AMD Protocol Explorer (APE)

Agent-Based Simulation for Neovascular AMD Treatment Planning

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24th June 2025

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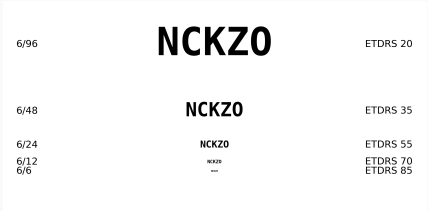
Acknowledgments

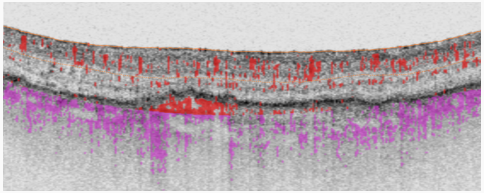
- Health Service Modelling Associates (HSMA) team
- Finance Director and IT Director
- NHS England Pharmacy & Clinical Support Team

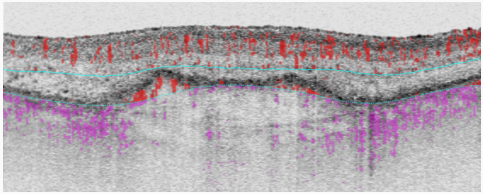
Understanding Neovascular AMD

What is Neovascular AMD (NAMD)?

- Leading cause of central vision loss
- Cannot read or recognize faces
- Leads to legal blindness if untreated
- Affects quality of life severely







The Biology Behind NAMD

Disease Process:

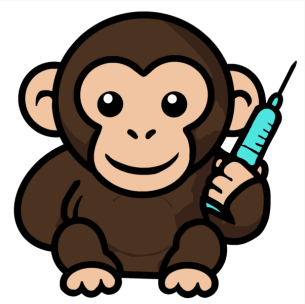
- Aging eye environment
- Increased VEGF (Vascular Endothelial Growth Factor)
- Abnormal blood vessel growth
- Leakage, fibrosis, and bleeding

VEGF?

VEGF is like fertiliser for blood vessels. Anti-VEGF is something that removes the fertiliser.

As VEGF keeps being made we have to keep removing it.

Hope



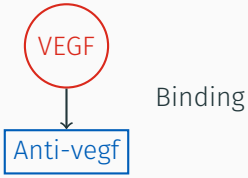
Revolutionary Treatment: Anti-VEGF Therapy

How it works:

- Antibodies or similar molecules bind to VEGF
- Remove growth factor from eye
- Stop abnormal vessel growth

The Challenge:

- Molecules cleared over time
- Requires repeated injections
- Optimal frequency unknown



Real-World Treatment Challenges

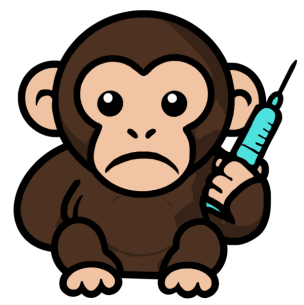
Why Patients Stop Treatment

- **Mortality**: Elderly population (average age 80+)
- **Frailty**: Too unwell to attend monthly appointments
- **Treatment failure**: Vision deteriorates despite therapy
- **NHS capacity**: Limited appointment availability

Discontinuation Rates

- Year 1: 10-15% stop treatment
- Year 2: Additional 10-15%
- By Year 5: Only 50-60% still on treatment

The Cost Challenge



NHS Annual Treatment Costs

Treatment Area	Annual NHS Spend	Annual Patient Numbers
Wet AMD (Anti-VEGF)	£600-800 million	40,000 new, 200,000 continuing
Cataract Surgery	£320-480 million	400,000
Hip Replacement	£500-700 million	100,000

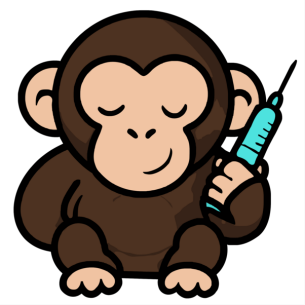
Cost per QALY

- Cataract surgery: £1,964 per QALY (exceptional value)
- Hip replacement: £2,128 per QALY (strong value)
- Wet AMD: £58,047 per QALY (3x NICE threshold)

Current Anti-VEGF Drug Costs (2024 list prices)

- Aflibercept (Eylea): £816 a dose, generic soon maybe £400
- Patients need 7-10 injections year 1, then 4-6/year ongoing

Why Model?



The Need for Modeling

Current Challenges:

- Complicated and tangled evidence base
- Limited real-world data
- Complex patient pathways
- Resource constraints

Modeling Benefits:

- Promote discussion
- Clarify outcome measures
- Explore treatment strategies
- Evidence-based decisions
- Predict resource needs
- Balance drug versus other costs

Two Modeling Approaches

Simple Approach (NHS England):

- Excel spreadsheet
- ”Best guess” parameters
- Average patient behavior
- Quick but limited insights

Our Approach (Agent-Based):

- Individual patient simulation
- Build from known parameters
- Probabilistic events
- Rich, detailed insights

Real-World Complexity in Our Simulation

Simple Models Assume:

- All patients start with same vision
- Perfect treatment adherence
- No appointment delays
- Uniform response to treatment

Our Simulation Includes:

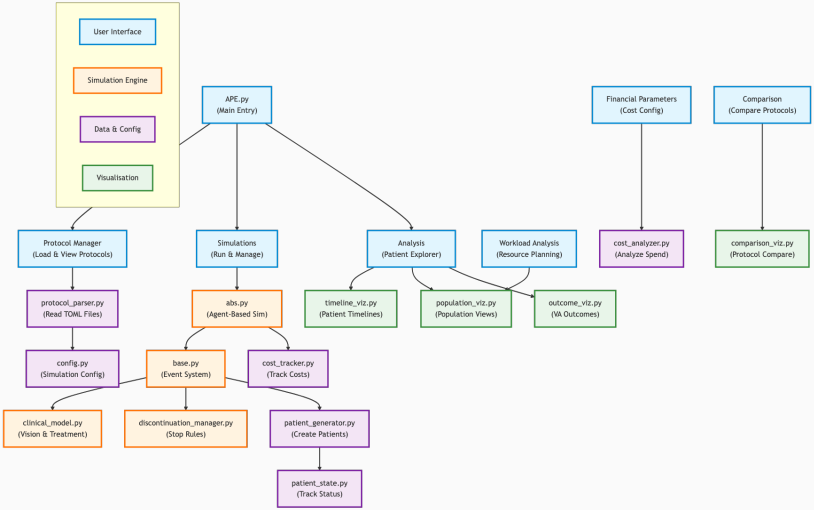
- Vision distribution at baseline
- Real discontinuation patterns
- Treatment gaps and delays
- Individual patient trajectories

Why This Matters

- Captures NHS capacity constraints
- Models actual patient populations
- Predicts realistic outcomes
- Enables better resource planning

The APE

Application Architecture



Live Demonstration

[Switch to Screen Recording]

Demonstration includes:

- Loading treatment protocols
- Running 1000-patient simulation
- Exploring patient journeys
- Visualizing population outcomes
- Comparing different protocols

Key Insights

What We've Learned

Model Reveals:

- Treatment pattern impacts
- Resource utilization peaks
- Patient outcome distributions
- Protocol efficiency metrics

Enables:

- Evidence-based protocols
- Capacity planning
- Cost-effectiveness analysis
- Commissioning decisions

Future Development
Cost calculator module in development for full economic analysis

Thank You

Questions?

Contact:
your.email@nhs.net

Project Repository:
`https://github.com/lh/vegf-1`
Application:
`https://vegf-1.streamlit.app`

Acknowledgments:
HSMA Team | NHS England | Trust Leadership