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NOVEMBER 2021

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Cover: Myopia and children
Increased screen time among children

Forging a path into 2022

In a year that many were hoping would see a 'return to normal' post-COVID-19, much of the country has still been impacted by lockdowns and uncertainty. We are pleased to have been able to provide consistency in our CPD offerings and deliver *Optometry Connection™* to you, our members, in 2021.

This fifth issue of *Optometry Connection™* for 2021 includes 8T hours and features an article on myopia control by Philip Cheng. The article presents two case studies to illustrate how myopia can be managed in everyday practice.

We also bring you our yearly updated Pharmaceutical Benefits Scheme (PBS) list of medicines prescribed by optometrists. As of 1st February 2021, the Department of Health mandated the inclusion of active ingredients on PBS prescriptions, so we have ensured that our listing of active ingredients completely aligns with those on the PBS. We have seen the addition of Cationorm to the PBS list this year, an unpreserved tear supplement used for the treatment of severe dry eye syndrome in patients sensitive to preservatives in multi-dose eye drops.

In some of the biggest PBS-related news for the year, Ikervis (ciclosporin) was added to the PBS list on October 1st. It is the only ciclosporin drug available on the PBS. This represents is a new pathway of therapeutic prescribing available to optometrists in the treatment of chronic severe dry eye disease with keratitis. Phone or online authority via HPOS is required in order to prescribe Ikervis and there are several clinical and treatment criteria that must be met in order for the patient to be deemed eligible for a PBS prescription. *Optometry Connection™* provides members with an article on prescribing ciclosporin for dry eye disease by Margaret Lam.

In further therapeutic news, there have been supply issues of anti-viral (aciclovir) and anti-inflammatory agents (prednisolone acetate and phenylephrine) in 2021. Optometrists have had to utilise alternative products: Currently Xorox and ViruPos are the listed products available with aciclovir; Pred Forte is listed as an available product with prednisolone acetate, but its supply is only authorised under Section 19A of the Therapeutic Goods Act 1989 until 1 February 2022. In a follow-up from last year's article on therapeutic prescribing patterns by optometrists, Fiona Moore takes a look at what has changed in the 2019-2020 financial year.

Optometry Australia continues to update the list of certified ophthalmic compounding pharmacies on our website and reminds members that 'TO BE COMPOUNDED' must be written on any prescriptions that require compounding.

Finally, in a year that has been difficult for many, Optometry Australia has forged ahead with its advocacy efforts and is proud to present two articles from 'LOOK' scholarship recipients, Nicola Mountford and Shelley Hopkins, who provide an update on their work in their respective fields of expanding scope and vision screening in schools.

We would also like to thank all of our contributors and advertisers throughout the year, and CooperVision for sponsoring this issue of *Optometry Connection™*.

Kerryn Hart
Clinical Editor

Simon Hanna
Education Editor

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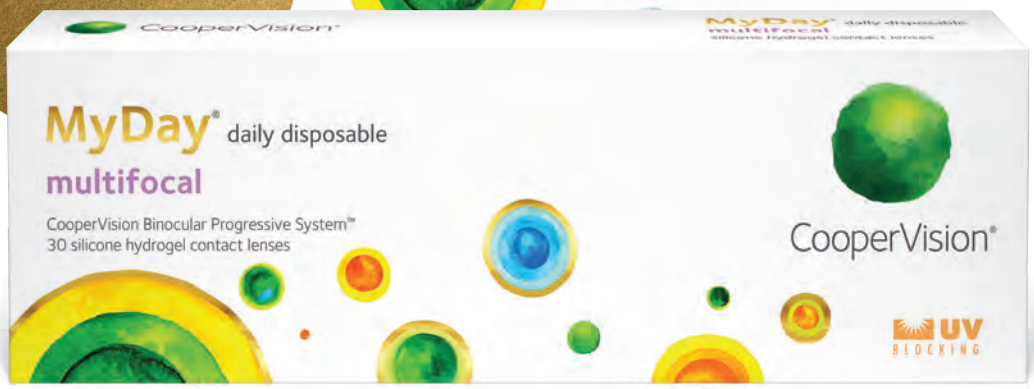
NEW



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References: 1. CooperVision® data on file, 2021. Prospective, subject-masked, randomised, bilateral, two-week dispensing study at 5 US sites with MyDay® daily disposable multifocal; n=58 habitual multifocal contact lens wearers. 2. CooperVision® data on file, 2020. Prospective, double-masked, bilateral, one-week UK dispensing study with MyDay® daily disposable multifocal; n=104 habitual multifocal contact lens wearers.

Starting myopia management

FEATURE ARTICLE

Philip Cheng
BOptom, GCOT, FIAOMC
The Myopia Clinic, Melbourne

In April 2021, the World Council of Optometry passed a resolution recommending optometrists incorporate a standard of care for myopia management in clinical practice. This is a significant moment in optometry that will change and shape the way myopia is managed for children around the world.

Gone should be the days of myopia simply being a refractive condition corrected with single vision distance glasses, or practitioners shrugging their shoulders to say that nothing can be done to slow myopia progression in a child. Myopia is a progressive eye health condition that, in most cases, can be controlled with the toolbox of evidence-based interventions that optometrists have access to.

When is the right time to start myopia management? As axial elongation from myopia progression cannot be reversed, myopia management should be discussed as soon as a child is diagnosed with myopia. Practitioners should carefully evaluate the risk of progression, which include genetic risk, ethnicity, age of onset, level of myopia, binocular vision, and environmental factors such as near work and indoor time.[1] Practitioners should also educate parents on what myopia is and what we can do to slow its progression.

Many parents are concerned about their children's eyesight and will want to do their best to prevent their eyes from deterioration. A question that I frequently hear from parents who bring their children in to see me – often when the child is already at -4.00D, -5.00D or higher - is why have myopia interventions not been discussed with them before? They also often wish they had known about, or started, treatment earlier. But some parents are less concerned, usually from a lack of understanding of the condition, and a few may even decline interventions. Parents have the right to make their choice; our duty as practitioners is to have the conversation to help them make that informed choice for their child.

Here are two case studies to illustrate how myopia can be managed in everyday practice.

Cast study 1 – Contact lens intervention

A six-year-old girl of Chinese ethnicity came to see me in May 2020, her parents very concerned about her recent diagnosis of myopia by an optometrist. There is a strong family history of myopia. Prior to her visit she also saw an ophthalmologist, who confirmed her low myopia of R -1.25D L -1.25D with cycloplegic refraction and prescribed her with 0.01% atropine.

During her consultation at my clinic I had a detailed discussion with her parents about her myopia and effective myopia control interventions available to her. These include atropine eye drops with spectacle correction, peripheral defocus spectacle lenses, multifocal soft contact lenses, and orthokeratology. Vision correction is necessary at -1.25D for her functioning at school, and uncorrected myopia may also enhance progression. But her parents were not particularly keen for her to wear glasses, hence our attention turned to contact lens options. Young children can wear contact lenses successfully and safely, and the overall risks are low.[2] While both multifocal soft contact lenses and orthokeratology are effective for myopia control, my experience with both treatment modalities suggests multifocal soft lenses may be slightly more effective for low myopia cases. This is related to a lesser amount of peripheral defocus and spherical aberrations produced by the effect of orthokeratology in low myopia.

Should myopia management be commenced on a first time myope at -1.25D? Practitioners should evaluate the individual's risk of progression to make this decision. A six-year-old child should not be myopic; she ideally should still be mildly hyperopic at this age.[3] Hence there is already a significant myopic shift compared to a child with normal eye development at her age.

Parents have the right to make their choice; our duty as practitioners is to have the conversation to help them make that informed choice for their child.

Age of myopia onset is a strong predictor of future high myopia,[4] due to a longer period of time for progression to occur. Her family history and ethnicity also put her at greater risk.

In this case, myopia management is certainly indicated. Even if one preferred to act conservatively in first monitoring and confirming progression over three or six months, the options for myopia control interventions should still be discussed with the parents to help facilitate commencing treatment later on. Many parents are keen on starting treatment as soon as possible.

This girl was fitted with CooperVision MiSight 1 day contact lenses, R -1.25D L -1.25D. The lenses fitted well and a topography of the lens on eye was taken to help explain the dual-focus optics of this treatment lens (**Figure 1**). Her mum took on the responsibility of helping her with lens insertion and removal at the beginning. She enjoyed her clear vision and had no problems adapting to wearing contact lenses.

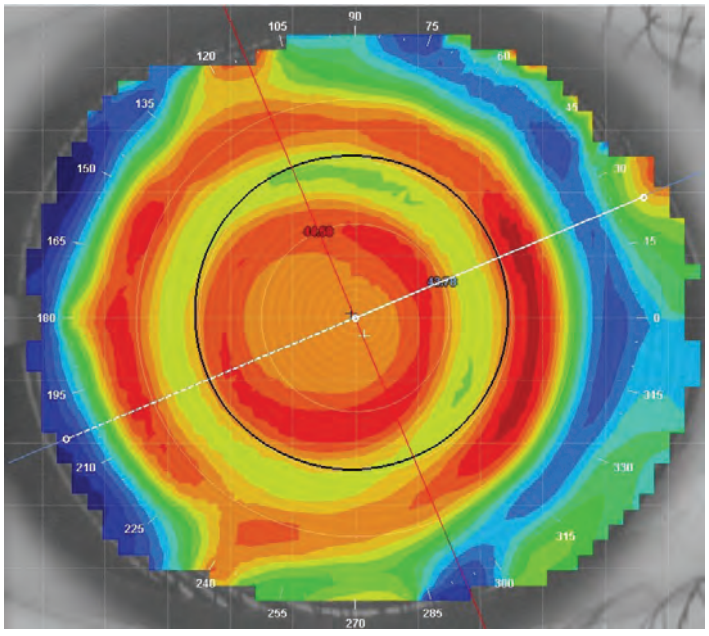

Figure 1.
Topography image of MiSight contact lens fitted on eye to assess lens centration.

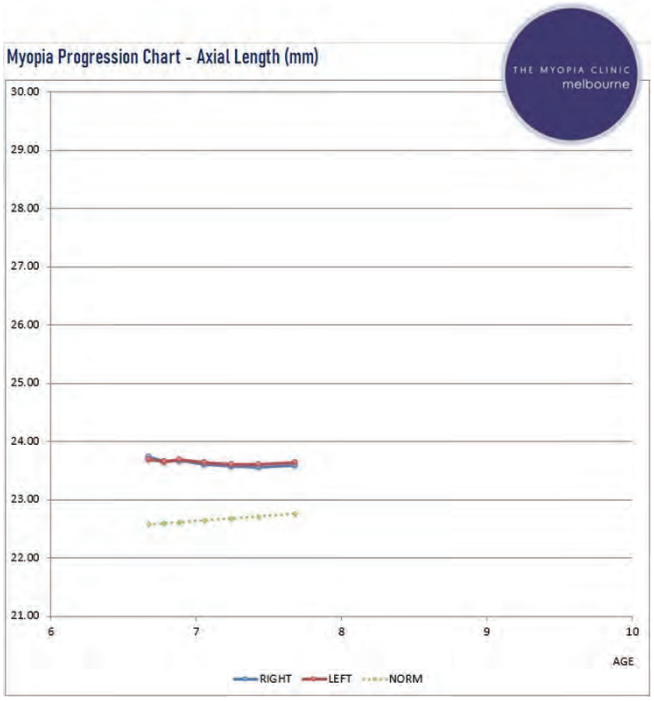

Figure 2.
Monitoring myopia progression with axial length measurement for a child wearing MiSight 1 day contact lenses.

Her myopia progression was monitored by measuring axial length with optical biometry, the standard recommended by the International Myopia Institute,[5] as well as her subjective refraction. Interestingly, there was a small but notable regression in her axial length over time, particularly in her right eye by 0.16mm, which corresponded to a decrease in her refraction by 0.25D. This may be an indication of the changes in choroidal thickness in response to the peripheral myopic retinal defocus effect[6] from her MiSight contact lenses. This was confirmed with an over-refraction of R +0.25D while wearing her contact lenses, and her prescription was subsequently updated to R -1.00D L -1.25D six months after commencing treatment.

Her parents are very happy with her one-year myopia control outcome of no progression in her myopia in terms of refraction or axial length (**Figure 2**). This is a better-than-expected outcome for a child in this age group with myopia, as myopia control interventions generally can slow but not necessarily stop all progression, particularly as younger myopes tend to progress faster.[7] She will continue on her current treatment and be monitored every three to six months. →

Case study 2 – Spectacle intervention

This patient, aged seven, attended her optometric review and recently noticed a change in her distance vision. She is of Asian descent and her mum is a -10.00D myope. At her previous examination at this clinic, she was found to be +0.50D hyperopic, which is a low amount of hyperopia at her age, and placed her in a higher risk category for myopia development. A baseline axial length measurement was taken for future comparison, and a review scheduled for six months.

Refraction measured -0.50D R&L – a 1.00D myopic shift in six months – and her axial lengths had increased by R 0.48mm L 0.51mm, which is significant eye elongation at a rate far in excess of normal eye growth at this age.[8] Her mum was interested in starting myopia management as she could see how quickly her myopia would progress. Myopia control options suitable for a -0.50D myope – atropine, myopia control spectacle lenses and multifocal soft contact lenses - were discussed.

As the child had a preference to wear glasses, we spoke about the Hoya MiyoSmart spectacle lenses with D.I.M.S. (Defocus Incorporated Multiple Segments) technology. A potential issue for prescribing vision correction at this low level of myopia is the risk of non-compliance[9] which can affect treatment outcomes. I stressed the importance of wearing the glasses on a full-time basis to maximise the effect of the treatment. Her spectacle frame was carefully chosen and adjusted as stable fitting with good centration of the optics is important for vision quality with these lenses (**Figure 3**).

This child was reviewed three months after starting her myopia treatment, which found a much-reduced rate of eye elongation compared to her previous progression. She had been very compliant with wearing her glasses all day, every day. At her recent review, her overall axial elongation measured R 0.19mm L 0.20m over the one-year period wearing MiyoSmart spectacle lenses, with a refractive change of -0.50D R&L. Her rate of axial length growth is approximately one-quarter of the changes prior to commencing treatment, demonstrating the efficacy of this early intervention to slow her myopia progression (**Figure 4**).

Her mum is pleased to see her new prescription is now -1.00D R&L, as without treatment she could now be at -2.00D or greater, judging by the speed of her eye elongation prior. We discussed the possibility of wearing contact lenses if she was interested, but she liked the look of wearing glasses, hence we opted to update her MiyoSmart lenses with the new prescription.

Conclusion

Optometrists in Australia are well placed to manage myopia in children. With a range of accessible myopia control treatment options available, there is no excuse not to have a conversation with parents when a child presents with myopia or is showing progression. Every myopic child or teenager deserves the opportunity of maintaining good vision and eye health. The key to keeping myopia as low as possible is to start interventions at the earliest opportunity. With effective myopia management, we can make a real difference to a child's life.

Figure 3.
A MiyoSmart spectacle lens demonstrating a central vision zone surrounded by an annulus of defocus segments.

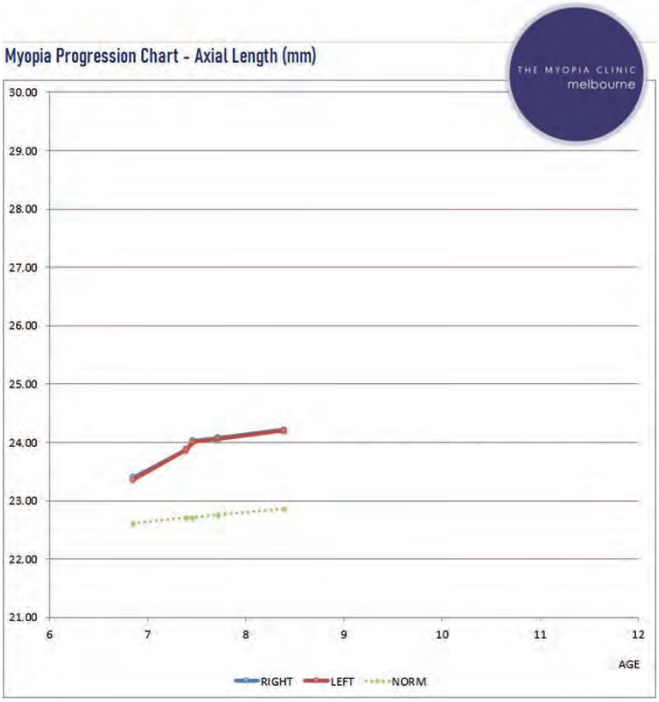

Figure 4.
Axial length changes before and after intervention with MiyoSmart spectacle lenses.

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Minh Nguyen
BVisSc, MOptom
The Eyewear Shop, Camp Hill QLD

Optometry AUSTRALIA MEMBER

Lipaemia retinalis in a diabetic patient

A 31-year-old female (MI) presented for routine ocular review. She was on insulin, metformin, and lipitor for type 2 diabetes (since 2011) and hyperlipidemia. The patient did not monitor her blood-glucose levels and reported improving serum lipids levels from her last consultation with her general practitioner. Ocular examination revealed best corrected visual acuities of R 6/6-2, and L 6/6-1 with R -0.50/-0.50x33, and L -0.75/-0.50x140. Intraocular pressure with non-contact tonometry was 15mmHg in both eyes. Ocular motility was full and normal. Pupil reactions were normal with no signs of relative afferent pupillary defect. Dilated fundus examination revealed pale salmon appearance of the fundus and creamy white discoloration of blood vessels in both eyes (**Figures 1** and **2**).

The retina appeared significantly different in comparison to retinal imaging in 2018 in **Figures 3** and **4**. In the peripheral retinal there was moderate nonproliferative diabetic retinopathy in the form of blot haemorrhages and microaneurysms in all four quadrants of both eyes. An OCT scan revealed normal retinal nerve fibre layer thickness in both eyes. The macula contour appeared normal with marked hyperreflectivity from blood vessels. MI was diagnosed with lipaemia retinalis and referred to her general practitioner for targeted review of her triglyceride levels. She was also referred through the public health system to an ophthalmologist for further ophthalmic review to rule out other differential diagnosis and for further systemic health review.

Lipaemia retinalis (LR) is an ocular manifestation of elevated serum triglyceride levels in hyperlipidemia.[1, 2, 3] It is characterised by the milky discolouration of retinal blood vessels that reverts back to its original appearance when serum triglyceride levels return to normal range.[1,2] Hyperlipidemia as a primary disorder is related to conditions of elevated chylomicrons, a lipoprotein that transports triglycerides from the intestinal site or absorption to the systemic circulation.[5] Secondary causes of hyperlipidemia include systemic disorders such as diabetes mellitus, obesity, alcoholism, systemic lupus erythematosus, hypothyroidism, and certain medications.[3, 5]

LR occurs when serum triglyceride levels exceed 111.1mmol/L due to increased concentration of chylomicrons.[1, 4] Chylomicrons scatter light and at high concentrations gives blood vessels a characteristic milky white appearance as seen in LR.[5] This can make veins and arteries more difficult to distinguish in the retina.[1] The ophthalmic appearance of LR directly corresponds with serum triglyceride levels in hyperlipidemia. Peripheral retinal vessels are initially affected, appearing creamy and thin in early stages with triglyceride levels ranging from 138.9mmol/L to 194.4mmol/L.[1, 5] In moderate LR with triglyceride levels between 194.4mmol/L to 277.8mmol/L, central retinal vessels are affected. At a severe stage of LR where triglyceride levels exceed 277.8mmol/L, choroidal blood vessels become visibly affected giving the retina a salmon pink colour.[1, 5]

The patient in this report presents a severe case of LR where triglyceride levels likely exceed 277.8mmol/L. Plasma triglyceride levels below 1.7mmol/L are considered within normal healthy range and between 2 to 6mmol/L is considered high.[6] MI has hyperlipidemia secondary to poorly controlled type 2 diabetes. At a three-month review, MI's clinical retinal appearance was unchanged and she reported poorly controlled blood-glucose levels and hyperlipidemia. Close systemic review and lipid-lowering measures are vital to prevent complications of hyperlipidemia such as stroke, heart attack and cardiovascular disease such as atherosclerosis.[6] Measures such as a low-fat diet, regular exercise and maintaining blood-glucose levels to a normal range are necessary for lowering serum-triglyceride levels. Losing weight, consuming more omega 3 fatty acids, and including food with low glycemic index into the patient's diet are also recommended.[5, 6]

LR is a clinical presentation of elevated serum triglyceride levels in hyperlipidemia and optometrists should be aware of the implications of this serious but treatable metabolic disorder.[4] The condition LR does not require treatment but systemic hyperlipidemia requires treatment by lowering serum triglyceride levels with a low fat diet and lipid-lowering medication.[1, 3] Once triglyceride levels return to normal level, the clinical ocular appearance of LR resolves.[4] LR does not typically affect vision, but long-standing cases can lead to irreversible lipid exudation in the retina and loss of vision.[5] In the early stages of the condition LR presents in the peripheral retina and is potentially underdiagnosed. Thorough examination of the peripheral retina may serve as a good clinical indicator of patients with high chylomicron and triglyceride levels.[5] Diagnosis and ophthalmic evaluation are important indicators for systemic evaluation and targeted treatment of these patients.[1]

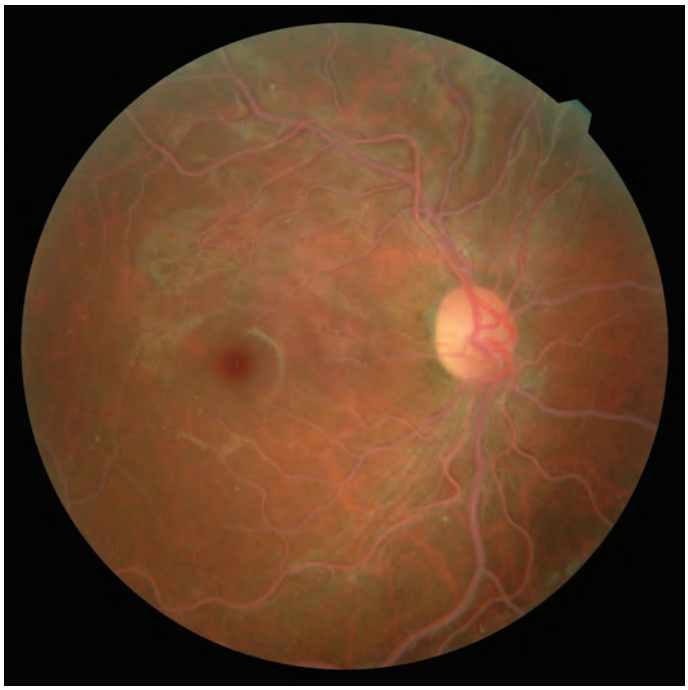

Figure 1.
Right eye retinal fundus photograph with lipemia retinalis 2021

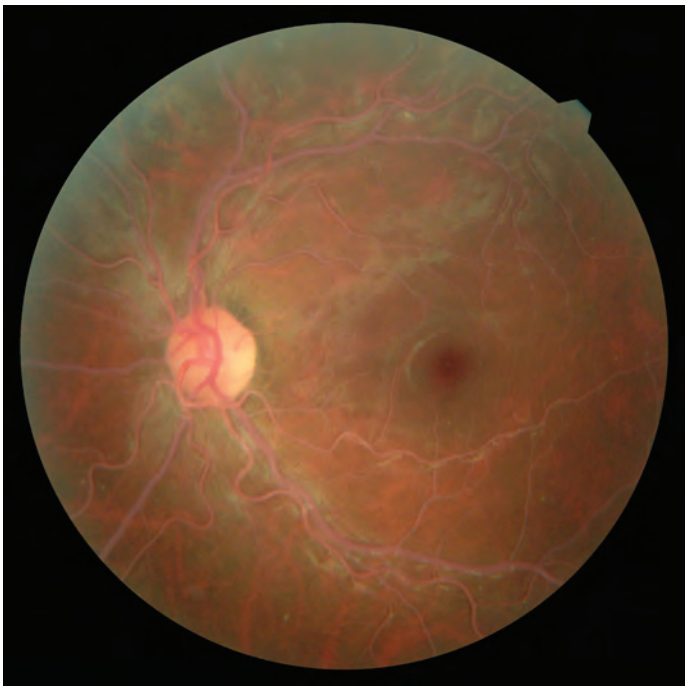

Figure 2.
Left eye retinal fundus photograph with lipemia retinalis 2021

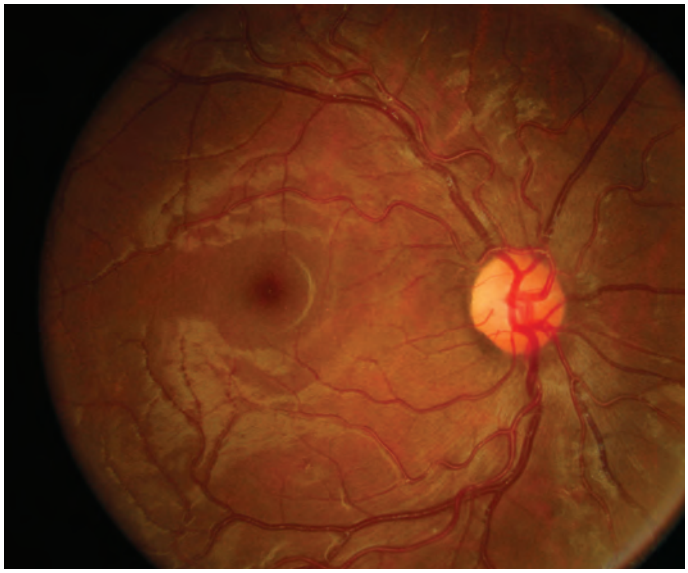

Figure 3.
Right eye digital retinal photography 2018

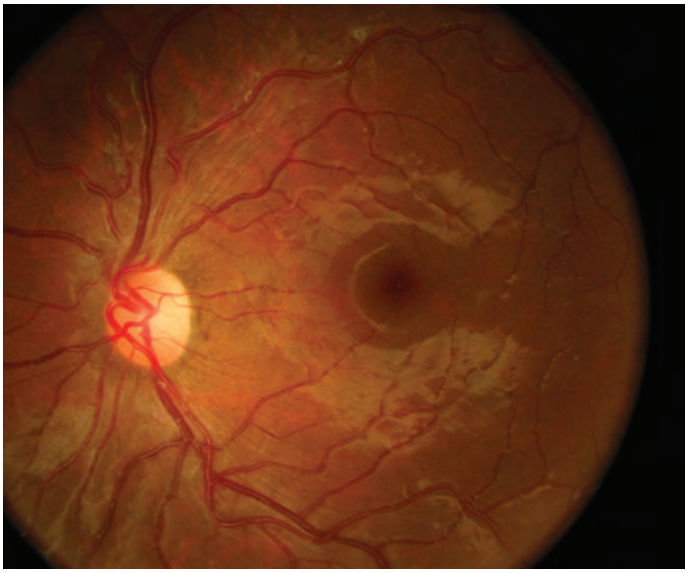

Figure 4.
Left eye digital retinal photography 2018

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Contact lens associated sterile corneal infiltrates and microbial keratitis

Current understanding and therapeutic management

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As a contact lens wearer for over 20 years now, time out of my lenses can be a significant inconvenience, especially when working with a mask during the COVID-19 pandemic. As a contact lens practitioner, however, I know that sometimes our contact lens wearers do present with infiltrative events that require immediate management – including time out of lens wear – and that managing such conditions early, will prevent prolonged time in spectacles. Armed with a range of ocular therapeutics, managing most contact lens-related adverse events is well within the realm of optometric practice, together with advising patients to have an up-to-date pair of spectacles and to take time out as necessary. Authors Lily Ho, Isabelle Jalbert, Kathleen Watt and Alex Hui review the current evidence relating to the management of corneal infiltrative events in contact lens wear, including microbial keratitis.

Approximately 5% of the Australian population wear contact lenses, with silicone hydrogels being the predominant material and daily disposables being the predominant modality. An estimated 10-25% of wearers will experience asymptomatic corneal infiltrative events, and 0.4% will experience microbial keratitis. This rate is significantly lower for daily disposable users. Corneal infiltrative events are a result of the corneal epithelium identifying an invading pathogen or corneal insult, resulting in a release of cytokines and chemokines, and ultimately infiltration of leukocytes into the cornea which can be observed clinically as infiltrates.

The first decision that a clinician must make regarding observed corneal infiltrates is whether they are infectious or sterile in nature, as the management and therapeutic agents used differ significantly. In sterile infiltrates, it is hypothesised that endotoxins and exotoxins from bacteria may be a primary factor for the cellular response and infiltration seen. Contact lens peripheral ulcer-type infiltrates are thought to represent an inflammatory response to the high number of Gram-positive bacteria which colonise the lens surface and release toxins. For contact lens-related microbial keratitis, the majority of infections are due to *Pseudomonas aeruginosa*. Contact lenses can cause disruption to the ocular surface, including breaks in the corneal epithelium, which allows pathogens, particularly opportunistic ones, to gain access to the deeper corneal layers to facilitate infections.

For microbial keratitis, timely treatment with the appropriate antimicrobial therapy is crucial to minimise vision loss. Any infiltrate with overlying corneal staining needs to be carefully differentiated as microbial keratitis, and potentially treated as such until confirmed otherwise. Microbial keratitis signs and symptoms will worsen without treatment, while sterile infiltrates will be self-limiting. Microbial keratitis may present with lid oedema, moderate to severe conjunctival injection that is generalised, an irregular infiltrate greater than 1mm in size anywhere in the cornea with overlying staining and moderate anterior chamber reaction. In contrast, sterile infiltrates may present with no lid oedema, mild to moderate conjunctival injection, a round and regular infiltrate that is typically 1mm in size or smaller, in the mid-peripheral to peripheral cornea, with possible overlying staining and minimal to no anterior chamber reaction. These tend to start to resolve on contact lens discontinuation, unlike microbial keratitis which continues to progress.

Once a case of microbial keratitis has been diagnosed, treatment commences with intense antimicrobial therapy including fluoroquinolone monotherapy, or fortified duotherapy. There is equivocal evidence for corticosteroid use, and if used, these are commenced 24-48 hours after initiation of antibiotic treatment. Cycloplegia is also beneficial, and patients are reviewed within 24 hours. These will scar and loss of vision is a possibility. Hospitalisation may be required. In the case of sterile infiltrates, treatment commences with fluoroquinolones four times a day in the case of a contact lens peripheral ulcer or when there is a break in the epithelium. This may be commenced in conjunction with fluorometholone acetate 0.1%, also four times a day. Cycloplegia is typically not required, and patients are again reviewed within 24 hours. Scarring is rare, except in the case of a contact lens peripheral ulcer, and they are likely to recur.

This review by Ho et al provides a thorough and up-to-date, evidence-based approach to the management of contact lens-related infiltrative events. It makes an excellent clinical guide for the practicing practising contact lens practitioner.

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Reference: 1. Cummings S, Giedd B, Pearson C. Clinical performance of a new daily disposable spherical contact lens. *Optom Vis Sci.* 2019;96:E-abstract 195375.

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Contact lens prescribing trends 2021

The 22nd annual survey of Australian contact lens prescribing was conducted between February and April this year. The same survey format as in previous years was employed. An e-mail invitation to participate in the survey was sent to all members of Optometry Australia, with a link to a questionnaire, and a request that this be downloaded, printed and completed to provide details of the first ten patients fitted with contact lenses after receipt of the questionnaire. The survey was specifically designed to be straightforward to complete while capturing key information about their patients.

Practitioners were asked general questions about themselves. For each contact lens fitting they were requested to complete the following details: date of fitting, age and sex of patient, lens material, lens design, frequency of replacement, times per week of wear, modality (daily or extended wear) and care system. Practitioners were asked to return the photographed or scanned copies of the questionnaire by e-mail. Only data relating to soft lenses is reported this year because the submitted rigid lens fit data was unreliable due to aberrant reporting patterns.

Demographics

As is the case elsewhere in the world,[1] a majority of lenses (68%) was fitted to females. The average age of contact lens wearers at the time of fitting has increased over the past two decades, from 32.3 ± 12.9 years in 2002 to 37.0 ± 18.9 years in 2021. The age at fitting this year ranged from 0 to 89 years.

Figure 1 is a composite of pie charts detailing the key findings of the 2021 survey in relation to soft lenses.

Soft lens material and designs

There has been a slight increase this year in the fitting of lenses made from silicone hydrogel materials, which now represent 88% of all soft lens fits, up from 87% in 2020. The balance comprises mainly of mid-water content hydrogel materials (8%), with high and low water content fits being 3% and 1% respectively.

Figure 2 shows the trend in fitting soft lens materials from 2000 to 2021, inclusive. There has been a continual rise in the fitting of silicone hydrogel lens materials over this period, although the rate of increase has perhaps slowed over the past decade.

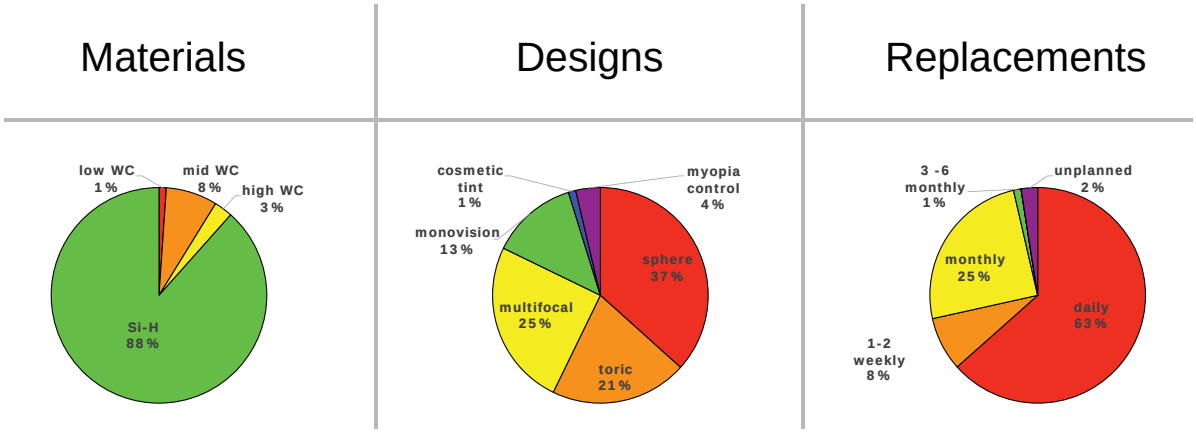

Figure 1. Detailed results for soft contact lens prescribing in the 2021 Australian survey, with respect to lens materials, lens designs and lens replacement frequencies. *Si-H, silicone hydrogel; WC, water content.*

The key categories of soft lens designs are spherical, toric, multifocal, monovision (perhaps a 'fitting approach' rather than lens design), myopia control and coloured (tinted). As can be seen from the 'Designs' pie chart (**Figure 1**), the days of primarily fitting spherical soft lenses have long passed. Although spherical designs still represent the majority of soft lens fits, the distribution is more evenly spread among other design options. Presbyopia corrections now represent 38% of all soft lens fits, which is one contributing factor to increase in the average age of lens wearers, as discussed above.

Caution needs to be exercised when interpreting data relating to lens design, as our survey asks respondents to indicate the element of the design that is the main reason for prescribing. In recent times the availability of combined lens designs, such as toric multifocals, has increased. Accordingly, the true percentages for some design options may be greater than indicated in **Figure 1.**

Correction of astigmatism

Figure 3 shows trends in toric lens fits as a proportion of all spherical and toric lens fits between 2000 and 2021. Overall, there has been a gradual increase in toric lens fitting during this period. In 2020, the level of toric lens prescribing in Australia reached the theoretical threshold of prescribing, which would be expected if all lens wearers with ≥ 0.75D of astigmatism were fitted with toric lenses (about 43%, shown by the dotted line in **Figure 3**).[3,4] However, it can be seen that there has been a slight decrease in toric lens fitting, below this threshold line, in 2021. As time goes on, the level of toric lens prescribing would be expected to hover around this threshold level.

The slight decline in toric lens prescribing between 2013-2016, as can be seen in **Figure 3**, was possibly due to accelerated prescribing of silicone hydrogel daily disposable lenses during this period. The availability of toric designs was lagging behind spherical designs for this lens type. As the data for 2017-2020 shows, this situation has generally rectified, notwithstanding some variance in the data, which can perhaps be attributed to the more recent introduction of a broader range of parameters in toric silicone hydrogel daily disposable lenses.

Lenses designed for arresting the progression of myopia – referred to as 'myopia control' – which are mainly fitted to children, have slowly gained traction in Australia over the past few years and now account for 4% of soft lens fits (same as 2020). This figure of 4% does not include additional rigid lens fits for myopia control using orthokeratology. Other lens designs, such as coloured lenses, continue to be prescribed at very low levels. →

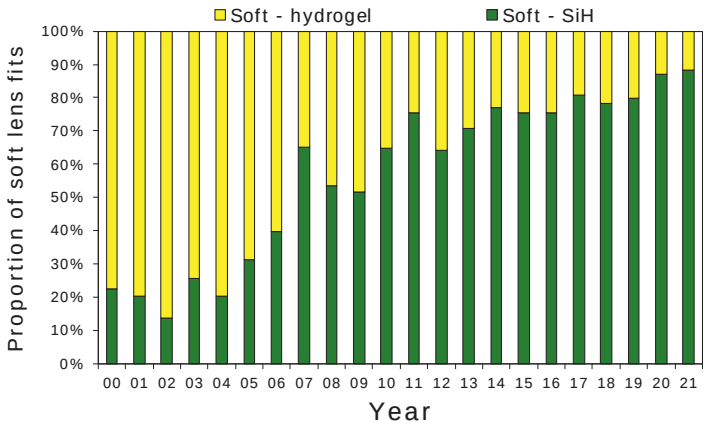

Figure 2.
Trends in silicone hydrogel and hydrogel lens materials prescribed in Australia between 2000 and 2021

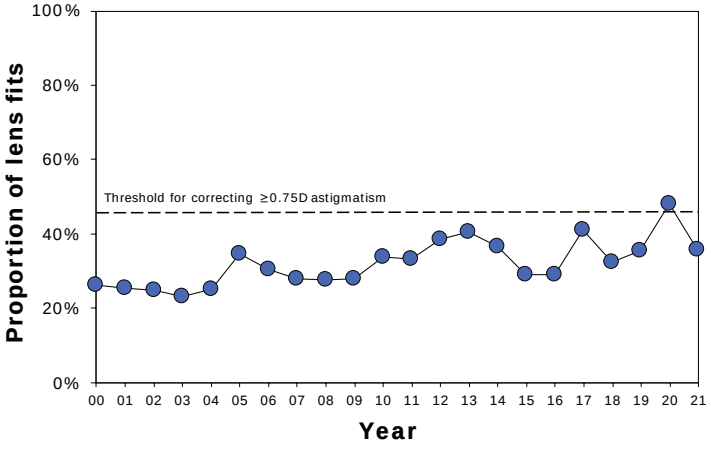

Figure 3.
Trends in toric soft lens prescribing in Australia between 2000 and 2021. The dotted line shows the theoretical rate of toric lens prescribing if all patients with astigmatism ≥ 0.75D were fitted with toric lenses.

2021 survey highlights:

- **Daily disposable silicone hydrogels prominent (56%)**
- **Spherical soft designs a minority (37%)**
- **Multipurpose solutions ubiquitous (95%)**
- **Soft lens myopia control holding steady (4%)**

Soft lens replacement frequency

The vast majority of soft lenses fitted in 2021 were replaced daily, which at 63%, is down a little from the all-time-high of 65% in 2020. Monthly and one to two weekly replacement lens fits account for 25% and 8% of all soft lens fits, respectively. (**Figure 1**)

When considering material and design together, it is interesting to observe that silicone hydrogel daily disposables represent 56% of soft lenses fitted in Australia.

Soft lens wearing modality and care solutions

Extended wear lens fitting, almost exclusively with silicone hydrogel materials, has remained constant at under 10% of all lens fits over the past decade, and represented 9% of soft lens fits in 2021.

Multi-purpose solutions are used by the vast majority of those wearing reusable lenses, with this solution type representing 95% of prescribed care regimens in 2021. The balance is peroxide systems.

Australia versus the world

We conduct annual contact lens fitting surveys in many countries each year, and in 2020 we surveyed 24 countries.[1] This provides an opportunity to benchmark against international colleagues, and this year we compare soft contact lens prescribing in Australian against world trends (the latter derived from 2020 data[1]) (**Figure 4**). Five key categories of lens type are represented. The outer and inner rings display the Australian and world-wide fitting data, respectively.

Notwithstanding the fact that these survey data are 12 months apart, the most profound difference revealed in **Figure 4** is that daily disposable silicone hydrogel lenses – widely believed to be the most advanced lens type in terms of eye health – are prescribed at twice the rate in Australia (56 %) compared with the rest of the world (28%). The primary counterbalance for this observation is that rate of fitting reusable daily wear silicone hydrogel lenses in Australia (24%) is considerably lower than the world average (40%).

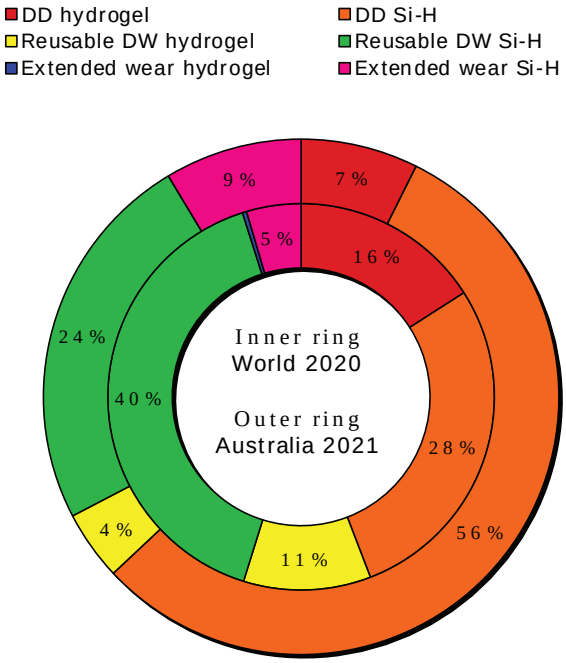

Figure 4.
Percentage of soft contact lenses prescribed in Australia (2021, outer ring) compared with the world (2020, inner ring). Si-H, silicone hydrogel; DD, daily disposable; DW, daily wear

Conclusions

In this second consecutive COVID-affected year, we are pleased once again to have received a sufficient number of survey forms to report on soft contact lens prescribing trends in Australia with a reasonable level of confidence. The dominance of silicone hydrogel materials and daily lens replacement reflects an ongoing trend. •

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2. Final subjective refraction values are provided to 0.01D. *Euromonitor, Eyewear 2021 edition; Essilor International; Retail value sales at RSP.

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Managing myopia in children:
A cornerstone of contemporary optometry

For many people, the perception is that we as optometrists simply 'sell glasses.' However, many of us undoubtedly did not enter this profession to sell glasses, but to provide health care, which does include 'prescribing' glasses. The key word here is 'care'; we care for and manage the health not only of the eye, but the body and the person attached to it. This disconnect of perception persists because many people do not consult an optometrist until they experience blurred vision, and presumably is also influenced by the advertising associated with optometry which generally highlights the sale of spectacles. Many people still attend their general practitioner for ocular issues, despite optometry having far more in-depth knowledge and more sophisticated equipment to assess it.

Optometry aims to safeguard vision by detecting the earliest signs of pathological changes, regardless of symptoms, and intervening when appropriate. It is the duty of care that we as optometrists assume for our patients – the 'Hippocratic Oath' we swear to abide by when we enter this profession. Optometric care means doing everything possible to ensure that this precious organ can provide good vision for a lifetime, which can be many years considering that a child born today in Australia is expected to live more than 80 years,[1] with a decent number becoming eligible for a letter from the Queen.[2]

Maintaining good vision for life is not simply about providing optical correction – we understand that our risk of developing sight-debilitating eye conditions increases with age, so early detection and intervention is required. Optometry in Australia certainly is committed to this, as many have quickly adopted advanced technologies for analysing the ocular structures in more depth.

The steady rise in myopia has been well documented over recent decades, particularly in capital cities across East Asia. However, this increase is now evident throughout the world, and is forecast to affect 50% of the global population by 2050.[3] This may also be accelerated by COVID-19 and 'quarantine myopia' developing from increased time indoors and on screens. This is a major concern for optometry because although we can prescribe or 'sell' more glasses, the association of axial elongation with myopic maculopathy and other conditions[4] including glaucoma, cataract and retinal detachment, combined with increasing longevity, is arguably the greatest threat to a lifetime of good vision. Optometry is rightly fastidious about the detection and management of retinal pathology in adults, particularly those middle-aged and older. This country has arguably led the world in raising the awareness of macular disease and it is truly impressive that so many Australians understand this threat to ocular health and seek eyecare accordingly.[5]

However, alarmingly, there are still many myopic children using single vision corrections or treatments of relatively little benefit.

Australia has also made significant contributions to the understanding of myopia in children through research at various institutions. Furthermore, optometry students today

receive a good education in the subject and a number of university optometry schools operate myopia clinics using the most effective, evidence-based treatments. Practising optometrists needing to increase their knowledge of myopia and its management have access to post-graduate education and resources from several universities, the Brien Holden Vision Institute and the Myopia Profile educational platforms.

Ideally, all young progressing myopes would be having their condition actively managed to minimise axial elongation to the greatest extent possible. However, alarmingly, there are still many myopic children using single vision corrections or treatments of relatively little benefit.

Given that any amount of myopia increases the lifetime risks of various ocular pathologies and that any progression is irreversible and only increases those risks,[4] a myopic child must receive an urgent intervention if possible. Hence, waiting for myopia to progress further cannot be supported by our current understanding of paediatric myopia and its risks.[6]

Consider an eight-year-old child who presents for their first eye examination. Cycloplegic refraction reveals them to be -1.00D in both eyes and there are no other findings of significance. How should we approach this situation? Firstly, we know children of this age should be at least +0.50D hyperopic.[7] Thus, they are already 1.50D more myopic than expected for their age. It is likely that this child will continue to progress, and we know that progression is typically fastest when the child is young.[8] Without appropriate intervention at this young age, this child could become highly myopic. Hence the pressing need to prescribe one of the proven treatments[9] chosen to suit the child's lifestyle and which will allow for maximum compliance. Those effective treatments are, in no particular order:

1. Orthokeratology contact lenses
2. Certain soft multifocal contact lenses
3. Certain novel spectacle designs
4. Low dose atropine

Ideally, optometrists should only prescribe interventions which have a solid evidence base, preferably in the form of randomised controlled trials (RCT) conducted over at least three years. For example, 0.01% atropine has been shown to have minimal efficacy in slowing axial elongation whereas 0.025% and 0.05% are moderately effective.[10] Some novel spectacle lens designs for myopia management have good supporting evidence, but others have been shown to make little or no difference to progression.[11,12] One soft contact lens design, the subject of a three-year RCT,[13] was the first treatment to receive United States FDA approval for slowing the progression of myopia in children in 2019. Many practitioners still prescribe progressive spectacles designed for presbyopes for young myopes despite evidence that these lenses are much less effective than alternative treatments.[14]

As optometrists, it is our duty of care to do the best by our patient. It is imperative that we adopt the mindset of trying to preserve as much vision for each patient as possible. Whilst this child in our chair may have zero pathology, an abnormally elongated eye will be at significantly greater risk of pathology, so to 'save' sight we need to prevent as much elongation of the globe as possible. To do this, we need to begin early, and choose effective treatments from the outset. It is also necessary to balance this with what the child and their guardian wants for them. Fortunately, there are certain contact lens, spectacle and therapeutic options available, and the 'right' option is the one that works best for the specific child.

In an ideal world, patients will have full trust in their optometrist and there will be no difficulty persuading some parents or guardians of the need for myopia management. Parents are rightly cautious when contemplating a situation that is unfamiliar. Effective myopia management often involves the optometrist explaining to the parent and child for the first time why myopia is not a benign condition and then employing treatments to significantly slow its progression to minimise the lifetime risks of uncorrectable visual impairment. To do this requires education, reassurance and often the justification of a higher current cost than single vision spectacles to result in a lower long term financial and personal cost. Over time, as public awareness of myopia and its management increases, these conversations should become easier. For now, they can be difficult and time-consuming but nonetheless essential and arguably, very rewarding – not just financially, but also professionally.

Optometry in Australia has for decades performed a vital role in preserving the vision of the people. Because myopia is a serious threat to retinal health and vision, effectively and urgently managing our myopic children is a fundamental optometric responsibility that must be embraced by all practitioners. To practice evidence-based myopia management is to provide our young patients with their best chance of good vision for life and is a cornerstone of contemporary optometry. •

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BOptom, PhD

LOOK Scholarship:

Advantages of school-based eye care programs over traditional screening models

Globally, uncorrected refractive error is the leading cause of vision impairment in children, with the World Health Organization estimating that 13 million children worldwide are affected.[1] Studies from developed countries such as France and Australia report high rates of uncorrected vision conditions among school-aged children (20% and 35% respectively), highlighting that the issue is not exclusive to developing countries.[2, 3] Early correction of vision conditions in children is critical to achieve optimal visual outcomes, as well as to minimise any negative effects on development and academic performance. School screenings play a key role in helping to identify children with vision conditions, however, they do not provide treatment and require follow-up with local eye care providers. Unfortunately for many children (up to 70 - 80%) further eye care following a school screening is either not available or not accessed, and they fail to receive appropriate spectacle correction.[4, 5] School-based eye care programs that provide comprehensive eye care services onsite for those who fail a vision screening, including the capacity to dispense subsidised spectacles and initiate referral pathways as necessary, are a feasible solution to address the high rates of uncorrected vision conditions in schoolchildren.

Follow-up rates with an eye care provider are a critical component of a vision screening program.[6] However, in traditional screening models they tend to be very low (e.g. only 35% of children referred from a North Carolina vision screening attended an eye exam) or delayed (mean time between first failed vision screening and first visit to an eye care provider in the USA was 1.8 years for children aged 5 – 13 years), resulting in a need to investigate alternative eye care models.[6-8] Reasons for not attending follow-up eye care are multi-faceted, and include financial barriers (e.g. inadequate insurance coverage or parental concerns around cost), logistical barriers (difficulty scheduling follow-up appointment) and perceptual barriers (e.g. no interest in seeking further care).[4]

A different approach that addresses some of these barriers is through school-based eye care, which includes both vision screening and comprehensive eye examinations, with spectacle dispensing and referral as appropriate. In many school districts in the USA (in particular, areas of higher socio-economic disadvantage), school-based eye care programs that provide eye examinations immediately following a failed screening and dispense spectacles have been introduced.[8] A recent review evaluated ten USA pre-school and school-based eye care programs.[8] Differences existed across the programs in terms of consent process, screening and eye care personnel, screening and eye examination tests, and testing location. Despite these differences, in two of the larger programs a similar proportion of children needed spectacles. In the Wills Eye Vision Screening Program for Children (Philadelphia), 12% (1321/10726) of children screened had refractive error and required spectacles, and in the Vision First program (Cleveland) spectacles were dispensed to 8.4% (5355/63841) of children.[9]

The success of these USA programs in responding to the unmet visual needs of children from disadvantaged backgrounds through provision of free eye care and spectacles raises the question of whether school-based eye care models might have the same impact in Australia. Optometry Australia's LOOK scholarship facilitated the opportunity to gain a more comprehensive understanding of school-based eye care. Consultation was undertaken in March and April 2021 with three experts in school-based eye care programs from the USA and the UK; two were paediatric ophthalmologists, and the third an optometrist and researcher. A series of recommendations have been developed based on the literature and consultation undertaken:

1. Establish need: Identify regions and schools where there are known unmet needs in relation to children's eye care (e.g. low socioeconomic areas, regional/remote communities).
2. Develop a simple consent process.
3. Liaise with local health services and school health nurses providing existing screenings to determine whether collaboration between screening service providers and school-based eye care service providers could improve service provision and referral pathways.
4. Establish clear program goals, e.g. provision of spectacles for correctable vision loss:
   - → Establish test battery for vision screening and a minimum test battery for optometrists based on clinical guidelines; provide clear referral criteria from vision screening to eye examination
   - → Use evidence-based prescribing guidelines for spectacles (e.g. Leat, 2011) and ensure the ability to dispense subsidised spectacles onsite[10]
   - → Determine clear referral criteria and pathways to community optometry or ophthalmology for ongoing care where required
   - → Develop review periods for the program (e.g. yearly) and set up opportunities for local personnel to connect with the eye health team between visits
5. Ensure sustainability of the program through an appropriate funding model that considers both initial and ongoing costs of the program (including vision screening personnel and optometrists, spectacles, screening and eye testing equipment, consumables and educational/eye health promotional resources for parents and teachers).

In summary, school-based eye care programs present an opportunity to reduce the impact of uncorrected vision conditions experienced by many Australian schoolchildren through provision of eye examinations and dispensing of spectacles at schools. •

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LOOK Scholarship

Looking abroad and looking ahead at lasers and surgery in optometry

Optometrists in an increasing number of US states have a scope of practice that extends far beyond ours in Australia; their advancements for the profession have been nothing short of trailblazing. What was once a creative sidestep in interpretation of legislation later became written law, common practice, admired progression, and the beginning of a new era for optometry.

I was honoured and inspired to receive the LOOK Scholarship from Optometry Australia. What started as an examination of Oklahoma's optometry landscape soon became much more, particularly research into laser utilisation that spanned multiple countries. I had the privilege of learning from renowned overseas colleagues who have been innovators in these fields, and virtually attended an engaging and complex course on advanced procedures hosted in Tahlequah, Oklahoma.

This research focussed on optometrists performing Selective Laser Trabeculoplasty, Nd:YAG Capsulotomy, Laser Peripheral Iridotomy, and minor surgical procedures, particularly the removal of benign lid lesions with periocular local anaesthetics. Currently, around 20% of Oklahoman optometrists routinely perform advanced procedures. Many of these occur in private practice settings, university clinics, and community outreach programs. There have now been almost 30 years of successful, commonplace use of lasers and minor surgical procedures by optometrists without any reported adverse outcomes or increases in litigation.[2] This has been interspersed with challenges from the medical profession and staunch opposition from ophthalmology.[3] However, collaboration between the professions is becoming increasingly evident, and change is sweeping throughout the nation. Optometrists in eight US States are now legislated to perform advanced procedures.[4]

Sweeping changes

This year the ground swell of change within optometry has been particularly formidable. Since the drafting of this report in early 2020, three states in the USA have obtained laser and surgical scope of practice expansions. This momentum was gained after years of advocacy from within the profession, supported by a recent US government assessment of inefficiencies in the healthcare system. This assessment referred to the ability of "optometrists to effectively provide some of the same healthcare services as physicians".[5]

It is an imperative that further clinical studies directly compare the safety and efficacy of advanced procedures between optometry and ophthalmology practitioners, as it is obvious that the existing data is lacking and at times politically motivated.[6] A literature review uncovered convincing evidence emerging in the UK, where hospital-based training of specialised optometry clinicians is resulting in excellent safety and efficacy outcomes from laser procedures.[7, 8] Education and training are key; optometrists in the US undergo intensive theoretical and practical training in order to become accredited in advanced procedures This education is now being incorporated into primary optometry degree programs. In this way, scope expansion in the US has mirrored some of the change that has occurred in the Australian landscape since the introduction of therapeutic prescribing rights.

Australia has several steps to make prior to leaping into lasers. In most US states, oral therapeutic prescribing often preceded laser rights - a steppingstone which makes fundamental clinical sense and is highlighted as a key objective in Optometry 2040.[9] The stark public health need of an ageing population requiring overwhelming resources and skill for anti- VEGF therapies is currently directing the focus of scope expansion in Australia to justifiably assist in this burden.[10] From any perspective, the way must be forward.

The most imperative outcome of this research has been that Australian optometrists must continue to progress and adapt in a rapidly evolving international professional climate. As we inevitably expand scope, each practitioner should ask themselves, "even if I myself do not wish to perform these procedures, could willing and well-trained colleagues of mine do so with skill and utmost patient care?" •

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An annual review of optometrists' prescribing patterns of therapeutic medications in Australia

The number of optometrists working in Australia with therapeutic medication endorsement continues to rise as there is an increased number of optometrists qualifying to practice.[1]

This study is a snapshot of what medications are being prescribed by optometrists in Australia, and in what quantities. This is a comparison of statistics presented by the Pharmaceutical Benefit Scheme of Australia for the year July 2019 until June 2020 and those presented in *Pharma* September 2020 in the article titled 'Evaluation of Optometrists Prescribing Patterns of therapeutic medications in Australia'.

The Australian Government through the Department of Human Services presents items listed on the Pharmaceutical Benefits Scheme for statistical analysis. Item codes corresponding to those drugs prescribed by optometrists can be entered into the Medicare Australia website.[2] Statistics are generated for both the Pharmaceutical Benefit Scheme (PBS) and Repatriation Pharmaceutical Benefit Scheme (RPBS, i.e. items supplied to war veterans). The statistics can be generated to view as a volume of items of services or as a value of benefit in a dollar amount that has been processed by Medicare Australia. The statistics presented by Medicare Australia refer only to paid services that are processed from claims presented by approved pharmacies. I have excluded chloramphenicol from the statistics as this medication can be prescribed by nurse practitioners, mid-wives and medical practitioners with the same item code as optometrists. It is therefore impossible to distinguish the amount of chloramphenicol that is solely prescribed by optometrists. Dry eye therapies are also omitted as prescriptions as these therapies are usually written for those on income assistance and therefore does not truly reflect all of the dry eye therapy market.

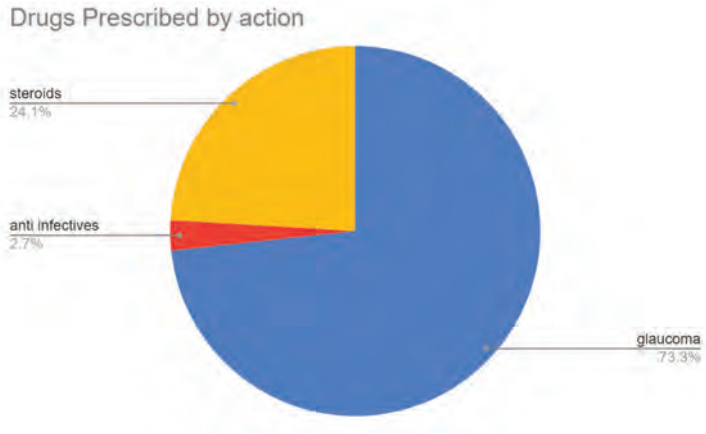

Figure 1.
A graphical representation of drugs prescribed by Australian optometrists by action for the period July 2019 to June 2020 (excluding chloramphenicol and dry eye therapies)

Drug	Number of Prescriptions dispensed July 2019 to June 2020	Number of Prescriptions dispensed July 2018 to June 2019
Latanoprost	33412	30223
Fluorometholone	13428	9678
Latanoprost + Timolol	11395	9762
Bimatoprost + Timolol	7587	6708
Prednisolone Acetate + Phenylephrine	5873	5476
Travoprost + Timolol	5311	4807
Timolol	5212	4485
Fluorometholone Acetate	5194	7028
Travoprost	3775	3371
Brinzolamide + Brimonidine	3669	3101
Brimonidine	3339	4506
Dexamethasone	3198	3222
Tobramycin	2502	2645
Brinzolamide + Timolol	2268	1795
Dorzolamide + Timolol	2221	2330
Brimonidine + Timolol	2073	2008
Hydrocortisone Acetate	1996	1874
Tafluprost	1673	1255
Dorzolamide	967	1016
Pilocarpine	517	452
Betaxolol	471	529
Ciprofloxacin	337	270
Ofloxacin	236	235
Aciclovir	102	1143
Framycetin	78	48
Gentamicin	27	29
Total Prescriptions dispensed	**123439**	**114662**

Table 1.
Drug and the amount prescribed by Australian optometrists for the period July 2019 through June 2020 and the period July 2018 through June 2019 (excluding chloramphenicol and dry eye therapies)

Table 1 is a list of drugs prescribed by optometrists and dispensed by pharmacy in decreasing order of amount dispensed. Latanoprost is the most prescribed drug followed by fluorometholone, with latanoprost and timolol combination ranked third.

Discussion

Is the increase in the total number of prescriptions dispensed a direct response to the increase in the number of optometrists that are in therapeutic practice? According to the Optometry Board of Australia there were 6080 practising registered optometrists as at 31 March 2021. The number of therapeutically endorsed optometrists is 4135, or 68%.[1] On average, each therapeutically endorsed optometrist writes 30 PBS prescriptions per year, not including those written for dry eye treatments or for chloramphenicol. This number of prescriptions is slightly lower than last year's amount of 31 PBS prescriptions written per therapeutically endorsed optometrist, despite there being a 5% increase in those practitioners that are able to prescribe. This suggests there is great scope for optometrists to unleash their potential as the primary eye carer and not just prescribers of refractive corrections. The complicating factor over the last year is the shutdown of optometry practices due to COVID-19. To try and understand if this is a mitigating factor, I have included a month-by-month analysis of our most prescribed drug latanoprost. I have included the previous year's prescription numbers by way of comparison in **Figure 2** and **Figure 3**.

March 2020 was the beginning of lockdowns in Australia coinciding with the Ruby Princess outbreak in New South Wales.[3] May 2020 is the month where New South Wales, Victoria and Queensland have significantly less prescriptions than the previous May. A further analysis of data going forward could further demonstrate a trend in association with lockdowns. Currently, it appears COVID-19 has had only a minor impact on the number of drugs prescribed by optometrists over the last twelve-month period. →

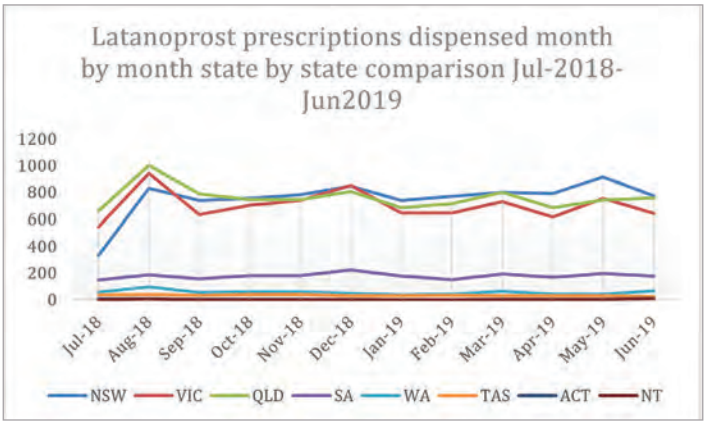

Figure 2.
Latanoprost prescriptions dispensed month by month state by state July 2018 to Jun 2019

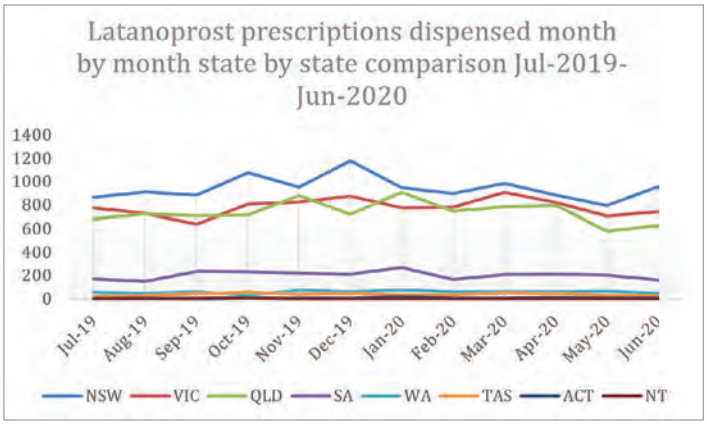

Figure 3.
Latanoprost prescriptions dispensed month by month state by state July 2019 to Jun 2020

Fluorometholone has moved to the second most prescribed drug compared with third last year. This is possibly due to the unavailability of Prednisolone acetate + Phenylephrine (Prednefrin forte)[4] forcing the optometrist to select another steroid to fill the void, although the numbers for Prednefrin forte are very similar between this review and the last. There has been quite a decrease in the amount of Fluorometholone Acetate prescribed, so on the whole the amount of all steroids prescribed is about the same as the previous review.

There is a dramatic reduction in the amount of Aciclovir prescribed, corresponding with the ongoing supply issues.[5]

Glaucoma preparations, especially latanoprost, make up the greatest number of prescriptions written by action. Optometrists are increasingly involved in glaucoma collaborative co-management schemes emerging in association with state public health. In Queensland, Metro North Health has just launched the Glaucoma Collaborative Care Clinic (GCCC) which will follow the RANZCO Guidelines for the Collaborative Care of Glaucoma[6] and the RANZCO Principles of Collaborative Care of Glaucoma.[7] The clinic is set to be a partnership between the community-based optometrist, the GP and Royal Brisbane and Women's Hospital with the goal of managing stable glaucoma in the community, with a flow-on effect of reducing the burden and emphasis of care on the public health/hospital system. The Royal Victorian Eye and Ear Hospital has a GCCC[8] which differs in the fact there is an accreditation process. This assures all optometrists who wish to be involved in the scheme can be identified by their accreditation, and that there will be a clear understanding of the processes of collaborative care. NSW has the Centre for Eye Health (CFEH) Glaucoma Management Clinic (GMC) where the goal is early detection of disease and to reduce the demand on ophthalmologists in the public health system by creating an alternative pathway for those with early, moderate or stable glaucoma. This clinic operates as a satellite clinic of Prince of Wales Hospital with a consultant ophthalmologist on site at CFEH once a fortnight as well as having the ability to review patient records remotely. Subsequent glaucoma appointments are seen either back in the GMC, by CFEH optometrists or in collaboration with the referring optometrist depending on factors such as the disease stage, stability etc. All other aspects of the patient's eye care remains with the referring practitioner.[9 10] There seems to be no scheme in South Australia or Tasmania at present. Western Australia has no scheme, yet the Lions Eye Institute has advocated for community eye care to be provided by optometrists in collaboration with local hospitals and ophthalmologists in a telehealth scenario.[11] The Northern Territory appears to rely on outreach clinics provided by non-government organisations such as the Brien Holden Foundation[12] and The Fred Hollows Foundation.[13]

Conclusion

State public health systems are reaching out to community-based optometry practices to help share the burden of caring for those with early or stable glaucoma. Optometry is perfectly placed to assist in this sensible sharing of care. Optometry Australia's Glaucoma Care into Practice clinical note offers ideas of how optometrists can seamlessly incorporate glaucoma shared care into their practice. •

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A closer look at ciclosporin and dry eye disease

Dry eye (keratoconjunctivitis sicca) is a multifactorial ocular surface disease, accompanied by ocular symptoms and characterised by a loss of tear film homeostasis. Ocular signs include tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities. These all play aetiological roles in the pathophysiology of dry eye disease. The definition of dry eye disease from Dry Eye Workshop (DEWS) II focuses on tear film hyperosmolarity as a core mechanism, precipitating a compounding inflammatory cascade that damages the ocular surface.[1,2]

Consequently, dry eye disease (DED), beyond a condition that is caused by insufficient tear production, is a complex ocular surface disorder in which the tear film is unstable and no longer provides sufficient nourishment or protection to the ocular surface which becomes inflamed and damaged.[3]

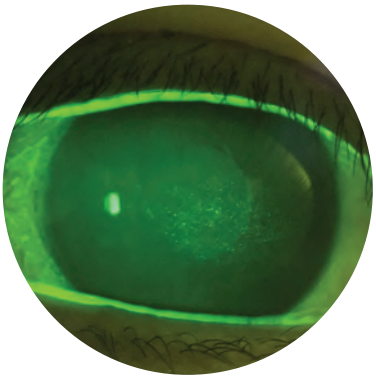


Figure 1.
Dry eye disease with confluent corneal fluorescein staining.

Inflammation has an entwined role in the pathophysiology of DED, promoting symptoms of irritation and ocular surface damage. Anti-inflammatory agents are thus appropriate treatments in the management of DED. The purpose of these treatments is to inhibit the expression of inflammatory mediators in order to re-establish the appropriate production of a healthy tear film and to reduce signs and symptoms of the disease.[4]

There is a higher prevalence of DED in females than males, an associated increased risk with age, hormonal imbalance (including menopause and reduced androgen levels), ocular surface disorders, refractive surgery, dietary imbalance in omega-3 and omega-6 intake, and auto-immune diseases.[5]

Mechanism of treatment

Prescribing anti-inflammatory agents, such as ciclosporin, that target specific inflammatory pathways to break the inflammatory cycle, is a sound therapeutic strategy for managing DED.[6]

Ciclosporin (international non-proprietary name and UK name), cyclosporine (United States), or as its major form, cyclosporine A (CsA), was isolated from a fungus called *Tolypocladium Inflatum Gams*. It was first prescribed as an antifungal agent,[7] although its potent immunosuppressive properties were quickly recognised.

What we understand of ciclosporin's mechanism of action is that it inhibits calcineurin, which inhibits lymphocyte T activation.[8] This creates a multi-step immune response that results in preventing the transcription and release of pro-inflammatory cytokines, dampening the message from these pro-inflammatory cellular messenger proteins.[9] Additionally, ciclosporin inhibits cellular apoptosis of the conjunctival epithelial cells, potentially increasing tear film production, hence its relevance to the management of DED.[10]

Dosage guide to ciclosporin

At the time of publishing, two commercially available formulations of topical ciclosporin for DED have been approved by the Therapeutic Goods Administration and can be prescribed by eyecare professionals in Australia.

- → Ikervis ciclosporin (0.1mg/mL 0.1%) prescribed as one drop instilled once a day. Ikervis is listed on the Pharmaceutical Benefits Scheme (PBS), where an authority is required.
- → Cequa ciclosporin (0.09mg/mL 0.09%) prescribed one drop instilled twice a day, (ideally twelve hours apart). Cequa is not listed on the PBS.

Differences between ciclosporin types commercially available in Australia

Ciclosporin is a cyclic polypeptide, a chain of amino acids linked in a circular sequence of bonds. Ciclosporin has a large molecular weight, low aqueous solubility and possesses hydrophobic characteristics, so its drug delivery vehicle must enhance and optimise its ocular bioavailability.[11]

Ikervis' ciclosporin product achieves this by utilising a cationic (positively charged) oil-in-water nanoemulsion delivery. The corneal epithelial cells are negatively charged, and Ikervis' oil-in-water emulsion, being positively charged, prolongs the residence time on the ocular surface and facilitates corneal and conjunctival penetration.[11]

The cationic emulsion itself in Ikervis has been shown to contribute to tear film stability and provide beneficial

moisturising and lubricating effects,[12,13] and in combination with ciclosporin, suppresses the secretion and expression of pro-inflammatory cytokines.[9,14] In addition to contributing to tear film stability, the nanodroplets contain cetalkonium chloride (CKC) which acts as its cationic surfactant, further improving the residence time on the ocular surface.[15] Ikervis is indicated for the treatment of severe keratitis in adult patients with DED which has not improved despite treatment with tear substitutes.

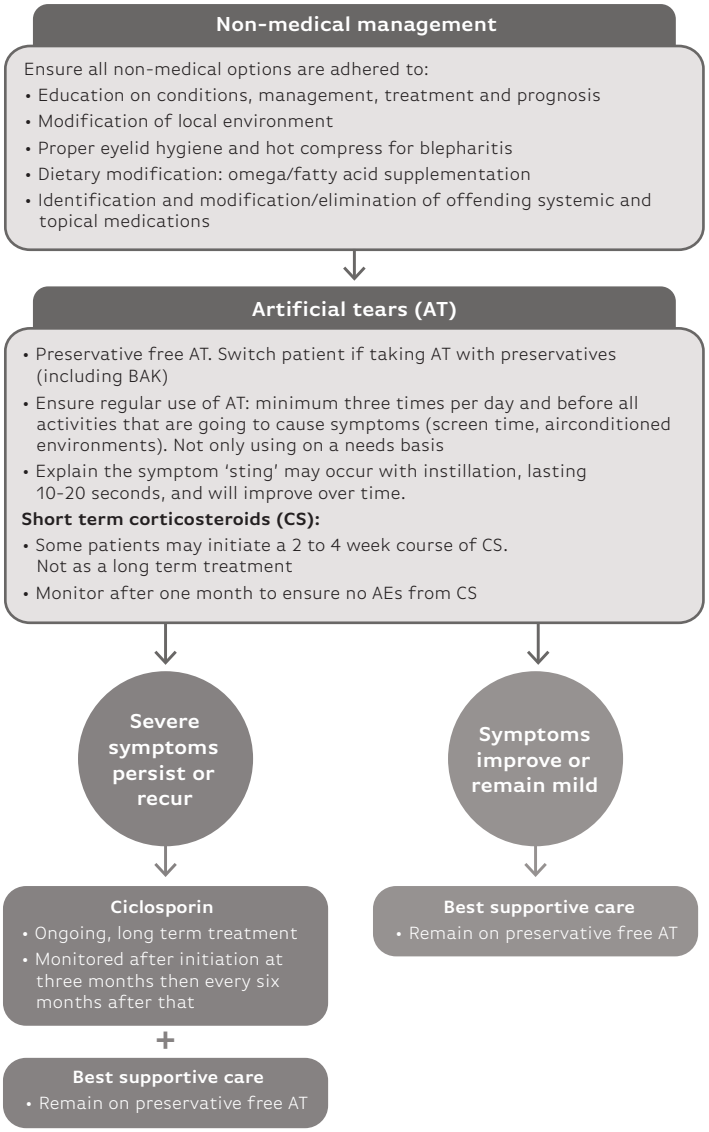
Cequa's ciclosporin incorporates nanomicellar technology to enhance its delivery of ciclosporin and increased penetration to ocular tissues. Cequa's nanomicelles are composed of polymers that encapsulate ciclosporin molecules. This creates a hydrophilic outer layer compatible with the aqueous environment of the tear film to facilitate transport through the tear film onto the ocular surface. In addition, the small nanomicellar structure helps ciclosporin molecules gain entrance into corneal and conjunctival cells. Once inside the tear film's aqueous layer the nanomicelles break up to release ciclosporin into the ocular tissues.[16] Cequa is indicated to increase tear production in patients with moderate to severe keratoconjunctivitis sicca (dry eye) where prior use of artificial tears has not been sufficient.

Ciclosporin prescribing guide

Figure 2 represents a proposed treatment algorithm describing when to consider ciclosporin amongst our existing prescribing options for dry eye.

Ciclosporin is indicated for patients that do not improve despite the use of ocular lubricants. Once a patient does not improve with artificial tear film supplements the current prescribing algorithm considers pharmacological agents, such as topical corticosteroids, to intentionally inhibit the expression of inflammatory mediators. This restores the secretion of a healthy tear film and reduces signs and symptoms of the disease. [17] Very early in a normal mental flowchart many eyecare practitioners prescribe a short pulse of a two-to-four-week course of topical corticosteroids to attempt to reduce the inflammatory reaction and obtain symptomatic improvement.

Normally it would be appropriate to taper topical corticosteroid therapy after a short period of use when there is improvement of ocular symptoms. Even though for DED it is typically the milder topical corticosteroids prescribed, it is established that long-term corticosteroid use has a causative link with glaucoma, cataracts, and other steroid-related adverse effects. →



AEs = adverse events; AT = artificial tears; CS = corticosteroid

Figure 2.
A proposed treatment algorithm describing when to consider ciclosporin amongst our existing prescribing options for dry eye.[18]

Should symptoms persist beyond the initial course of corticosteroids, or to reduce patient reliance on long term topical corticosteroid therapy, it is appropriate to consider prescribing topical ciclosporin therapy. Ciclosporin could also be prescribed to continue to produce sustained improvement in a patient's signs and symptoms of DED without the potential adverse effects of topical corticosteroid therapy.

It is also worthwhile considering ciclosporin as an option for prescribing regimens, with potential improvements in reduced corneal fluorescein staining, ocular symptoms recorded in dry eye surveys such as patient scores Ocular Surface Disease Index (OSDI), Tear Break Up Time (TBUT), Schirmer Tear Test and other clinical signs of DED.

A proposed treatment algorithm

Ciclosporin should not be used in patients who have an allergy to any medication containing the active substance ciclosporin or any other ingredients in the prescribed ciclosporin medium. Ciclosporin is also contraindicated in patients with active or suspected ocular or peri-ocular infection, or patients with ocular or peri-ocular malignancies or premalignant conditions.

Due to its actions as an immunosuppressive agent, it should be prescribed with caution in patients who have a potential for eye injury, those with active infections, and for those patients who wear contact lenses.

Topical ciclosporin has shown no difference in safety and effectiveness in the elderly. Safety and efficacy has not been established in patients below the age of 18.[9,19]

Summary

When patients show insufficient improvement for their dry eye symptoms despite existing interventions to minimise symptoms, including the management of an appropriate topical corticosteroid, ciclosporin agents are worth considering. Additionally, with access now available for commercially produced ciclosporin agents such as Ikervis and Cequa, ciclosporin should be considered in our therapeutic armament for patients in place of corticosteroids for patients that experience persistent and ongoing symptoms of DED.

Prescribing topical ciclosporin should be considered as an appropriate long-term therapy to potentially break the vicious, ever-compounding inflammatory cascade of DED, as topical ciclosporin has no association with any significant systemic immunosuppressive adverse effects, nor does it have the adverse ocular effects that are associated with long term topical corticosteroid use.

About the author

Margaret Lam graduated from the School of Optometry and Vision Sciences at the University of New South Wales in 2001. She started her independent optometry practices, theeyecarecompany by George and Matilda, across Sydney, Australia, in 2005. Margaret sees patients for primary eye care as well as specialty contact lenses.Margaret has extensive expertise in specialty contact lens fitting, including orthokeratology, keratoconus and all types of corneal ectasia, and has been a past recipient of the Neville Fulthorpe Award for Clinical Excellence. Margaret enjoys working in an independent optometry practice, is also an Adjunct Senior Lecturer for the School of Optometry and Vision Science at the University of New South Wales, and mentors and teaches Undergraduate and Postgraduate Masters Students in Advanced Contact Lenses. Margaret has also worked in several Advisory roles with leading contact lens companies, writes for the Optometry journal mivision and has published articles in Australian Optometry, and Clinical and Experimental Optometry.Margaret's practices joined George and Matilda Eyecare, a community of independent practices across Australia, and has also been working as their Head of Optometry Services She also currently serves as the National President of the Cornea and Contact Lens Society of Australia, on the National Board of Directors for Optometry Australia, and on the Board of Directors for Optometry NSW/ACT Division.

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PBS list of medicines prescribed by optometrists

Revised October 2021

Note: Active Ingredient must be included in your PBS prescriptions (Mandatory from 1 Feb 2021)

From 1 February 2021, Department of Health regulations require the inclusion of active ingredients on all Pharmaceutical Benefits Scheme (PBS) and Repatriation PBS (RPBS) prescriptions, except for:

- Handwritten prescriptions;
- Paper based medication charts in the residential aged care sector;
- Medicinal items with four or more active ingredients.

Prescribers may continue to include a product/brand name on prescriptions. Where a brand name is included on prescriptions, the active ingredient must appear first. Consumers' ability to identify a medicine's active ingredient is critical for medicines safety.

Anti-glaucoma preparations

	Active ingredients	Product	Maximum quantity	Repeats
	Betaxolol 0.5% eye drops, 5 mL	Betoptic, Betoquin	1	5
	Bimatoprost 0.03% eye drops, 3 mL	Lumigan, Bimatoprost Sandoz, Bimtop, APO-Bimatoprost, Bimprozt	1	5
*	Bimatoprost 0.03% eye drops, 30 x 0.4 mL unit doses	Lumigan PF	1	5
	Bimatoprost 0.03% + timolol 0.5% eye drops, 3 mL	Ganfort 0.3/5	1	5
*	Bimatoprost 0.03% + timolol 0.5% eye drops, 30 x 0.4 mL unit doses	Ganfort PF 0.3/5	1	5
	Brimonidine tartrate 0.15% eye drops, 5 mL	Alphagan P 1.5	1	5
	Brimonidine tartrate 0.2% eye drops, 5 mL	Alphagan, Enidin	1	5
	Brimonidine tartrate 0.2% + timolol 0.5% eye drops, 5 mL	Combigan	1	5
	Brinzolamide 1% eye drops, 5 mL	Azopt, BrinzoQuin	1	5
	Brinzolamide 1% + brimonidine tartrate 0.2% eye drops, 5 mL	Simbrinza	1	5
	Brinzolamide 1% + timolol 0.5% eye drops, 5 mL	Azarga	1	5
	Dorzolamide 2% eye drops, 5 mL	Trusopt, Trusamide, APO-Dorzolamide	1	5
	Dorzolamide 2% + timolol 0.5% eye drops, 5 mL	Cosopt, Cosdor, Dorzolamide/Timolol 20/5 (APO)	1	5
	Latanoprost 0.005% eye drops, 2.5 mL	Latanoprost (APO, Actavis, Sandoz), Xalaprost, Xalatan	1	5
	Latanoprost 0.005% + timolol 0.5% eye drops, 2.5 mL	Xalacom, Xalamol 50/5, Latanaprost/Timolol (APO, Sandoz)	1	5
	Pilocarpine hydrochloride 1% eye drops, 15 mL	Isopto Carpine	1	5
	Pilocarpine hydrochloride 2% eye drops, 15 mL	Isopto Carpine	1	5
	Pilocarpine hydrochloride 4% eye drops, 15 mL	Isopto Carpine	1	5
*	Tafluprost 0.0015% eye drops, 30 x 0.3 mL unit doses	Saflutan	1	5
	Timolol 0.5% eye drops, 5 mL	Timoptol	1	5
	Timolol 0.5% eye drops, 2.5 mL	Timoptol XE	1	5
	Travoprost 0.004% eye drops, 2.5 mL	Travatan	1	5
	Travoprost 0.004% + timolol 0.5% eye drops, 2.5 mL	DuoTrav	1	5

* = unit doses

Note: To satisfy PBS criteria for combination antiglaucoma agent, patient must have been inadequately controlled with monotherapy

PBS LIST OF MEDICINES PRESCRIBED BY OPTOMETRISTS

Anti-viral eye preparations				
Active ingredients	**Product**	**Restrictions**	**Maximum quantity**	**Repeats**
Aciclovir 3% eye ointment, 4.5 g	ViruPOS, XOROX	Restricted: herpes simplex keratitis	1	0

Antibiotics				
Active ingredients	**Product**	**Restrictions**	**Maximum quantity**	**Repeats**
Chloramphenicol 0.5% eye drops, 10 mL	Chlorsig	Restricted: for treatment of patients identifying as Aboriginal or Torres Strait Islander	1	2
† Ciprofloxacin 0.3% eye drops, 5 mL	CiloQuin, Ciloxan	Authority required: bacterial keratitis	2	0
Framycetin sulfate 0.5% eye/ear drops, 8 mL	Soframycin		1	2
Gentamicin 0.3% eye drops, 5 mL	Genoptic	Restricted: Suspected pseudomonal eye infection	1	2
† Ofloxacin 0.3% eye drops, 5 mL	Ocuflox	Authority required: bacterial keratitis	2	0
Tobramycin 0.3% eye drops, 5 mL	Tobrex	Restricted: Suspected pseudomonal eye infection, perioperative use in ophthalmic surgery	1	2
Tobramycin 0.3% eye ointment, 3.5g	Tobrex		1	0

† = Note: must be in consultation with an ophthalmologist if prescribed under PBS scheme.

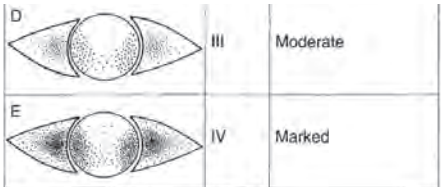
Anti-inflammatory agents				
Active ingredients	**Product**	**Restrictions**	**Maximum quantity**	**Repeats**
Dexamethasone 0.1% eye drops, 5 mL	Maxidex		1	0
Fluorometholone 0.1% eye drops, 5 mL	FML Liquifilm		1	0
Fluorometholone acetate 0.1% eye drops, 5 mL	Flarex		1	0
Hydrocortisone acetate 1% eye ointment, 5 g	Hycor		1	0
Prednisolone acetate 1% + phenylephrine hydrochloride 0.12% eye drops, 10 mL	Prednefrin Forte	Restriction: uveitis	1	0
Prednisolone acetate 1% eye drops, 10mL*	Pred Forte		1	0

* Supply of this product is authorised under Section 19A of the *Therapeutic Goods Act 1989* until 1 February 2022

Tear supplements				
Active ingredients	**Product**	**Restrictions**	**Maximum quantity**	**Repeats**
Carbomer-980 0.2% eye gel, 10 g	Optifresh Eye Gel, PAA, Viscotears	Restricted: severe dry eye including Sjögren's syndrome	1	5
Carmellose sodium 0.5% + glycerol 0.9% eye drops, 15 mL	Optive		1	3
Carmellose sodium 0.5% eye drops, 10 mL	Evolve Carmellose		1	5
Carmellose sodium 1% eye drops	Refresh Liquigel		1	5
Carmellose sodium 0.5% eye drops, 15 m	Refresh Tears Plus		1	5
Hypromellose 0.3% w/v eye drops, 10 mL	Evolve Hypromellose		1	5
Hypromellose 0.3% w/w eye drops, 10 mL	In A Wink, Genteal		1	5
Hypromellose 0.5% eye drops, 15 mL	Methopt		1	5
Hypromellose 0.3% + carbomer-980 0.2% eye gel, 10 g	HPMC PAA, Genteal Gel		1	5
Dextran-70 0.1% + hypromellose 0.3% eye drops, 15 mL	Poly-Tears, Tears Naturale		1	5
Polyethylene glycol-400 0.4% + propylene glycol 0.3% eye drops, 15 mL	Systane		1	5
Polyvinyl alcohol 1.4% eye drops, 15 mL	PVA Tears, Liquifilm Tears		1	5

Unpreserved tear supplements				
Active ingredients	**Product**	**Restrictions**	**Maximum quantity**	**Repeats**
* Carbomer-974P 0.3% eye gel, 30 x 500 mg unit doses	Poly Gel	Restricted: severe dry eye syndrome in patients sensitive to preservatives in multi-dose eye drops. Authority required (STREAMLINED): Optometrists have two authority codes that are streamlined. You do not need to contact PBS to obtain an authority number. Write the pre-approved code on the prescription. **4105** - HyloFresh & HyloForte **6172** - all other unit-dose tear supplements	3	5
* Carbomer-980 0.2% eye drops, 30 x 0.6 mL unit doses	Viscotears Gel PF		3	5
* Carmellose sodium 0.5% eye drops, 30 x 0.4 mL unit doses	Cellufresh, Optifresh Tears		3	5
* Carmellose sodium 1% eye drops, 30 x 0.4 mL unit doses	Celluvisc, Optifresh Plus		3	5
* Dextran-70 0.1% + hypromellose 0.3% eye drops, 28 x 0.4 mL unit doses	Bion Tears		3	5
Perfluorohexyloctane 100% eye drops, 3 mL	NovaTears		1	5
* Polyethylene glycol-400 0.4% + propylene glycol 0.3% eye drops, 28 x 0.8 mL unit doses	Systane		2	5
Hyaluronate sodium 0.1% eye drops, 10 mL	Hylo-Fresh		1	5
Hyaluronate sodium 0.2% eye drops, 10 mL	Hylo-Forte		1	5
Soy lecithin 1% + tocopherol 0.002% + vitamin A palmitate 0.025% eye spray, 100 actuations	Tearsagain		2	5
Liquid paraffin + glycerol + tyloxapol + poloxamer-188 + trometamol hydrochloride + trometamol + cetalkonium chloride eye drops, 10 mL	Cationorm		1	5

* = unit doses

Immunosuppressant therapy				
Active ingredients	**Product**	**Restrictions**	**Maximum quantity**	**Repeats**
* Ciclosporin 0.1% eye drops; 30 × 0.3 mL unit doses	Ikervis	Treatment of chronic severe dry eye disease with keratitis. Clinical criteria - Patient must have: ■ a corneal fluorescein staining (CFS) grade of 4 at treatment initiation, using the modified Oxford scale or equivalent:  ■ an ocular surface disease index (OSDI) score of at least 23 ■ The condition must not be adequately controlled by monotherapy with a preservative free artificial tear substitute The treatment must be in combination with a preservative free artificial substitute. Authority required (phone 1800 888 333 or online authority through HPOS: http://www.servicesaustralia.gov.au/HPOS) More information available at https://www.pbs.gov.au/medicine/item/12663L	1	5

* = unit doses

Topical ocular lubricant ointments				
Active ingredients	**Product**	**Restrictions**	**Maximum quantity**	**Repeats**
Paraffin 1 g/g eye ointment, 3.5 g	Poly Visc		2	5
Paraffin 1 g/g eye ointment, 2 x 3.5 g	Poly Visc, Ircal, Refresh Night Time		1	5
Retinol palmitate 0.0138% + paraffin eye ointment, 5 g	VitA-POS		2	5

Ophthalmic compounding pharmacists

Optometry Australia keeps an updated list of ophthalmic compounding pharmacists on our website www.optometry.org.au. Please keep us updated if you know of a certified ophthalmic compounding pharmacist that is not on our list by emailing national@optometry.org.au.

Scheduled medicines list for optometrists

Effective 18 October 2019

The Optometry Board of Australia (OBA) approved list of topical schedule 2, 3 and 4 medicines that optometrists with a scheduled medicines endorsement are qualified to administer, obtain, possess, prescribe, supply or use for the purposes of the practice of optometry. This list can also be found on OBA's website.

Medicines below that are not listed on the PBS can still be prescribed, but must be written as a private prescription. Private prescriptions do not have restriction on maximum quantity of repeats, e.g. Patanol (olopatadine).

Schedule 2 pharmacy medicine		
Anti-infectives	**Decongestants/anti-allergics**	**Miotics, mydriatics and cycloplegics**
Dibromopropamidine	Antazoline	Phenylephrine ≤ 2.5%
Propamidine	Azelastine	
	Ketotifen	
	Levocabastine	
	Lodoxamide	
	Naphazoline	
	Pheniramine	
	Sodium Cromoglycate	

Schedule 3 pharmacist-only medicine
Anti-infectives
Chloramphenicol

Schedule 4 prescription-only medicine					
Anti-infectives	**Anti-inflammatories**	**Decongestants/ anti-allergics**	**Anti-glaucomas**	**Miotics, mydriatics and cycloplegics**	**Local anaesthetics**
Aciclovir	Cyclosporin	Olopatadine	Apraclonidine	Atropine	Amethocaine
Azithromycin	Dexamethasone		Betaxolol	Cyclopentolate	Lignocaine
Bacitracin	Diclofenac		Bimatoprost	Homatropine	Oxybuprocaine
Cephazolin	Fluorometholone		Brimonidine	Pilocarpine	Proxymetacaine
Ciprofloxacin	Flurbiprofen		Brinzolamide	Phenylephrine	
Framycetin	Hydrocortisone		Dorzolamide	Tropicamide	
Ganciclovir	Ketorolac		Latanoprost		
Gentamicin	Loteprednol		Pilocarpine		
Gramicidin	Prednisolone		Tafluprost		
Neomycin			Timolol		
Ofloxacin			Travoprost		
Polymyxin					
Tetracycline					
Tobramycin					

Note: Do you prescribe low dose Atropine for myopia control?

If you are prescribing low-concentration Atropine, please clearly label the prescription with **'To Be Compounded'** to avoid confusion in the dispensing process.
There have been incidents where prescriptions for low-concentration Atropine have been incorrectly processed by pharmacists as Atropt (atropine sulphate 1%).
Low-concentration Atropine eye drops must be prepared by a compounding pharmacy that is equipped to compound eye drops.

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Successful treatment of ocular complications of primary immune deficiency syndrome with amniotic membrane

Dry Eye Disease (DED) is one of the most frequently presenting diseases in eye-care. It causes morbidity ranging from minor irritation and cosmetic changes to extreme pain, ocular deformation, and vision loss. These changes can also result in loss of confidence, functionality, and mental health issues. Worse affected individuals tend to withdraw from work and community.[1]

DED is multifactorial and affects tear function, eyelids, the ocular surface, and neuro-sensation. It is characterised by a loss of tear film homeostasis, inflammation and altered ocular surface sensation. This is due to a concept called the 'cycle of inflammation'; a series of co-dependent events which lead back to the starting point, with amplification of the disease itself.[2] The cycle of inflammation involves the immune, lymphatic and vascular systems, as well as neurosensory pathway signalling.

Despite decades of research and development, there is not a single tear replacement or treatment that can simultaneously attenuate all these interactions on multiple fronts. Interventions such as tear replacements tend to focus on a single feature of the cycle and can provide short-term relief. Treatments such as pulsed light and thermal pulsation act directly on aberrant blood vessels and meibomian glands, directing therapy closer to the root cause of the disease.

Two biological substances first used in medical treatments more than 100 years ago circuit-break the cycle at multiple points. The first, autologous serum, is a blood product. It contains proteins, growth factors, vitamins, antioxidants, glucose and electrolytes required for structural repair and tear replacement. The number of articles published annually on autologous serum has substantially increased. Although, a recent Cochrane database review failed to identify long-term benefits from autologous serum,[3] anecdotal evidence abounds and fuels the need for larger controlled studies. →

The second biological, amniotic membrane (AM), was first used for skin grafting in 1909-1910.[4] However, it would be 1940 before the first documented AMs in eye care would appear. De Roth investigated AM's for treating conjunctival disease.[5] Today, AMs are obtained from healthy female donors during caesarean section births. AM tissue is repurposed into either eye drops or tissue for placement on the ocular surface. Whilst not always effective, AMs have been used very successfully in many different types of ocular disease. They have seven proposed therapeutic benefits:

1. Reduction of inflammation: An example of AM anti-inflammatory activity involves interleukin. The interleukin-1 gene family mediates ocular surface inflammation. It has three main components Interleukin 1α (IL-1α), Interleukin 1ß (IL-1ß) and Interleukin 1 receptor agonist (IL-1RA). IL-1α and ß are pro-inflammatory. Whereas IL-1RA is anti-inflammatory. IL-1α and ß are elevated in patients with DED. It has been found that amniotic membranes reduce the expression of IL-1α and ß.[6]
2. Analgesia: An obvious analgesic feature of AMs is mechanical. The physical presence of the AM limits the effects of blinking and eyelid conditions such as trichiasis, entropion and ectropion. Furthermore, as AMs reduce tissue inflammation, it follows that it should also reduce associated pain. Additional direct effects on corneal peripheral nerves are addressed below.
3. Angiogenesis: AMs have opposing effects on blood vessel growth. Amniotic epithelial cells inhibit angiogenesis. They express anti-angiogenic substances including thrombospondin-1, endostatin and heparin sulphate proteoglycan. In addition, AMs exhibit TIMP 1, 2, 3 and 4 which have strong anti-angiogenic effects by limiting expression of metalloproteases. Conversely, mesenchymal AM tissue exclusive of epithelial cells promotes angiogenesis.[7] These opposing features make AM well suited to different therapeutic objectives.
4. Re-epithelialisation: AMs can be used to facilitate ocular surface epithelial growth. Host and AM epithelia bear close resemblance to each other. This makes host re-epithelialisation particularly effective when the AM basement membrane (epithelium side) directly faces the host epithelium. Conversely, AM stroma down regulates the inflammatory response and may be better suited to acute inflammation and non-healing ulcers.[8]
5. Biocompatibility: Traditional approaches to allografting and xenografting require immunosuppression to minimise the risk of rejection. However, these medications present with varying side effects and degrees of toxicity. Conversely, an early observation of grafted AMs was the non-medicated and effective uptake of donor tissue without rejection. This is attributed to the immunomodulating presence of growth factors, anti-inflammatory cytokines and the expression of Human Leukocyte Antigens which mediate tissue biocompatibility.[9]
6. Antimicrobial effects: In the presence of microbial keratitis, treatment with AM compared with standard antimicrobial treatment, has been shown to reduce healing times and improve visual outcomes in meta-analysis. Two features of AM contribute to its antimicrobial activity. AMs contain antimicrobial mediators such as transferrin, lysozyme, and immunoglobulin. They may also help retain conventional topical antibiotics on the ocular surface for sustained release during therapy.[10]
7. Neuro-protection: AMs express several neuroprotectants and participate in peripheral nerve growth and repair. In a rat animal model involving lesioned sciatic nerves wrapped in amniotic membranes, multiple studies show that treatment appears to promote axonal growth and nerve numbers, new fibre growth and myelination.[11] In a single human DED study, cryopreserved AM was also associated with significant improvement in central corneal nerve density and corneal sensitivity. Treatment of neurotrophic keratitis (NK) with AM also appears promising. However, in-vivo studies are few, and the extent to which improved clinical outcomes are due to corneal nerve regeneration remains unclear.[12]

Primary immune deficiency disease and amniotic membrane case report

Primary immune deficiency disease (PIDS) is a relatively rare family of diseases characterised by inherited immune system defects and increased infection risk. PIDS sub-classification includes; antibody deficiencies, combined immunodeficiencies, complement deficiencies, and phagocytic cell deficiencies.[13] This case report involves a 27-year-old patient (GR) with PIDS. She had severe and disabling dry eye for several years. The pre-treatment bilateral findings were 6/9 visual acuity, severe bulbar and palpebral conjunctival injection and lid margin telangiectasias. Superficial corneal and conjunctival staining was confluent. Scars on both corneas were consistent with prior infiltration episodes of unknown cause. GR's condition was disabling; increasingly requiring days to weeks off work. GR was refractory to tear replacements and lid hygiene products, immunosuppression, thermal compression and intense pulsed light. She had also trialled neurological medications such as Lyrica.

GR was the first AM recipient in Australia by an optometrist, following introduction of new rules allowing optometrists to access and fit AMs. The procedure involves stabilising the eyelids, preferably with a speculum, placing the AM on the cornea and a bandage contact lens (BCL) over the AM. The AM decomposes in about three days, leaving just the bandage contact lens. After approximately one week the BCL is removed. GR's left eye was treated, and the surface changes observed in bulbar injection over the first three weeks are shown in **Figure 1**.

Visual acuity improved to 6/4.8. Surface staining resolved. There was no detected improvement in lid margin telangiectasias. At week three, GR was pain-free with no visual symptoms. At six

months, GR remains pain-free with no recurrence of the physical signs of dry eye disease. The right eye has now also been treated. One month following treatment, GR reports a similar result to that achieved with the left eye.

This case report documents the effect on physical signs and symptoms of AM treatment in a patient with PIDS. Duration of treatment effect is at least six months. At this time, normal function and comfort has been restored to GR's eyes. To the best of the author's knowledge, this is the first documented successful AM treatment for the ocular complications of PIDS. •

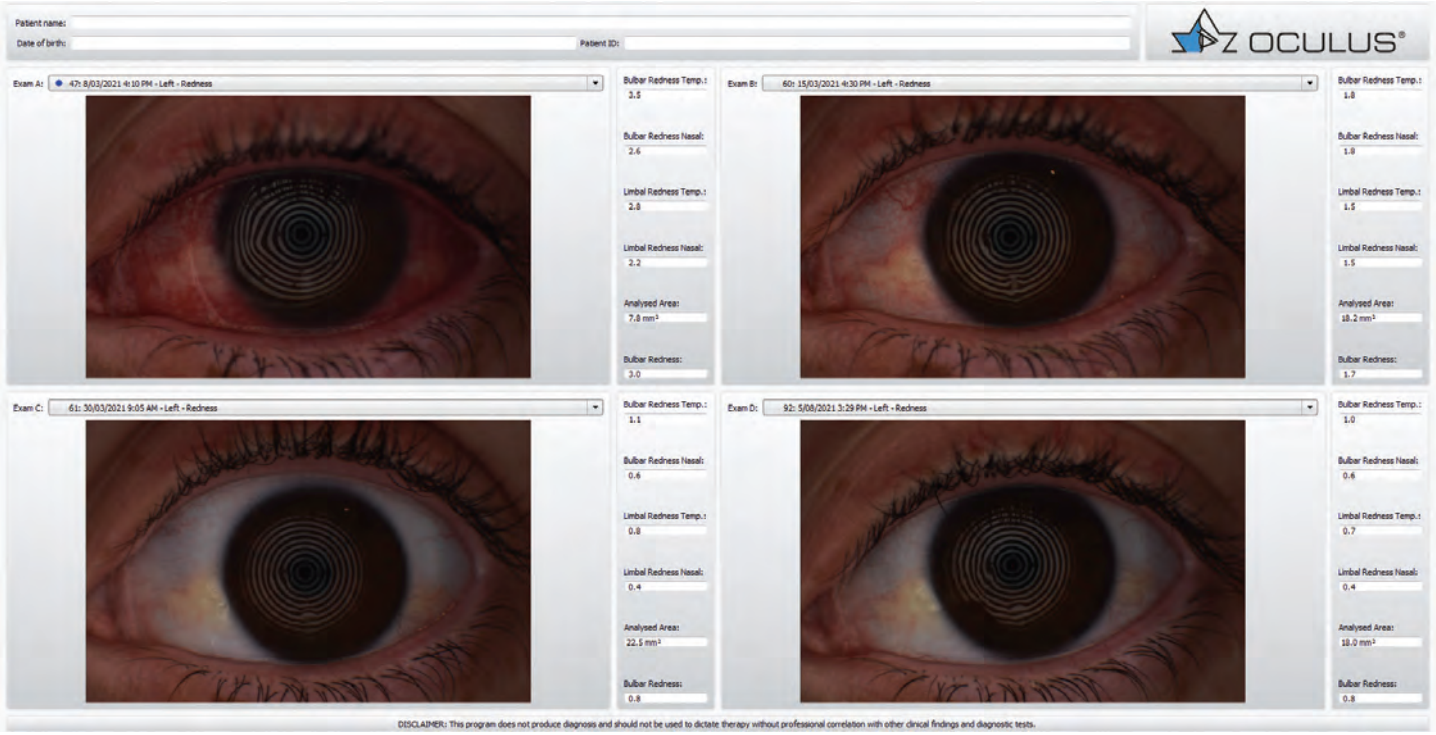

Figure 1.
(From top left to bottom right) Bulbar injection observed on day of treatment and at weeks 1, 3 and 22 post treatment.

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WHEN YOU NEED MORE THAN ARTIFICIAL TEARS*

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Before prescribing, please review the Product Information available from Seqirus Medical Information (1800 642 865) or www.seqirus.com.au/products

▼ This medicinal product is subject to additional monitoring in Australia. This will allow quick identification of new safety information. Healthcare professionals are asked to report any suspected adverse events at www.tga.gov.au/reporting-problems.

MINIMUM PRODUCT INFORMATION: IKERVIS® (ciclosporin 0.1% ophthalmic emulsion) **Indication:** Treatment of severe keratitis in adult patients with dry eye disease which has not improved despite treatment with tear substitutes. **Contraindications:** Hypersensitivity to the active substance or any of the excipients; Ocular or peri-ocular malignancies or premalignant conditions; Active or suspected ocular or peri-ocular infection. **Precautions:** Any reversible underlying conditions, not associated with dry eye disease, should be treated prior to initiating IKERVIS®; History of ocular herpes; Contact lenses should be removed before instillation of eye drops and re-inserted at wake-up time and careful monitoring of severe keratitis is recommended; Glaucoma – limited experience with IKERVIS®. Exercise caution especially with concomitant beta-blockers; Co-administration with eye drops containing corticosteroids may potentiate effects of IKERVIS® on the immune system; May affect host defences against local infection and malignancies. **Use in Pregnancy (Category C):** No data available; Not recommended in pregnancy unless the potential benefit to mother outweighs the potential risk to fetus. **Use in Lactation:** Insufficient information on breastfed infants; it is unlikely that sufficient amounts are present in breast milk. A decision must be made to discontinue either IKERVIS® or breastfeeding during treatment. **Use in Children:** No data available. **Interactions with other medicines:** No data available. **Adverse Effects:** Common: erythema of eyelid; lacrimation increased; ocular hyperaemia; vision blurred; eyelid oedema; conjunctival hyperaemia; eye pruritus. Very common: eye pain, eye irritation. **Dosage and administration:** The recommended dose is one drop of IKERVIS® once daily to be applied to the affected eye(s) at bedtime.

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ciclosporin 1mg/ml

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*For the treatment of severe keratitis in adult patients with dry eye disease which has not improved despite treatment with tear substitutes[1]

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References: 1. Ikervis Product Information. **2.** Jones L *et al. Ocul Surf* 2017; 15:575-628. **3.** Baudouin C *et al. Br J Ophthalmol* 2016; 100:300-306.

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Herpes zoster case report

Herpes zoster (HZ) represents the reactivation of the varicella zoster virus after a previous, primary infection which established viral latency in nerve ganglia.[1] Unlike primary infections with the virus in children, which results in relatively mild symptoms of chicken pox, reactivation of the virus in adults typically leads to a painful, blistering rash limited to the dermatome of the nerve in which the virus was latent.[2]

When this reactivation occurs within the ophthalmic division of the trigeminal nerve, the presentation is known as herpes zoster ophthalmicus (HZO). In addition to a painful rash on the skin around the eye or forehead, HZO presentations can also affect numerous structures of the eye, including the cornea, conjunctiva, uvea, trabecular meshwork and retina.[2] Thus, HZO should typically be considered as part of a differential diagnosis and workup for numerous ocular conditions. HZO represents between 10 and 25% of herpes zoster presentations, and are of particular concern because they are more frequently associated with complications, particularly in the absence of treatment.[2]

Case study and examination

A 58-year-old woman presented with symptoms of itching, burning and tingling sensation on the skin of her right forehead and part of the skin around her right eye since the previous morning.

Corrected visual acuity was 6/6 in each eye, with normal pupillary reflexes and no restrictions of extraocular movements. There were no abnormalities observed on slit lamp evaluation of the anterior or posterior segments of the eye with pupillary dilation, with no signs of pseudodendrites on the cornea. The intraocular pressure in both eyes via Goldmann tonometry was 15 mmHg. Gross examination of the skin on her right forehead showed three distinct raised areas.

Directed questioning elicited a positive history of chickenpox infection in childhood, and otherwise no general health concerns or history of systemic diseases or medications which may cause immunosuppression. She also reported no history of allergy or use of any particular substances in the area around her forehead or eyes which may have caused an allergic reaction.

Diagnosis and management

Considering the symptoms of localised burning and the multiple raised areas only on the right side of the forehead, and an absence of any other history suggestive of causing discomfort, a working diagnosis of herpes zoster ophthalmicus was made. A discussion with the patient followed regarding treatment with oral antiviral medications, including the ideal timing of initiating therapy. She was informed of the greatest effectiveness of the medication in HZO treatment occurring if given within 72 hours of the rash onset, but at this stage the skin presentation was not conclusive. After further discussion regarding the relative safety of oral antiviral medications and expressing a desire to shorten the disease course and effects, the patient requested to be referred to her GP for a prescription of antiviral medications.

The patient was prescribed oral valaciclovir 1000 mg three times a day for seven days. She was also advised to manage any development of pain promptly with paracetamol and if insufficient to return to the GP for assessment. At follow up the next day her forehead took on the more characteristic HZ blistering rash appearance, however she fortunately did not develop any significant ocular complications.

Discussion

Herpes zoster management is centred on managing the acute episode, including the infection and associated pain, as well as mitigating long term risk of developing post herpetic neuralgia (PHN). In the eye, HZO presentations necessitate additional therapeutic goals of preventing or treating any associated inflammatory or infectious complications within the eye. This includes, among other conditions, HZO associated conjunctivitis, blepharitis, keratitis, uveitis, trabeculitis and retinitis. Diagnosis of HZO is typically made clinically, with the characteristic rash appearance often used as a definitive clinical feature, however this may not be obvious in the prodromal phases of the condition. Rarely, HZ can present without a rash at all (zoster sine herpete).[3]

Contemporary management of HZO utilizes systemic antivirals, as their use has been reported to decrease the rate of ocular complications from 50-60% down to 20-30%.[4] Available oral antiviral medications for HZ in Australia include aciclovir, valaciclovir and famciclovir. They all work through inhibition of viral DNA synthesis, and require viral thymidine kinase enzymes to become activated and thus are selective to only virally infected cells.[4] Incorporation of these molecules into the replicating viral DNA strand prevents further elongation.[4] Aciclovir has a relatively poor oral bioavailability of only 15-30%, thus requiring frequent (five times a day) and relatively high doses (800 mg each dose) to treat HZO.[4] In contrast, valaciclovir is a prodrug of aciclovir, which greatly improves bioavailability and results in higher peak circulating concentrations and a comparatively decreased dosage schedule (standard dosage for

HZO of 1000 mg three times a day).[4] Famciclovir is a prodrug of penciclovir, which is similar in structure to aciclovir and works through similar mechanisms. Famciclovir was developed to improve penciclovir's poor oral absorption.[4] The dosage for famciclovir to treat HZO in immunocompetent patients is 500 mg three times a day.[5] These drugs all have a favourable safety profile and are generally well tolerated by most individuals without any complications.[6] Some caution should be made for individuals who may have renal impairment as this drug is primarily excreted by the kidneys, and excessive concentrations may lead to neurotoxicity and hallucination, although this is reportedly rare.[2,4]

The majority of the literature and clinical trials have suggested that oral antiviral treatment for herpes zoster is most effective when given within 72 hours of the rash presenting

The majority of the literature and clinical trials have suggested that oral antiviral treatment for herpes zoster is most effective when given within 72 hours of the rash presenting.[4] For patients where the rash has begun to crust over, they are unlikely to gain benefit from antiviral use, however if there is evidence of continued rash development then treatment can be considered even if beyond the 72 hour window.[4] Given the high rate of complications, patients with HZO should be given oral antivirals even if outside of the 72 hour window in hopes of reducing associated ocular conditions.[2]

There is some controversy within the literature regarding whether antiviral use decreases the risk of PHN, primarily due to different definitions and measurement of PHN amongst different clinical trials.[2,4,6] Pain in the acute phases of the condition should be managed aggressively to reduce the risk of PHN developing later, with recommendations of using oral paracetamol alone or in combination with weak opioids as first line therapy before moving on to more aggressive treatments.[6] Involvement of a pain clinic or pain specialist early in the management of PHN is recommended.[6]

A live attenuated herpes zoster vaccine is available in Australia for patients 50 years or older. Up until 31st October 2021 it was available free of charge to patients aged 70-79 to encourage this group to be vaccinated, as they are expected to have higher rates of HZ as well as higher risk of developing PHN.[7] Timing of when the vaccine should be given is subject to debate within the literature, as the efficacy of the vaccine is expected to wane over time and at this stage booster shots are not recommended.[6] The current Australian Government Department of Health recommendation is for the vaccine to be given to those 50 to 59 years only if they live with someone with a weakened immune system.[8] The live, attenuated vaccine is not recommended in patients who are immunocompromised. A recombinant shingles vaccine using only part of the virus is also available in other jurisdictions such as the United States, and is thought to potentially provide longer term protection against HZ.[9] In a retrospective study, the recombinant vaccine was 89% effective in preventing HZO in patients 50 years of age or older over a two year period.[10]

Due to its potential for diverse presentations, HZO should be considered in presentations of inflammatory and infectious eye disease. If HZO is suspected or diagnosed, prompt management with oral antiviral medications should be initiated in coordination with the patient's GP, and pain managed aggressively to lower the risk of developing PHN and further ocular complications. •

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Therapeutic prescriptions and optometry:

Trends in New Zealand

In 2005, optometrists in New Zealand were given designated prescriber rights, which meant that they were able to prescribe a range of therapeutic medicines from a regulated list of topical medications. Nine years after these initial prescribing rights were granted, both recognising the safe and appropriate prescribing that was occurring by optometrists and in response to difficulties in managing a list of legislatively approved medicines, amendments to the Medicines Act in 2014 further expanded these rights. This new amendment gave optometrists in New Zealand the legal status of authorised prescribers, alongside medical practitioners, dentists, and nurse practitioners. This title meant an appropriately qualified optometrist could now prescribe any medication approved by Medsafe for use in New Zealand, limited only by scope of practice.[1]

In addition to enabling access to a much broader range of medications, it also removed restrictions regarding the mode of delivery. Medications could now be dispensed in any formulation, including capsules, sprays, tabs, oral solutions, and creams, in addition to the previously permitted topical solutions, ointments, and suspensions. This technically includes intravitreal medications such as aflibercept (Eylea), which is now permissible for an optometrist to prescribe. However, an optometrist cannot administer the medication as the act of intravitreal injection remains outside of optometrist scope of practice managed by the Optometrists and Dispensing Opticians Board (ODOB).

However, optometrists working in tertiary settings use these prescribing rights to ensure timely availability of intravitreal drugs, potentially saving an additional consultation for the patient. Access to a wider range of drug delivery modalities also enables better integration with other healthcare providers as a much broader range of conditions can be co-managed between optometry, ophthalmology, and general medical practice. This has been beneficial in cases where either regional or personal challenges make seeing a healthcare provider difficult. For example, a patient may have hypertensive retinopathy and high blood pressure, but has run-out of their existing blood pressure medication. After consultation with their general practitioner, the optometrist can issue a prescription to cover the period until their next appointment, embodying the mantra that the best time to treat a patient is when they are in front of you.

While these changes came into place from July 2014, optometry is traditionally a risk-averse profession. Despite these newfound permissions, uptake was gradual such that by the end of 2014 just 142 scripts for non-topical medications had been issued. Growth in non-topical medication prescribing was initially slow, with early communications from the ODOB encouraging restraint. However, uptake began increasing from 2017 after the ODOB published safe prescribing guidelines for a range of optometric conditions to their website.[2] This allowed the optometry scope of practice to cautiously expand, while the optometric and neighbouring professions had time to adjust

to the new boundaries. The tone of continuing education conferences from ophthalmology groups also changed during this period, with content now providing advice on when and how to safely prescribe oral medications for optometric conditions, as well as establishing new recommendations on safe referral and co-management guidelines. For example, greater emphasis was placed on managing recurrent herpes simplex keratitis with prophylactic oral aciclovir; something that previously would have required referral to a medical practitioner. These events, and the informal dissemination of information back through the profession, took time, but helped set the expectations of what an optometrist could, or perhaps should, be managing in-house before they felt comfortable enacting a change to their practice.

Figure 1 shows that since 2014, the number of non-topical prescriptions has increased year-on-year, such that during 2020, there were a total of 1613 non-topical medication prescriptions issued by optometrists. Including data to June 2021, of the 752 therapeutically endorsed practitioners with an annual practicing certification (representing 91% of all practicing optometrists), 60% had issued a non-topical medication at least once, with a mean number of just over 16 scripts; both of these measures are up from the previous report in 2019 of 53% and 12.4, respectively.[3] Note, however, that the distribution of scripts is heavily skewed right, with a small group of optometrists issuing a large number of oral medication prescriptions: the median is just four scripts, and 10 optometrists had issued over 100 oral medication scripts. The increase in the number of practitioners prescribing suggests that the total number of scripts for non-topical medications will continue to grow over the next few years, as both more therapeutic optometrists enter the workforce and existing optometrists adapt to their increased scope of practice.

Some of the year-on-year number of prescription increases can be attributed to the new cohort of graduate optometrists entering the workforce whose training increasingly includes oral medication prescribing as routine clinical practice. However, when non-topical medication is assessed as a proportion of all therapeutic prescribing, non-topical medications appear to be plateauing at approximately 4%. This likely reflects a limited range of conditions which are better served by an oral medication, versus the more direct, locally acting, and first-pass metabolism bypassing, topical route. It also could be interpreted as evidence that optometrists are not inappropriately using oral medications in place of topical, just because they can. →

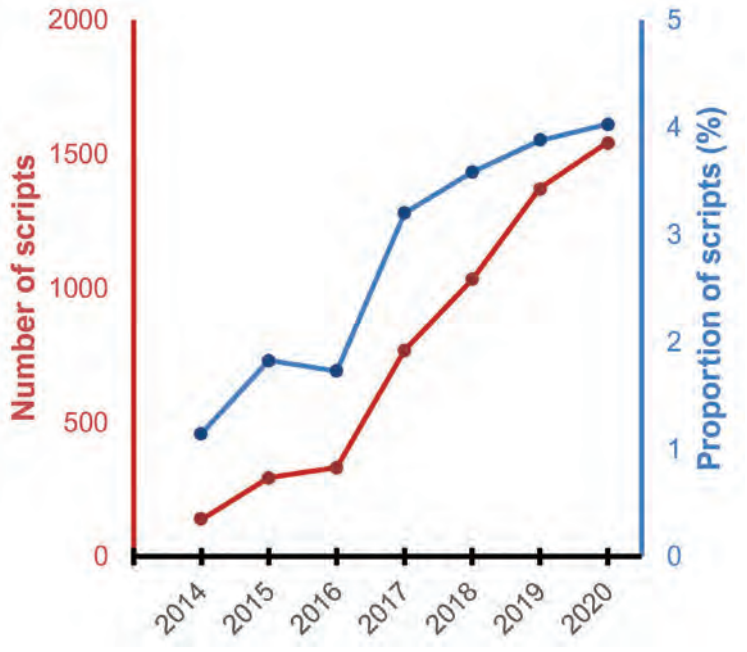

Figure 1.
While the number of prescriptions issued by optometrists for non-topical medications increases each year (red), as a proportion of all therapeutic prescriptions, the rate appears to be plateauing at approximately 4% (blue).

Since 2014, the number of non-topical prescriptions has increased year-on-year, such that during 2020, there were a total of 1613 non-topical medication prescriptions issued by optometrists.

Further evidence of restraint comes from the fact that despite the massively increased range of medications available to prescribe, 85% of prescriptions come from just eight classes of medication and comprise just 15 different drugs in total. Antibiotics make up most oral medication prescriptions (59%), primarily the macrolide azithromycin, tetracyclines (mostly doxycycline and minocycline), and the ß-lactam amoxicillin. While some scripts are for the treatment of acute infections, like hordeolum, canaliculitis and preseptal cellulitis, the vast majority are for the management of meibomian gland dysfunction (MGD), where the primary action of the drug is not antibacterial.[4]

Looking closer at prescribing for MGD, there is already evidence of optometrists keeping up to date with their oral medication prescribing. In 2014 long-term low dose tetracyclines (typically doxycycline) was the mainstay treatment for meibomian gland dysfunction,[5] and indeed was the most prescribed antibiotic. But since then, several clinical trials have shown at least an equivalent effect with short-term, higher doses of azithromycin, which tends to be better tolerated by the patient.[4] This change in prescribing behaviour can be seen in **Figure 2**, with azithromycin now prescribed at a rate over five times higher than that of doxycycline.

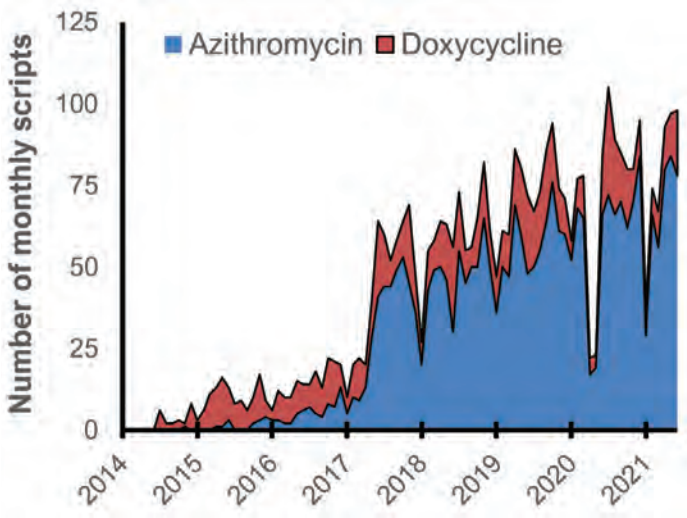

Figure 2.
The two most prescribed oral medications are azithromycin and doxycycline, with azithromycin currently prescribed at approximately five times the rate of doxycycline. The two large monthly decreases are a result of COVID-19 lockdowns.

Anti-allergy makes up the second biggest group of non-topical medications, at 10% of prescribed oral medications. The most common drug in this group is cetirizine, followed by loratadine, both second-generation antihistamines. Here, there is a strong seasonal component to the prescribing frequency, and it is commonly prescribed alongside topical antihistamines with mast cell stabilising properties, such as olopatadine or ketotifen.

Other prescribed oral medications include the analgesics ibuprofen, aspirin, and paracetamol, which are all available over the counter, but are infrequently (~1% each) prescribed to reduce patient costs or increase compliance.[6] Oral prednisone is prescribed for the management of complex uveitis, optic neuritis, and post-surgical complications - but typically in tertiary settings alongside ophthalmologists. The proton pump inhibitor omeprazole is commonly prescribed alongside oral steroids or nonsteroidal anti-inflammatories to reduce gastric side-effects. An increasing number of optometrists are now either independently (having been ODOB approved as independent glaucoma prescribers), or co-managing glaucoma, and acetazolamide is now the fifth most prescribed oral medication at 3%.

Approximately 7000 oral medication scripts have been issued by optometrists since 2014, and there have been no adverse events reported related to optometrist prescribing, nor any misuse of prescribing rights identified by the ODOB, who monitor optometrist prescribing with the Ministry of Health. An optimistic interpretation of this could be that these 7000 prescriptions would have traditionally been managed by the already overburdened medical system, and therefore represents better patient access to care and hopefully better patient outcomes. •

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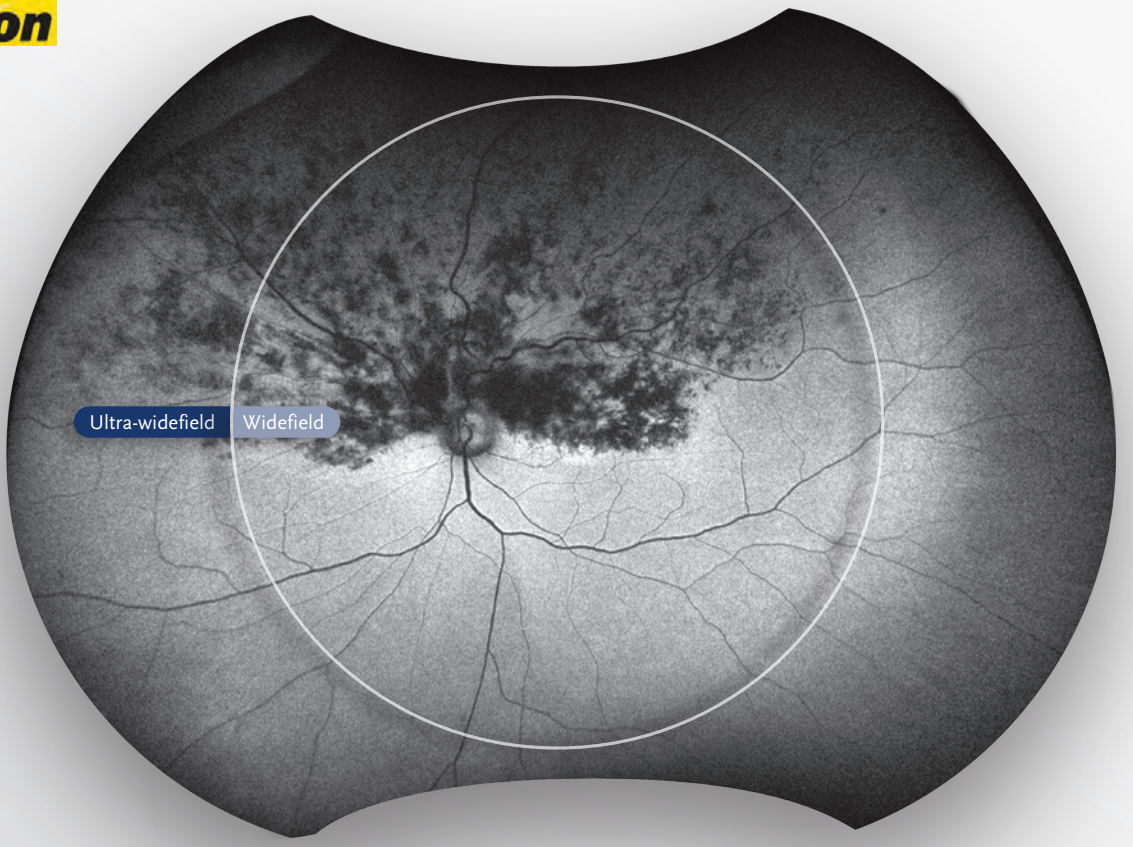

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Ergonomics and Digital Eyestrain:
Selecting the best lens solution

A 2016 case study stated that the most common occupational injury faced by computer users was repetitive strain injury (RSI).[1] Computer users face a higher possibility of getting RSI due to their prolonged working time and static posture. The most common symptoms experienced were those of pain and stiffness in the neck and shoulder regions. The symptoms commonly came from awkward posture, excessive body movement or leaning forward towards the computer screen. The study concludes that workstation design can greatly contribute to the reduction of RSI.

What does this have to do with an optometrist? Our patients rarely come to us complaining of neck and back pain. However, a 2016 report from the Vision Council[2] states that 65% of patients using digital devices experience digital eyestrain (DES), including dry, irritated eyes, blurred vision, eye fatigue, neck and back pain and headaches.

Many practitioners have changed their examination routines to ask about DES and are able to offer good advice about workstation set up, such as keeping the screen at arm's length, and arranging the height of the monitor to ensure the top 1/3 of the screen is at eye level. Advice on illumination and font sizing to make the visual task as comfortable as possible should be considered.

However, all of this becomes meaningless if we then compromise on the lens and lens treatment choice. When we dispense a pair of spectacles we have the power to bolster or destroy the work station set up. We need a vision solution that will consider all the different working distances necessary from the outer reaches of the desk, computer screen, keyboard, peripheral notes, and mobile phone along with the ability to interact with work colleagues (**Figure 1**).

Figure 1.
Typical work place set up viewed through a PC type lens.

Assuming the screen sits at 80cm (about average arm's length) the patient needs +1.25D of power to see it clearly. This power will be exerted by the accommodation system and/or made up by a near addition. If single vision near spectacles are prescribed when the addition exceeds +1.25D the patient will need to lean forward to see their screen clearly. If an intermediate pair is supplied the patient may not have enough residual accommodation to easily see a smart phone at 30cm. They also will not be able to see further than the screen. In other words, with a single vision solution the patient may have to use excessive body movement to ensure clarity of vision over a range of working distances.

If a full progressive lens is utilised the power at pupil height is the full distance prescription. To access enough power to see the screen the patient will have to lift their chin causing postural problems. With high additions the corridor will be too narrow to be of use, especially if a short corridor is employed to 'bring the addition in more quickly'. The patient will have to employ an awkward posture to see clearly.

What is needed is a lens that has the correct amount of power at pupil height to see the screen clearly, the full addition lower down to view keyboard, documents and smart phone and an area of reduced power above pupil to access the outer reaches of the desk and adjacent work colleagues. Digressive lenses were developed to fill these needs.

The first digressives tended to have a fixed digression, of around 0.75D or 1.25D over a very short corridor of 10mm. They worked well with lower additions, but with higher additions the larger digressions gave a lot of aberration, and vision beyond the screen could be severely compromised.

These designs have been largely superseded by longer corridor designs where the pupil sits inside the corridor. The benefit of these designs is that the aberration is much less noticeable and, regardless of addition power, the distance achieved at pupil height will always be the same. To account for working distances and tasks, different designs are produced (**Figure 2**). When choosing a design for desktop monitor use, it is important to choose a design that has the correct power at pupil height and the main viewing distance coincides with the widest vision zone in the lens. The temptation is to use an indoor progressive type design ('Room' design in Figure) as a compromise so that the patient can walk around in them. If the main task is desktop screen use, this will not stop RSI, as the patient's head position will still be elevated to access enough power to see the screen clearly.

The main concern with using these lenses is not knowing exactly what the power at pupil height is. Most manufacturers will give a range of clear vision available or tables of the different digressions per addition.

If we consider a typical computer lens of this type ('PC' design in Figure):

Corridor length = 26mm (18mm below pupil, 8mm above pupil)

Range of comfortable vision 40cm (full addition) to 125cm (full digression).

Digression amount for a +2.25D add = 1.45D. (At 8mm above pupil the patient can see clearly out to 1.25m.)

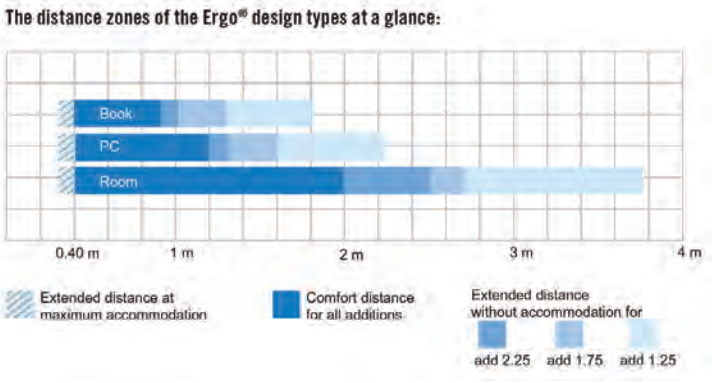

Figure 2.
A typical range chart for a suite of digressive lenses.

At pupil height 2/3 of the digression will have occurred and so power at pupil height = 2.25 - 0.97 = 1.28D. This gives us a working distance of 78cm. This should cover most desktop monitors.

We can calculate that the power is digressing at a rate of 0.2D every 4mm of corridor. If the screen is a few millimetres either side of the 78cm working distance, then it will require only a small head movement or small amount of accommodation to access the correct power on the lens.

If the screen is much further away, reducing the add by 0.25 will give about an extra 10cm. This will give the added benefit of widening the corridor. It is tempting to look at the room-type designs for the longer working distance, but the widest vision zone will not be in the correct place.

If the screen is closer, increasing the addition is an option, but this will narrow the corridor down. It would be better to increase the distance prescription by +0.25D. Again, the near design ('Book' design in **figure 2**) is not an option as these extended reading-type designs tend to have the widest vision zone in a downward direction with a narrower corridor when looking straight ahead. This type of lens is ideal for laptop use.

As a final point, when advising about lighting and screen brightness, it is important to recommend the use of an antireflection coating for computer use. The light emitted from a screen can cause distracting and tiring internal reflections in the spectacle lens and an antireflective coating will reduce this and reduce eye fatigue.[3]

There are many demands that the digital age places on the visual system but there are solutions available. We can be assured that these options can provide a genuine improvement to meet patient's visual requirements. Patients are demanding more; they are seeking better experiences and customisation of lens solutions is the key to adding value to their lives. •

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Fine tuning: Patients sensitive to increments smaller than a quarter dioptre

For more than a century, spectacle and contact lens prescriptions have been written in increments of 0.25D. This was the case because trial lenses, manual and automated phoropters were only available in 0.25D steps. In addition, these subjective-refraction instruments allow only separate, successive adjustments of the sphere, cylinder and axis of the correction.

Today, with phoropters that offer smooth power changes in increments of 0.01D and 0.1 degree and that also allow simultaneous adjustment of sphere, cylinder and axis, it is possible to determine a subjective refraction with greater precision and get much closer to the patient's true dioptric sensitivity. Semi-automated algorithms using psychometric methods combined with vectorial refraction technology were developed for this, and measurements of dioptric sensitivity in patients have been carried out in Essilor Research & Development studies designed to validate these new refraction techniques.[2] The following article presents the results and discusses their implications for the future.

Measurements of dioptric sensitivity in the patients during refractive examination

The study measured dioptric sensitivity in a representative sample of 146 ametropic patients during subjective-refraction. There were extensive inclusion and exclusion criteria; significant inclusion criteria were visual acuity of 6/9.5 or better in each eye and 6/7.5 in both eyes with current prescription, as well as exclusion criteria of any current or evolving pathology in the eye. It was carried out using Essilor Instruments' Vision-R 800 phoropter – which provides continuous power changes – and semi-automated algorithms used to determine the refraction. The average age of the subjects was 35 +/- 13yrs (from 19 to 66), and the average ametropia was -2.55 D +/-2.00 D (from -6.25 D to +2.63 D).

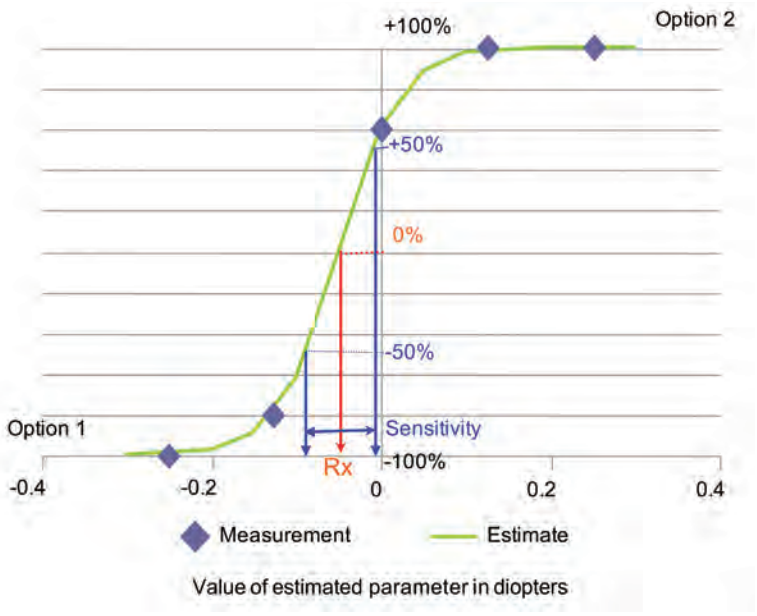

Figure 1.
Measurements of dioptric sensitivity in the patients. Each patient's sensitivity is evaluated using a distribution curve of their answers according to the dioptric level presented. This curve represents the probability of their answer for each choice between 1 or 2.

Dioptric sensitivity was defined as the 'minimum' dioptric difference to which a patient is sensitive. It was evaluated with a probability distribution curve of patient answers, using half of the distance separating the dioptric values corresponding to the two probability points of -50% and +50% (**Figure 1**). These two points represent an area of insensitivity where the patient cannot easily choose between one option and another. The interval separating them provides a good evaluation of the dioptric sensitivity. The prescription value, corresponding to a zero probability, yields the most probable value of the dioptric threshold, which is established for each of the refraction components.

Measurements were made for the various traditional tests used during a refraction:

- → Determining the sphere using optotypes (letters) or duochrome
- → Determining the cylinder power and axis (converted into a dioptric value) using the Jackson cross-cylinder method
- → Determining the binocular balance by comparing the right and left eyes with a test composed of lines of letters dissociated with polarised filters.

The results are shown in **Figure 2** and are shown for each test by the distribution of the proportion of patients that were sensitive to values under 0.125 D, 0.25 D and 0.375 D, respectively, as well as over 0.375 D. The following observations were made:

Dioptric sensitivity in patients varied significantly depending on the test used and the refraction component being examined. The tests used can greatly affect a result.

When evaluating the sphere, patient sensitivity was lowest with tests using optotypes (letters): only 31% had a dioptric sensitivity less than 0.25 D. This result is particularly interesting because optotypes are the most commonly used tests for determining sphere in most refractions, yet they appear to be the least precise. Patient sensitivity was highest with duochrome: 72% were sensitive to dioptric changes less than 0.125 D, so duochrome proved to be the most precise for adjusting the sphere value.

When evaluating the cylinder, as many as 56% of patients were sensitive to cylinder power changes of less than 0.125 D. Similarly, 53% of the patients were sensitive to the dioptric effect of axis variation (i.e. the dioptric translation of changes to the cylinder axis) in increments of less than 0.125 D. The patients were sensitive to much smaller changes in cylinder power and axis than the 0.25 D steps traditionally used.

When determining the binocular balance, 42% of the patients could perceive differences less than 0.125 D, which corresponds to the common observation of the inversion in preference of one eye over the other during the introduction of a balance power of +0.25 D in one eye. (This makes it necessary to retain the balance of the corrections giving preference to the dominant eye if it is not possible to retain the exact binocular balance.) The patients were often sensitive to smaller increments of difference in correction between the right and left eyes, than the 0.25D steps generally used.

On the basis of these measurements, it was possible to determine an overall dioptric sensitivity coefficient for each patient using an average of their sensitivities for each test: sphere, cylinder, axis and binocular balance. If we combine these results, it's clear that 95% of the patients were sensitive to dioptric increments smaller than 0.25 D and that 44% of them were sensitive to increments of under 0.125 D (**Figure 3**). →

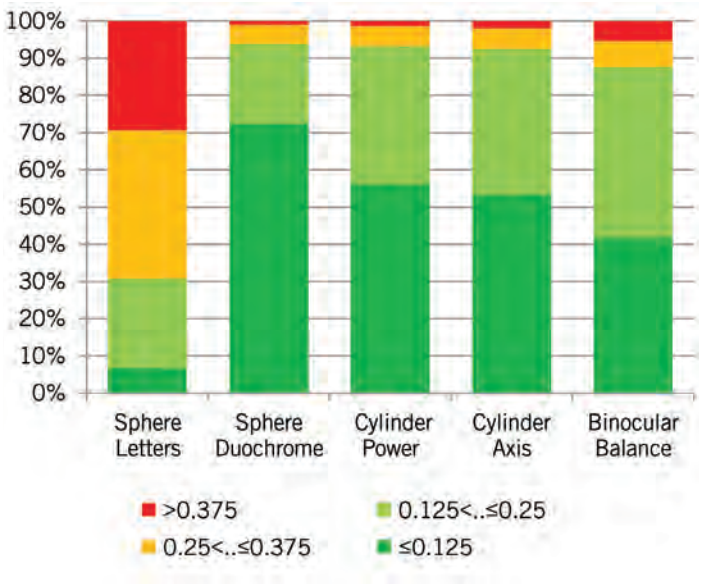

Figure 2.
Distribution of patients' dioptric sensitivity for different refraction tests.

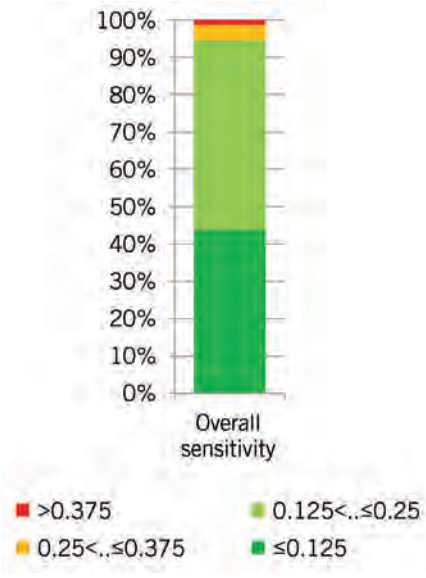

Figure 3.
Average overall dioptric sensitivity in the patients.

Discussion and outlook

The results of these measurements suggest the following:

- *Traditional refraction devices limit precision in subjective refraction*

  Given that they use lenses that vary by 0.25D, traditional subjective refraction instruments are, by nature, not sufficiently accurate compared with the patient's true dioptric sensitivity.

  Today, more precise optical technologies, combined with semi-automated refraction algorithms make it possible to improve precision when determining the subjective refraction. This means a patient's sensitivity and not the device used can be the main limiting factor in the precision of the refraction.

- *The refraction tests used influence the result*

  The measurements performed showed that the patient sensitivity varied from one optometric test to another. The precision with which the refraction components are evaluated can also vary significantly. However, each practitioner performs refraction with their own method and different approaches to refraction are possible. Depending on the practitioner, refraction results can vary by as much as +/-0.50 according to estimates given in a number of studies.[3]

  Semi-automated refraction algorithms, guided by the practitioners, offer the possibility of standardising refraction methods and improving the reproducibility of results from one practitioner to another.

- *Dioptric sensitivity in patients: a new parameter to consider*

  We frequently observe that some patients are much more sensitive to power changes than others. Measuring dioptric sensitivity in patients is a useful complementary approach when determining the refraction.

A parameter for quantifying a patient's dioptric sensitivity can, for example, be used for the following:

→ Adjusting the phoropter's power change increments during the refraction process itself, using smaller increments if the patient is sensitive to them and larger ones if not,

→ Choosing the type of lenses to offer the patient, either in 0.25D or 0.01D steps, depending on the patient's sensitivity,

→ Integrating into the lens design a new customised parameter associated with the patient's dioptric sensitivity.

Measuring dioptric sensitivity in patients clearly opens up a new field of testing.

- *Increments of 0.01 D are necessary to most accurately capture patient sensitivity*

  If we are to get as close as possible to the real dioptric sensitivity of a patient, we must be able to precisely control the optical powers presented to them.

  Even though patients are obviously not sensitive to power changes of 0.01 D, being able to change the powers by a value of 0.01 D during a refraction remains useful in determining a patient's real sensitivity, which is often close to 0.10D or less.

- *Digital surfacing makes it possible to manufacture lenses in increments of 0.01D*

  Developed more than 20 years ago, digital surfacing can be used to manufacture lenses with high-precision corrections. Previously, since refraction could be determined only in 0.25D steps, this technology was not used to make lenses in smaller increments.

Today, with phoropters that can determine a patient's exact refraction through continuous power changes, it is possible to develop a new category of lenses calculated on the basis of increments of 0.01D. The performance of the lens design and calculation systems can now be fully leveraged to target the prescription's exact power. Lenses of this type, which can offer patients a correction closer to their exact ametropia, are now available.

Conclusion

Although the 0.25 D increment has long been considered the smallest possible value for both correction and optical instruments, measurements have shown that most people are sensitive to smaller variations. Improvements in subjective refraction techniques on the one hand, and lens design and manufacturing expertise on the other, now allow us to achieve greater precision in optical correction. This can be integrated in 0.01D steps in lens calculation and manufacturing to more accurately reflect patient sensitivity. Advances in technology enable us to improve precision throughout the entire optical correction chain and offer patients optical corrections that are more accurate than ever before. •

To suit the format of this publication and with the permission of the authors, this article has been edited from the original which appeared in Points de Vue - International Review of Ophthalmic Optics online publication - June 2020.

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Optometrists and missed diagnosis

RISK MANAGEMENT

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A missed diagnosis in clinical practice is a critical issue for both optometrists and patients. All optometrists need to be able to respond when a diagnosis is missed and a patient's health may be at risk.

Each year the Australian Health Practitioner Regulation Agency (AHPRA) and the Optometry Board of Australia (the Board) publish key information about the profession. This includes the following statistics for complaints made about registered optometrists in 2019/2020:

- 41 notifications about optometrists were made to AHPRA
- 25 of the 41 notifications (61%) were about 'clinical care' provided by optometrists, and
- 26 of the 41 notifications (63%) were made directly by patients.

This data indicates that clinical care is the dominant category of complaints made about optometrists. Other categories are offences against other law (i.e. a criminal offence), communication (not related to clinical care), breach of non-offence provision of the National Law, 'behaviour' and 'other' (19.5%). Of the 15 National Boards regulated by AHPRA, only the dental profession has a higher proportion of complaints made about clinical care.

The Board's statistics also show that patients make the most complaints about optometrists, rather than employers or colleagues. Based on AHPRA's data, only the psychology profession has a higher proportion of complaints made directly by patients.

So what does this information tell us about the issue of misdiagnosis for optometrists?

Firstly, the term 'clinical care' is much broader than technical skills. It includes an optometrist's ability to communicate clearly with patients about adverse events. For example, clinical care extends to an optometrist explaining a treatment plan to a patient after a colleague has missed a diagnosis in an earlier consultation.

Secondly, the high proportion of complaints made by patients about optometrists may indicate a breakdown in communication. It is important to recognise that most patients do not have an in-depth understanding of the technical skills and nuance involved in optometry practice. When a diagnosis is missed, or an adverse event occurs, a patient's first thought is likely to be that an error has been made. It is an optometrist's role to clearly explain the issues to the patient and, if appropriate, prepare a treatment plan. If this communication process breaks down, it is more likely the patient will complain.

What steps should an optometrist take following a missed diagnosis or an adverse event? Each case will be different, but optometrists should consider:

- talking to the patient yourself – don't rely on a practice manager or an assistant
- obtaining advice from an experienced colleague or a specialist if necessary
- arranging ongoing management of the patient – don't rely on a patient to arrange urgent treatment with a referral letter
- reviewing systems to minimise the likelihood of a similar missed diagnosis in future, and
- notifying your professional indemnity insurer for advice and support.

Ultimately, clear communication is essential, particularly when responding to a missed diagnosis or an adverse event. It can be vital for the patient's health and may reduce the likelihood of a complaint about the clinical care provided by an optometrist. •

1. Australian Health Practitioner Regulation Agency [Internet] Canberra: Summary of AHPRA Annual Report 2019/20; c2020 [Cited 2021 3 Sep], Available from https://www.ahpra.gov.au/Publications/Annual-reports/Annual-Report-2020.aspx

Jonathan Craig
Policy and Advocacy Advisor for Vision 2020 Australia

Referral pathway for adults with vision loss

Losing vision is a frightening prospect. Try breaking up your typical morning routine into actions. It might involve making coffee and breakfast, checking social media, picking out clothes, helping your kids get ready for school, tracking down your lost keys or wallet.

Count each thing you'd usually do as an action. How many of these actions could you perform while wearing, for example, incorrectly fitted or very dirty glasses? How many of these actions could you perform in pitch darkness? You've spent your whole life doing things in a particular way, and almost everything you do relies on your eyes.

As optometrists, you're often the first people to detect vision loss. Sometimes, that means patients are in the chair in front of you the first time they imagine living with less, or even no, vision. Because of its relatively low prevalence, many people have never met anyone with vision loss before, so they don't have much to go on. On an almost daily basis I meet people who have no idea how I can perform everyday tasks as a person who is blind. Their curiosity is a constant reminder that many things myself, my family and friends find commonplace are completely unfamiliar to most people. But for your patient, the questions I'm asked out of idol curiosity – "how do I read", "how can I watch a movie", "will I ever work again", become urgent and personal. From their perspective, every habit and hobby they've ever enjoyed may seem to be disappearing before their eyes. What can you do for them in this dizzying moment?

This is the question answered by the new Adult Referral Pathway for Blindness and Low Vision Services[1], developed by a working group of service providers, eye health professional bodies, patient and peer support organisations, and Optometry Australia.

Spearheaded by Vision 2020 Australia, the working group has designed the Referral Pathway to address a well-recognised service linkage gap between optometrists, ophthalmologists and service providers or peer support groups for people with blindness or vision loss.

The Referral Pathway helps practitioners connect people who are newly diagnosed with vision loss to the supports and services they need to maintain their independence, because along with the clinical information you can provide, there is also a positive story you can tell your patients. It's easy to imagine that losing vision means losing everything, but that couldn't be further from true. People with vision loss and blindness are doing every one of the tasks I mentioned above easily. They are workers, parents, teachers, mentors, and leaders, just like anyone else. Your patient's vision may change, but their life doesn't have to.

The Adult Referral Pathway for Blindness and Low Vision Services aims to:

- Improve patient outcomes by connecting people to supports and services
- Enable a parallel care structure to increase patient support
- Provide clear referring guidelines for eye health professionals
- Link eye health professionals with service delivery organisations
- Empower patients to make informed decisions about supports and services.

The Referral Pathway identifies two touchpoints where a practitioner should offer to help connect a patient with blindness or low vision services. The first is upon diagnosis of a condition, such as AMD or glaucoma, at which point there is an opportunity to have an informal conversation.

Vision 2020 Australia's Blindness and Low Visions Service Provider Resource lists all of Australia's state and national peer support and service organisations. A printable version can be downloaded from http://www.vision2020australia.org.au/resources/adult-referral-pathway/

The goal of this conversation should be to explain that though it's absolutely reasonable to be concerned about the future, people with any level of vision loss are entirely capable of living full and productive lives similar to those of people with full sight. There are, of course, differences in the methods and strategies used to live those lives, but there are specialists ready to teach these methods and strategies. There are also groups designed to connect your patient with other people who either have lived with vision loss for a long time and can act as mentors, or who are adjusting to it currently and can learn alongside them.

As their treating optometrist you would continue to manage your patient's primary care, using the clinical practice guides Optometry Australia has developed. But this conversation is an opportunity to help your patient address the non-clinical aspects of their changing vision.

The patient may not be ready at that point to accept a referral to a low vision service. They may feel overwhelmed, and be struggling to come to terms with a diagnosis. Their vision loss might not yet be significantly impacting them, and they may feel that thinking about it a lot at this point would make them feel worse, not better. There are many other reasons a patient might not accept a referral immediately. That's ok. At this stage your job is to help them understand the key message that people with low vision or blindness can still cook, clean, work, watch TV, and waste time on Facebook. They may not understand how this is possible, but just knowing that may change their perspective on their future.

There is another key step you can take at this point. As you might imagine, learning that you may lose significant amounts of vision can have a negative impact on mental health. The Referral Pathway therefore recommends that along with offering services and supports for people with vision loss, practitioners should also encourage patients to visit their GP, which is the quickest and simplest way to access supports such as a free mental health plan.

The second touchpoint for referral is when a patient presents with visual acuity of less than 6/12 or equivalent visual field loss. This is the point at which, according to the World Health Organization, vision loss begins to impact daily life. This touchpoint should also be triggered by other ocular pathology which could conceivably have a significant impact.

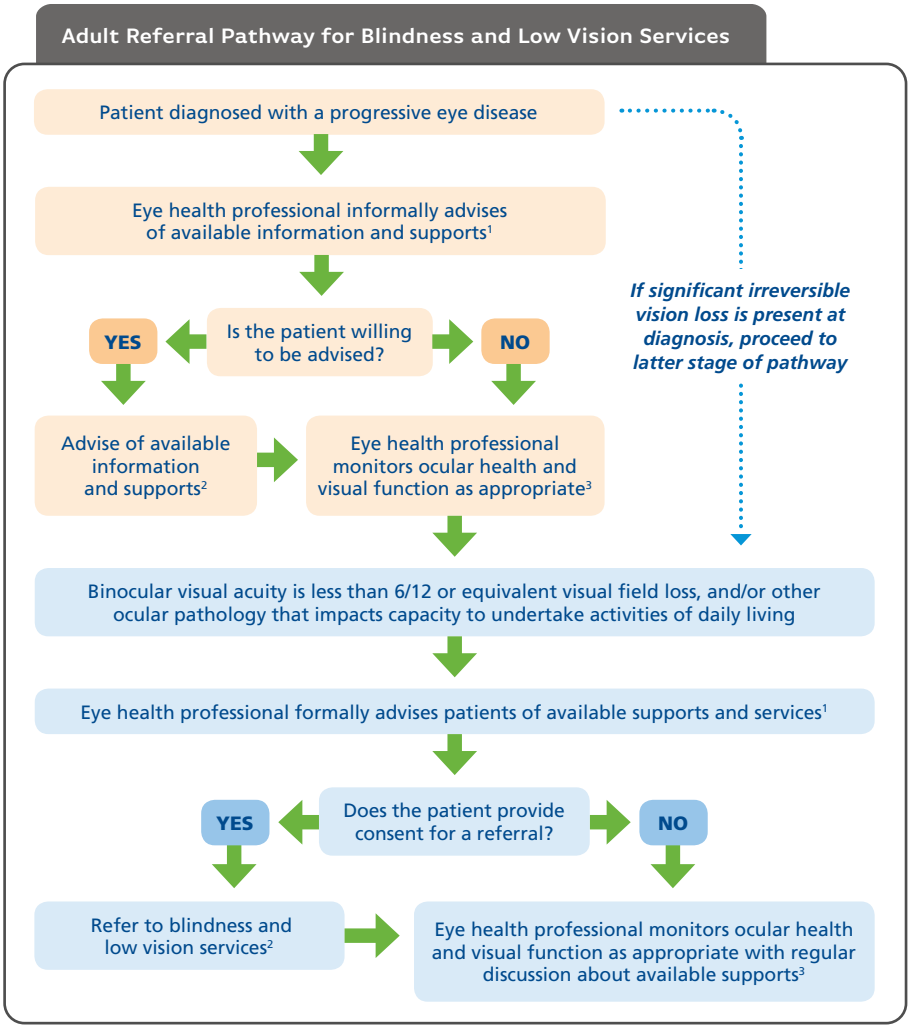

Figure 1.
Vision 2020 Australia's Adult Referral pathway for Blindness and Low Vision Services

Again, it's critical that you take this opportunity to recommend a GP visit for your patient so they can access mental health supports, should they need them. Though the prospects for a person with vision loss in the 21st century are extremely positive, that doesn't diminish a patient's feeling of fear and concern, nor does it account for the period of adjustment, and inevitable frustration, as they learn to approach familiar tasks in new ways.

The working group therefore suggested that you should encourage your patient to visit a GP before you discuss other practical steps, in the knowledge that they may not be ready for referral.

It is at this point that you should offer your patient a formal referral to blindness or low vision services, explaining that, though it is reasonable to feel upset by the loss of vision, there are supports available that will ensure they remain independent and continue living mostly as they're used to.

If your patient doesn't accept your offer of a formal referral, that's ok. You've already done important work just by letting them know these options are available.

Your job now is to continue monitoring your patient's condition. If they present a second time, even if their vision hasn't decreased since you last saw them, it is still recommended that you should again formally advise your patient that a range of services are available to help them develop strategies to deal with the impacts of vision loss, or connect them with peers who are facing the same challenges.

When someone is experiencing vision loss, you're often one of the first people they'll talk to about it. For an adult, it's understandable that the idea of vision loss can feel very unsettling. Optometrists often ask what more they can do to help patients at this crucial point. This Referral Pathway, and its accompanying resource, finally delivers a definitive and comprehensive answer, developed by experts with substantial experience helping patients adapt to their situation.

By telling your patients about the available options, and even connecting them directly with supports and services that will help them stay independent, you can make a huge difference in their lives.

About the author

Jonathan Craig is a Policy and Advocacy Advisor for Vision 2020 Australia. He has also worked as a writer, journalist and accessibility consultant, and is former editor of the national quarterly magazine from Blind Citizens Australia.

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Navigating that bump in the road:

A practical guide to assessing eyelid lesions.

Early referral of suspicious eyelid lesions is one of the most important factors in securing a successful outcome for the patient.[1] Although most lesions are innocuous, identifying those that do warrant specialist assessment and/or intervention isn't always straightforward.[1,2] This article discusses key considerations when a patient presents with an eyelid bump or lump.

Do you know your anatomy?

One of the thinnest and most intricate areas of skin, our eyelids play a vital role in corneal health and optical functioning. They do this through mechanical protection, regulation of light and tear film maintenance.[3] Please refresh your eyelid anatomy, if appropriate.

What questions will you ask?

A good history is pivotal to differentiating high-risk lesions from those that pose little harm and can be monitored. Be systematic and thorough when questioning the patient.

- About the patient
  - → Age, UV exposure (e.g. occupation, hobbies), smoking status, immune health, previous or family history of cancer, history of radiation therapy
- About the lesion
  - → Duration? Changing in any way (e.g. growing, appearance, colour)? Blood/discharge/ulceration? Loss of eyelashes? Irritation to the ocular surface? Concern about cosmesis?

How do you conduct the clinical examination?

Your comprehensive examination should include everting all four eyelids and inspecting the fornices. Fairness of skin and lid closure (normal, incomplete) should also be assessed. If a lesion is found, pay particular attention to:

- → Size
- → Location (upper or lower lid, lateral or medial)
- → Symmetry
- → Pigmentation
- → Inflammation
- → Ulceration
- → Consistency (firm, fixed to underlying tissue, mobile)
- → Transillumination
- → Border appearance (well defined, irregular)
- → Eyelashes (loss, misdirection)
- → Fluid or discharge.

With the patient's consent, take high-quality external and slit lamp images (phone cameras are fine). Images are important to document future progression and to send with a referral letter if required.

Low-risk lesions[2,4–6]

Classically benign-looking lesions do not normally require referral. An asymptomatic skin tag, chalazion or papilloma in a younger patient is appropriate to monitor and review after six months. However, referral is indicated if the lesion is changing, is symptomatic or poses a cosmetic concern.

If unsure, I encourage optometrists to send a photo (with patient consent) so a clinical team can take a quick look between consults and advise if referral is appropriate and the urgency. In my experience, this open dialogue between the professions improves the process for all involved. Patients are not needlessly referred, saving precious appointment times for those who need it most. Please check that your local ophthalmologist is happy to receive images in this manner.

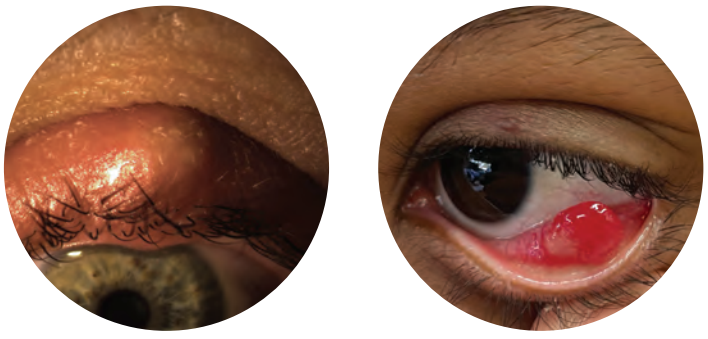

Figure 1.
Left: Patient with a chalazion on the upper eyelid (Source: Dr Lewis Levitz, Vision Eye Institute). **Right:** Pyogenic granuloma following chalazion rupture

Chalazion

Caused by chronic meibomian gland blockage, chalazia are the most common eyelid lesion (**Figure 1**). They can increase in size over several weeks and tend to bulge externally through the skin,and less commonly through the conjunctiva. Although they can be quite large, they are typically harmless.

Most will resolve spontaneously within a few weeks. If necessary, initial treatment with hot compresses can be given. Optometrists can liaise with the patient's GP to consider a six-to-eight-week course of minocycline or doxycycline if eyelid pathology is evident (e.g. blepharitis, rosacea, acne) and the patient is not too symptomatic. Surgical excision is indicated when the chalazion does not respond to medical management after two to three weeks, or when the lesion is large and symptomatic.

Some chalazia remain contained within the tarsus. Others break through anteriorly beneath the skin or on the conjunctival side. In the latter case, the contents of the chalazion trigger a granulomatous inflammatory response (a pyogenic granuloma – **Figure 1**). If this occurs, encourage spontaneous drainage with warm compresses and massage. Despite being called 'pyogenic', these are not infectious, and antibiotics are rarely needed.

Note that some eyelid cancers can be mistaken for a chronic chalazion, so these patients should be referred for a biopsy.

Atypical or recurrent chalazia should be biopsied to rule out malignancy.

Sebaceous cyst

These are small, smooth cysts filled with white-yellow material (sebum). Sebaceous cysts are harmless and rarely turn cancerous, but can become infected.

Squamous papilloma

Originating in the squamous epithelium, these are very common small, wart-like lesions in middle-aged and older adults. Papilloma can be flat or a pedunculated skin tag.

Naevus

A naevus is a small, painless, light or dark brown lesion. These can be congenital or acquired but do not change significantly over time.

Sudoriferous cyst (Cyst of Moll)

This is a common cyst of the apocrine sweat glands on the eyelid margins (**Figure 2**). They have a smooth, round appearance and will transilluminate because they are filled with clear fluid.

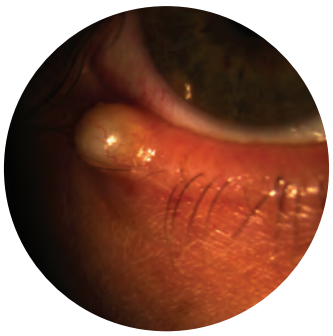

Figure 2.
Patient with sudoriferous cyst (Source: Dr Lewis Levitz, Vision Eye Institute)

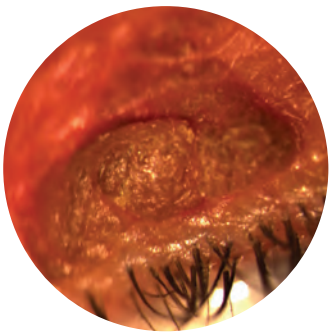

Figure 3.
Patient with seborrhoeic keratosis (Source: Dr Lewis Levitz, Vision Eye Institute)

Seborrhoeic keratosis

These lesions are well defined, greasy looking, often pigmented and papillomatous-like (**Figure 3**). They vary in size and may be described as 'dried, stuck-on mud'.

Solar/actinic keratosis

Solar keratosis is a scaly area found on sun-damaged skin that is considered precancerous/precursor to squamous cell carcinoma (**Figure 4**). Many patients have fair skin with a history of excessive sunburn.

The clinical appearance can vary:

- → Usually found in multiple areas but may be solitary
- → Flat or thickened papule or plaque
- → Scaly or inflamed
- → tender or asymptomatic.

A solitary lesion rarely progresses to SCC. However, having more than ten lesions is associated with a 10–15% lifetime risk of developing SCC.[5,6] A solar keratosis lesion that is tender, thickened, ulcerated or enlarging is suspicious for SCC and should be biopsied and/or excised.

Asymptomatic flat keratoses can be reviewed every six to nine months, with referral for biopsy if any change is noted. →

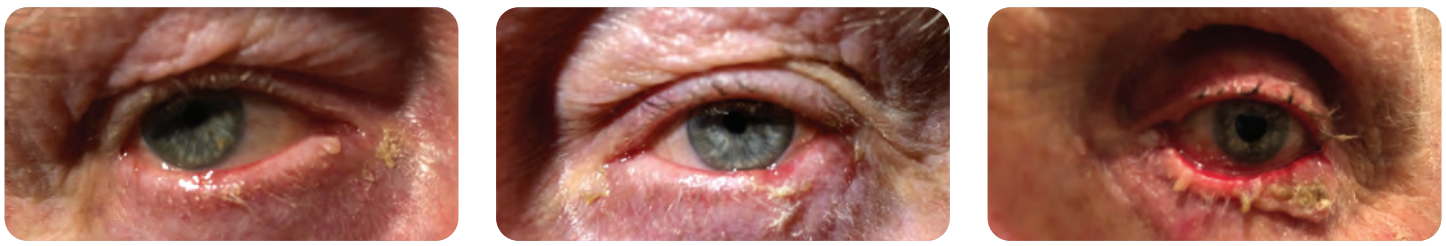

Figure 4.
Left: Patient with solar keratosis. **Middle:** Patient undergoing small wedge excision for early SCC. **Right:** Patient with advanced SCC.

High-risk lesions[2,7,8]

Although skin cancer is the most common of all cancers in Australia, only around 10% affect the eyelids. However, they do pose certain challenges due to the complex anatomical location in which they tend to occur (lower lid, medial canthus). Prompt referral of suspicious lesions increases the likelihood of complete resection, minimal damage to adjacent structures, preservation of normal eyelid function and vision and, in certain situations, prevention of death. Early surgical excision with clear margins is the gold standard treatment.

Not all ophthalmologists perform biopsies so you may want to check first

Red flags that should lower your threshold for referral

- Elderly patient
- Located on lower eyelid (especially medial half)
- History of skin cancer
- History of immunosuppression
- History of long-term UV exposure
- Signs of UV damage (hyperkeratosis, scaling, loss of lashes, bleeding)
- Changing appearance, size or colour
- Disruption of architecture (distortion of eyelid contour or skin)

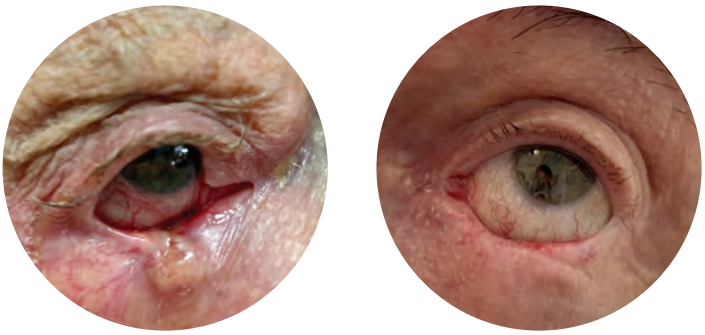

Figure 5.
Left: Patient with advanced BCC who was sent for Mohs surgery to limit eyelid loss. Right: Different patient after removal of an advanced BCC, which required a large excision and sliding skin flap (non-eyelid tissue). He suffers chronic secondary dry eye and discomfort due to the anatomical disruption, including loss of the lower meibomian glands.

Basal cell carcinoma (BCC)

BCC is the most common of all eyelid malignancies, responsible for around 80–90% of cases.[2,8] The classic nodular appearance is a central ulcer (with or without depression) surrounded by pearly edges and telangiectatic changes. Less common are BCCs with diffuse subcutaneous infiltration – these can have a waxy, sclerotic plaque.

As they are locally invasive, most BCCs need to be surgically excised (**Figure 5**). Left untreated, it can extend around the eye and into the orbit (especially the medial canthus). Sinus and brain involvement is also possible.

Squamous cell carcinoma (SCC)

SCC can also be locally invasive, but it is ten times less common than BCC.[7,8] Metastatic spread via the lymphatics or blood system is also rare. Having multiple solar keratoses predisposes the patient to developing SCC.

Classic SCC lesions have rolled edges with central ulceration that may be accompanied by keratotic scaling. But their appearance can range from a flat, hypervascular, flakey lesion to a thickened, well-demarcated reddish tumour surrounded by inflamed tissue.

Beware any long-standing, small, reddish lesion with localised ectropion.

Sebaceous gland carcinoma (SGC)

SCG is very rare but may be suspected in a patient with persistent blepharoconjunctivitis or chronic/recurrent chalazion (especially if asymmetrical). It has been reported that Asians are six times more likely to have eyelid SGC.[8] These carcinomas involve the meibomian glands and typically present as a yellow nodule in the upper lid, along with adjacent inflammation.

Metastasis can occur to regional lymph nodes (pre-auricular and cervical) as well as the lungs, brain, liver and bone.

Malignant melanoma

Melanomas are extremely rare, representing less than 1% of all eyelid tumours.[2,7,8] Carefully check the fornices because they can start at the palpebral/bulbar conjunctiva.

Be suspicious of melanoma if you see:

- → a new, pigmented lesion
- → an old, pigmented lesion with increasing irregularity, rapid growth, bleeding, ulceration or a new satellite lesion.

Monitoring is required for several years following surgical treatment of any eyelid malignancy. These patients also require a full-body skin check by a dermatologist for any other cutaneous cancers.

About the author

Dr Nima Pakrou is an experienced ophthalmologist, with expertise across a range of eye conditions. He completed his initial ophthalmology training at the Royal Victorian Eye and Ear Hospital (RVEEH) and his subspecialty training in the UK. Dr Pakrou's subspecialties include cataract surgery, medical retinal diseases, lacrimal surgery and intraocular inflammation. He practises at Vision Eye Institute Footscray in Melbourne and holds public appointments at the RVEEH and The Alfred.

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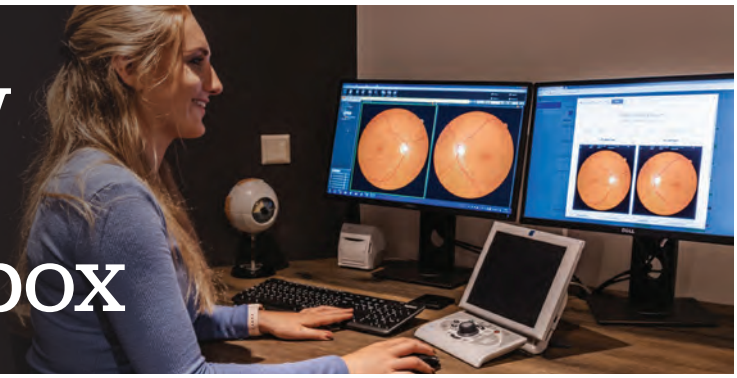
Jason Sun
Chief Operating Officer, Eyetelligence

Adding Narrow AI to the diagnostic toolbox



Artificial intelligence (AI) is changing the way practitioners approach eye disease detection, diagnosis, and management around the world. What was once a concept described in sci-fi books and movies is now becoming a reality. 'Narrow AI' – AI systems that are skilled at one specific task, or a very narrow set of closely-related tasks – is increasingly accessible to optometrists and ophthalmologists for support in their decision making.

Roots in ophthalmology

In April 2018 the United States Food and Drug Administration first approved the application of AI for the detection of referable diabetic retinopathy and diabetic macular oedema from retinal photographs. The deep learning system had been developed by IDx and was approved based on a prospective study of 900 people with diabetes from 10 locations across the United States. For that study, AI used non-mydriatic (2-field) images of the participants for classification; the results of which were compared against decisions by human expert graders using optical coherence tomography (OCT) and mydriatic photography. The AI system was found to exceed stringent pre-specified sensitivity and specificity levels (>85% and >82.5% respectively).[1]

Now, in Australia, Eyetelligence, a MedTech company headed by ophthalmologist Dr Mingguang He (Professor of Ophthalmic Epidemiology at the University of Melbourne), has launched 'Eyetelligence Assure' – a world-first offline AI platform specifically developed to support optometrists in practice by detecting glaucoma, as well as diabetic retinopathy and neovascular age-related macular degeneration. The offline platform ensures sensitive patient information (including fundus images) are kept with the optometrist and do not need to be uploaded onto the cloud. This avoids additional patient consent protocols and cybersecurity risks.

Eyetelligence Assure is based on an AI tool, known as Eyegrader, that Professor He and colleagues developed and extensively tested in Guangzhou, China. Prof He grew up in Guangzhou, trained in medicine and commenced working as an ophthalmologist at the Guangzhou Zhongshan Ophthalmic Centre – one of China's major hospitals dedicated to eye care – eventually becoming Chair of Department and deputy CEO.

In 2015, he took up residency in Australia, having been offered a research acceleration professorship from the University of Melbourne and Centre for Eye Research Australia. This enabled him to focus attention on further expanding and refining his AI platform.

Eyetelligence Assure, which uses a convolutional neural network, was trained with over 200,000 ophthalmologist-labelled full colour fundus images (including both lesion and non-lesion regions) to detect and grade diabetic retinopathy, glaucoma, and neovascular age-related macular degeneration. The AI algorithm was validated with an independent sample comprising thousands of multi-ethic images collected from various clinical settings in Australia and countries around the APAC region.[2,3]

Eyetelligence Assure will not replace a clinician. Instead, it is a valuable support tool that can assist with standardising clinical approaches and supporting clinical diagnosis.

In the case of glaucoma, the algorithm was trained to recognise signs such as vertical cup disc ratio changes, localised RNFL defect, and disc haemorrhage etc. It then classifies individual images as high risk, medium risk/suspect, or low risk / negative result.

Classifications are accompanied by a stated confidence level, which demonstrates how certain the AI is based on the tens of millions of data parameters it has been trained with.

Together with the Centre for Eye Research Australia and Monash University, Eyetelligence won a prestigious and competitive $5 million Medical Research Future Fund grant in 2019 to further refine AI algorithms to better suit real-world clinical settings.

Now TGA and CE-approved, Eyetelligence Assure has been trialled and is in use in independent and corporate optometry practices across the country. In response to feedback, Prof He and Chief Research Officer Dr Zongyuan Ge continue to refine, while expanding the capability of this AI platform.

Accuracy in clinical support

Eyetelligence Assure can detect and grade glaucoma, referrable diabetic retinopathy (DR) and referrable neovascular age-related macular degeneration with 95% accuracy.[2,3]

At a time when the prevalence of eye disease is increasing due to Australia's ageing population,[4] the platform is designed to provide optometrists of all levels of experience with greater confidence in their decisions. Additionally, as a tool that generates reports it can also be used to explain findings to patients, provide the rationale for further testing that may incur out of pocket expenses, and prepare thorough referrals if required.

In a clinical practice, once a retinal image is taken, Eyetelligence Assure screens the image for eye diseases and generates two reports – a fundus grading report for the patient's health professionals and one for the patient themselves.

The fundus grading reports are presented with traffic light indicators: red (high risk), orange (medium risk/suspect) and green (low risk/negative), making it easy for all clinicians and staff, regardless of expertise or experience to perform the test and refer the results to the optometrist to see if the patient requires appropriate in-clinic investigations e.g., (visual field tests, OCT), or needs to be referred. Responses to an unpublished survey of Australian optometry practices have shown Eyetelligence Assure is highly accurate and specific in identifying patients requiring visual field testing. This allows a more targeted approach to visual field testing and improves optometrists' ability to bill Medicare or the patients, while ensuring potential glaucoma patients are being investigated appropriately.

Figure 1 presents the case of a patient in a real-world clinical setting, where OCT shows the right eye has a very large vertical cup disc ratio and some neuroretinal rim loss, while the left eye has thinning of the inferior and superior neuroretinal rim. In this case, Eyetelligence Assure determined that the patient is at high risk or certain for glaucoma in the right eye and at medium risk for the left eye. Once the structural findings are confirmed with a visual field test, a referral to an ophthalmologist is indicated.

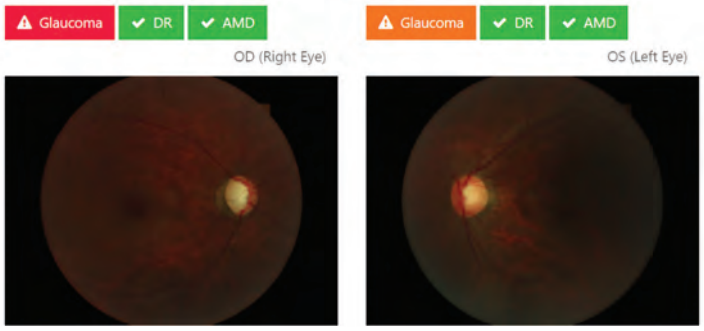


Figure 1. In a real world setting, Eyetelligence Assure determined that this patient is at high risk or certain for glaucoma in the right eye and at medium risk for the left eye.

Figure 2. Eyetelligence Assure identified small notching and a retinal nerve fibre defect in this patent's right eye

While **Figure 1** was relatively straight forward, **Figure 2** demonstrates the potential for Eyetelligence Assure to support practitioners when challenging cases present in a busy practice. In the right eye, the Eyetelligence Assure software was able to detect small notching and a retinal nerve fibre layer defect. The software labelled the right eye as medium risk for glaucoma. The left eye was relatively normal, with a healthy rim. Visual field testing was required to confirm the presence of glaucoma and the report generated can be used to educate the patient about the finding and need for further examination.

False positives, false negatives

While AI is rapidly evolving, and the Eyetelligence Assure platform detects and grades glaucoma, referrable diabetic retinopathy and referrable neovascular age related macular degeneration with 95%[2,3] accuracy, one in 20 cases will present with a false positive.

There are several reasons for this:

- → As a support tool the platform works with a single image and no other clinical data eg., clinical presentation, signs, findings from additional examinations such as intraocular pressure, visual fields, OCT etc,
- → Although Eyetelligence Assure has a built-in automated quality control system, classification may vary depending on image quality, artefacts, and pixel features of the fundus camera,
- → Certain features or artefacts cannot yet be recognised by the algorithm, eg. when a very young retina is scanned, the inner limiting membrane reflection artefact misleads the AI, resulting in a false positive classification for diabetic retinopathy. Despite this, the platform is still of value for examining young eyes as it can detect and classify any presence of glaucoma optic neuropathy.

For these reasons, Eyetelligence Assure will not replace a clinician. Instead, it is a valuable support tool that can assist with standardising clinical approaches and supporting clinical diagnosis.

As is the case with human diagnosis, false positive classifications can occur with Eyetelligence Assure (5% of cases) and false negatives will occur (10% of cases). Most false negatives will occur in the presence of other remarkable abnormalities, such as co-existing eye diseases, warranting further investigation.[2,3]

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Form and function: Makeup, cosmetic procedures and eye health

Makeup and cosmetic procedures can have vastly different effects on the ocular adnexa, and some cosmetic procedures can even affect patients systemically. Patients may be unaware of the risks of these kinds of procedures. Being able to provide general advice regarding makeup techniques and best practices can be valuable for our patients, especially those with ocular surface disease.

Makeup

Makeup has been used since ancient times; the use of Kohl eyeliner dates back to the Bronze age, approximately 4000BC.[1] Nowadays the use of makeup is commonplace. A study conducted on over 1200 females aged 20-35 years old showed the prevalence of its use was as high as 90%.[2] It is difficult to find clinical research relating to makeup use across all sexes, however a Korean study, which also included perfume and hair products, found that 7% of males use some type of cosmetic product.[3]

Makeup application around the eyes includes mascara which is brushed onto eyelashes to accentuate their length and thickness, eyeliner which is placed around the eyelid margin to accentuate the size and darkness of the eyes, and eyeshadow which is applied to the upper lids for accenting eye shape, colour and as decoration. As optometrists we will most likely see makeup on the eyelashes, eyelid margin, on contact lenses or migrated into the tear film.[4] Numerous studies report this can occur due to eye rubbing, passive migration and poor or inadvertent application techniques.[4] This can cause symptoms of ocular irritation.[1] The implications of makeup debris around the eye or in the tear film can vary, from transient tear film instability and ocular surface irritation to blepharitis, keratitis and even pigmentary lesions in the conjunctiva or tear film drainage system.[4] There have been reports of patients with large black lesions, presumed melanomas, removed only to find they're clumps of pigment with an inflammatory casing.[5] A common but significantly damaging makeup procedure is "tightlining" which is where eyeliner is applied to the inside rim of the eyelid margin.[1,4] This process actively blocks the meibomian gland openings along the eyelid margin which in turn can cause gland atrophy and chronic dry eye.[1] Research shows application of eyeliner causes acute irritation 96% of the time when applied on the inner lash line as opposed to 20% of the time when applied to the outer lash line.[6]

Lastly, traditional Kohl, an eyeliner type product, contains lead. Patients using it in spiritual practices, such as in some African, Middle Eastern and South Asian communities, should be warned of the risk of this product.[1]

Furthermore, makeup products should be replaced regularly, every three to six months or more often if displayed on the packaging, to minimise the risk of infection.[1] A study showed that after three months of use, bacteria was found in 30% of mascaras tested.[1] Anecdotally, I find patients are unaware or apathetic of this recommendation due to large product volumes and wastage or cost of frequent replacement. Products such as cake mascara where water is added to apply should not be used due to microbial infection risks from the water.[1] Other products with high water content such as liquid eyeliner or water-based mascara have a higher chance of bacterial contamination and should be replaced more regularly.[1] Pencil-based products such as eyeliner which can be sharpened, and hence bacteria removed, can be safer than other creme products.[1] Water-proof mascara, which is solvent based, have added components to minimise bacterial growth, but in turn are more difficult to remove.[1]

Removal of makeup is paramount for skincare and eye care. Products which are water-based may be removed with water only; however most products have some component which is lipophilic requiring an oil-based makeup remover to remove it effectively.[1] Oil-based makeup removers have been shown to remove waterproof mascara and have the least effect on the tear film, yet all makeup removers tested (including micellar water) caused an increase in tear film evaporation.[4] Furthermore, there is sufficient research to show eyelid cleaning formulations have a subjective improvement in chronic eye discomfort and clinical improvement in meibomian gland blockage and dry eye for patients with heavy use of makeup.[7]

So, how can we educate patients?

- → When choosing makeup, we can advise them to look for ophthalmologically tested makeup
- → We can remind them to be careful when applying makeup around the eyes; eye products should be applied outside the eyelashes and eyelid margin, and eyeshadow or cream products shouldn't be used right up to the eyelid margin.
- → We should remind them to replace products after three to six months or sooner if advised on the packaging
- → Makeup should be effectively removed with an oil-based makeup remover
- → Contact lenses should be inserted before makeup application and taken out before removal of makeup if they're reusable lenses

Cosmetic use of ocular medications

In the grey area between makeup and cosmetic procedures lies the use of eyelash growth serums or products.[1] Optometrists know the family of prostaglandin analogues as the first-line topical treatment for glaucoma, and may also know that in overseas markets there is an eyelash growth product called Latisse which is made from bimatoprost 0.03%.[8] Aside from the intended use outcomes in the case of glaucoma, it can also cause a higher prevalence of meibomian gland dysfunction.[8] Anecdotally when patients ask me about this product, I find they don't realise the implications of it making lashes thicker and darker also means increased periorbital pigmentation and even the potential for iris colour change.[1]

Cosmetic Procedures

Cosmetic procedures around the eye may include eyelid or eyebrow tattooing, eyelash dying, and extensions or perms. Lid surgery or periorbital fillers and botulinum toxin (botox) for treatment of rhytides (wrinkles) are also performed. Allergic reactions are the most commonly encountered side effect of eyelash extensions and eyelid tattooing with the prevalence being 79% and 56% respectively.[9]

Only recently in the December 2020 edition of *Optometry Connection* there was an extensive article by Leigh Plowman about the risks of false eyelashes.[10] The procedure of eyelash extensions is attaching animal hair or artificial lashes to the natural lash with glue.[9] Eyelash extensions have been shown to cause ocular side effects 73% of the time.[9] These side effects range from itching and redness to serious conditions such as toxic conjunctivitis and conjunctival erosion.[9] Many factors of the process, such as the gel used to hold down natural eyelashes to the glue used to attach false lashes, are allergy provoking.[9] For example, the glue used is most commonly formaldehyde-emitting.[9] Furthermore, mechanical side effects such as nocturnal lagophthalmos, incomplete blinking and traction alopecia have also been reported.[8,9]

Eyelash dying involves semi-permanent dye applied to the lashes, with petroleum jelly often used as a protective barrier to the periorbital skin.[9] Eyelash dye and curlers can also cause adverse effects such as allergic conjunctivitis and dermatitis.[9] →

As optometrists we will most likely see makeup on the eyelashes, eyelid margin, on contact lenses or migrated into the tear film.

Eyelid tattooing, also known as blepharopigmentation, is the practice of tattooing along the eyelash margin for the effect of permanent eyeliner.[9] Adverse reactions include dermatitis and allergic reactions to the pigments used.[9] Inadvertent pigmented ocular penetration (tattooed conjunctiva) and meibomian gland blockages or dysfunction after permanent eyelid tattooing has been recorded, as well as corneal burns from the numbing cream.[9,11] Eyebrow tattooing or eyebrow hair removal laser treatment can also be dangerous to the eye due to Bell's phenomenon, where the eyes roll back when closed and hence sensitive eye tissue is closer to tattoo needle and laser penetration.[11-12] Cases of uveitis, vitreous haemorrhage, macula hole and traumatic iris injury have been reported after cosmetic laser procedures.[11-12]

Cosmetic injectables can relate to dermal fillers or botox and are used cosmetically for improving the appearance of dark circles under the eyes or wrinkles.[11,13] Dermal fillers may be from a range of substances such as autologous fat or hyaluronic acid and are injected periorbitally.[11] Of importance, side effects are rare but can be as serious as vision loss due to inadvertent vascular injection causing an embolus in the ophthalmic artery.[11] Botox is also used periorbitally for treatment of rhytides.[11] Botox was actually first used in the eye for strabismus, hence it can be used in ophthalmology to treat lid conditions. As a consequence it can also cause muscle paralysis of the eyes or eyelids causing eyelid droop and double vision.[11]

How can we educate patients?

- → We advise that magnetic false eyelashes are a good alternative to more permanent eyelash extensions[8]
- → We should advise patients to use eyelid and eyelash cleaning products if they've got eyelash extensions
- → We should warn against eyelid tattooing
- → For all cosmetic procedures we should advise patients to be cautious about the practice and clinicians they see, for example, excellent knowledge of facial vascular anatomy is very important for clinicians using dermal fillers and Botox
- •

"This is a follow up article to "Anti-aging & Eyecare - Curious about skincare and cosmeceuticals?" **which was published in the July 2021 edition of Optometry Connection™.**

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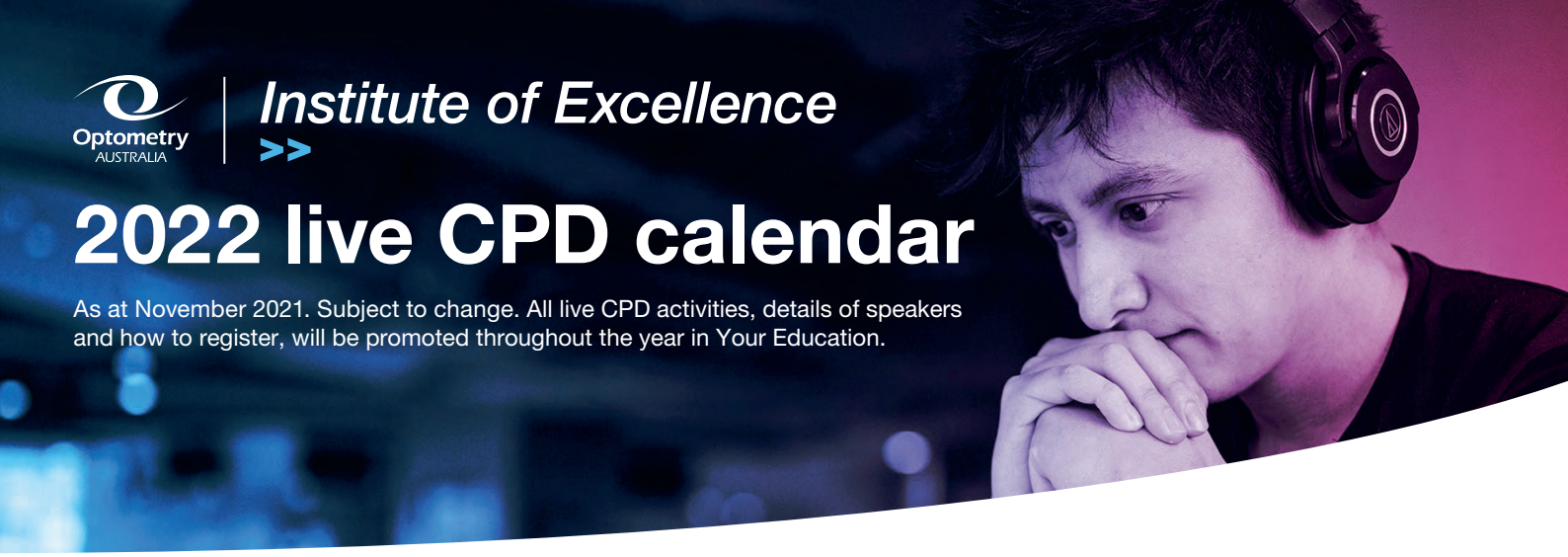

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2022 live CPD calendar

As at November 2021. Subject to change. All live CPD activities, details of speakers and how to register, will be promoted throughout the year in Your Education.

Monthly webcast series

Month	Date	Time (AEST/AEDT)	Theme
January	18 January 2022	7:30pm AEDT	PII and Risk Management
February	15 Februrary 2022	7:30pm AEDT	Medicare Billing
March	15 March 2022	7:30pm AEDT	OCT/Glaucoma
April	19 April 2022	7:30pm AEST	Dry Eye
May	24 May 2022	7:30pm AEST	AMD
June	17-19 June 2022		Optometry Virtually Connected
July	19 July 2022	7:30pm AEST	Diabetes
August	16 August 2022	7:30pm AEST	Refractive Surgery
September	20 September 2022	7:30pm AEST	Contact Lenses
October	18 October 2022	7:30pm AEDT	Retinal Disease
November	15 November 2022	7:30pm AEDT	Myopia

Optometry Virtually Connected 2022

Date	Stream 1	Stream 2
Friday 17 June 2022	Combined Plenary Session	
Saturday 18 June 2022	Contact Lens	Retinal Disease
Sunday 19 June 2022	Anterior Eye Disease	Glaucoma & Neuro Optometry

Interactive Discussion Workshops

Series	Session	Dates
Dry Eye	Session 1	16 February 2022
	Session 2	23 February 2022
	Session 3	2 March 2022
	Session 4	9 March 2022
Myopia Management	Session 1	27 April 2022
	Session 2	4 May 2022
	Session 3	11 May 2022
	Session 4	18 May 2022

9/10

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