	69.23	28	10	35.71
Age-related macular degeneration	2	1	50.00	23	4	17.39
Diabetic retinopathy	11	4	36.36	3	1	33.33
Glaucoma	1	1	100	3	0	0
Total	169	97	57.40	181	94	51.93

¹Undiagnosed major eye disease or condition defined as main attributed cause of vision impairment in participants who self-reported 'No' or 'Unsure' to the question 'have you ever been told by a doctor that you have the following condition?' for that condition

²Number of participants with VI attributed to each main cause

³Number of participants with VI attributed to each main cause who self-reported 'No' or 'Unsure' to the question 'have you ever been told by a doctor that you have the following condition?' for that condition

⁴Proportion of participants with uncorrected refractive error as the main cause of vision impairment who self-reported that they did not wear distance correction

The following is a discussion of each of the five major conditions responsible for preventable or reversible vision loss in Australia from the National Eye Health Survey.

6.8.1 Age-related macular degeneration

The pooled global prevalence of AMD was reported in a meta-analysis of 39 studies around the world to be 0.37%.⁶ A 2017 paper using the NEHS data reported the prevalence of AMD in Australia as well as the proportion of participants with AMD who had accessed an optometry or ophthalmology service in the past 12 months. The prevalence of late AMD was 0.96% in non-Indigenous Australians and 0.17% in Indigenous Australians. AMD was attributed as the main cause of vision loss in 11.1% of non-Indigenous Australians and 1.1% of Indigenous Australians.⁷ The low rate of AMD amongst Indigenous participants is consistent with previous Australian studies as well as studies from the USA, which report low rates in African American and Latino populations. It has been hypothesized that the higher levels of retinal pigmentation may have a protective function for later stage disease due to the protection of melanin against oxidative damage.

In the NEHS, 30% of non-Indigenous, and 50% of Indigenous Australians with intermediate AMD had not accessed optometry or ophthalmology services within the past 12 months. Early diagnosis is important, as presenting VA is a strong predictor of outcome for anti-VEGF treatment in neovascular AMD.

6.8.2 Cataract

The NEHS reports a national cataract surgery coverage rate, which was defined as:

[all participants who had cataract surgery (self-reported) in at least one eye/all participants who had cataract surgery (self-reported) in at least one eye + participants who had VI or blindness with cataract in one or both eyes (graded as probable or definite by trained graders)] x 100 (Table 5).

Cataract surgery coverage was 61.47% for Indigenous participants and 87.63% for non-Indigenous participants. Treatment coverage did not differ by remoteness of area for either Indigenous (P = 0.149) or non-Indigenous (P = 0.590) groups.

Table 5. Rates of cataract surgery coverage in non-Indigenous and Indigenous participants in the NEHS.

	N ¹	n	Cataract Surgery Coverage ² (% (95% CI))	OR (95% CI)	p*	χ ² p value**
Indigenous						0.149
Major City	78	49	62.82 (51.13, 73.50)	1 (reference)		
Inner Regional	42	29	69.05 (52.91, 82.38)	1.32 (0.59, 2.94)	0.497	
Outer Regional	77	44	57.14 (45.35, 68.37)	0.79 (0.41, 1.50)	0.472	
Remote	24	17	70.83 (48.91, 87.38)	1.44 (0.53, 3.89)	0.475	
Very Remote	10	3	30.00 (6.67, 65.25)	0.25 (0.06, 1.06)	0.060	
Total	231	142	61.47 (54.86, 67.78)			
Non-Indigenous						0.590
Major City	263	228	86.69 (81.98, 90.55)	1 (reference)		
Inner Regional	154	141	91.56 (86.00, 95.43)	1.66 (0.85, 3.26)	0.136	
Outer Regional	171	148	86.55 (80.50, 91.28)	0.99 (0.56, 1.74)	0.966	
Remote	86	74	86.05 (76.89, 92.58)	0.95 (0.47, 1.92)	0.879	
Very Remote	46	40	86.96 (73.74, 95.06)	1.02 (0.40, 2.59)	0.961	
Total	720	631	87.63 (85.01, 89.95)			

¹The number of participants who had cataracts and vision impairment or blindness + the number of participants who have had cataract surgery

²Cataract Surgery Coverage = $\frac{\text{number of participants who have had cataract surgery}}{\text{number of participants who have cataracts and vision impairment or blindness} + \text{the number of participants who have had cataract surgery}}$

* p values denote whether differences between Remoteness Areas were significantly different from the reference RA, Major City

** χ² p value: chi-squared test after logistic regression model. Statistical significance was set as a p value of ≤0.05 (two tailed).

6.8.3 Diabetic retinopathy

The NEHS reports that 52.87% of diabetic (self-reported) Indigenous participants adhered to the NHMRC diabetic eye-examination guidelines (within the past 12 months) and 77.7% of non-Indigenous participants adhered to the screening guidelines (within the past 2 years). Some Indigenous participants (22.95%) reported they had never had an eye exam. Screening varied by the remoteness of areas for Indigenous participants with those living in very remote areas having the lowest rates 35.42% (P = 0.013).

6.8.4 Glaucoma

The pooled global glaucoma prevalence is reported to be 3.5% in a meta-analysis of 50 population studies around the world.⁸ A 2019 paper reported the prevalence of glaucoma in Australia using the NEHS data with a level of certainty assigned to the diagnosis. The prevalence of definite glaucoma in Indigenous Australians was 1.5% (95% CI 1.0–2.2) and 0.6% (95% CI 0.4–1.1), respectively. When combined with the prevalence of probable glaucoma, the prevalence was calculated to be 3.4% (95% CI 2.7–4.3) among non-Indigenous Australians and 1.6% (95% CI 1.1–2.3) in Indigenous Australians.⁹ The lower rates of glaucoma in Indigenous Australians are hypothesized to be due to genetic factors and/or lower life expectancy.

In the NEHS non-Indigenous population, 70.6% (36/51) of definite and 40.0% (26/65) probable glaucoma cases (combined rate = 53.4%, 62/116), self-reported a history of being previously diagnosed with glaucoma. Of the undiagnosed cases, 7.4% (4/54) had an IOP >21 mmHg and 50% (27/54) had accessed optometry or ophthalmology services within the past 12 months. Among the Indigenous population, three (37.5%, 3/8) participants with definite glaucoma and four with probable glaucoma (23.5%, 4/17) self-reported a history of being previously diagnosed with glaucoma (combined rate=28.0%, 7/25). Six per cent (1/18) of Indigenous participants with undiagnosed glaucoma had an IOP >21 mm Hg and 56% (10/18) had accessed an optometry or ophthalmology service in the past 12 months.⁹

6.8.5 *Uncorrected refractive error*

Uncorrected refractive error is the leading cause of vision impairment (53%) and second leading cause of blindness globally (21%), accounting for more than 110 million cases of vision loss.¹⁰ According to the results from the NEHS, Australia compares favourably to these figures. In the NEHS, uncorrected refractive error was determined to be the main cause of vision loss, if distance visual acuity in one or both eyes improved to better than or equal to 6/12 Snellen Equivalent with pinhole testing or autorefraction. Participants whose vision was better than 6/12 Snellen Equivalent, did not undergo pinhole testing or autorefraction, so mild refractive error was not identified.

Refractive error treatment coverage rate = $\left(\frac{n_1}{n_1+n_2}\right) \times 100$. In this formula, n_1 is the number of participants who reported that they wore spectacles and/or contact lenses for distance vision and achieved bilateral presenting distance visual acuity $\geq 6/12$ and n_2 was the number of participants who had refractive error as their main cause of bilateral vision loss ($< 6/12$). The prevalence of uncorrected refractive error was 4.0% and treatment coverage was 93.5% (95% CI 92.0–94.8) for non-Indigenous Australians. Coverage rates were stable across the remoteness strata for non-Indigenous participants. For Indigenous Australians, the prevalence of uncorrected refractive error was 6.7% and treatment coverage was 82.2% (95% CI 78.6–85.3).¹¹

The widespread availability of spectacle dispensing optometry practices may explain the high treatment coverage for non-Indigenous Australians. Two previous Australian studies conducted in the early 1990s, the Blue Mountains Eye Study (BMES) and the Melbourne Vision Impairment Project (VIP) found that the rates of correctable visual acuity were 45.6% and 57%, respectively,^{12,13} although the definitions of uncorrected refractive error were different in these studies. BMES defined it as an improvement of 2 or more lines in anyone with 6/9 Snellen Equivalent or worse and VIP defined it as a 2-or-more lines improvement in anyone with 6/6-2 Snellen Equivalent or worse. Therefore, these differences should be interpreted with caution. Despite this, the coverage seems to have improved under the Australian Government Implementation Plan under the National Framework for Action to Promote Eye Health and Prevent Avoidable Blindness and Vision Loss.

6.8.6 *Other causes of avoidable vision loss and blindness*

6.8.6.1 *Eye injuries*

Eye injuries are an avoidable cause of vision loss and blindness with 90% of eye injuries being preventable.¹⁴ Each year in Australia, approximately 545,000 eye injuries occur. The latest AIHW report examines Australian hospital administration records from the National Hospital Morbidity Database in the five-year period between 2010-11 and 2015-16 for eye injury cases.¹⁵

Key statistics of hospital admission cases:

- Across Australia, between 2010-11 and 2015-16, 52,000 people required hospital admission for the treatment of an eye injury.
- The most common injury areas were ‘open wound of the eyelid and periocular area’ (27%) and ‘fracture of orbital floor’ (18%).
- The most common cause of injury was a fall (35%), which mostly occurred in those aged 65 years and over, and more frequently in women than in men.
- The next most common cause was assault (23%), which was the most common cause for men.
- ‘Exposure to inanimate mechanical forces’ was the third most common cause (20%), including foreign bodies as well as projectile objects.
- 3,720 Aboriginal and Torres Strait Islander patients were admitted for an eye injury in this time period.
- The most frequent cause for Indigenous Australians was assault (61%).

Key statistics for sports-related eye injuries:

- Between 2010-11 and 2015-16, 3,291 injuries in males and 595 injuries in females were sustained during a sporting activity.
- Injuries occurred most commonly in the 25–44 years age range.
- Injuries in males occurred most commonly playing one of the following: football, rugby, soccer.
- Horseback riding was the most common cause of injuries for females.

Key statistics for workplace-related eye injuries:

- Between 2010-11 and 2015-16, 3,000 eye injury cases occurred while a person was working for an income.
- The most common injury was an injury of the eye and orbit (35%) followed by an orbital bone fracture (22%).
- Construction was the most frequent employment sector where an injury occurred (14%). The next most common were the agriculture, forestry, and fishing sectors (9%).

Key statistics for eye injuries presenting to an emergency department (ED):

- 86,602 cases presented to an ED with an eye injury between 2012-13 and 2015-16.
- The majority (44%) of cases were due to a foreign body in the eye. Less than 1% of eye injuries of this type required hospital admission.

6.8.6.2 Paediatric eye injuries

Globally, ocular injury is responsible for up to 50% of unilateral blindness in children.¹⁶ A recent study (2017) of paediatric ocular and adnexal injuries in Western Australia investigated the nature and severity of injuries requiring hospitalisation. Between 2003 and 2013, 482 children had an eye injury, representing an incidence rate of one case per 11,913 children, and an average of 40 admissions per year. The most common mechanisms were 'being struck by an object' (27%) and 'being hit by a projectile' (26%). Fifty-two percent of injuries occurred at home and 29% injuries occurred at outdoor locations. The injuries occurred more commonly on weekends than weekdays.¹⁷ In a study of sporting-related injuries in Western Australian children, 93 cases of ocular and adnexal injury were identified between 2002 and 2013. Cycling, football (including soccer and Australian rules football), tennis, trampolining, fishing, and swimming were the sports responsible for the greatest number of injuries, a total of 63%. Of the paediatric eye injuries that occurred between 2002 and 2015, 5.2% of cases were non-accidental in nature. Children with non-accidental eye injuries were younger and more likely to be male than those with accidental eye injuries. No non-accidental injuries were found in children who were over 24 months old.¹⁸

The prevalence of paediatric eye injuries in Perth during the COVID-19 lockdown period (March – May 2020) and immediate post-lockdown period (June – August 2020) was assessed in a recent retrospective study. Previous research has established that the rates of domestic violence and traumatic brain injury in children increased following natural disasters and economic recession.^{19,20} There is indirect evidence of increased incidence of domestic violence globally since the start of the pandemic.^{21,22} In Perth, Western Australia; however, there was no significant difference in the total number of accidental eye injury presentations during the lockdown period despite a significant decrease in emergency department attendance overall. In contrast, the referrals to the hospitals' Child Protection Unit for suspicious injuries declined during the lockdown.

6.8.6.3 Trachoma

In 1996, the World Health Organisation Alliance for the Global Elimination launched a new global public health campaign with the 'SAFE' strategy standing for surgery for advanced disease, antibiotics to clear the *C. trachomatis* infection, facial cleanliness, and environmental improvement to reduce transmission. There has been remarkable success in the global campaign to eliminate trachoma, as it has been eliminated from a growing number of countries.²³ The global disease burden due to trachoma decreased by 69.8% after adjusting for age and population growth. Additionally, it had the greatest reduction in attributable DALYs of all common eye diseases (cataract, glaucoma, refractive disorders, and age-related macular degeneration).²⁴ Trachoma still remains a leading cause of preventable vision loss and blindness. Globally in 2019, 95.2 million people were treated with antibiotics, and 92,622 people received surgical treatment for advanced stages of trachoma.²⁵

Australia is the only developed country, which continues to have pockets of endemic trachoma. The first national data of trachoma prevalence in Australia came from the 1980 National Trachoma and Eye Health Program of the Royal Australian College of Ophthalmologists. The prevalence of active trachoma and trachomatous trichiasis at the time was 17.6% and 6%, respectively. Since then the National Indigenous Eye Health Survey in 2008 reported the national prevalence of active trachoma to be 3.8%.²⁶ In the 2016 National Eye Health Survey, three participants (0.17%) were found to have trachomatous trichiasis.²⁷ Despite the ongoing burden of disease from trachoma, it appears that the prevalence of trachoma is decreasing in Australia.

6.9 Part 3 – Eye Health Promotion Activities

6.9.1 Organisations involved in Health Promotion

Organisation	Description
Federal Government Department of Health	The Department of Health lists the current health promotion initiatives and programs on their website. Currently, there are no eye health promotion programs listed. Website - https://www.health.gov.au/initiatives-and-programs
WA Health	The 2022-26 draft health promotion strategic framework has been released for feedback. The framework focuses on the most common modifiable risk factors to prevent disease and injury in WA. The four priority areas of the report are ‘Reducing tobacco use and making smoking history’, ‘Halting the rise in overweight and obesity’, ‘Reducing harmful alcohol use’, ‘Preventing injury and promoting safer communities’. There was no mention of action towards preventable vision loss and blindness in the framework. Website - https://ww2.health.wa.gov.au/Health-for/Health-professionals/Health-promotion
Australian Health Promotion Association, WA Branch	The Australian Health Promotion Association is the national professional association for people interested or involved in the practice, policy, research, and study of health promotion. Website - https://www.healthpromotion.org.au/11-branches/western-australia
Healthway	Healthway is the WA Health funding arm for sport, arts, community activities, health promotion projects and research for Western Australia. Website - https://www.healthway.wa.gov.au/our-organisation/
WA Health Promoting Schools	WA Health Promoting Schools is a not-for-profit organisation, which supports WA schools to take up the Health Promoting Schools Framework developed by the World Health Organization and encourages a whole-school approach to addressing health issues, including relationships and sexuality education. Website - https://wahpsa.org.au/
Public Health Advocacy Institute of Western Australia	The Public Health Advocacy Institute works to influence, build, promote, and support advocacy for public health priorities through innovation in education, applied research, engagement, and practice. Website - https://www.phaiwa.org.au/

6.9.2 Health Promotion Programs

Campaign	Description
National Eye Health Awareness Campaign	The National Eye Health Awareness Campaign 2009 was an initiative of the Australian Government, which aimed to educate all Australians about the importance of protecting themselves against avoidable blindness and vision loss. Website - https://www.anao.gov.au/work/assurance-activity/national-eye-health-awareness-campaign-2009
The Environmental Health Trachoma Project	The Environmental Health Trachoma Project with the hashtag (#endingtrachoma) aims to reduce the incidence of trachoma and skin infections in ‘trachoma at risk’ Aboriginal and Torres Strait Islander communities in remote WA. The Environmental Health Trachoma Project is supported by the Public Health Advocacy Institute of Western Australia (PHAIWA). Website - https://www.phaiwa.org.au/endingtrachoma/
Trachoma Screening in the Kimberley	Run by WA Health, this project occurs every September in the Kimberley region of WA. It aims to raise awareness of trachoma in Aboriginal communities and the importance of participating in the screening program.

	<p>Website - https://healthinonet.ecu.edu.au/key-resources/programs-and-projects/1325/?title=Trachoma+Screening+in+the+Kimberley&contentid=1325_4</p>
Tri-state Trachoma Elimination Program	<p>The Tri-state Trachoma Elimination Program aims to address trachoma present in remote areas of SA, WA, and the NT; it is run by the National Aboriginal Community Controlled Health Organisation (NACCHO).</p> <p>Website - https://healthinonet.ecu.edu.au/key-resources/programs-and-projects/2380/?title=Tri-state+Trachoma+Elimination+Program&contentid=2380_4</p>
Squeaky Clean Kids Program	<p>The Squeaky Clean Kids Program aims to help reduce the incidence of trachoma in regional WA Aboriginal communities. The WA Country Health Service supports the program to send out over 200,000 bars of free soap to 63 Aboriginal communities in the Kimberley, Pilbara, Mid-West, and Goldfields regions of WA.</p> <p>https://www.wacountry.health.wa.gov.au/About-us/Publications/Annual-reports/WACHS-Annual-Report-2018-19/Overview</p>
Keep Sight	<p>KeepSight is a national diabetes eye-screening program, which encourages those with diabetes to have regular eye checks to prevent diabetes-related vision loss.</p> <p>Website - https://www.keepsight.org.au/about</p>
Don't make smokes your story	<p>National campaign by the Department of Health targets smoking in the Aboriginal and Torres Strait Islander population.</p> <p>Website - https://campaigns.health.gov.au/smokes</p>

6.10 Issues and Recommendations

6.10.1 *The National Burden of Vision Disorders is Increasing*

Details:

- The burden for all vision disorders increased slightly between 2003 and 2018. AMD increased by 2%, cataract and lens disorders increased by 2.5%, glaucoma increased by 0.4%, other vision disorders increased by 0.2% and refractive errors increased by 0.7%.
- This is despite a significant reduction in the national fatal burden during the same time period.
- This suggests that the overall health of Australians is improving; however, the eye health of Australians remains unchanged or slightly worse during this period.
- Despite this, WA had a DALY rate of 3.2 for hearing/vision, which was the lowest in the country.

Recommendations:

- 1) Consider projects that aim to increase broad awareness about eye health in Western Australia. The National Eye Health Awareness Campaign 2009 sets an example, which has not been repeated since.

6.10.2 *Avoidable Vision Loss and Blindness is Prevalent and Undiagnosed*

Details:

- 90% of vision impairment and blindness among both Indigenous and non-Indigenous Australians is preventable or treatable and approximately 50% of the causes of vision impairment are undiagnosed.
- In the NEHS 30% of non-Indigenous, and 50% of Indigenous Australians with intermediate AMD had not accessed optometry or ophthalmology services within the past 12 months. Early diagnosis is important, as presenting VA is a strong predictor of the outcome for anti-VEGF treatment in neovascular AMD.
- The NEHS reports that 52.87% of diabetic (self-reported) Indigenous participants adhered to the NHMRC diabetic eye examination guidelines (within the past 12 months) and 77.7% of non-Indigenous participants adhered to the screening guideline (within the past 2 years).
- Results from the National Eye Health Survey found that 46.6% of the non-Indigenous population and 72.5% of the Indigenous population who had probable or definite glaucoma did not have a known history of the diagnosis.
- In the NEHS, 50% of non-Indigenous and 56% of Indigenous participants with undiagnosed glaucoma had accessed optometry or ophthalmology services within the past 12 months.
- This suggests that preventative eye health could reduce the burden of eye disease significantly and there is a large burden of silent, undiagnosed eye disease in the community.

Recommendations:

- 1) Consider projects that have a focus on screening and identification of eye diseases, to reduce the burden of preventable vision loss and blindness and uncover undiagnosed eye disease.

6.10.3 *There is Limited Data About Eye Health Promotional Projects and There Appears to be Limited Focus on Eye Health Promotion in WA*

Details:

- There was limited publicly available information about eye health-promotion projects nationally or in Western Australia.
- There is no centralised organisation, which coordinates eye health promotion in Western Australia.
- According to the 2022-26 WA Health Promotion Strategic Framework, there appears to be no focus on preventative eye health in Western Australia.

Recommendations:

- 1) Consider projects that increase the states focus on eye health promotion. Consider submitting feedback to the WA Health Promotion Strategic Framework calling for a greater focus.
- 2) 'Vision Initiative' is a Victorian Government and Vision2020 collaboration, which was established in 2002 as an integrated eye health promotion program. Consider collaboration or consultation from the program leaders to help develop a WA-based eye health-promotion program.
<https://www.visioninitiative.org.au/>

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RESEARCH

7. Research

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7.4 Executive Summary

- This report section explores the current ophthalmic research activity in Western Australia.
- A literature search was performed on the Scopus database to identify ophthalmic research published by Western Australian researchers within Western Australian institutions between 2011 and 2021.
- There were 974 papers identified with contributions from 6621 individual researchers.
- A total of 8375 institutions were affiliated with identified publications, including Western Australian, national, and international institutions.
- There were 220 Western Australian institutions affiliated with identified publications.
- One collaboration event is considered between each institution that is listed on the same publication. The average number of collaborations per publication was 745.78.
- There may be multiple institutions from Western Australia collaborating with multiple national or international institutions, hence the large number of collaborations.
- The biggest collaboration (538 collaborations) within Western Australia was between the Lions Eye Institute and the Centre for Ophthalmology and Visual Sciences at the University of Western Australia with. Within Australia, Western Australian institutions had maximum collaborations with Victorian institutions (652) and internationally, the most collaborations were with institutions in the United States (1533).

7.5 Introduction

This report section explores the current ophthalmic research activity in Western Australia. It aims to highlight the key organisations and researchers involved and the existing national and international collaborations.

7.6 Data Sources and Methodology

7.6.1 Scopus

Scopus is one of the largest databases of peer-reviewed scientific literature metadata, including citations and abstracts with approximately 27.0M documents.¹ On 5 October 2021, a literature search was performed on the Scopus database to identify ophthalmic research published by Western Australian researchers in the previous 10 years (2011-2021). A search string containing general, anatomy, and pathology keywords was used (Appendix 1). The research papers were filtered by location to include only those from Western Australia. Document metadata was cleaned and analysed. Collaborations were analysed using the affiliation metadata. One research paper may have multiple affiliations listed. One collaboration event is considered between each institution that is listed on the same publication. There may be multiple institutions from Western Australia collaborating with multiple national or international institutions, hence the large number of collaborations.

7.7 Researchers

Western Australian (WA) institutions were listed as affiliations on 974 ophthalmic publications between 2011 and 2021. There were 6621 individual researchers listed as co-authors on these publications. The majority of publications (772, 79%) were research articles (Table 1). An analysis of article count per researcher included all article types except for 'Erratum'. The top three researchers by article count were Mackey D.A, Hewitt A.W, and Chen F.K with 236 (24%), 145 (15%), and 129 (13%) publications, respectively with a WA institutional affiliation (Table 2, Figure 1, and Figure 2). The author impact factor is the average number of citations over all the publications by a given author.

Table 1. Number of publications by article type and number (%).

Publication Type	Count	Percentage
Article	772	79.26
Review	80	8.21
Letter	59	6.06
Conference Paper	37	3.80
Book	22	2.26
Erratum	4	0.41
Total	974	

Table 2. Top 20 ophthalmology researchers by article count with Western Australian institutional affiliations.

Author Name	Article Count	Review Count	Letter Count	Conference Count	Book Count	Total Count	Total Percentage
Mackey D.A.	191	20	18	6	1	236	24.23
Hewitt A.W.	122	11	8	4	0	145	14.89
Chen F.K.	100	11	12	5	1	129	13.24
Yu D.Y.	60	8	2	1	1	72	7.39
Morgan W.H.	57	7	6	2	0	72	7.39
Balaratnasingam C.	56	4	2	2	1	65	6.67
Yazar S.	55	5	3	2	0	65	6.67
Craig J.E.	56	0	2	1	0	59	6.06
McAllister I.L.	51	1	1	2	0	55	5.65
Degli-Esposti M.A.	50	3	0	1	0	54	5.54
Sampson D.D.	32	1	0	15	1	49	5.03
Burdon K.P.	44	0	1	1	0	46	4.72
Lamey T.M.	42	0	0	0	2	44	4.52
De Roach J.N.	41	1	0	0	2	44	4.52
McLaren T.L.	41	0	0	0	2	43	4.41
McLenachan S.	37	4	0	0	0	41	4.21
MacGregor S.	39	0	1	0	0	40	4.11
Lucas R.M.	34	6	0	0	0	40	4.11
Cringle S.J.	32	5	0	0	1	38	3.90
Forrester J.V.	34	3	0	0	0	37	3.80

Figure 1. Article counts of the top 10 ophthalmology researchers with Western Australian institutional affiliations.

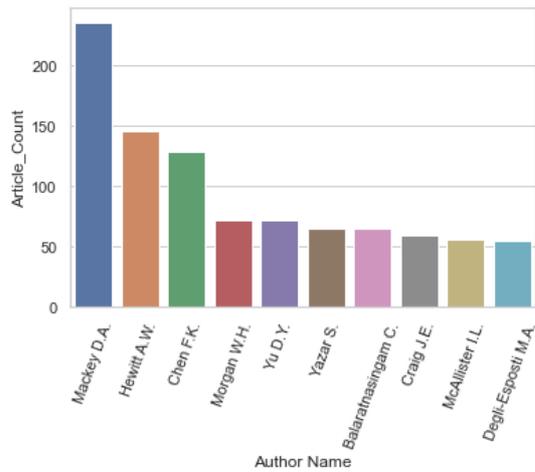
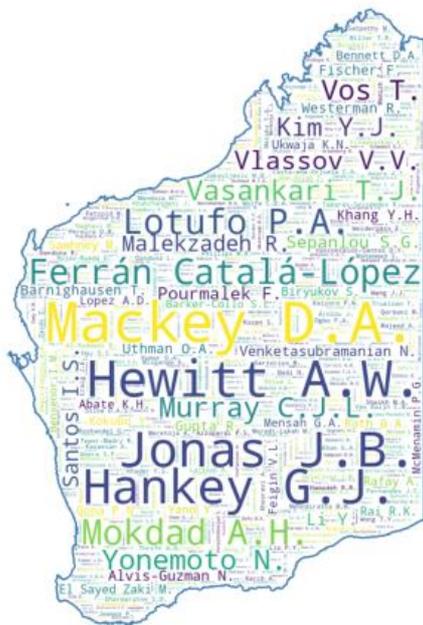


Figure 2. Word cloud diagram of researchers (size by number of publications).



7.8 Institutions

There were 220 Western Australian institutions affiliated with identified publications, with a mean of 12 publications per institution. The top three institutions by article count were the Lions Eye Institute (643), Centre for Ophthalmology and Visual Science (614), and the Royal Perth Hospital Department of Ophthalmology (144) (Table 3). The full list of Western Australian institutions is available in Appendix 2.

A total of 8375 institutions were involved in the 974 publications; 672 institutions were located in Australia and 7703 had international locations. There was a mean (standard deviation) of 11.36 (37.08) institutional affiliations per publication. The Australian states with the top three number of institutions outside Western Australia were Victoria (160), New South Wales (118), and Queensland (91) (Table 4). The top three countries with institutions involved were the United States (928), United Kingdom (394), and Germany (187) (Table 5).

Table 3. Top 10 institutions by article count.

Affiliations	Article Count	Review Count	Letter Count	Conference Count	Book Count	Total Count	Total Percentage
Lion's Eye Institute, Western Australia	500	57	48	21	17	643	66.02
Centre for Ophthalmology and Visual Science, University of Western Australia	496	56	34	15	13	614	63.04
Department of Ophthalmology, Royal Perth Hospital	114	11	14	4	1	144	14.78
Centre for Experimental Immunology, Lion's Eye Institute	66	7	0	1	0	74	7.60
School of Electrical, Electronic and Computer Engineering, University of Western Australia	37	1	0	18	2	58	5.95
Department of Medical Technology and Physics, Sir Charles Gairdner Hospital	49	4	0	0	2	55	5.65
Department of Ophthalmology, Sir Charles Gairdner Hospital	36	3	6	3	1	49	5.03
Centre for Microscopy, Characterisation and Analysis, University of Western Australia	27	2	0	12	1	42	4.31
Immunology and Virology Program, Centre for Ophthalmology and Visual Science	37	2	0	1	0	40	4.11
Department of Ophthalmology, Perth Children's Hospital, Nedlands, Australia	32	4	2	0	0	38	3.90

Table 4. Number of institutions in Australia (by state) affiliated with publications.

State	Institute Count
WA	220
VIC	160
NSW	118
QLD	91
SA	48
ACT	22
TAS	11
NT	1
Norfolk	1
Total	672

Table 5. Number of international institutions (by country) affiliated with publications.

Country	Institute Count
United States	928
United Kingdom	394
Germany	187
Iran	174
Japan	141
Netherlands	113
India	104
France	101
China	97
Canada	95

7.9 Collaborations

Each publication has a number of associated affiliations, which are considered as collaborating institutions. One collaboration event is considered between each institution that is listed on the same publication. The average number of collaborations per paper was 745.78. Collaborations were considered within Western Australia, at a national level, and at an international level.

7.9.1 Western Australia

The biggest collaboration within Western Australia was between the Lions Eye Institute and the Centre for Ophthalmology and Visual Sciences at the University of Western Australia with 538 collaborations (Table 6).

Table 6. Number of collaborations between individual institutions in Western Australia.

Institution 1	Institution 2	Number of Collaborations
Lion's Eye Institute, Western Australia	Centre for Ophthalmology and Visual Science, University of Western Australia	538
Lion's Eye Institute, Western Australia	Department of Ophthalmology, Royal Perth Hospital	138
Department of Ophthalmology, Royal Perth Hospital	Centre for Ophthalmology and Visual Science, University of Western Australia	132
Department of Medical Technology and Physics, Sir Charles Gairdner Hospital	Centre for Ophthalmology and Visual Science, University of Western Australia	52
Lion's Eye Institute, Western Australia	Department of Medical Technology and Physics, Sir Charles Gairdner Hospital	43
School of Electrical, Electronic and Computer Engineering, University of Western Australia	Centre for Microscopy, Characterization and Analysis, University of Western Australia	40
Department of Ophthalmology, Royal Perth Hospital	Department of Medical Technology and Physics, Sir Charles Gairdner Hospital	39
Department of Ophthalmology, Perth Children's Hospital	Centre for Ophthalmology and Visual Science, University of Western Australia	37
Immunology and Virology Program, Centre for Ophthalmology and Visual Science	Centre for Experimental Immunology, Lion's Eye Institute	36
Lion's Eye Institute, Western Australia	Department of Ophthalmology, Sir Charles Gairdner Hospital	36

7.9.2 National

Within Australia, Western Australian institutions had the most collaborations with Victorian institutions (652) (Table 7). The biggest collaboration was between the Lions Eye Institute in Western Australia and the Centre for Eye Research in Victoria (Table 8).

Table 7. Number of collaborations with Western Australian institutions and other Australian states.

State	Number of Collaborations
VIC	652
NSW	425
QLD	327
SA	191
TAS	136
ACT	81
Norfolk	3
NT	1
Total	1816

Table 8. Number of collaborations by individual institutions within Australia.

Institution 1	Institution 2	Number of Collaborations
Lion's Eye Institute, Western Australia	Centre for Eye Research Australia, Royal Victorian Eye and Ear Hospital	219
Centre for Ophthalmology and Visual Science, University of Western Australia	Centre for Eye Research Australia, Royal Victorian Eye and Ear Hospital	211
Lion's Eye Institute, Western Australia	Menzies Institute for Medical Research, University of Tasmania, Hobart, Australia	111
Centre for Ophthalmology and Visual Science, University of Western Australia	Menzies Institute for Medical Research, University of Tasmania, Hobart, Australia	111
Centre for Ophthalmology and Visual Science, University of Western Australia	Department of Ophthalmology, Flinders University	74
Lion's Eye Institute, Western Australia	Department of Ophthalmology, Flinders University	72
Lion's Eye Institute, Western Australia	Department of Ophthalmology, University of Melbourne	62
Centre for Ophthalmology and Visual Science, University of Western Australia	Department of Ophthalmology, University of Melbourne	60
Lion's Eye Institute, Western Australia	Department of Ophthalmology, University of Sydney	48
Centre for Ophthalmology and Visual Science, University of Western Australia	QIMR Berghofer Medical Research Institute, Brisbane, QLD, Australia	48

7.9.3 International

Internationally, Western Australian institutions collaborated most with United States institutions (1533) (Table 9). The largest collaboration was between the Lions Eye Institute Western Australia and the Department of Twin Research and Genetic Epidemiology, United Kingdom (Table 10). There were more collaborations per institution with the United Kingdom (2.51) compared with the United States (1.65); however, there were collaborations with a greater total number of institutions in the United States (1533) compared with the United Kingdom (990). A chord diagram (Figure 3) visually demonstrates the collaboration between local (blue), national (green) and international (red) institutions. An interactive version of this diagram is also available as a separate attached file.

Table 9. Top 10 countries that collaborate with Western Australian institutions.

Country	Number of Collaborations
United States	1533
United Kingdom	990
Germany	307
Iran	256
Japan	251
Netherlands	251
Singapore	233
Canada	200
Finland	188

Table 10. Western Australia's international collaborations by individual institution.

Institution 1	Institution 2	Number of Collaborations
Lion's Eye Institute, Western Australia	Department of Twin Research and Genetic Epidemiology, Kings College London, London, United Kingdom	55
Centre for Ophthalmology and Visual Science, University of Western Australia	Department of Twin Research and Genetic Epidemiology, Kings College London, London, United Kingdom	54
Lion's Eye Institute, Western Australia	Institute of Ophthalmology, University College London, London, United Kingdom	54
Lion's Eye Institute, Western Australia	Department of Epidemiology, Erasmus MC University Medical Center Rotterdam, Rotterdam, Netherlands	50
Centre for Ophthalmology and Visual Science, University of Western Australia	Singapore National Eye Center, Singapore	44
Centre for Ophthalmology and Visual Science, University of Western Australia	Institute of Ophthalmology, University College London, London, United Kingdom	44
Lion's Eye Institute, Western Australia	Singapore National Eye Center, Singapore	42
Centre for Ophthalmology and Visual Science, University of Western Australia	NIHR Biomedical Research Centre for Ophthalmology, Moorfield's Eye Hospital	39
Lion's Eye Institute, Western Australia	NIHR Biomedical Research Centre for Ophthalmology, Moorfield's Eye Hospital	38
Centre for Ophthalmology and Visual Science, University of Western Australia	MRC Human Genetics Unit, Institute of Genetics and Molecular Medicine, University of Edinburgh, Edinburgh, United Kingdom	36

Figure 3. Chord chart of institutional collaborations (Interactive version available as a separate file).

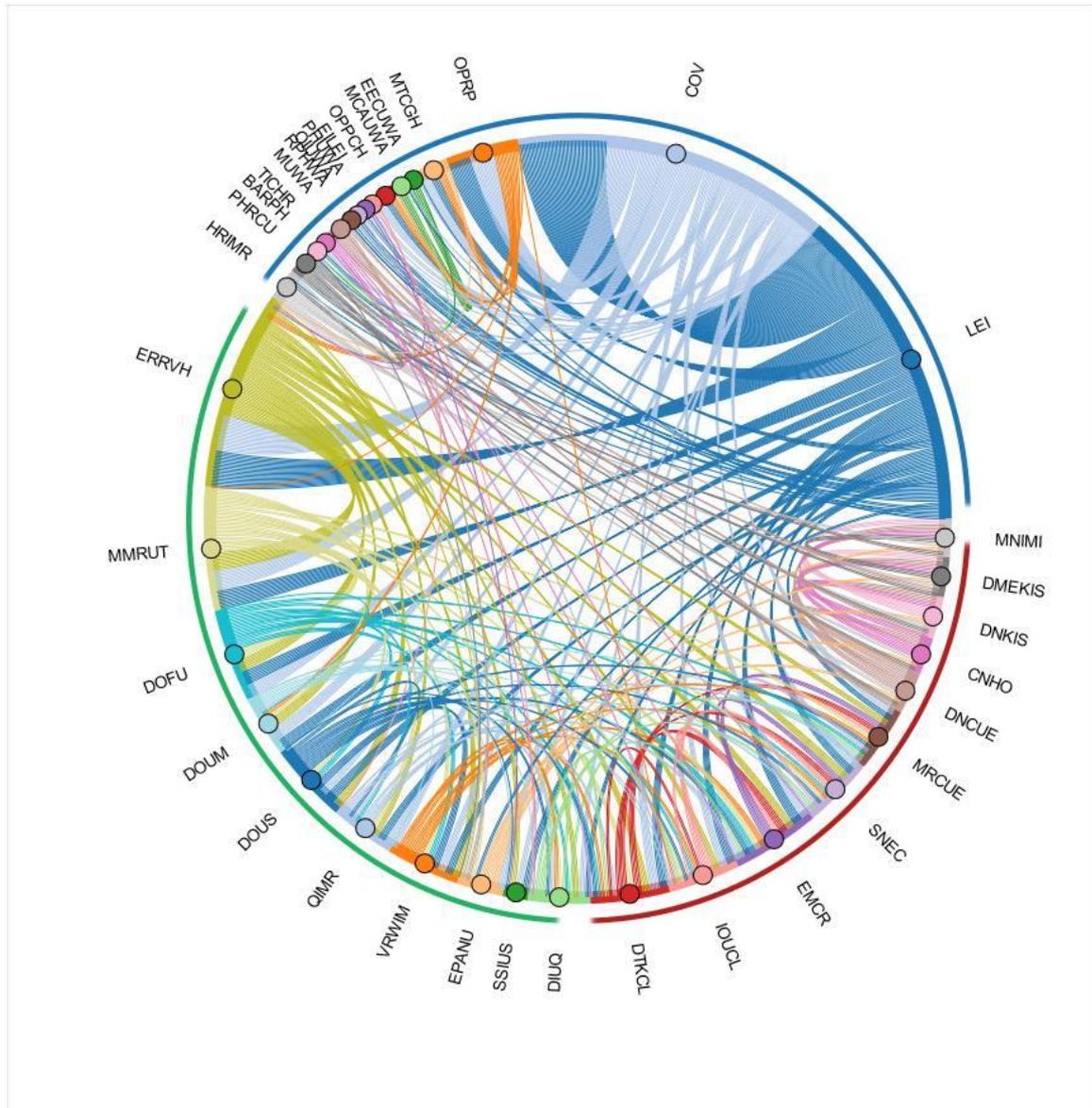


Table 11. Keyword table for the chord diagram.

Abbreviation	Institution name
LEI	Lion's Eye Institute, Western Australia
COV	Centre for Ophthalmology and Visual Science, University of Western Australia
OPRP	Department of Ophthalmology, Royal Perth Hospital
MTCGH	Department of Medical Technology and Physics, Sir Charles Gairdner Hospital
EECUWA	School of Electrical, Electronic and Computer Engineering, University of Western Australia
MCAUWA	Centre for Microscopy, Characterisation and Analysis, University of Western Australia
OPPCH	Department of Ophthalmology, Perth Children's Hospital, Nedlands, Australia
EILEI	Centre for Experimental Immunology, Lion's Eye Institute
OFH	Department of Ophthalmology, Fremantle Hospital
PHUWA	Department of Population Health, University of Western Australia
FSM	Fiona Stanley Hospital, Murdoch, WA, Australia
OIUWA	Oceans Institute, University of Western Australia
RPHWA	Royal Perth Hospital, Western Australia
MUWA	School of Medicine, University of Western Australia
TICHR	Telethon Institute for Child Health Research, University of Western Australia, Perth, WA, Australia

BARPH	Burns Service of Western Australia, Royal Perth Hospital
BUND	Biostatistics, Institute for Health Research, University of Notre Dame, Perth, WA, Australia
GEUWA	Centre for Genetic Epidemiology and Biostatistics, University of Western Australia
PHRCU	Centre for Population Health Research, Curtin University, Curtin, WA, Australia
RMCGH	Department of Respiratory Medicine, Sir Charles Gairdner Hospital
HRIMR	Harry Perkins Institute of Medical Research, Western Australia
WAIMR	Western Australian Institute for Medical Research, University of Western Australia
ERRVH	Centre for Eye Research Australia, Royal Victorian Eye and Ear Hospital
MMRUT	Menzies Institute for Medical Research, University of Tasmania, Hobart, Australia
DOFU	Department of Ophthalmology, Flinders University
DOUM	Department of Ophthalmology, University of Melbourne
DOUS	Department of Ophthalmology, University of Sydney
QIMR	QIMR Berghofer Medical Research Institute, Brisbane, QLD, Australia
VRWIM	Centre for Vision Research, Westmead Millennium Institute
EPANU	National Centre for Epidemiology and Population Health, Australian National University, Canberra, ACT, Australia
SSIUS	Save Sight Institute, University of Sydney
DIUQ	Diamantina Institute, University of Queensland, Brisbane, QLD, Australia
DTKCL	Department of Twin Research and Genetic Epidemiology, King's College London, London, United Kingdom
IOUCL	Institute of Ophthalmology, University College London, London, United Kingdom
EMCR	Department of Epidemiology, Erasmus MC University Medical Center Rotterdam, Rotterdam, Netherlands
SNEC	Singapore National Eye Center, Singapore
NHIRMH	NIHR Biomedical Research Centre for Ophthalmology, Moorfields Eye Hospital
MRCUE	MRC Human Genetics Unit, Institute of Genetics and Molecular Medicine, University of Edinburgh, Edinburgh, United Kingdom
DNCUE	Department of Neurology, Cairo University, Cairo, Egypt
CNHO	Colombian National Health Observatory, Instituto Nacional de Salud, Bogotá, Colombia
DNKIS	Department of Neurobiology, Care Sciences and Society, Karolinska Institutet, Stockholm, Sweden
DMEKIS	Department of Medical Epidemiology and Biostatistics, Karolinska Institute, Stockholm, Sweden
MNIMI	Mario Negri Institute for Pharmacological Research, Milan, Italy

7.10 Issues and Recommendations

<p><i>7.10.1 High research output from few authors and institutions.</i></p> <ul style="list-style-type: none"> • The majority of research output in Western Australia is generated by the top institutions and researchers. • Sixty-seven (67) % of publications were authored by the top 5 researchers (0.076% of researchers). • Sixty-six (66) % of publications were affiliated with the top institution (The Lions Eye Institute). • There is a long tail of 220 Western Australian research institutions which were affiliated with the research. • This suggests that there are many researchers and institutions producing once off or small volumes of work.
<ul style="list-style-type: none"> • Consider identifying and funding smaller researchers in order to diversify the scope of ophthalmic literature produced in Western Australia.

7.11 References

1. Visser M, Eck NJ van, Waltman L. Large-scale comparison of bibliographic data sources: Scopus, Web of Science, Dimensions, Crossref, and Microsoft Academic. *Quantitative Sci Stud.* 2021;2(1):20–41.

7.12 References

7.12.1 Appendix 1 – Search String used for the Scopus literature search

TITLE-ABS-KEY (ophthal* OR optom* OR eye OR eyelid OR eyelash OR mebomian OR lacrimal OR tarsal OR tarsus OR conjunctiv* OR cornea OR iris OR sclera OR vitreous OR choroid OR retina OR iritis OR hyphaema OR iridodialysis OR cyclodialysis OR retrobulbar OR commotio OR chorioretinitis OR purtscher OR keratopathy OR keratitis OR phlyctenulosis OR "contact lens" OR keratoconus OR "fuchs endothelial" OR "refractive surgery" OR conjunctivitis OR keratoconjunctivitis OR subconjunctival OR episcleritis OR scleritis OR blepharitis OR meibomitis OR ptosis OR ectropion OR entropion OR trichiasis OR blepharospasm OR canaliculitis OR dacryocystitis OR leukocoria OR vitreoretinopathy OR strabismus OR amblyopia OR glaucoma OR glaucomatocyclitic OR posner-schlossman OR "pigment dispersion syndrome" OR "pseudoeffoliation syndrome" OR iridocorneal OR blebitis OR anisocoria OR "horner syndrome" OR papilledema OR nystagmus OR macular OR chorioretinopathy OR myopia OR hypermetropia OR hyperopia OR "angioid streaks" OR vitreomacular OR epiretinal OR "retinitis pigmentosa" OR "cone dystrophy" OR "rod dystrophy" OR uveitis OR endophthalmitis OR cataract OR phakomatoses OR "visual field" OR "humphry visual field" OR "OCT" OR "optical coherence tomography" OR retinoscopy OR funduscopy) AND PUBYEAR > 2010 AND (LIMIT-TO (AFFILCOUNTRY , "Australia"))

7.12.2 Appendix 2 – List of Western Australian Institutions

Institution Name	Number of Publications
Lion's Eye Institute, Western Australia	643
Centre for Ophthalmology and Visual Science, University of Western Australia	614
Department of Ophthalmology, Royal Perth Hospital	144
Centre for Experimental Immunology, Lion's Eye Institute	74
School of Electrical, Electronic and Computer Engineering, University of Western Australia	58
Department of Medical Technology and Physics, Sir Charles Gairdner Hospital	55
Department of Ophthalmology, Sir Charles Gairdner Hospital	49
Centre for Microscopy, Characterisation and Analysis, University of Western Australia	42
Immunology and Virology Program, Centre for Ophthalmology and Visual Science	40
Department of Ophthalmology, Perth Children's Hospital, Nedlands, Australia	38
Sir Charles Gairdner Hospital, Western Australia	37
Oceans Institute, University of Western Australia	30
Telethon Kids Institute, University of Western Australia	28
School of Medicine and Pharmacology, University of Western Australia	26
ARC Centre of Excellence in Vision Science, University of Western Australia	24
Royal Perth Hospital, Western Australia	22
Harry Perkins Institute of Medical Research, Western Australia	22
School of Population and Global Health, University of Western Australia	21
School of Animal Biology, University of Western Australia	20
Eye and Vision Epidemiology Research (EVER) Group, Perth, Australia	19
School of Public Health, Curtin University, Bentley, WA, Australia	19
School of Biological Sciences, University of Western Australia	19
School of Surgery, University of Western Australia	18
Centre for Population Health Research, Curtin University, Curtin, WA, Australia	18
Department of Population Health, University of Western Australia	18
Centre for Medical Research, University of Western Australia	16
University of Western Australia, Australia	15
School of Women's and Infants' Health, University of Western Australia, Perth, WA, Australia	15
Telethon Institute for Child Health Research, University of Western Australia, Perth, WA, Australia	15
Medical School, University of Western Australia	14
School of Biomedical Sciences, University of Western Australia	13
Ocular Immunology Program, Centre for Ophthalmology and Visual Science	11
Curtin-Monash Accident Research Centre (C-MARC), Curtin University, Australia	11

Department of Molecular Ophthalmology, Lion's Eye Institute	11
Department of Physiology and Pharmacology, Lion's Eye Institute	11
School of Pathology and Laboratory Medicine, University of Western Australia, Perth, Australia	10
Centre for Neuromuscular and Neurological Disorders, Perron Institute for Neurological and Translational Science	9
Australian E-Health Research Centre, Commonwealth Scientific Industrial Research Organization (CSIRO), Floreat, Australia	9
Department of Respiratory Medicine, Sir Charles Gairdner Hospital	8
Perron Institute for Neurological and Translational Science, Nedlands, WA, Australia	8
School of Medicine, University of Western Australia	8
Centre for Molecular Medicine and Innovative Therapeutics, Murdoch University, Murdoch, WA, Australia	8
Department of Pulmonary Physiology and Sleep Medicine, Sir Charles Gairdner Hospital	8
School of Physiotherapy and Exercise Science, Curtin University, Perth, Australia	8
Princess Margaret Hospital for Children, Western Australia	7
Department of Ophthalmology, Fremantle Hospital	7
Western Australian Neuroscience Research Institute, Nedlands, WA, Australia	7
PathWest Laboratory Medicine of Western Australia, Perth, WA, Australia	7
Institute for Immunology and Infectious Disease, Murdoch University, Perth, WA, Australia	7
Burns Service of Western Australia, Royal Perth Hospital	7
Oceans Graduate School, University of Western Australia	7
School of Medical and Health Sciences, Edith Cowan University, Perth, WA, Australia	6
Department of Endocrinology and Diabetes, Sir Charles Gairdner Hospital	6
Department of Medical Oncology, Sir Charles Gairdner Hospital	6
School of Paediatrics and Child Health, University of Western Australia	6
Ear Science Institute, University of Western Australia	5
St. John of God Hospital, Subiaco, WA, Australia	5
School of Human Sciences, University of Western Australia	5
PathWest Laboratory Medicine, Fiona Stanley Hospital, Perth, Australia	5
Department of Neonatology, King Edward Memorial Hospital for Women, Perth, WA, Australia	4
Busselton Population Medical Research Institute, Busselton, WA, Australia	4
Centre for Clinical Research in Neuropsychiatry, University of Western Australia	4
Neurosurgical Service of Western Australia, Sir Charles Gairdner Hospital	4
Metabolomics Australia, Centre for Microscopy, Characterisation and Analysis, University of Western Australia, Perth, Australia	4
Western Australian Institute for Medical Research, University of Western Australia	4
School of Anatomy, Physiology and Human Biology, University of Western Australia	4
Perth Retina, Perth, WA, Australia	4
Department of Cardiology, Royal Perth Hospital	4
Department of Diagnostic Genomics, PathWest, QEII Medical Centre, Perth, WA, Australia	4
Department of Anatomical Pathology, PathWest Laboratory Medicine, QEII Medical Centre, Nedlands, WA 6009, Australia	4
Centre for Sleep Science, School of Human Sciences, University of Western Australia	4
Curtin Health Innovation Research Institute, Curtin University, Perth, Australia	4
Faculty of Health and Medical Sciences, University of Western Australia	4
Fremantle Hospital, Western Australia	4
Department of Molecular Ophthalmology, Centre for Ophthalmology and Visual Sciences	3
Centre for Neonatal Research and Education, University of Western Australia	3
Association for the Blind of Western Australia, Perth, WA, Australia	3
Department of Endocrinology and Diabetes, Perth Children's Hospital, Perth, Australia	3
School of Pharmacy and Biomedical Sciences, Curtin University, Bentley, WA, Australia	3
Faculty of Medicine Dentistry and Health Sciences, University of Western Australia	3

Department of Neurology, Royal Perth Hospital	3
Genetic and Epidemiology Group, Lion's Eye Institute	3
Department of Neurology and Clinical Neurophysiology, Sir Charles Gairdner Hospital	3
Institute for Health Research, University of Notre Dame, Fremantle, Australia	3
National Centre for Asbestos Related Diseases, University of Western Australia, QEII Medical Centre, Level 5, QQ Block, Western Australia 6009, Australia	3
Perth Children's Hospital, Perth, Australia	3
Department of Clinical Immunology, Royal Perth Hospital	3
Faculty of Health Sciences, Curtin University, Perth, Australia	2
Division of Obstetrics and Gynaecology, University of Western Australia	2
Fiona Stanley Hospital, Murdoch, WA, Australia	2
Lions Eye Bank of Western Australia, Lion's Eye Institute	2
Department of Renal Medicine, Sir Charles Gairdner Hospital	2
Neurogenetics Unit, Department of Diagnostic Genomics, PathWest Laboratory Medicine, QEII Medical Centre, Nedlands, WA 6009, Australia	2
Institute for Respiratory Health, University of Western Australia	2
School of Engineering, University of Western Australia	2
Department of Physiology and Pharmacology, University of Western Australia	2
Breast Clinic, Royal Perth Hospital	2
Centre for Genetic Origins of Health and Disease, University of Western Australia	2
Curtin UWA Centre for Genetic Origins of Health and Disease, Faculty of Health Sciences, Curtin University, Bentley, 6102, Australia	2
Curtin University, Perth, WA, Australia	2
Centre for Cell Therapy and Regenerative Medicine, University of Western Australia	2
Department of Mechanical Engineering, Curtin University, Perth, WA 6845, Australia	2
Department of Medical Oncology, Fiona Stanley Hospital, Murdoch, WA, Australia	2
School of Mechanical and Chemical Engineering, University of Western Australia	2
Department of Nephrology, Royal Perth Hospital	2
Department of Neonatology, Princess Margaret Hospital for Children, Perth, WA, Australia	2
Curtin School of Population Health, Curtin University, Perth, WA, Australia	2
Department of Pathology, Royal Perth Hospital	2
Department of Ophthalmology, Princess Margaret Hospital for Children, Perth, WA, Australia	2
Department of Ophthalmology, University of Western Australia	2
Vascular Engineering Laboratory, Harry Perkins Institute of Medical Research	1
South Street Eye Clinic, Fremantle Hospital	1
WA Network, Australia	1
State Emergency Service Association, Perth, WA, Australia	1
Neurofinity, School of Surgery, University of Western Australia, Nedlands, Australia	1
Telethon Institute for Child Health Research, Perth, WA, Australia	1
Neuropsychiatric Epidemiology Research Unit, Division of Psychiatry, Faculty of Health and Medical Sciences, University of Western Australia, Medical Research Foundation Building, Rear 50, Murray Street, Perth, 6000, Australia	1
The Australian Inherited Retinal Disease Registry and DNA Bank, Perth, WA, Australia	1
The Perron Institute, The University of Western Australia, Nedlands, Australia	1
Neurofinity, School of Surgery, University of Western Australia, Nedlands, WA, Australia	1
Ngangk Yira: Murdoch University Research Centre for Aboriginal Health and Social Equity, Murdoch, WA 6150, Australia	1
South Metropolitan Health Service, Western Australia	1
Translational 3D Printing Laboratory for Advanced Tissue Engineering (T3mPLATE), Harry Perkins Institute of Medical Research, QEII Medical Centre, Nedlands and Centre for Medical Research, The University of Western Australia, Perth, WA, Australia	1
The Mount Hospital, 150 Mounts Bay Rd, Perth, WA, Australia	1
North Metropolitan Health Service, Western Australia	1
Oxford Day Surgery and Dermatology, Perth, Australia	1
School of Veterinary and Life Sciences, Murdoch University, Murdoch, WA 6150	1

Perth Voices Clinic, South Street, Murdoch, WA 6150	1
School of Biomedical Sciences, CHIRI Biosciences Research Precinct, Curtin University, Bentley, WA	1
School of Allied Health, Curtin University, Perth, WA	1
School of Biomedical Sciences, Immunology and Cancer Group, Curtin University, Perth, WA	1
Proteomics International, PO Box 3008, Broadway, Nedlands, Perth, WA 6009	1
School of Chemistry and Biochemistry, University of Western Australia	1
Physiotherapy Department, Fiona Stanley Hospital, Murdoch, Western Australia	1
School of Computer Science and Software Engineering, University of Western Australia	1
School of Earth and Planetary Sciences, Curtin University, GPO Box U1987, Perth, WA 6845, Australia	1
Office of Population Health Genomics, Public and Aboriginal Health Division, Western Australian Department of Health, East Perth WA	1
School of Mathematics and Statistics, University of Western Australia	1
School of Molecular Sciences, University of Western Australia, Crawley, WA	1
School of Occupational Therapy and Social Work, Health Sciences, Curtin University, Perth, WA	1
School of Psychological Science, University of Western Australia, Perth, WA 6083,	1
School of Psychology, University of Western Australia, Perth, Western Australia	1
School of Biological Sciences and Biotechnology, Murdoch University	1
Oxford Compounding, North Perth, WA	1
National Research Centre for Asbestos Related Diseases, University of Western Australia, Nedlands, WA	1
ARC Centre for Personalised Therapeutics Technologies, Perth, Western Australia	1
Murdoch Business School, Murdoch University, Perth, WA	1
Clinipath Pathology, Osborne Park Microbiology, Perth, Western Australia	1
Dental School, University of Western Australia	1
Department of Anaesthesia and Pain Management, Princess Margaret Hospital for Children, Perth, WA	1
Department of Applied Geology, Curtin University, Perth, WA 6845,	1
Department of Clinical Immunology, University of Western Australia, Crawley, WA	1
Department of Gastroenterology and Hepatology, Fiona Stanley and Fremantle Hospitals, South Metropolitan Health Service, Western Australia	1
Department of General Medicine, Royal Perth Hospital	1
Department of Health, Western Australian Cancer Registry, Western Australia	1
Department of Immunology, Fiona Stanley Hospital, Perth, WA	1
Department of Infectious Diseases and Microbiology, Royal Perth Hospital	1
Department of Infectious Diseases, Fiona Stanley Fremantle Hospital Group, 11, Robin Warren Drive, Murdoch, Western Australia 6150, Western Australia	1
Department of Mathematics and Statistics, The University of Western Australia, Crawley, Western Australia	1
Department of Medicine, University of Notre Dame, 19 Mouat Street, Fremantle, 6959, Western Australia	1
Department of Microbiology, PathWest Laboratory Medicine, Fiona Stanley Hospital, Perth, WA	1
Department of Molecular Imaging and Therapy Service, Fiona Stanley Hospital, Murdoch, WA 6150, Western Australia	1
Department of Molecular Ophthalmology, Centre for Ophthalmology and Visual Science	1
College of Science, Health, Engineering and Education, Murdoch University, Murdoch, WA	1
Clinical Research Centre, Graylands Hospital, North Metropolitan Health Service Mental Health, Private Mail Bag 1, Mount Claremont 6010, Perth, WA	1
Molecular Therapy Laboratory, Murdoch University, Murdoch, 6150	1
Child Protection Unit, Perth Children's Hospital, Nedlands, WA, Australia	1
Australia and Pathology and Laboratory Medicine, University of Western Australia	1
Australian Centre for Oral Oncology Research and Education, Perth, WA, Australia	1
Australian and New Zealand Society of Ophthalmic Plastic Surgeons, Australia	1

BPMRI Busselton Health Study Centre, PO Box 659, Busselton, WA 6280, Australia	1
Biostatistics, Institute for Health Research, University of Notre Dame, Perth, WA, Australia	1
Brightwater Research Centre, Brightwater Care Group, Perth, Australia	1
CHIRI Biosciences Research Precinct, Curtin University, Perth, WA, Australia	1
COVID-19 Research Response, Fiona Stanley Hospital, Murdoch, Australia	1
CSIRO, Mineral Resources, 26 Dick Perry Ave, Kensington, WA 6152, Australia	1
Canning Eye Clinic, Cannington, Perth, WA, Australia	1
Centre for Comparative Genomics, Murdoch University, Western Australia	1
Centre for Genetic Epidemiology and Biostatistics, University of Western Australia	1
Centre for Sustainable Aquatic Ecosystems, Murdoch University, Perth, WA, Australia	1
Centre for the Genetic Origins of Health and Disease (GOHaD), University of Western Australia	1
Centres for Applied Statistics, University of Western Australia	1
Department of Neonatology, Perth Children's Hospital, Perth, WA, Australia	1
Department of Neonatology, Perth Children's Hospital, Perth, WA, Australia	1
Department of Neurology, Fiona Stanley Hospital, Perth, WA, Australia	1
Department of Neurology, Joondalup Health Campus, Perth, WA, Australia	1
Faculty of Health Sciences, School of Veterinary and Biomedical Sciences, Murdoch University, Murdoch, WA 6150, Australia	1
Faculty of Science, University of Western Australia	1
Food Futures Institute, Murdoch University, Perth, WA, Australia	1
GP Super Clinic at Midland Railway Workshops, Midland, WA, Australia	1
General Internal Medicine Department, Sir Charles Gairdner Hospital	1
Health and Wellness Institute, Edith Cowan University, Perth, Australia	1
Hollywood Medical Centre, Nedlands, WA, Australia	1
Journal of Mobile Technology in Medicine, Fremantle Hospital	1
Laboratory for Molecular Genetics, Centre for Medical Research, University of Western Australia, Perth, WA 6009, Australia	1
Level1 Melanoma Clinic, Hamilton Hill, WA 6163, Australia	1
Lions Outback Vision, Lion's Eye Institute	1
Maternal Fetal Medicine Service, King Edward Memorial Hospital, Perth, WA, Australia	1
Mathematics and Statistics, Murdoch University, Murdoch, WA 6150, Australia	1
McCusker Centre for Action on Alcohol and Youth, Curtin University, Bentley, WA, Australia	1
Metabolic Research Centre, Royal Perth Hospital	1
Faculty of Engineering and Mathematical Sciences, University of Western Australia	1
Experimental and Regenerative Neurosciences, University of Western Australia	1
Edith Cowan University, Joondalup, Australia	1
Department of Physiology and Pharmacology, Centre for Ophthalmology and Visual Science	1
Department of Ophthalmology, Bunbury Specialist Eye Centre, Bunbury, Australia	1
Department of Ophthalmology, Midland Swan Valley Clinic, Perth, WA, Australia	1
Department of Orthopaedics, Royal Perth Hospital	1
Department of Orthopaedics, The Joint Studio, Nedlands, Western Australia, Australia	1
Department of Otolaryngology Head and Neck Surgery, Sir Charles Gairdner Hospital	1
Department of Paediatrics, University of Western Australia, Crawley, WA, Australia	1
Department of Psychiatry and Clinical Neurosciences, University of Western Australia	1
Dobney Hypertension Centre, School of Biomedical Science, University of Western Australia, Crawley, WA, Australia	1
Department of Psychiatry, Sir Charles Gairdner Hospital	1
Department of Pulmonary Physiology and Sleep Medicine, West Australian Sleep Disorders Research Institute, Hospital Avenue, Nedlands, WA, Australia	1
Department of Radiology, Sir Charles Gairdner Hospital	1
Department of Stem Cell Research, Lion's Eye Institute	1
Department of Veterinary Anaesthesia, Murdoch Veterinary School, Murdoch University, 90 South Street, Murdoch, Perth, Australia	1
Division of Laboratory Medicine, Royal Perth Hospital	1

Exercise Medicine Research Institute, Edith Cowan University, Joondalup, WA 6027, Australia	1
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