Towards Personalised Myopia Control:

Predictors of Treatment Response in Paediatric Myopia Management

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INTRODUCTION

Myopia is a leading ophthalmic and public-health challenge of the 21st century. By 2050, **≈50 % of the world** may be myopic.

High myopia carries lifelong, sight-threatening risk: **myopic maculopathy, retinal detachment, glaucoma, cataract**.

Yet **treatment response remains highly variable**. Selection is still driven by clinician preference, parental acceptance and cost — not validated predictive markers.

AIM

To evaluate **2015 – 2025** evidence on **predictors of treatment response** in paediatric myopia, and assess the readiness of **responder profiling** for NHS clinical translation.

METHODS

Search: PubMed · Embase · Cochrane (2015 – 2025).
Eligibility: RCTs, meta-analyses, cohorts, UK / IMI policy.
Extracted: age, ethnicity, refraction, AL, parental Hx, behaviour.
Outcomes: refraction & axial-length progression.

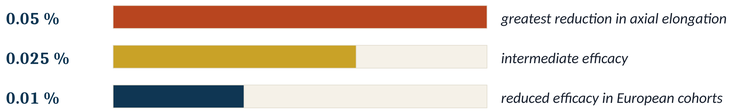
RESULTS

1. Age & Baseline Progression

6 – 10 yrs — Greatest absolute treatment benefit across atropine, OK and optical interventions — earliest possible initiation.

Rapid progressors — Greatest proportional slowing — particularly with higher-concentration atropine and orthokeratology.

2. Pharmacological — Atropine (LAMP, ATOM2)



East-Asian cohorts respond strongly to lower doses. **European cohorts** show reduced efficacy at 0.01 %. **Parental myopia** → stronger atropine response.

3. Orthokeratology & Optical Interventions

Orthokeratology consistently slows axial elongation, especially in rapid early progressors (ROMIO; Hiraoka 2012). **Dual-focus & peripheral-defocus contact lenses** (MiSight; BLINK) suit children with high accommodative lag.

4. Behavioural & Environmental Factors

OUTDOOR EXPOSURE

Slower untreated progression — reduces incident myopia in school-cluster RCTs (Wu 2018).

PROLONGED NEAR-WORK

Faster progression — yet rarely incorporated into predictive treatment algorithms (Tideman 2018).

5. Emerging AI & Predictive Models

Machine-learning models combining age, ethnicity, AL, parental myopia & early treatment response show **moderate predictive accuracy** (Yang 2024; Mak 2024). No validated AI tool yet exists for routine clinical use.

DISCUSSION

1. Most transformative gap

Responder profiling is the least developed yet most promising area in paediatric myopia care today.

2. Heterogeneity limits inference

Outcomes, follow-up and subgroup methodology vary widely across trials, complicating direct comparison.

3. Retrospective evidence base

No major RCT has yet allocated treatment by predefined responder characteristics; most data is post-hoc.

4. NHS implications

A stratified approach could improve cost-effectiveness and prioritise high-risk children for intensive Rx.

CONCLUSION

Treatment response varies substantially between individuals.

*Predictive analytics, prospective stratification and AI-driven modelling may enable **personalised, evidence-based myopia management within the NHS**.*

TOWARDS PERSONALISED CARE — PROPOSED CLINICAL PATHWAY

FUTURE RESEARCH PRIORITIES

- Prospective responder-stratified RCTs allocating treatment by predicted response.
- Integration of behavioural & biometric data — outdoor time, accommodative lag, AL.
- Validation of AI-assisted predictive models in ethnically diverse paediatric cohorts.
- Standardised responder definitions & shared NHS / international stratification.

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Review: Jan 2015 – Sep 2025 | **Refs:** LAMP · BLINK · ROMIO · MiSight · ATOM2 · IMI · NICE & RCOphth 2024