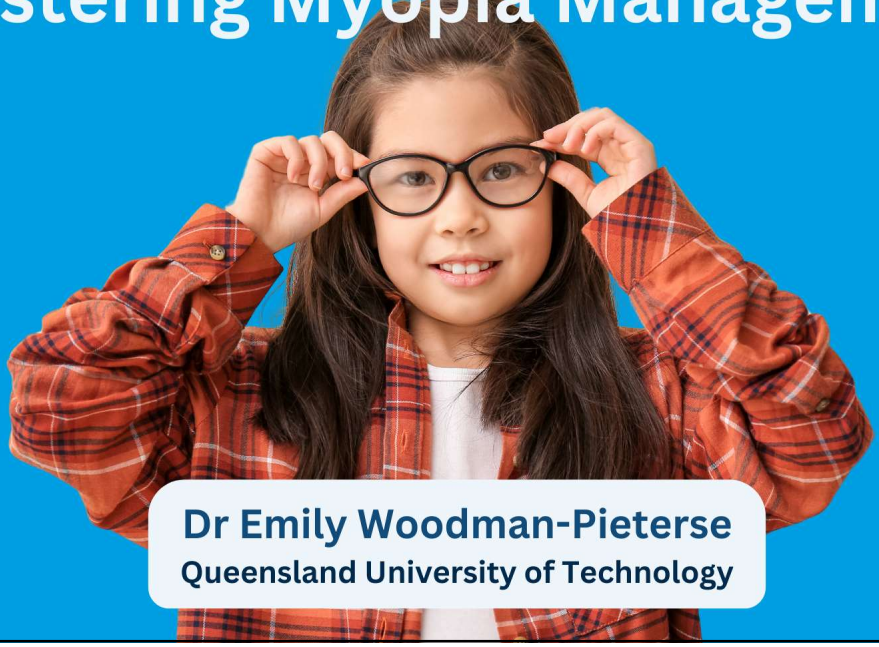
Mastering Myopia Management



Dr Emily Woodman-Pieterse
Queensland University of Technology

1

Assessing risk

2

Coming Up… Poll Question 1

- Have Your Device or Browser Ready

  Virtual Delegates – Scroll Down On Your Device To Interact Polls

  Or go to www.slido.com & enter code: 3450 959

- Or Scan QR Code:

- If you participated in Day 1, this is the same QR /Code for today's Poll Day 2

3

slido

Poll 1: Which of the following risk factors do you think has the greatest impact on rate of myopia progression?

ⓘ Start presenting to display the poll results on this slide.

4

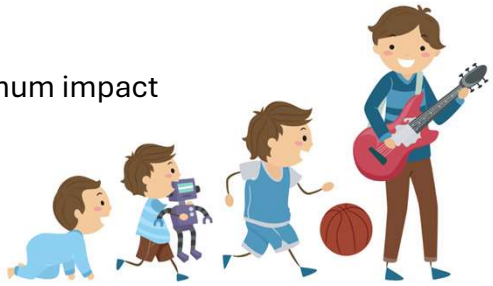
NON-MODIFIABLE RISK FACTOR

Age of onset

- No greater predictor of rate of progression
- Younger age = faster progression:
  - **10 y.o. progression rate ~40% of that of a 7 y.o.**
  - **13 y.o. progression rate ~25% of that of a 7 y.o.**
- Younger age of onset = more years left of eye growth

➡ **Higher myopia in adulthood**

- Start treatment as early as possible for maximum impact

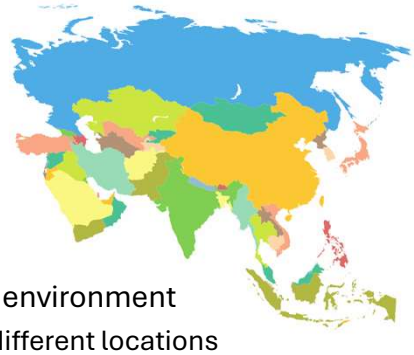


5

NON-MODIFIABLE RISK FACTOR

Ethnicity and geography

- **Ethnicity** is 2nd strongest predictor of progression
- 50% faster progression in Asian children
- Highest myopia prevalence in East Asia
  - 5-10x higher risk in East Asian ethnicity
  - 3-5x higher risk in any non-white ethnicity



- **Geography** is influenced by the urbanisation of the environment
  - Prevalence differs between same ethnicity living in different locations
  - Prevalence similar between different ethnicities living in same location
- Rates of myopia higher in urban vs rural areas

6

NON-MODIFIABLE RISK FACTOR

Parental history and genetics

- **60-80% of myopia is hereditary**
- Risk increases with no. of myopic parents:
  - 10% with no myopic parents
  - 20% with one myopic parent
  - 40% with two myopic parents
- **Parental history** of myopia linked to higher myopia, longer axial length, faster progression
- **Syndromic myopia** results from inherited genetic defect
  - High myopia accompanied by other ocular or systemic disorders (e.g. Marfan, Stickler, Ehlers Danlos syndromes; retinal dystrophies, ROP)
  - **RED FLAG** – if no. of dioptres is more than patient age

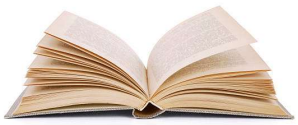
7

MODIFIABLE RISK FACTOR

Near work and screentime

Near work

- Risk increases due to nature of near work, not total hours of near work
- Increased risk of developing myopia in children who:
  - Continuously read for >30 mins
  - Shorter working distances (<30 cm)
  - Read >2 books/week



Digital screentime

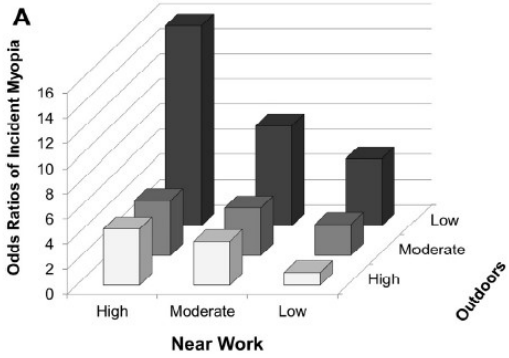
- No clear association between digital screen time and myopia
- Rise in myopia in East Asia predates digital devices
- Substitution of previous pen-to-paper tasks with screentime

8

MODIFIABLE RISK FACTOR

Outdoor Activity

- Highest levels outdoor activity linked with lowest levels of myopia
  - 2-5% lower risk per hour outdoor activity/week
- Increased outdoor time reduces impact of parental myopia and near work
- Time outdoors not physical activity
- Potential mechanisms – retinal dopamine, higher SF, longer wavelengths
- Appears more effective in preventing myopia onset, than slowing progression



(Rose et al., 2008)

9

Coming Up… Poll Question 2

- Have Your Device or Browser Ready

  Virtual Delegates – Scroll Down On Your Device To Interact Polls

  Or go to www.slido.com & enter code: 3450 959

- Or Scan QR Code:

- If you participated in Day 1, this is the same QR /Code for today's Poll Day 2

10

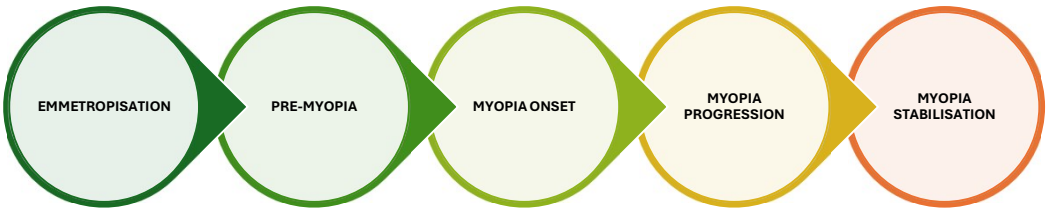
slido

Poll 2: Which of the following patients would be considered to have the greatest risk for high myopia development in the future?

ⓘ Start presenting to display the poll results on this slide.

11

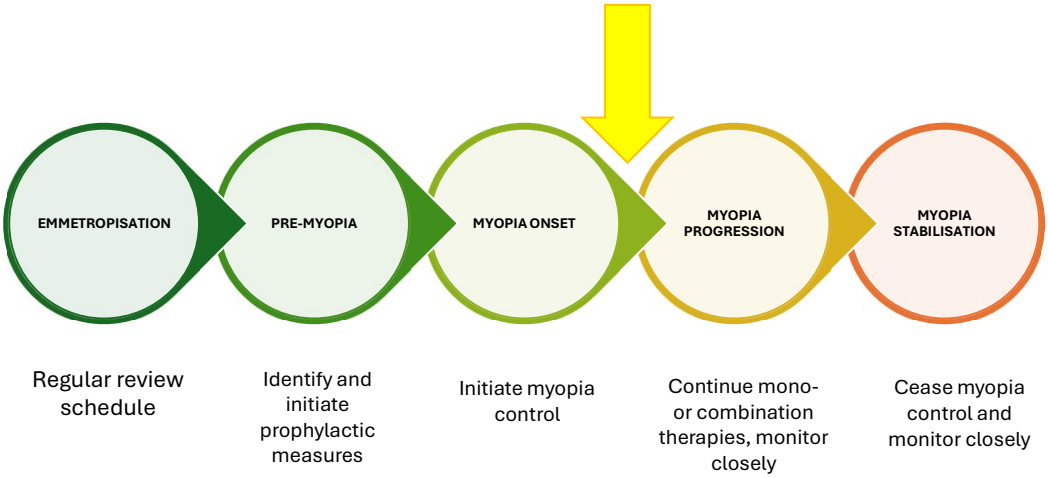
Spectrum of myopia



Regular review schedule	Identify and initiate prophylactic measures	Initiate myopia control	Continue mono- or combination therapies, monitor closely	Cease myopia control and monitor closely

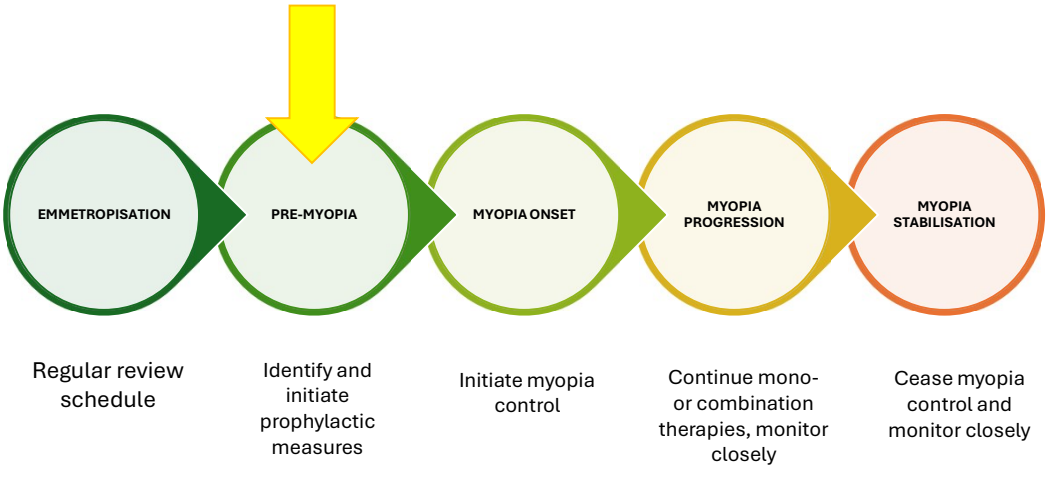
12

Traditional myopia control intervention



13

Prophylactic treatment – new paradigm



14

Public health strategy

Primary prevention – prevent onset in childhood

- Increase outdoor time & reduce educational pressures, esp. in early childhood
- Implementation of nationwide public health programs, school-based initiatives

Secondary prevention – early myopia control

- Prevent low myopia from becoming high myopia in adolescence/adulthood
- Traditional myopia control strategies tailored to individual patient

Tertiary prevention – prevent worsening of disease

- Prevent high myopia from progressing to pathological myopia
- Medical/surgical treatments

15

Interventions to delay or prevent myopia

- Modelling suggests delayed myopia onset has a greater effect than using myopia control on manifest myopia
- East Asian populations – each year of delayed onset ~ −0.75 D saved from final SER
- Non-Asian cohorts save ~ −0.25 to −0.50 D per year of delayed onset

16

Identifying the pre-myope: refraction

- Level of emmetropia/low hyperopia for a given age is the single best predictor of myopia development

Considered to have pre-myopia if refraction is:

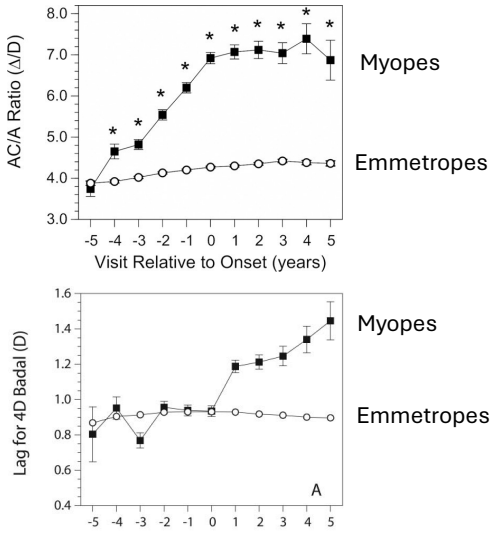
< +0.75 D at 6 years
≤ +0.50 D at 7-8 years
≤ + 0.25 D at 9-10 years
≤ plano at 11 years

- Refractive change
  - Pre-myopes exhibit shifts of ~ −0.25 D/yr, 3-4 yrs prior to myopia onset
  - Emmetropes have more stable refraction ~ −0.25 D over 8 yrs

17

Identifying the pre-myope: binocular vision

- Accommodative convergence to accommodation (AC/A) ratio
  - Ratio increases up to 4 years prior to onset of myopia and remains higher after onset
- Accommodative posture
  - Myopic children more likely to have higher/more variable lag
  - Higher lag likely a consequence rather than cause of myopia



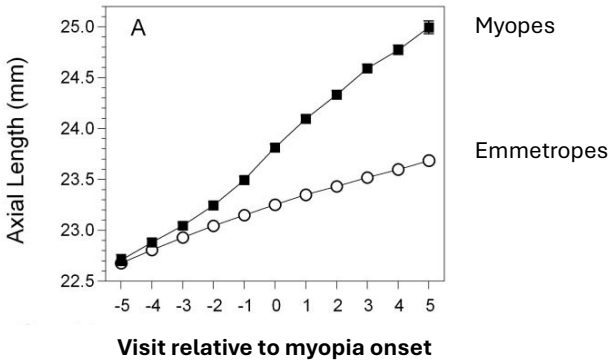
(Mutti et al., 2017)

(Mutti et al., 2006)

18

Identifying the pre-myope: biometry

- Axial length
  - Rate of elongation increases 3-4 yrs prior to myopia onset (≥ 0.20 mm/yr)
  - Most rapid 1-2 yrs prior to onset (≥ 0.30 mm/yr)
- Subfoveal choroidal thickness
  - Fastest growing eyes exhibit less choroidal thickening (< 5µm/yr)
  - Slower growing eyes exhibit greater choroidal thickening (> 10 µm/yr)



(Mutti et al., 2007)

19

Prophylactic interventions

Light-based

Outdoor time*
Classroom lighting
Red light therapy*

Environmental-based

Green space
Sleep
Wearable devices

Pharmacological

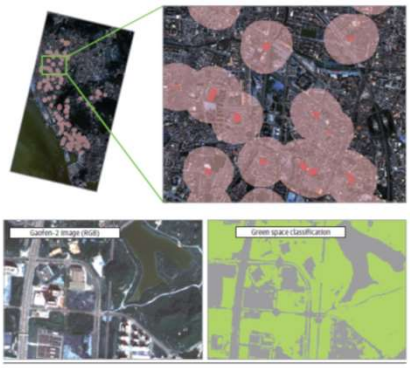
Low dose atropine

20

Environmental-based Interventions

Green Space

High res satellite imaging used to estimate normalised difference vegetation index (NDVI)



(Yang et al., 2024)

- Myopia prevalence higher in urban vs rural areas
- Lower myopia prevalence of myopia in children who live closer to green space
- Higher NDVI, lower myopia incidence
- Lower incidence in primary schools with: larger and more aggregated green space, and better connectivity and less distance between green spaces
- **Potential mechanisms**:
  - Greater incentive to go outdoors
  - May encourage children indoors to look in the distance through windows
  - Higher spatial frequencies in natural environment than man-made or indoor environments

21

Environmental-based Interventions

Sleep

- Sleep duration and timing associated with myopia in school children
- Chronotype is an individual's circadian preference
  - 3 main chronotypes – early, intermediate, late
- Increased risk of myopia with:
  - Shorter sleep duration
  - Later bedtime, wake up time and sleep midpoint (later chronotype)
  - Longer weekend catch up sleep correlated with higher myopia prevalence
- Many potential mechanisms, most popular that circadian rhythms are interrupted, which interrupts normal emmetropisation

22

Environmental-based Interventions

Wearable Devices

- Allows child or parent to monitor near work behaviours and outdoor activity
- Light sensor to measure ambient lighting:
  - Intensity, spectral content, timing and duration
- Accelerometers:
  - Sleep patterns & circadian rhythms
- Spec mounted range finders (infrared, ultrasound)
  - Working distances
- Can provide feedback to wearer through smartphone applications (e.g. iPhone, Apple watch)

23

Pharmacological Interventions

Low Dose Atropine

- Various concentrations used in pre-myopic populations
- **Protocol**: LAMP RCT with 0.05%, 0.01%, placebo each night for 2 yrs (Yam et al., 2023)
- **Results**:
  - 0.01% no additional benefit over placebo
  - 0.05% - significantly lower myopia incidence (28%) than placebo (53%) and 0.01% (46%)
  - Fewer children in 0.05% group were 'fast' progressors (1D shift)
- Retrospective cohort – 0.025% decreased SER progression over 12 m by 75% compared to control (Fang et al. 2010)
- **Concerns**: side effects (photophobia, blur), rebound, treatment duration

24

Myopia Control Interventions

25

Coming Up… Poll Questions 3 & 4

- Have Your Device or Browser Ready

  Virtual Delegates – Scroll Down On Your Device To Interact Polls

  Or go to www.slido.com & enter code: 3450 959

- Or Scan QR Code:

- If you participated in Day 1, this is the same QR /Code for today's Poll Day 2

26

slido

Poll 3: Which of the following is not considered a first-line myopia control treatment?

ⓘ Start presenting to display the poll results on this slide.

27

slido

Poll 4: Which of the following spectacle lens options is considered most effective for slowing myopia progression?

ⓘ Start presenting to display the poll results on this slide.

28

Efficacy in myopia control

HIGH LEVEL CONTROL (40-60% REDUCTION)

- Low dose atropine (0.025%+), OrthoK, multifocal CLs, Miyosmart & Stellest spectacles

MODERATE LEVEL CONTROL (30-40% REDUCTION)

- Essilor Myopilux Max (prismatic executive bifocals)

LOW LEVEL CONTROL (20-25% REDUCTION)

- Essilor Myopilux Plus, other novel spec designs, short corridor PALs (adds ≥ +2D)

INEFFECTIVE

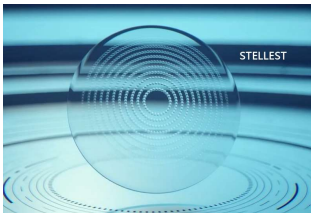
- Single vision distance spectacles and CLs, under- or overcorrection, antifatigue lenses

29

Miyosmart and Stellest spectacle lenses

Hoya Miyosmart

- Defocus Incorporate Multiple Segments (DIMS)
- Clear distance surrounded by tiny segments providing myopic defocus in mid-periphery

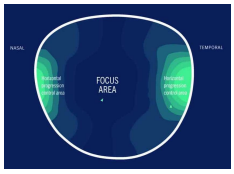


Essilor Stellest

- Highly aspherical lenslet (HAL)
- Central distance zone surrounded by 11 concentric rings of aspherical lenslets giving ‘volume of myopic defocus’

30

Emerging spectacle designs



Sightglass Vision DOT lens (not in AUS)

- Diffusion Optics Technology (DOT) lenses incorporate light scattering elements to reduce peripheral retinal contrast
- Contrast theory – activity of contrast signalling pathways in the retina drives eye growth during refractive development

Rodenstock MyCon

- Asymmetric horizontal progressive addition lens

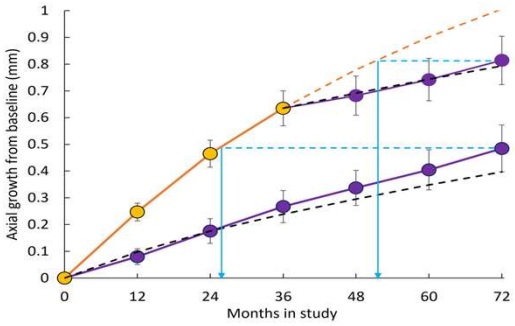
Zeiss Myocare

- Cylindrical Annular Refractive Element (CARE)

31

Dual focus/multifocal soft CLS

- **First-line soft lens choice**:
  - MiSight 1-day – 6 yr data available, continued tx effect, mirrors physiological axial growth
  - No cyl correction, only 1 BC
- **Alternatives**:
  - Biofinity **D centre MF +2.50 add only**
  - EDOF designs
    - Mylo lens (fully customisable)
    - SEED 1day Pure EDOF (mid add)
  - NaturalVue
- **Considerations**:
  - Centration important
  - Over-correction of myopia may be necessary



(Chamberlain et al., 2023)

32

Orthokeratology

- High efficacy over first 2-3 yrs
- Patient characteristics for greater AL control:
  - Larger pupil size (>6.4 mm)
  - Higher SER
  - Smaller BOZD
    - 5 mm vs 6 mm
  - Greater compression/Jessen factor
    - 1.75 D vs 0.75 D
- **Considerations**: rebound <14 yrs, haloes and glare, microbial keratitis

33

Low dose atropine: overview

- Causes mydriasis and cycloplegia in dose dependent manner
- Used in PM before bed, side effects peak while asleep
- **High level efficacy for 0.05-0.025%** (LAMP Study):
  - 0.05% gives best balance between efficacy and side effects
  - 0.025% lowest concentration prescribed in Asian children
- **Low evidence for 0.01% efficacy** (Eikance)
  - Greater efficacy in Caucasian populations
- Eikance commercially available, higher % requires compounding
- Treatment duration ~2-5 years followed by gradual taper

34

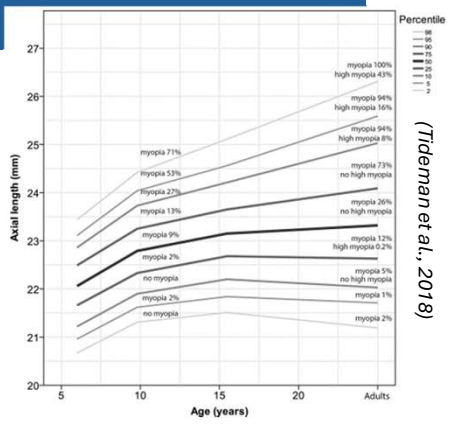
Combination treatments

- Optical and pharmacological treatments target different myopia control pathways
- Broadly speaking, combination treatments more effective than each treatment as monotherapy
- Evidence only exists for some combinations:
  - **Effective**
    - 0.01% atropine + OrthoK
    - 0.01% atropine + Miyosmart
    - 1% atropine + bifocals
  - **Ineffective**
    - MiSight 1-day + 0.01% atropine
    - Biofinity D-centre MFCL (+2.50 add) + 0.01% atropine
- **Have a low threshold for initiating dual/combination treatments**

35

Assessing progression

- **Cycloplegic refraction**
  - 1% cyclopentolate or 2 gutt 1% tropicamide (5 min apart)
  - Refract 30-60 min after first drop
  - Repeatability is better with cycloplegia
  - Autorefraction in addition to subjective refraction
- **Axial length**
  - 7x more sensitive than cyclo rx for measuring progression
  - Gold standard for monitoring
  - Use percentile growth curves or approximate rule to differentiate true progression from physiological eye growth



(Tideman et al., 2018)

RATE OF AXIAL ELONGATION IN CHILDREN	
Physiological growth	0.1 mm/year
Myopic progression	0.2 to 0.3 mm/year

(Mutti et al., 2007)

36

Treatment cessation

Myopia naturally stabilises with age

(Hughes & Woodman-Pieterse, 2024)

When to consider ceasing treatment?

- >15-16 yrs AND >12 m of stability
- Axial elongation can continue into adulthood in top 50th percentile

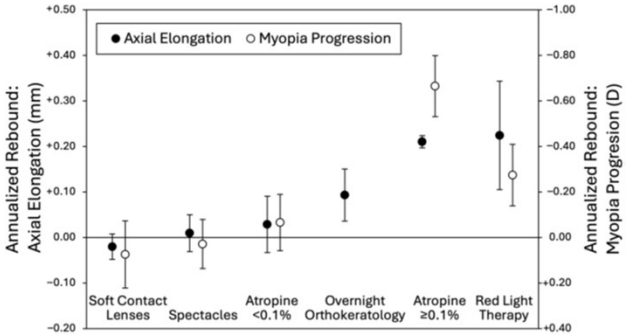
Considerations:

- Continue optical treatments as long as tolerable
- Review closely (3-6 m) and recommence treatment if necessary
- May extend treatment for those undergoing tertiary studies, other myopigenic lifestyle factors

37

Rebound on cessation of treatment

- Greater rebound associated with treatments with higher efficacy
- No rebound for specs or CL
- Minimal rebound for <0.1% atropine
- **Marked rebound**:
  - RLRL therapy
  - >0.1% atropine
- Difficult to interpret due to:
  - Cycloplegia
  - Change in CCT
  - Change in ChT
- Ideally need 1 year of data



(Bullimore & Brennan, 2024)

38

Coming Up… Poll Question 5

- Have Your Device or Browser Ready

  Virtual Delegates – Scroll Down On Your Device To Interact Polls

  Or go to www.slido.com & enter code: 3450 959

- Or Scan QR Code:

- If you participated in Day 1, this is the same QR /Code for today's Poll Day 2

39

slido

Poll 5: 8 y.o. male returns for 6/12 review after starting 0.025% atropine. Myopia has increased by −0.50 D and axial length by +0.20 mm in each eye. Which is the least appropriate management plan?

ⓘ Start presenting to display the poll results on this slide.

40

Thank you!

Dr Emily Woodman-Pieterse
Centre for Vision and Eye Research
Queensland University of Technology

e.pieterse@qut.edu.au

41