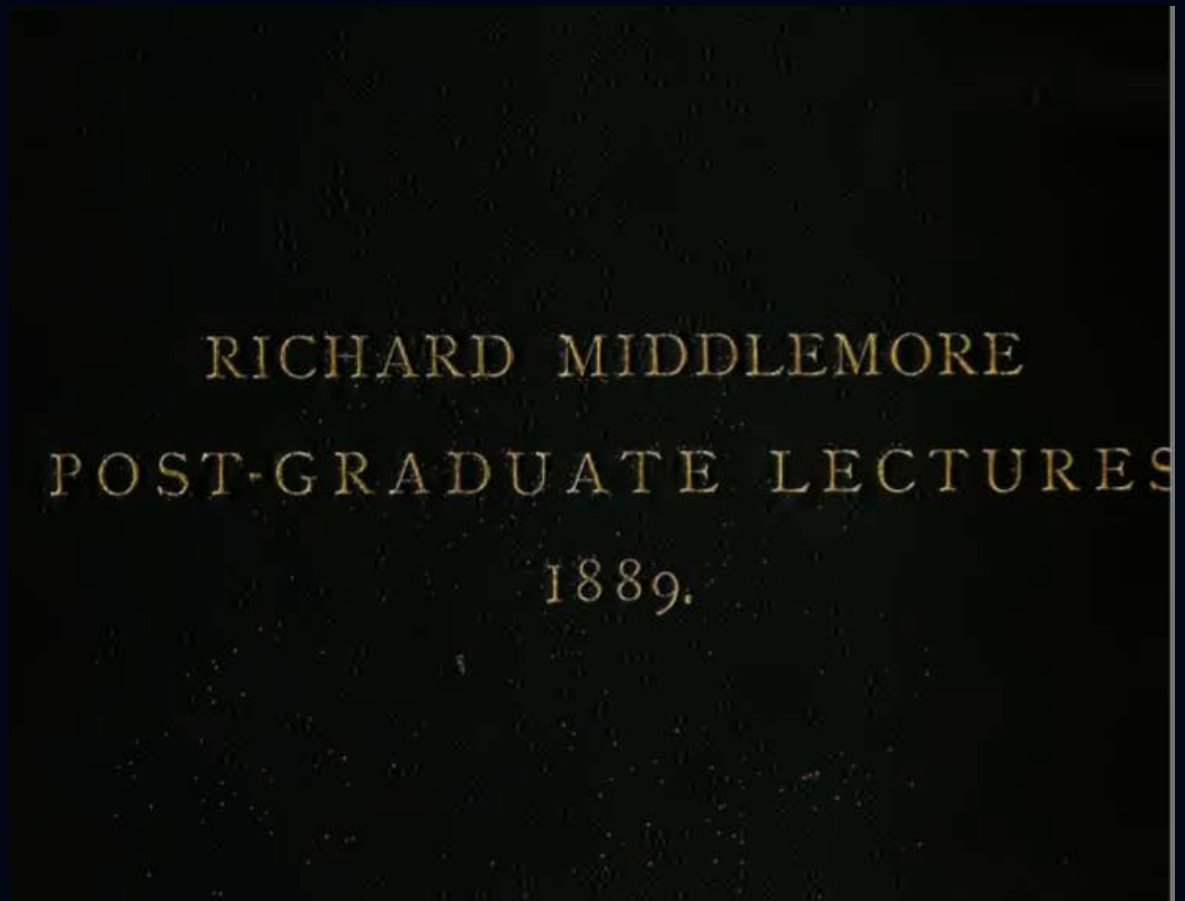
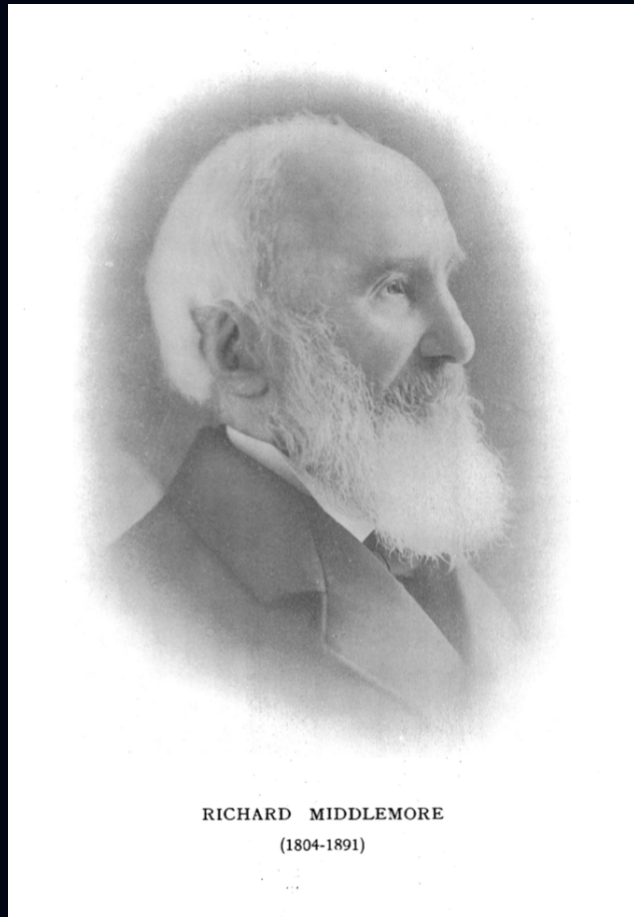
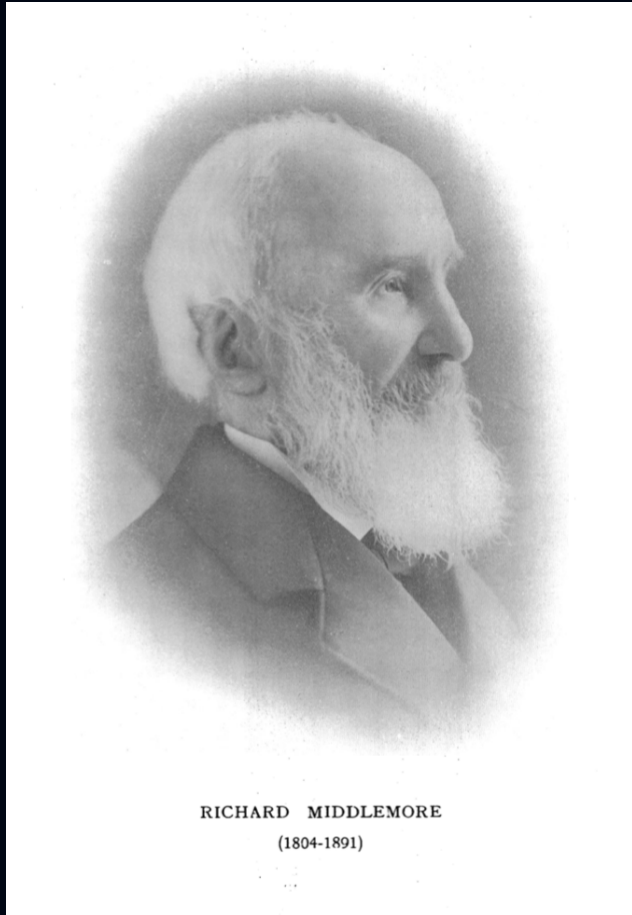


The 2019 Middlemore Lecture



The 2019 Middlemore Lecture



Richard Middlemore

1804 Born – from Edgbaston Family

1828 Asst Surgeon Birmingham Eye Hospital

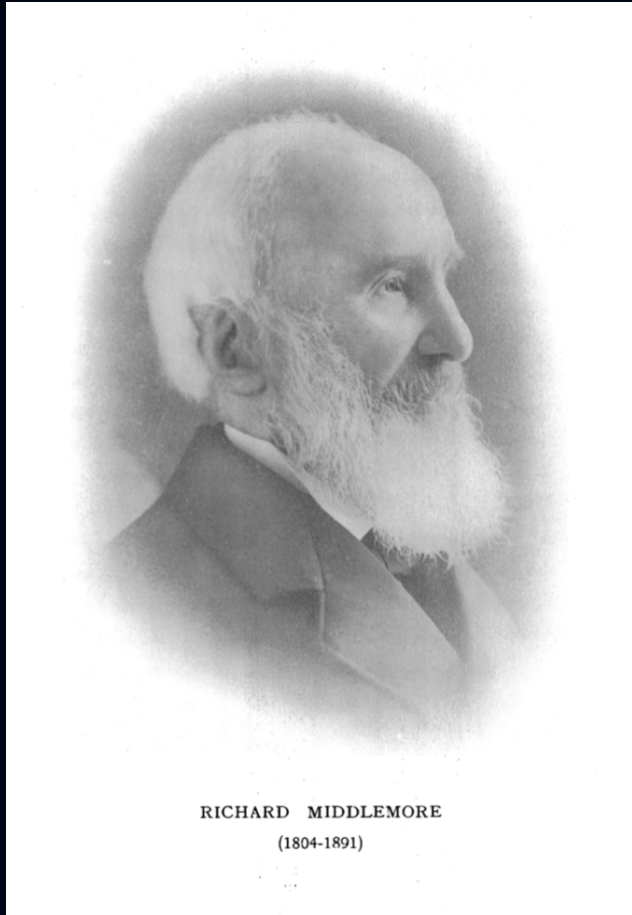
1831 Gained Jacksonian Prize

1835 Appointed Full Surgeon

1835 Published his magnum opus:

A Treatise on Diseases of the Eye

The 2019 Middlemore Lecture



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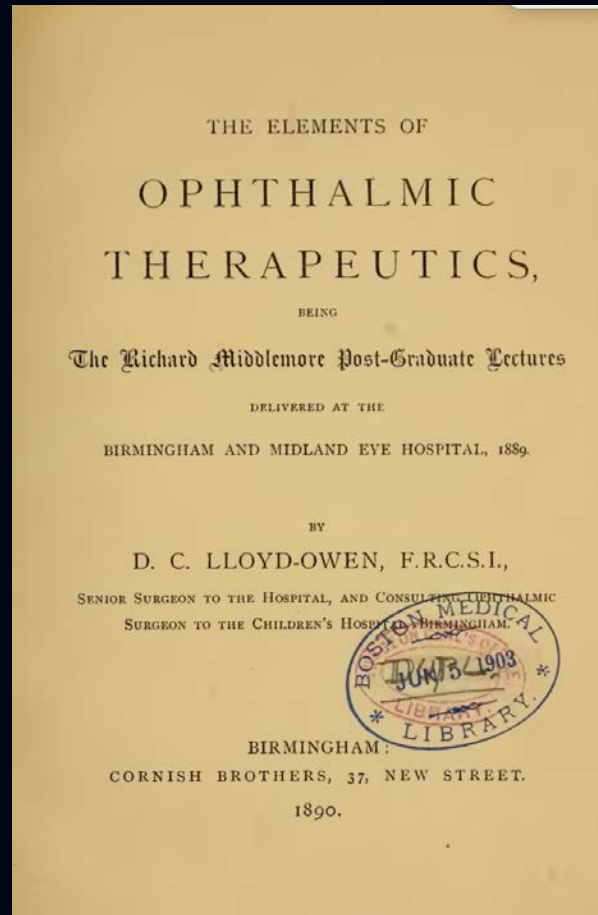
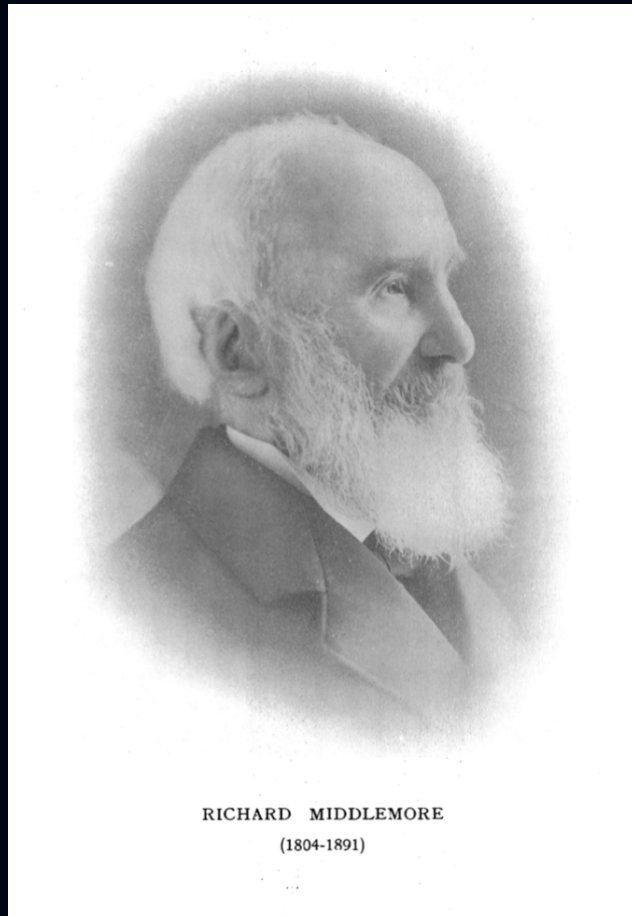
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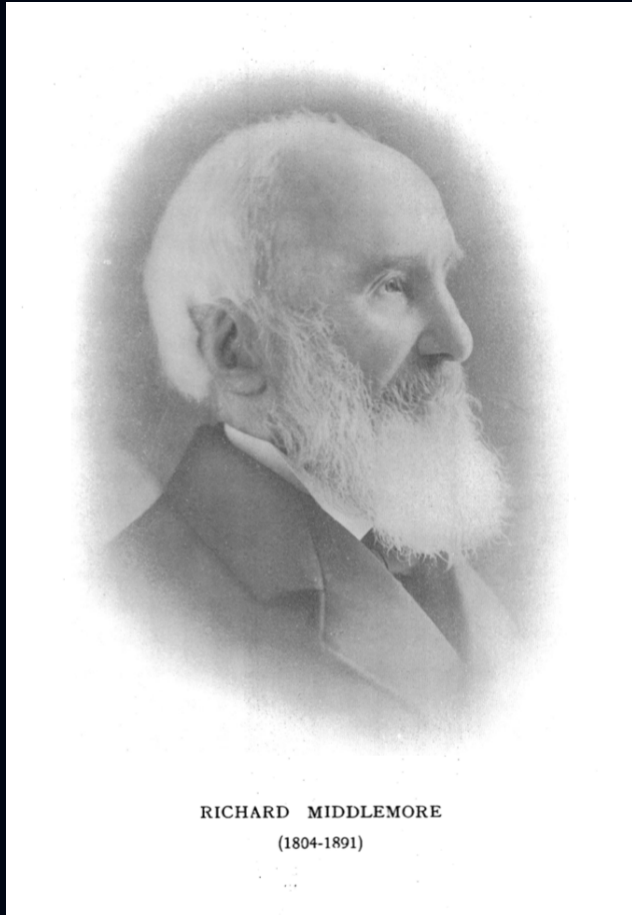
1841 'Retired to the Consulting Benches'

The 2019 Middlemore Lecture



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The 2019 Middlemore Lecture



RICHARD MIDDLEMORE
(1804-1891)

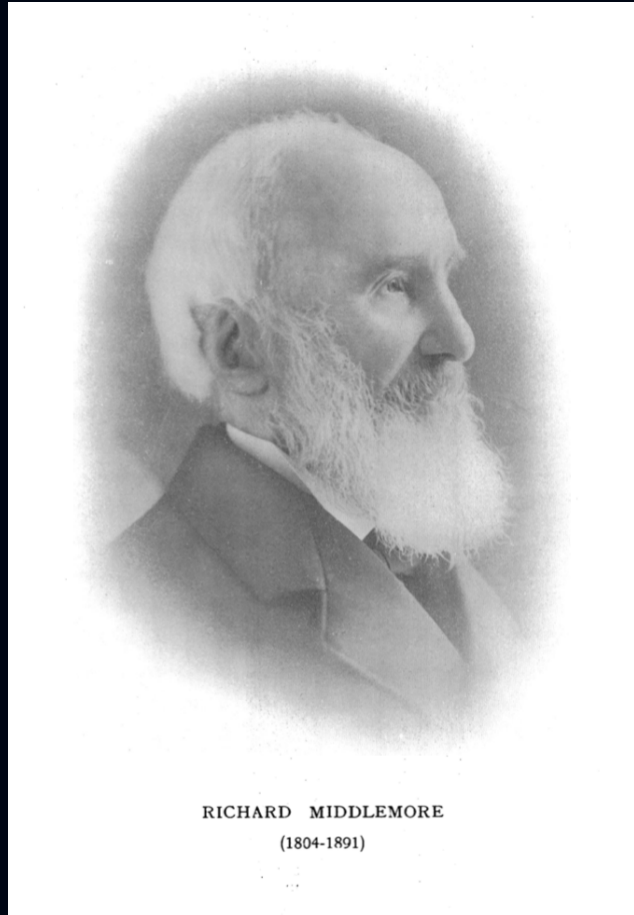
In 1831 he gained the Jacksonian prize for an essay on diseases of the eye. This essay he afterwards enlarged and elaborated, and in 1835 published it in two volumes. This work occupies some 1,600 pages, and, curiously enough, does not contain a single illustration.

elbow. In cataract extraction he held it essential to a good corneal section that even the wrist should be moved as little as possible. The propulsion of the knife should be by means of the movement of the thumb and first and second fingers only. He used a triangular knife, a sort of compromise between the old Beer knife and that of Sichel, with a carefully thickened blade, which would fill as far as possible the corneal incision as the knife advanced, and so retain the aqueous. He used the lower section, and, of course, did not employ iridectomy.

He did not regard the escape of vitreous with the fear which oppresses most of us. In a hard eye he even thought it a possible

Two of his sayings recur to my recollection. The first, "You must diligently search after the cause of the ophthalmic complaint, and treat such cause just as you would do if it did not occasion any disease of the eye, adding local aid;" and the second is, "A good oculist should be a good physician, a good surgeon, and something more."

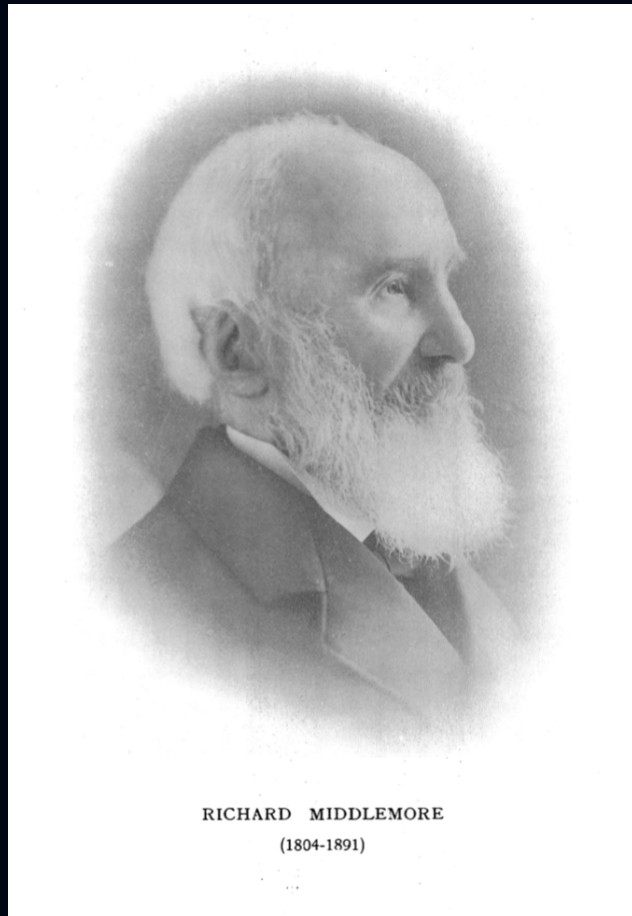
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Richard Middlemore

“Simple, kind, generous, always maintaining a high professional standard.”

The 2019 Middlemore Lecture



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Artificial intelligence (AI)
AI equal with human experts in medical diagnosis, study finds
Research suggests AI able to interpret medical images using deep learning algorithm

Oculomics

Why the eye holds the key
to systemic health and well-being

Alastair Denniston

University Hospitals Birmingham NHSFT

University of Birmingham

NIHR BRC for Ophthalmology, Moorfields Eye Hospital NHSFT/UCL

INSIGHT, Health Data Research UK



Why bother?



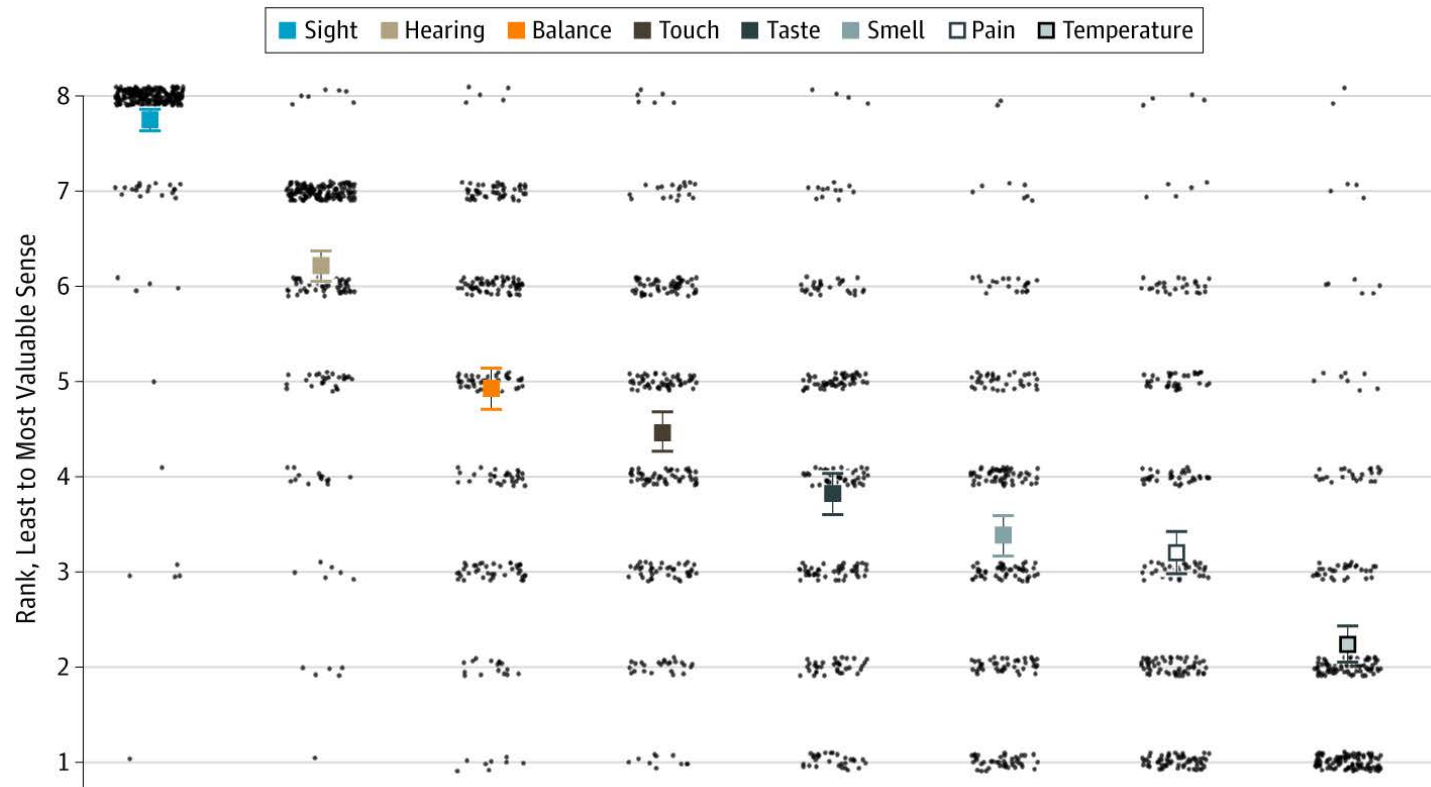
Why bother?

Brief Report

October 3, 2019

Evaluating Whether Sight Is the Most Valued Sense

Jamie Enoch, MSc¹; Leanne McDonald, MSc¹; Lee Jones, PhD¹; Pete R. Jones, PhD¹; David P. Crabb, PhD¹

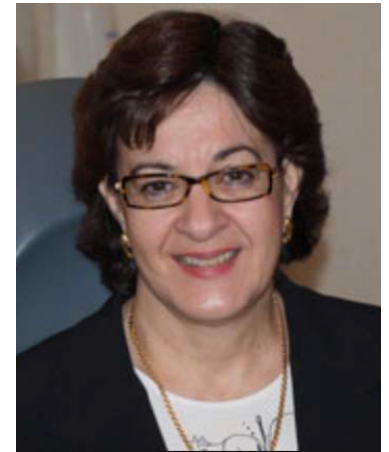


Patient at the Centre

Prof Philip
Murray



Miss Marie
Tsaloumas



Patient at the Centre



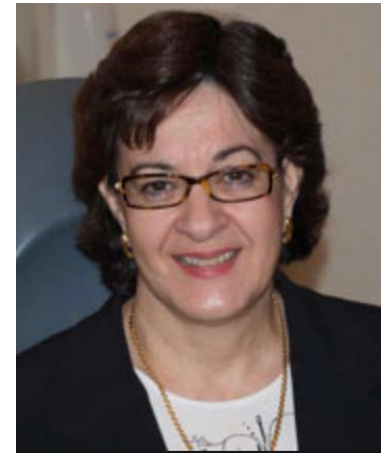
Patient at the Centre



Patient at the Centre



**I am
Committed
to You**



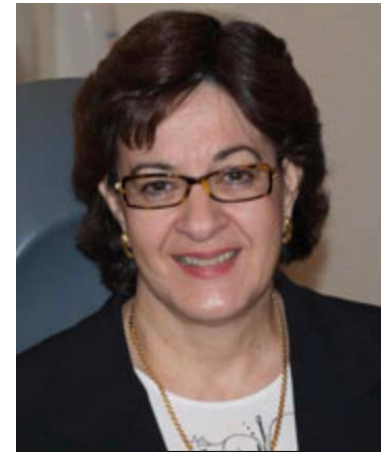
Patient at the Centre



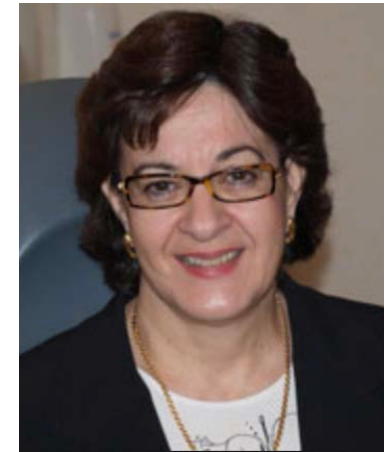
**I am
Committed
to You**



**I See
You**



Patient at the Centre



Patient at the Centre



Patient at the Centre



**Better
Understanding
of Disease**



Patient at the Centre



**Better
Understanding
of Disease**

**Better
Treatment**



Patient at the Centre



**Better
Understanding
of Disease**

**Better
Treatment**



**Better
Evaluation**



Patient at the Centre



**Better
Understanding
of Disease**

**Better
Treatment**



**Better
Evaluation**

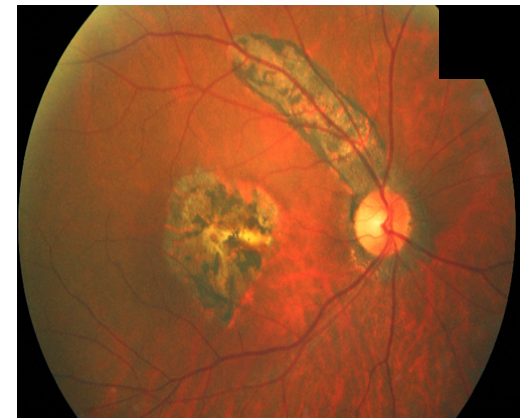
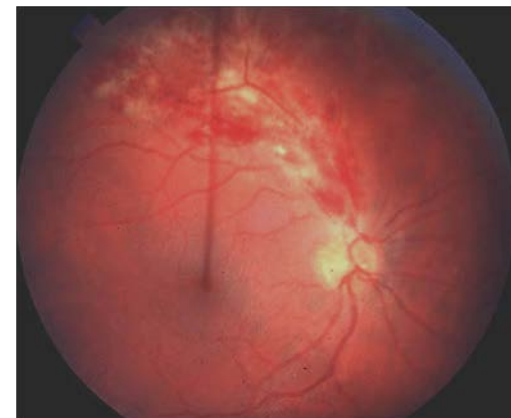
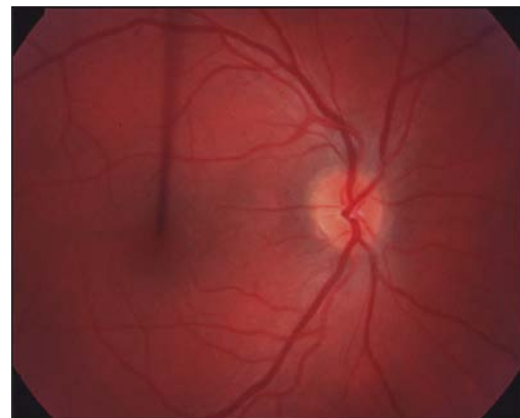
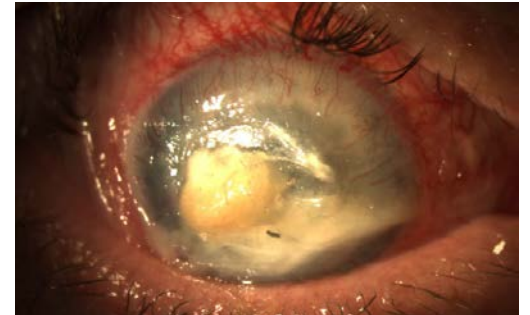
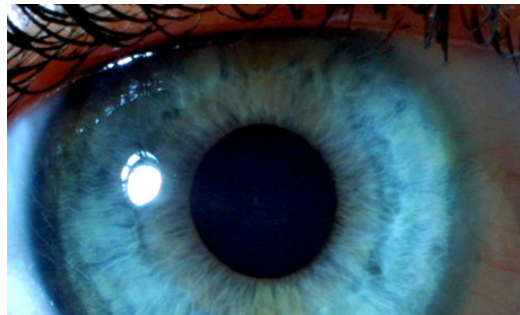
**Insights from
Scale**



Better Understanding of Disease



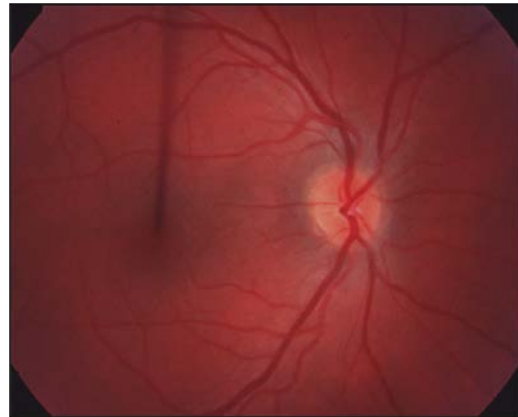
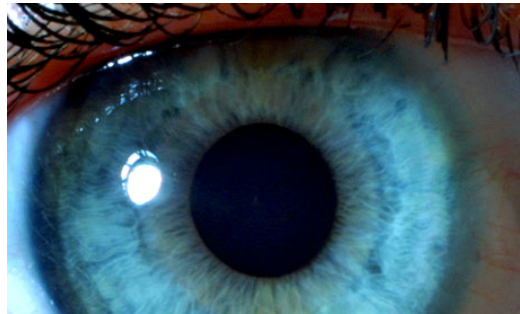
How the Immune System Functions in the Eye



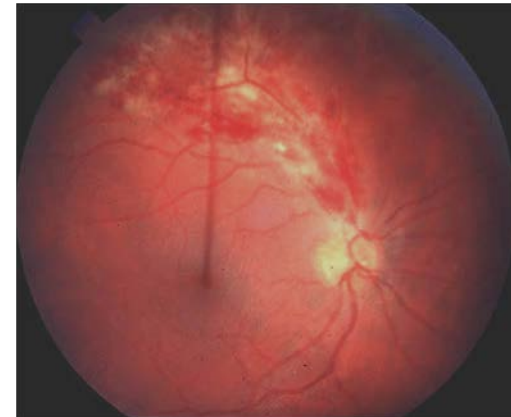
Better Understanding of Disease



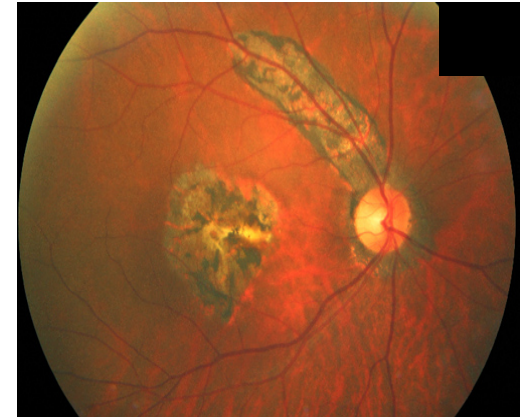
Maintain transparent
visual axis



Eliminate infection



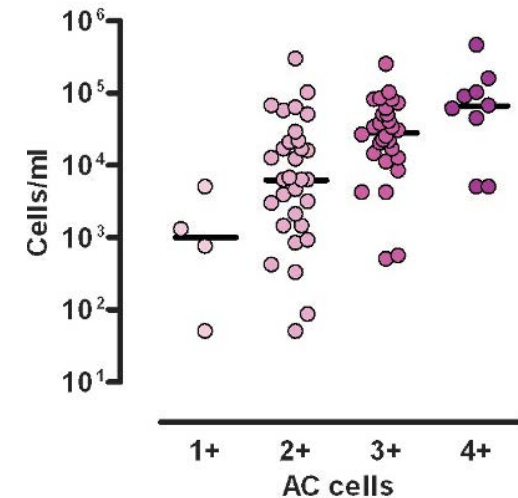
Minimise collateral
damage



Better Understanding of Disease



Identification and quantification of cell type(s) in uveitis

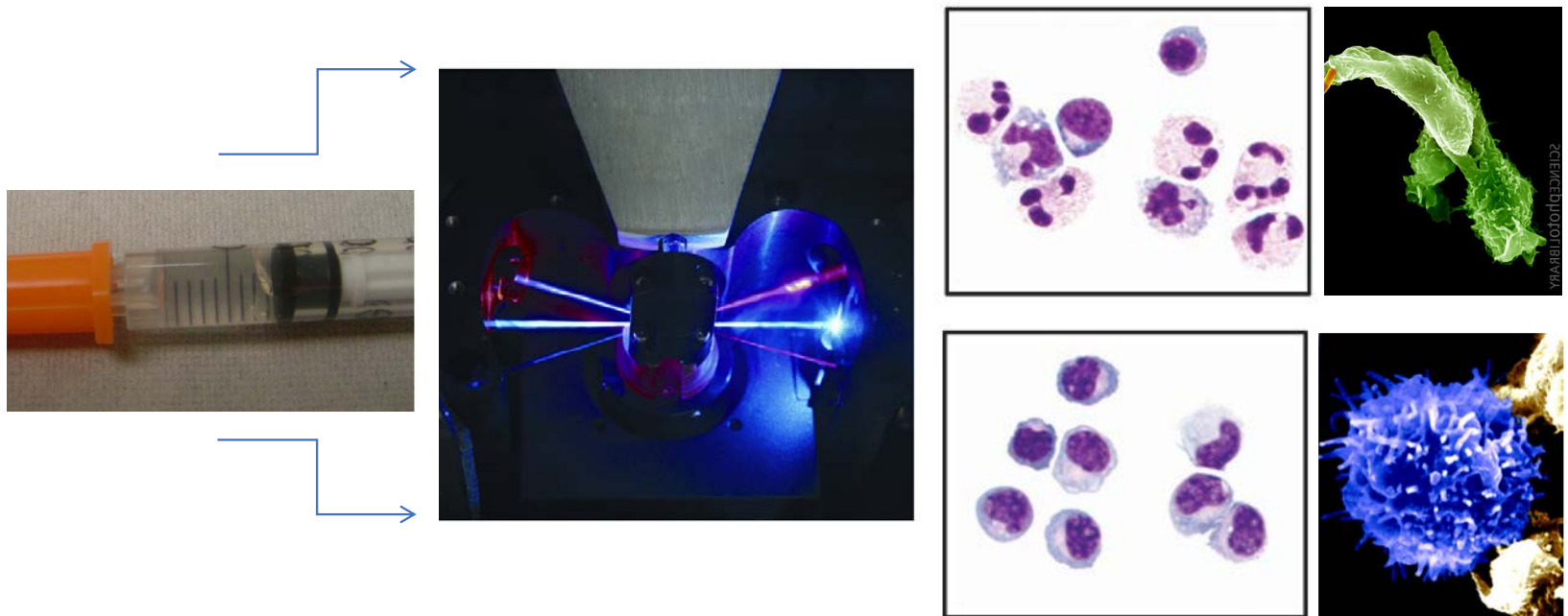


Denniston A.K.O., Curnow S.J. What can the aqueous humour tell us about uveitis? In: Pleyer U., Forrester J.S. Uveitis and Immunological Disorders, Progress III. Springer, 2009.

Better Understanding of Disease



Identification and quantification of cell type(s) in uveitis

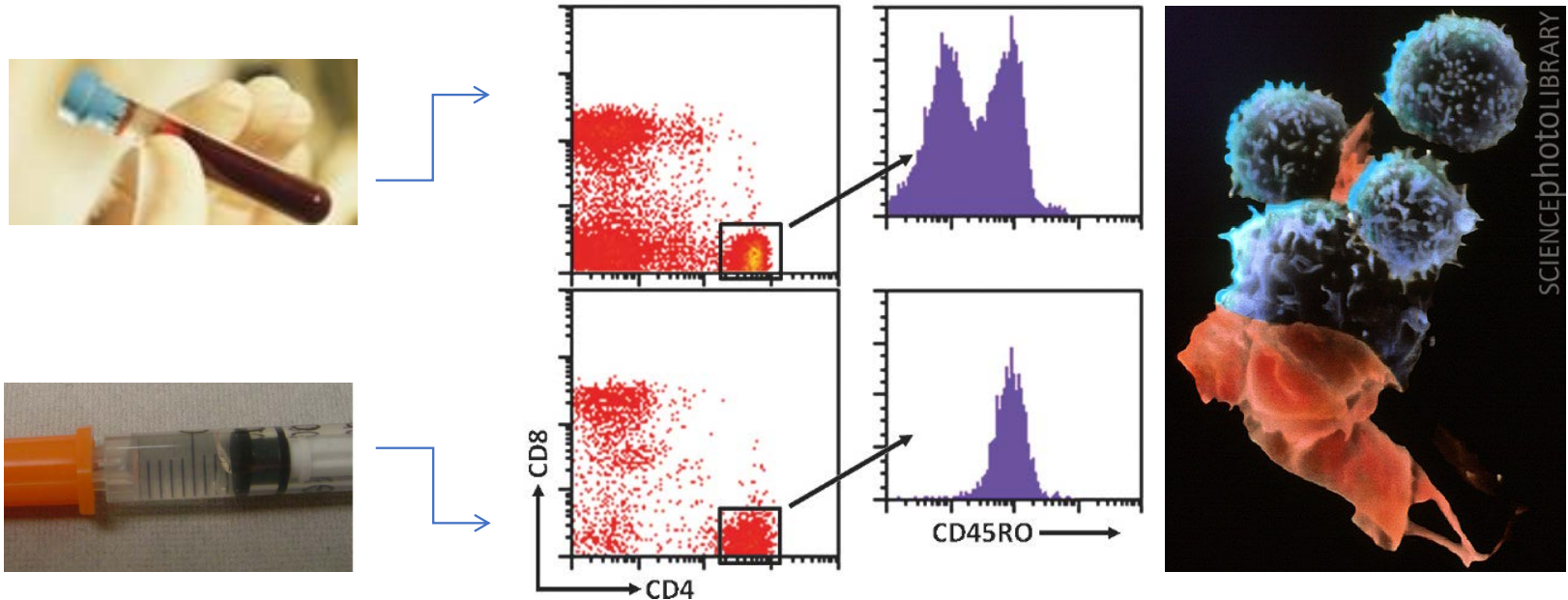


Denniston A.K.O., Curnow S.J. What can the aqueous humour tell us about uveitis? In: Pleyer U., Forrester J.S. Uveitis and Immunological Disorders, Progress III. Springer, 2009.

Better Understanding of Disease



Characterisation of lymphocyte recruitment

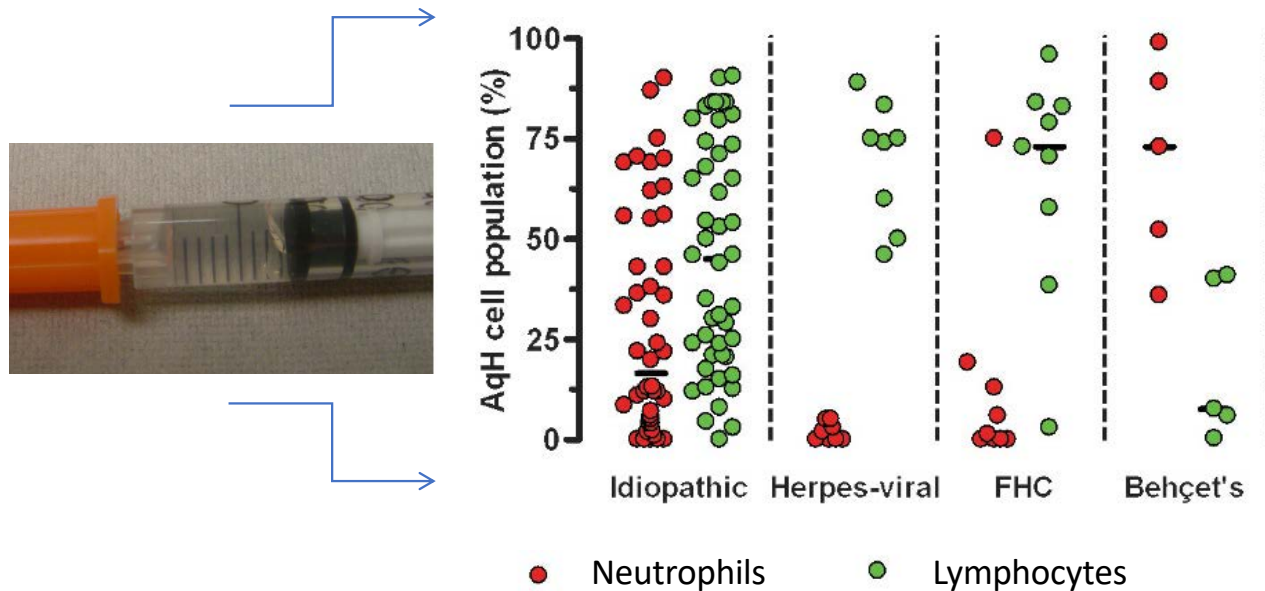


Curnow SJ ... Murray PI, Salmon M. Inhibition of T cell apoptosis in the aqueous humor of patients with uveitis by IL-6/soluble IL-6 receptor trans-signaling. J Immunol. 2004 Oct 15;173(8):5290-7

Better Understanding of Disease



Identification of disease-specific immune profiles



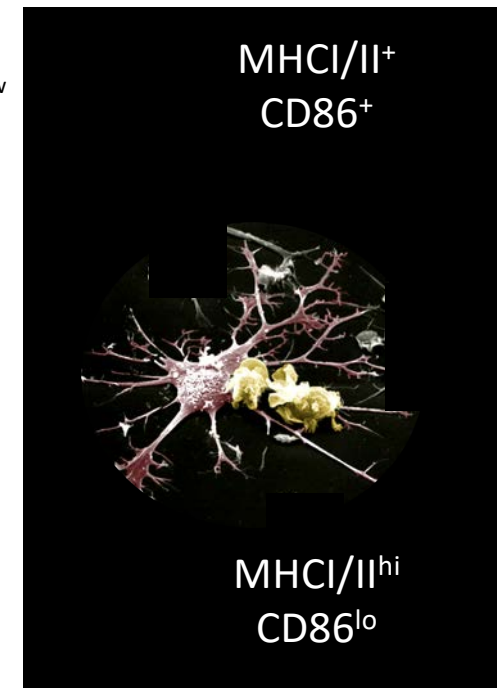
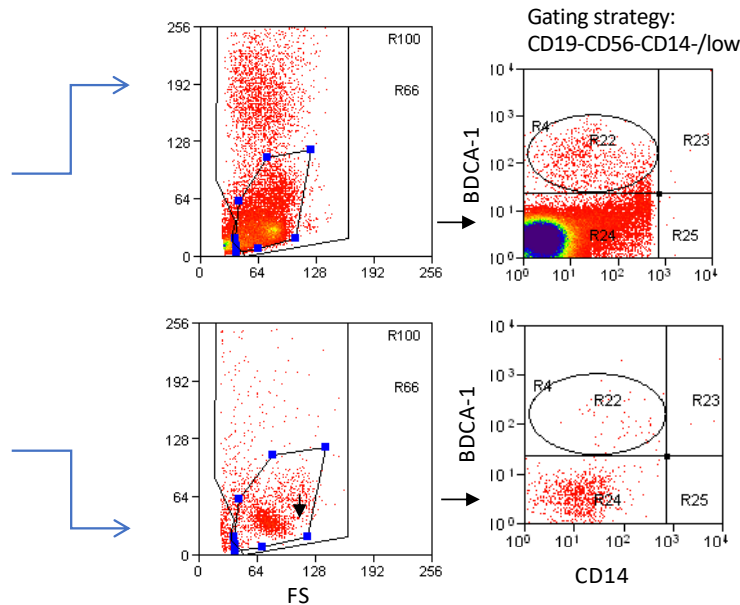
Curnow SJ ... Murray PI, Salmon M. Inhibition of T cell apoptosis in the aqueous humor of patients with uveitis by IL-6/soluble IL-6 receptor trans-signaling. *J Immunol.* 2004 Oct 15;173(8):5290-7

Denniston A.K.O., Curnow S.J. What can the aqueous humour tell us about uveitis? In: Pleyer U., Forrester J.S. *Uveitis and Immunological Disorders, Progress III.* Springer, 2009.

Better Understanding of Disease



First identification of live Dendritic Cell in the eye

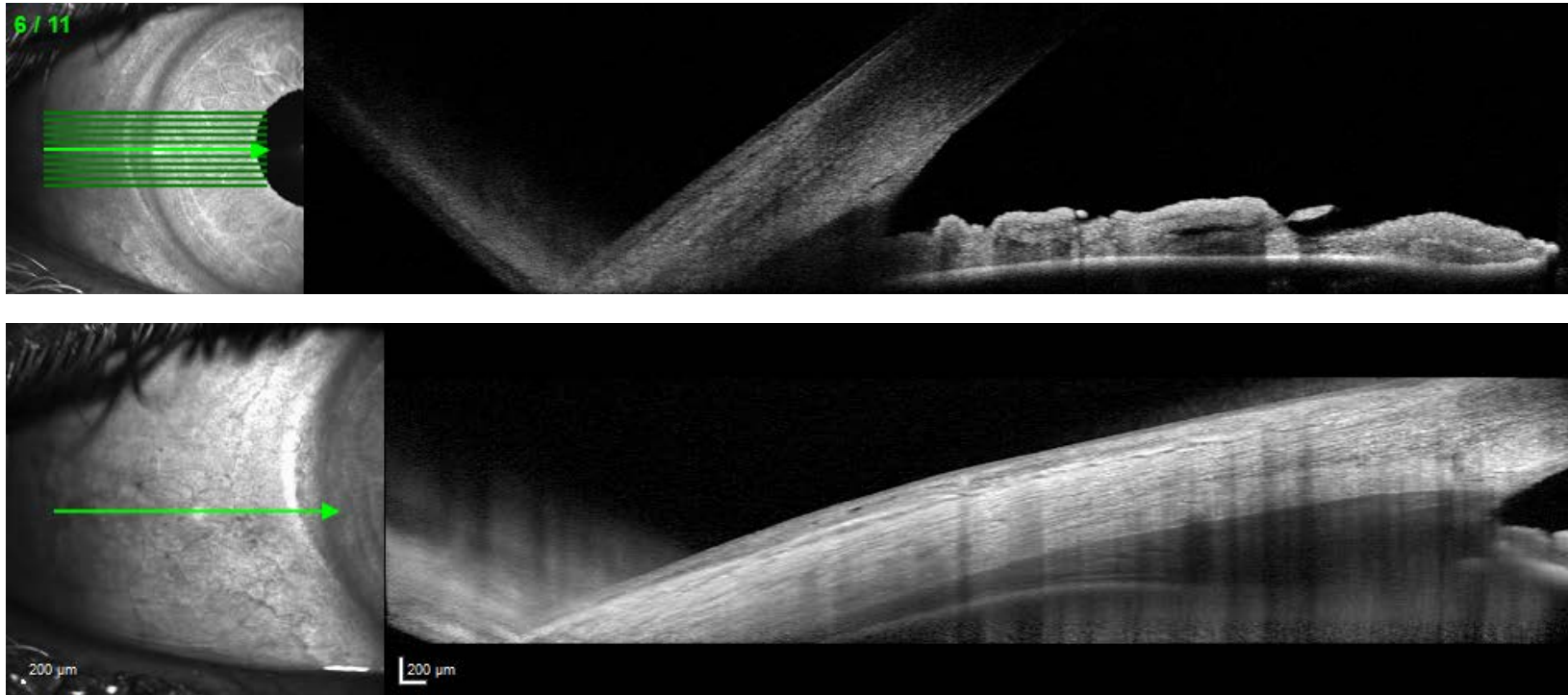


Denniston AK, Tomlins P, Williams GP, Kottoor S, Khan I, Oswal K...Wallace GR, Rauz S, Murray PI, Curnow SJ. Aqueous humor suppression of dendritic cell function helps maintain immune regulation in the eye during human uveitis. *Invest Ophthalmol Vis Sci*. 2012. 53:888-896

Better Understanding of Disease



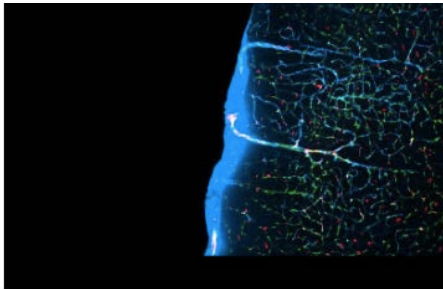
Hypothesis: anterior uveitis isn't actually uveitis



Ian Reekie PhD. 2019- Resident ocular T-lymphocytes and their Relevance to Anterior Uveitis in Humans



Better Understanding of Disease



Brainwashing. When mice sleep, fluid-filled channels (pale blue) to waste.

Maiken Nedergaard/Jeff Iliff

Hypothesis: existence of ocular 'glymphatics'



Paravascular Pathways in the Eye: Is There an 'Ocular Glymphatic System'?

Alastair K. Denniston; Pearse A. Keane

+ Author Affiliations & Notes

Investigative Ophthalmology & Visual Science June 2015, Vol.56, 3955-3956.
doi:10.1167/iovs.15-17243



PDF

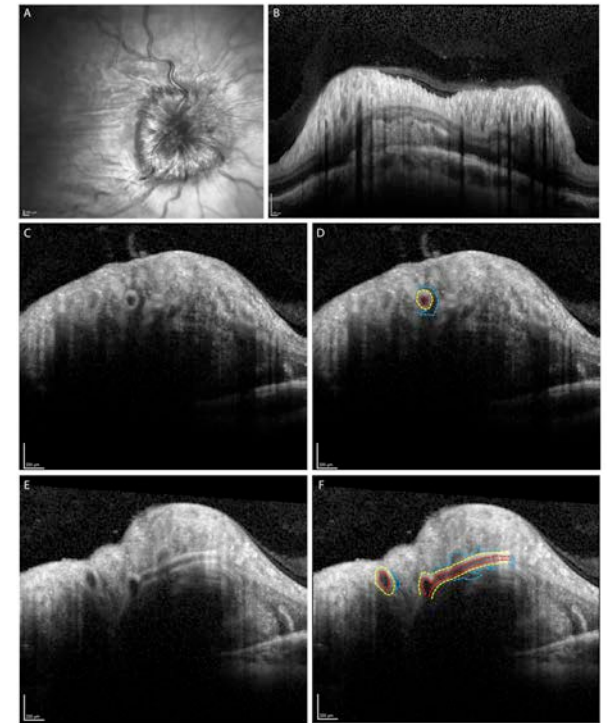


SHARE ▼



TOOLS ▼

In 2012, Iliff and colleagues¹ proposed the existence of a paravascular transport system, which they termed the 'glymphatic system.' We propose that a similar system is present in the eye, the 'Ocular Glymphatic System,' and that this may be a key player in retinal diseases ranging from AMD to retinal vasculitis.



Denniston, Keane IOVS 2015; IOVS 2016
Denniston, Keane, Aojula, Sinclair, Mollan IOVS 2017

Patient at the Centre



Better
Understanding
of Disease

**Better
Treatment**



Better
Evaluation



Better Treatment

VISUAL I

Jaffe et al
NEJM 2016

VISUAL II

Nguyen et al
Lancet 2016

Editorial on the VISUAL
studies

Denniston and Sen
Lancet.2016

THE LANCET

ARTICLES | [VOLUME 388, ISSUE 10050, P1183-1192, SEPTEMBER 17, 2016](#)

Adalimumab for prevention of uveitic flare in patients with inactive non-infectious uveitis controlled by corticosteroids (VISUAL II): a multicentre, double-masked, randomised, placebo-controlled phase 3 trial

[Prof Dr Quan Dong Nguyen, MD](#)   • [Pauline T Merrill, MD](#) • [Prof Glenn J Jaffe, MD](#) • [Prof Andrew D Dick, MD](#) •
[Prof Shree Kumar Kurup, MD](#) • [John Sheppard, MD](#) • et al. [Show all authors](#)

THE LANCET

COMMENT | [VOLUME 388, ISSUE 10050, P1134-1136, SEPTEMBER 17, 2016](#)

VISUALising a new framework for the treatment of uveitis

[Alastair K Denniston](#)  • [H Nida Sen](#)

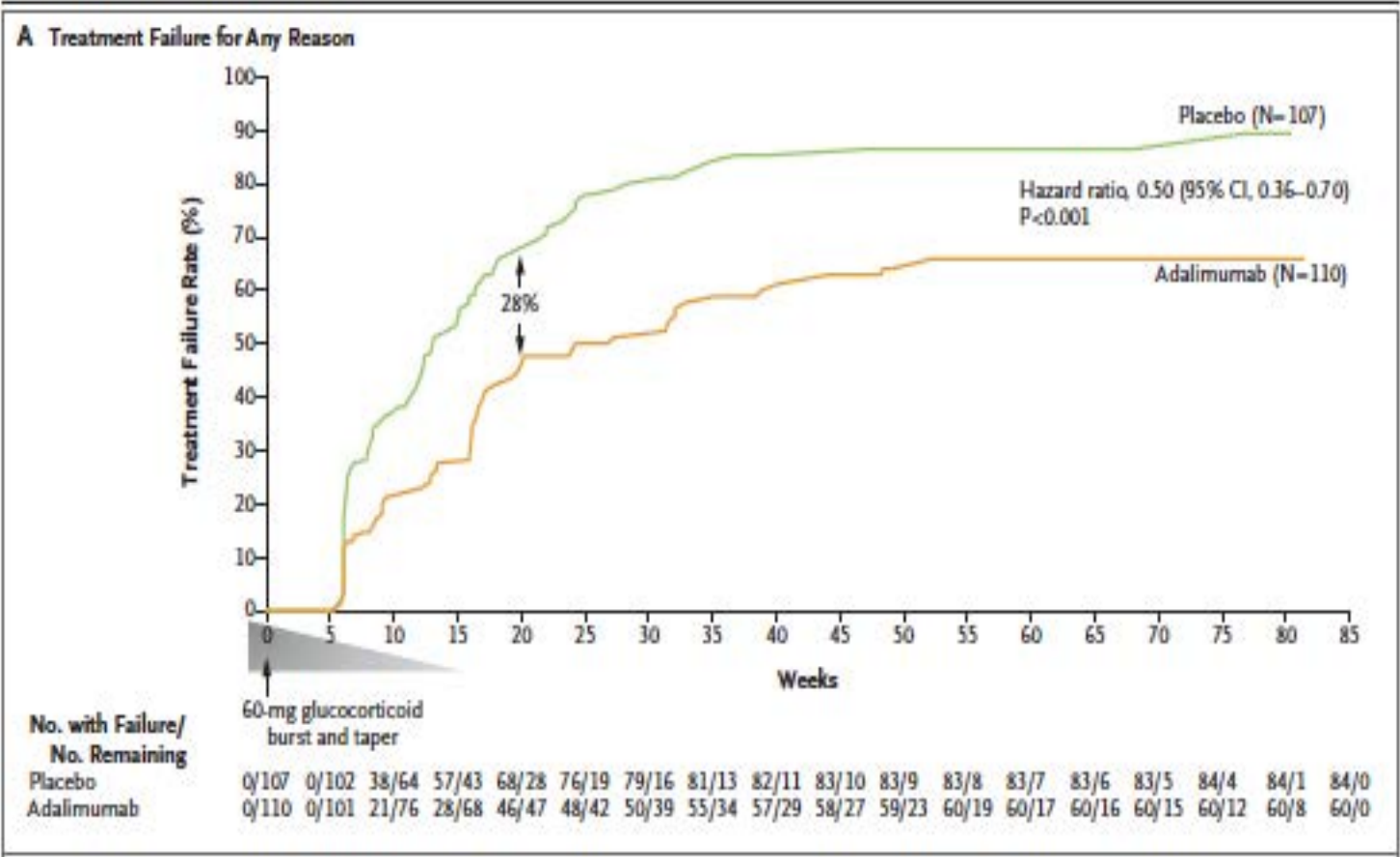
Better Treatment

NICE Approvals

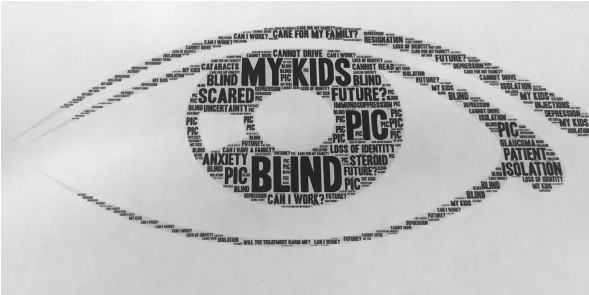
Adalimumab
Ozurdex
Iluvien

NICE Approvals

Adalimumab
Ozurdex
Iluvien

[illegible][illegible][illegible]

Better Treatment



In one year pre-steroid implant



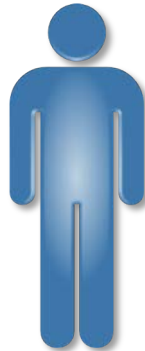
8 injections – 5
x aVEGF and 3 x
triamcinolone



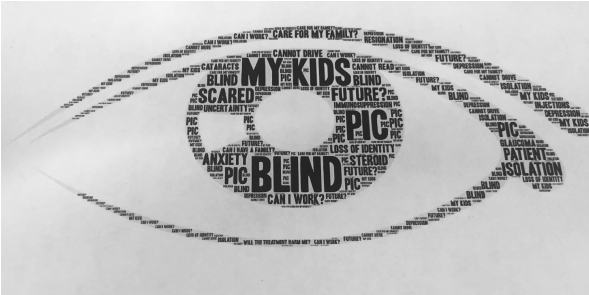
30 hospital
attendances



60 separate
episodes of
recorded care
(OCT, FFA, Tx,
etc.)



Better Treatment



In one year pre-steroid implant



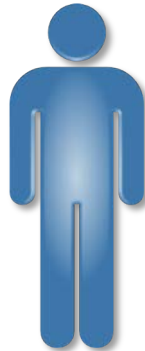
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attendances

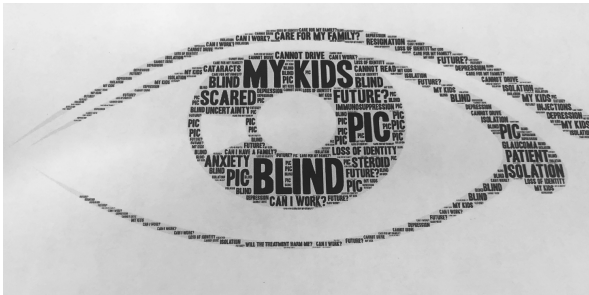


60 separate
episodes of
recorded care
(OCT, FFA, Tx,
etc.)



Iluvien

Better Treatment



In one year pre-steroid implant



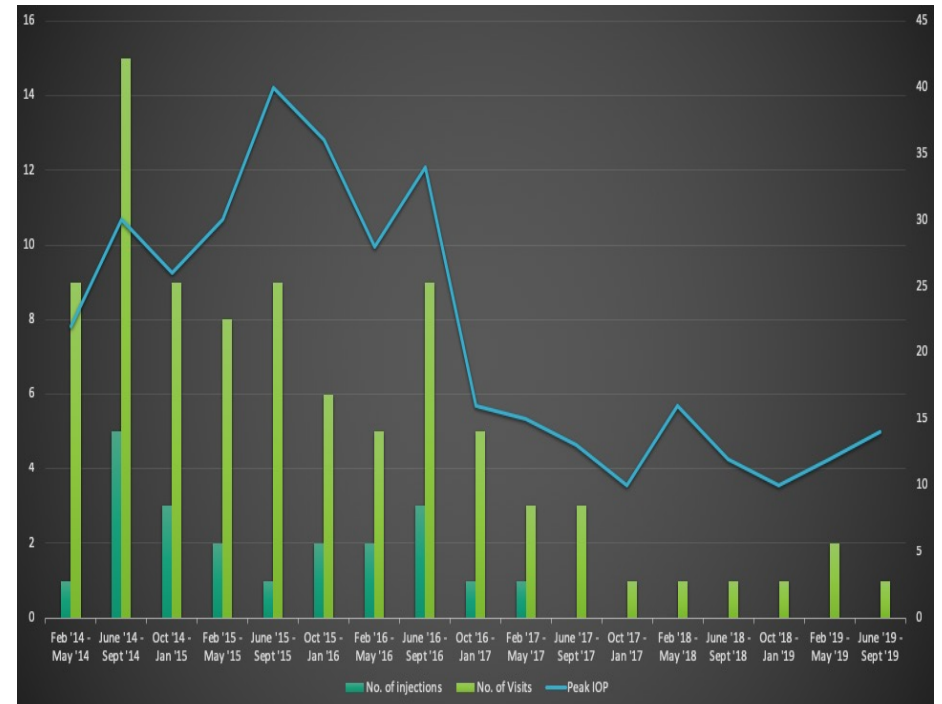
8 injections – 5
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30 hospital
attendances

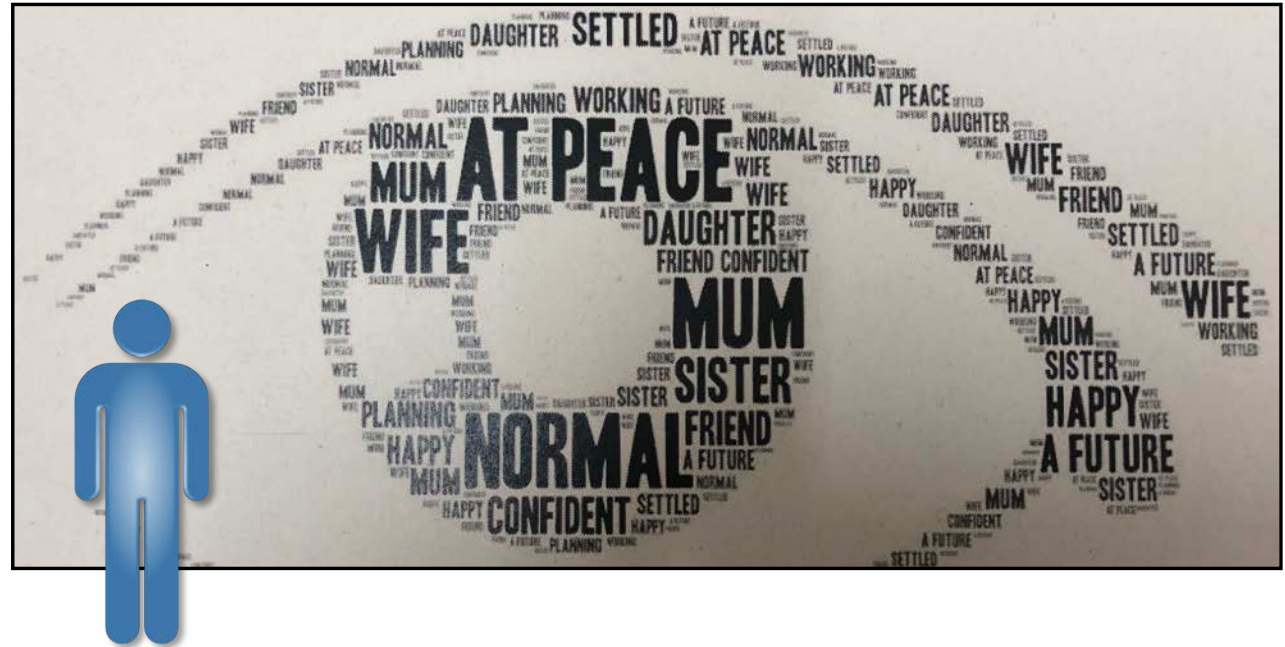
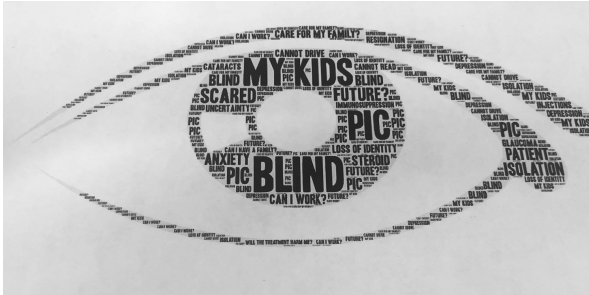


60 separate
episodes of
recorded care
(OCT, FFA, Tx,
etc.)



Iluvien

Better Treatment



Patient at the Centre



Better
Understanding
of Disease

Better
Treatment

Better
Evaluation



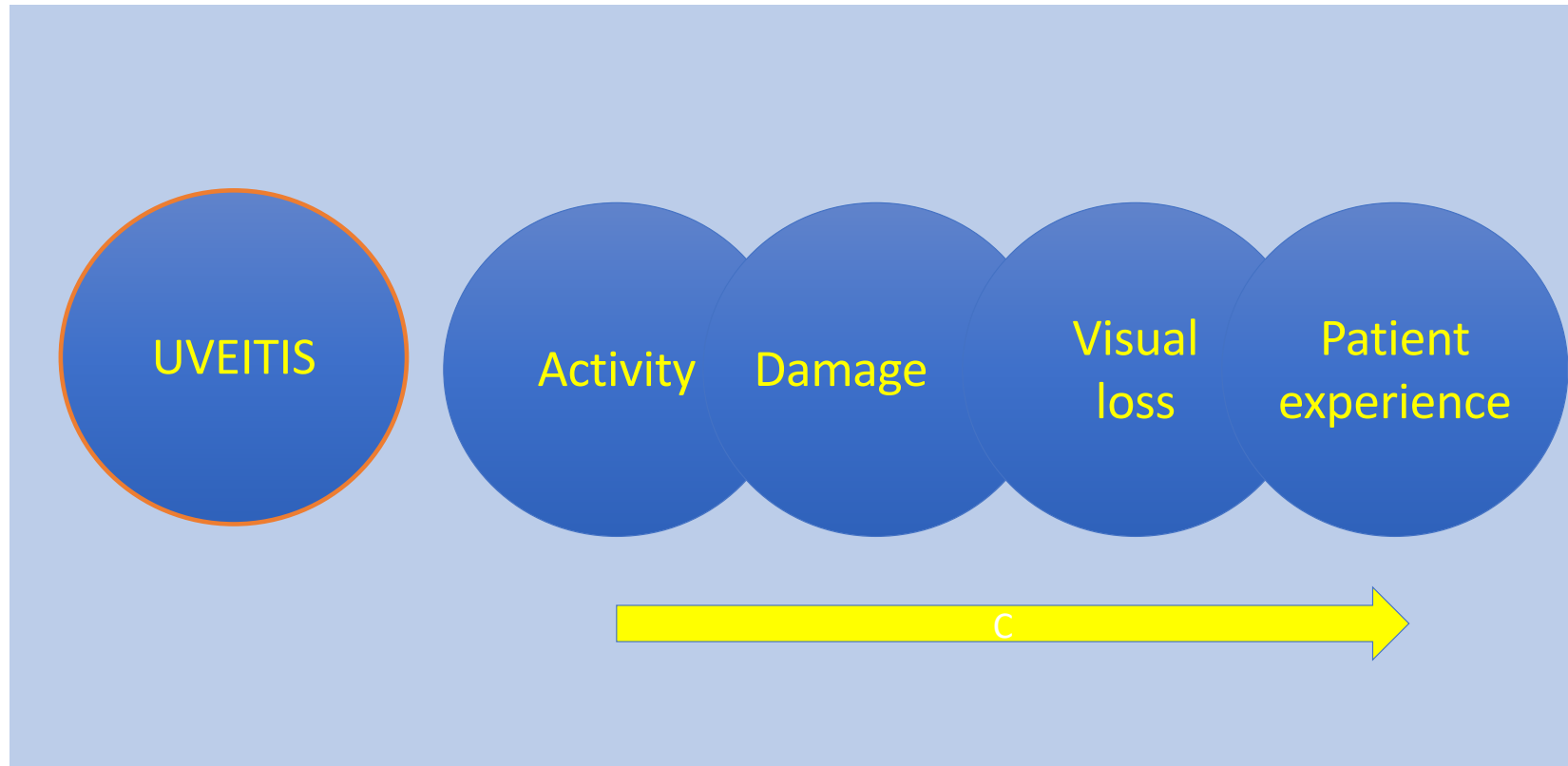
Better Evaluation



UVEITIS

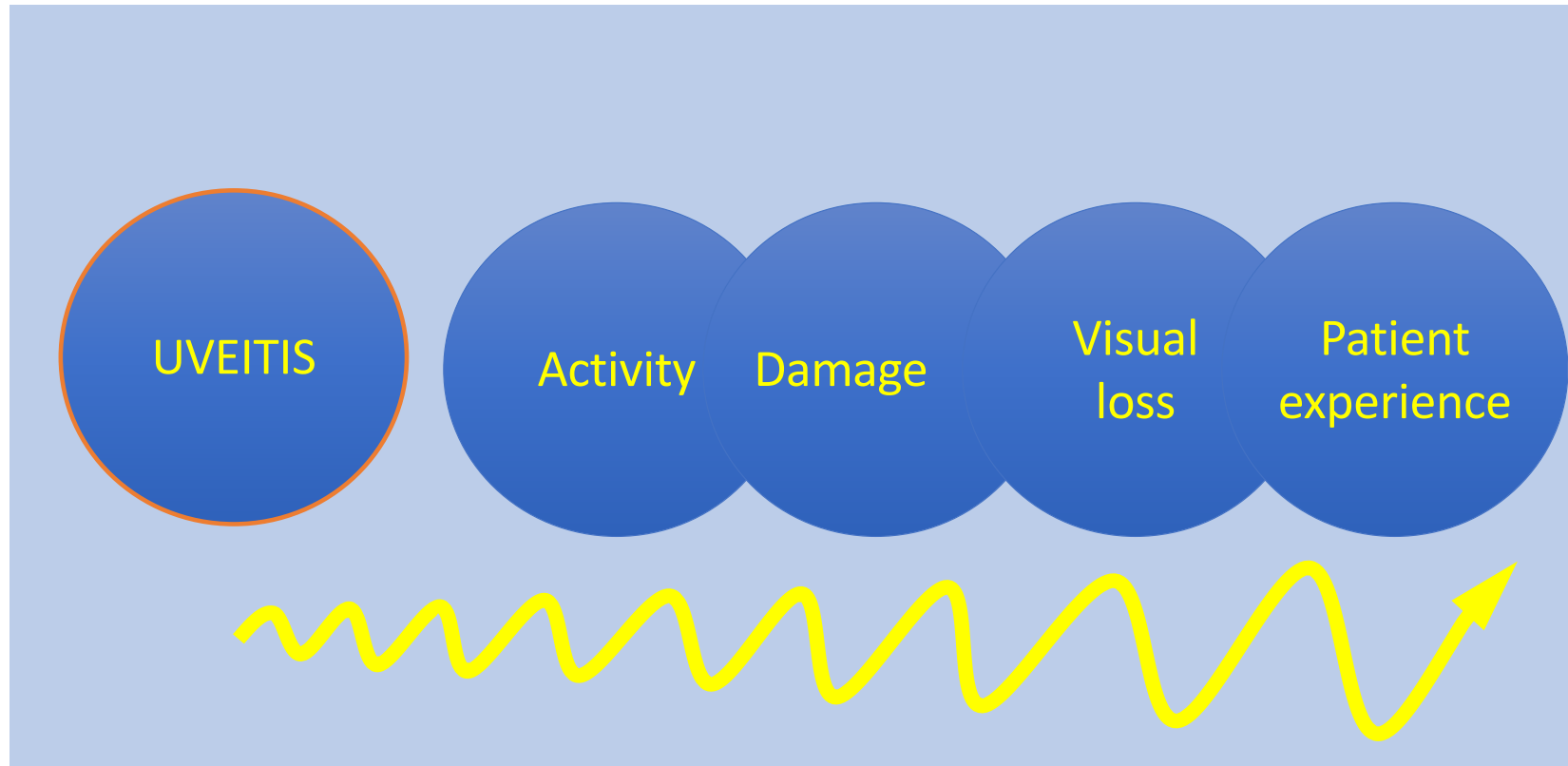
Patient
experience

Better Evaluation

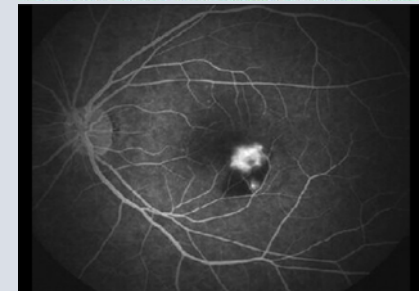
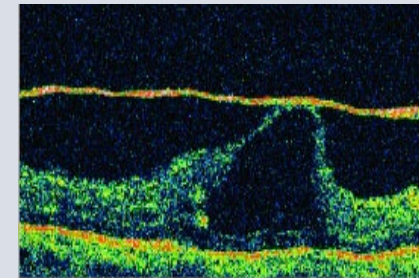
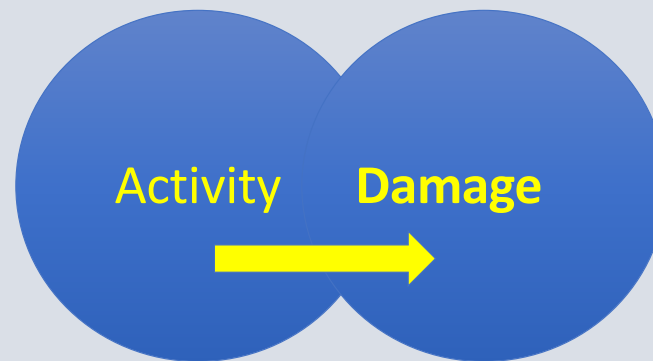
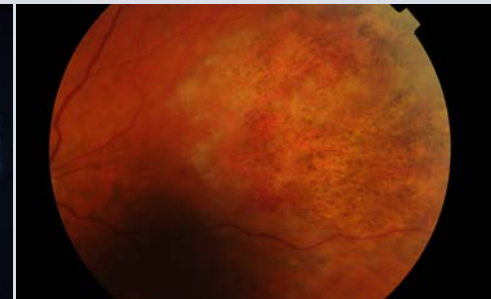
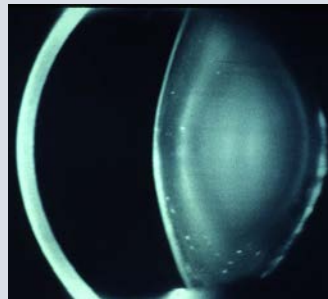
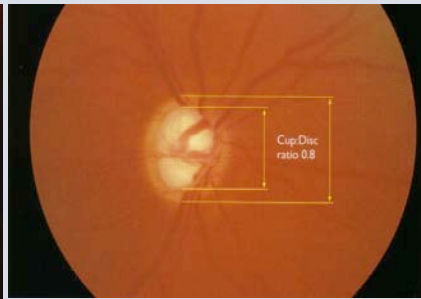
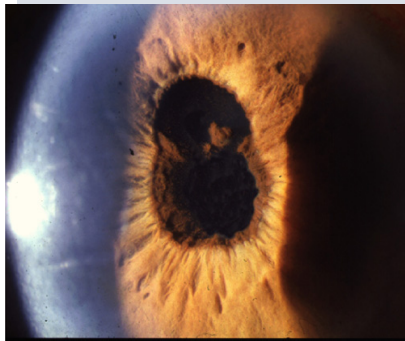


Denniston AK, Holland GN, Kidess A, Nussenblatt RB, Okada AA, Rosenbaum JT, Dick AD. Heterogeneity of primary outcome measures used in clinical trials of treatments for intermediate, posterior, and panuveitis. Orphanet J Rare Dis. 2015 Aug 19;10:97

Better Evaluation



Denniston AK, Holland GN, Kidess A, Nussenblatt RB, Okada AA, Rosenbaum JT, Dick AD. Heterogeneity of primary outcome measures used in clinical trials of treatments for intermediate, posterior, and panuveitis. Orphanet J Rare Dis. 2015 Aug 19;10:97



Band
Keratopathy

PS/PAS

Glaucoma

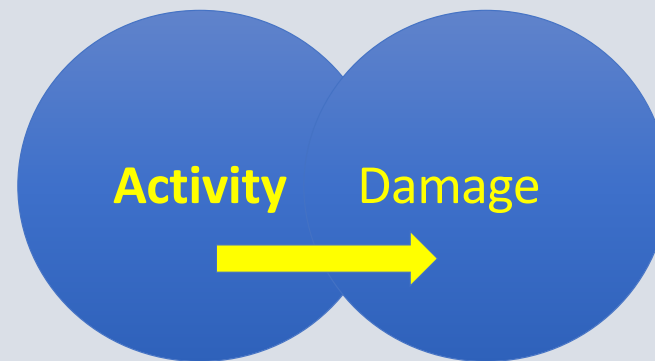
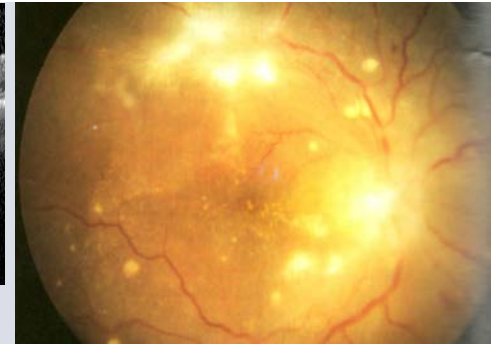
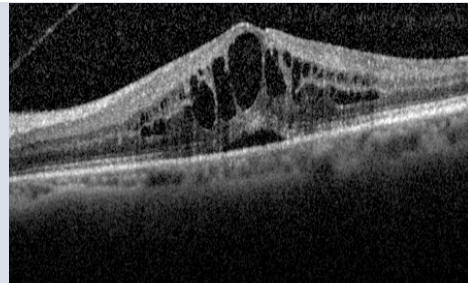
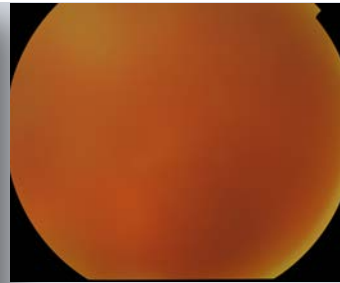
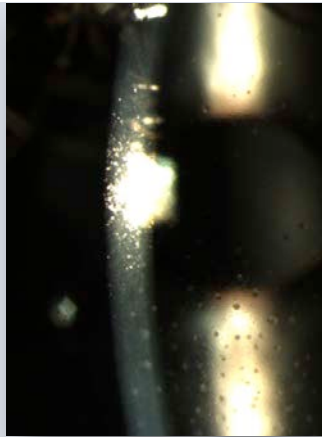
Cataract

ERM

Retinal
necrosis

Ischaemia

CNV



AC Cells

AC Flare

Vitreous
Haze

CMO

Retinitis

Choroiditis

Vascular
leakage

Problems with current endpoints

Clinical Status

Treatment
Decisions

Trials of
efficacy

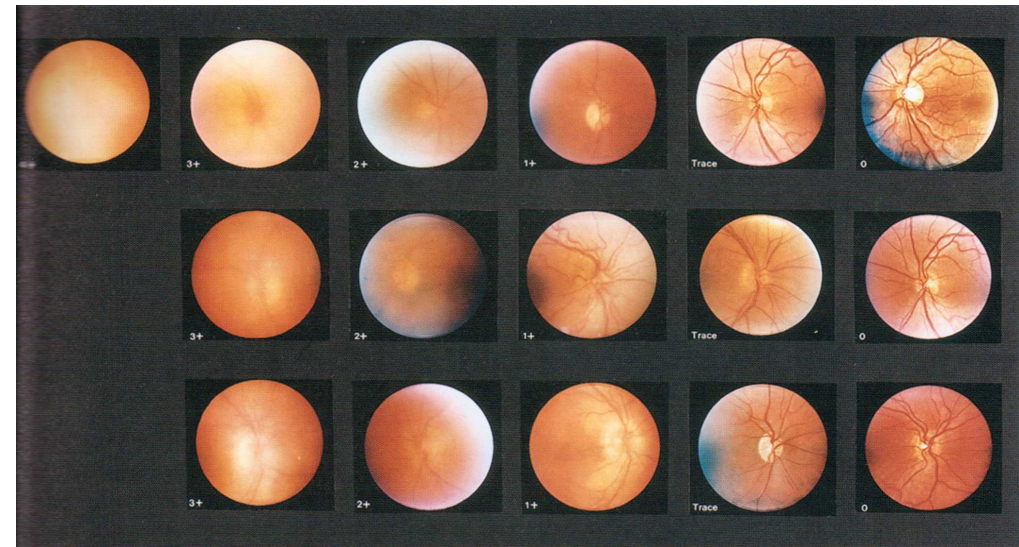
Drug licensing

- **Cost of trial per drug:**
 - Phase 1: \$5million
 - Phase 2: \$10million
 - Phase 3: \$20million
- **Total cost of drug to market:**
 - \$2.7billion



Problems with current endpoints

- 1) **Heterogeneity:** 14 different domains (eg AC cells, vitreous haze etc) used as primary outcome measures.¹
- 2) **Inconsistency:** Not all used SUN scales for relevant indices; variable use of 0.5+ as a step.¹
- 3) **Subjectivity:** poor interobserver agreement between clinical indices
- 4) **Ordinal scales:** big jumps between levels on existing scales



1. Denniston AK, Holland GN, Kidess A... Dick AD. Heterogeneity of primary outcome measures used in clinical trials of treatments for intermediate, posterior, and panuveitis. Orphanet J Rare Dis. 2015 Aug 19;10:97

Problems with current endpoints

Current measures of disease activity in uveitis are insensitive, unreliable and inadequate.¹⁻⁴

“There is a clear need for objective assessments of ocular inflammation, which are repeatable, reliable, and quantifiable.”

Malvina Eydelman, FDA¹

1. Guidance from FDA/National Eye Institute Working Group. 2015;
2. Hornbeak D *Ophthalmology* 2014 [PMID 24697913].
3. Denniston A and Barry RJ *Curr Pharm Des* 2015 [PMID 26350535]



Problems with current endpoints

- 1) **Heterogeneity:** 14 different domains¹
- 2) **Inconsistency:** Not all used SUN scales¹

Define a
Core Outcome Set
for Uveitis^{1,2}

1. Tallouzi MO et al. COSUMO: study protocol for the development of a core outcome set for efficacy and effectiveness trials in posterior segment-involving uveitis. Trials. 2017 Dec 1;18(1):576. 2. <http://www.comet-initiative.org/studies/details/640>

Problems with current endpoints

- 1) **Heterogeneity:** 14 different domains¹
- 2) **Inconsistency:** Not all used SUN scales¹
- 3) **Subjectivity:** poor interobserver agreement between clinical indices
- 4) **Ordinal scales:** big jumps between levels on existing scales

Define a
Core Outcome Set
for Uveitis^{1,2}

Develop **objective**
endpoints through
Quantitative Imaging³

1. Tallouzi MO et al. COSUMO: study protocol for the development of a core outcome set for efficacy and effectiveness trials in posterior segment-involving uveitis. *Trials*. 2017 Dec 1;18(1):576. 2. <http://www.comet-initiative.org/studies/details/640> 3. Denniston AK, Keane PA, Srivastava SK. Biomarkers and Surrogate Endpoints in Uveitis: The Impact of Quantitative Imaging. *Invest Ophthalmol Vis Sci*. 2017 May 1;58(6):BIO131-BIO140

So what are we trying to measure?

- 1. Cystoid macular oedema**
- 2. AC cells and AC flare**
- 3. Retinal vessel inflammation**
- 4. Retina/choroid inflammation**
- 5. Vitreous inflammation**

So what are we trying to measure?

1. Cystoid macular oedema

The Effectiveness of Pharmacological Agents for the Treatment of Uveitic Macular Edema (UMO): A Systematic Review

Mohammad O. Tallouzi [✉](#), MSc [ORCID](#), David J. Moore, PhD, Robert J. Barry, PhD, Melanie Calvert, PhD, Jonathan Mathers, PhD, Philip I. Murray, PhD & Alastair K. Denniston, PhD [...show less](#)

Pages 658-680 | Received 17 Oct 2018, Accepted 02 Jan 2019, Published online: 27 Feb 2019

Conclusion: The review highlights areas where the evidence base is still lacking, and appropriately focused trials are needed to inform best treatment to tackle this sight-threatening condition.

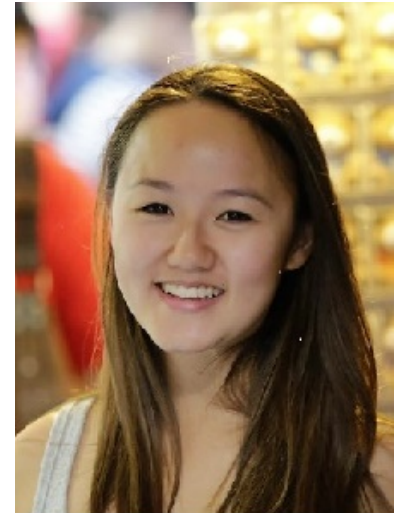
Tallouzi M. PhD. 2015- University of Birmingham.



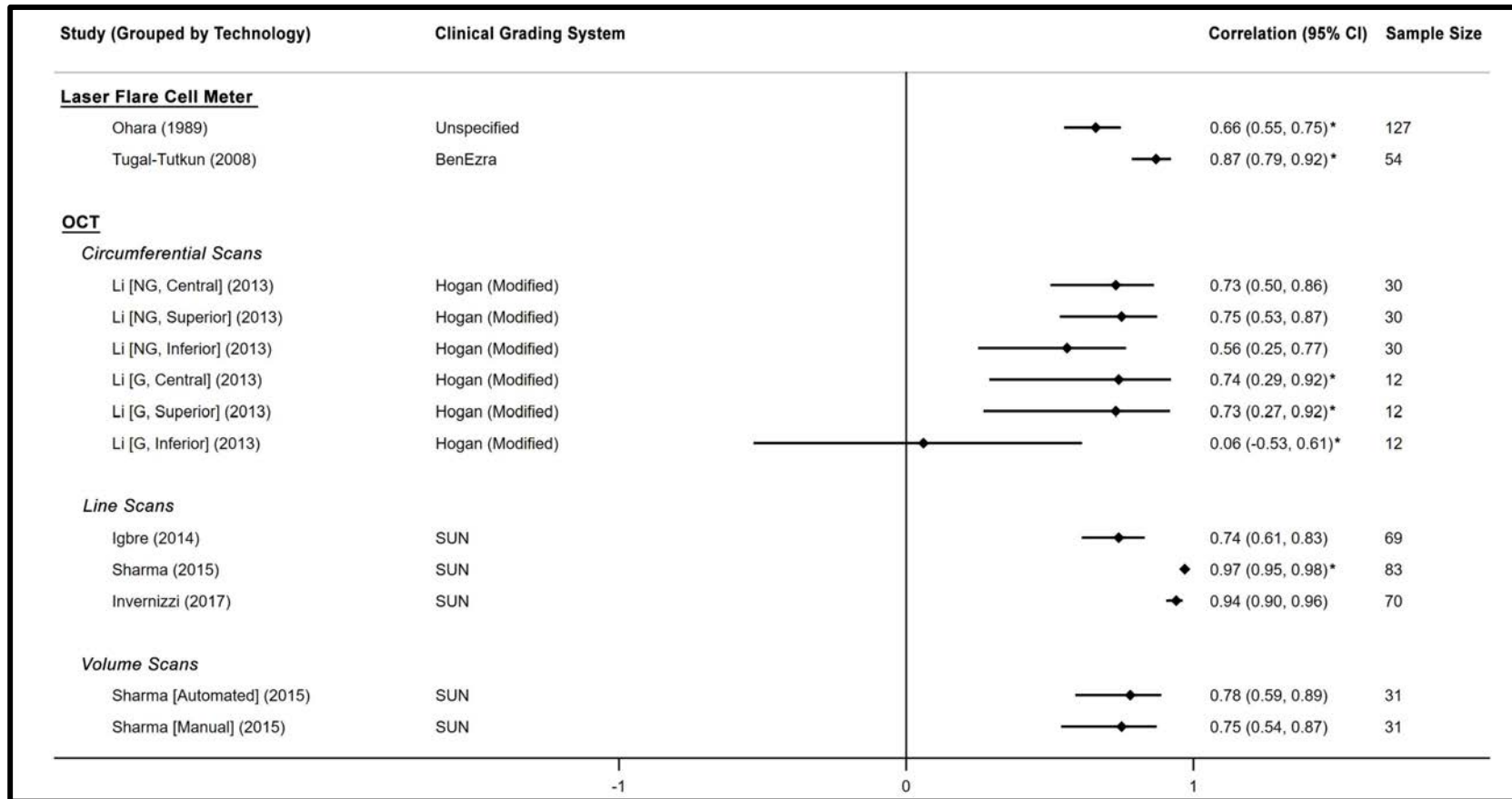
So what are we trying to measure?

1. Cystoid macular oedema
2. **AC cells and AC flare**
3. Retinal vessel inflammation
4. **Retina/choroid inflammation**
5. **Vitreous inflammation**

Liu X. PhD. 2017- University of Birmingham.



Automating AC Cell Counts



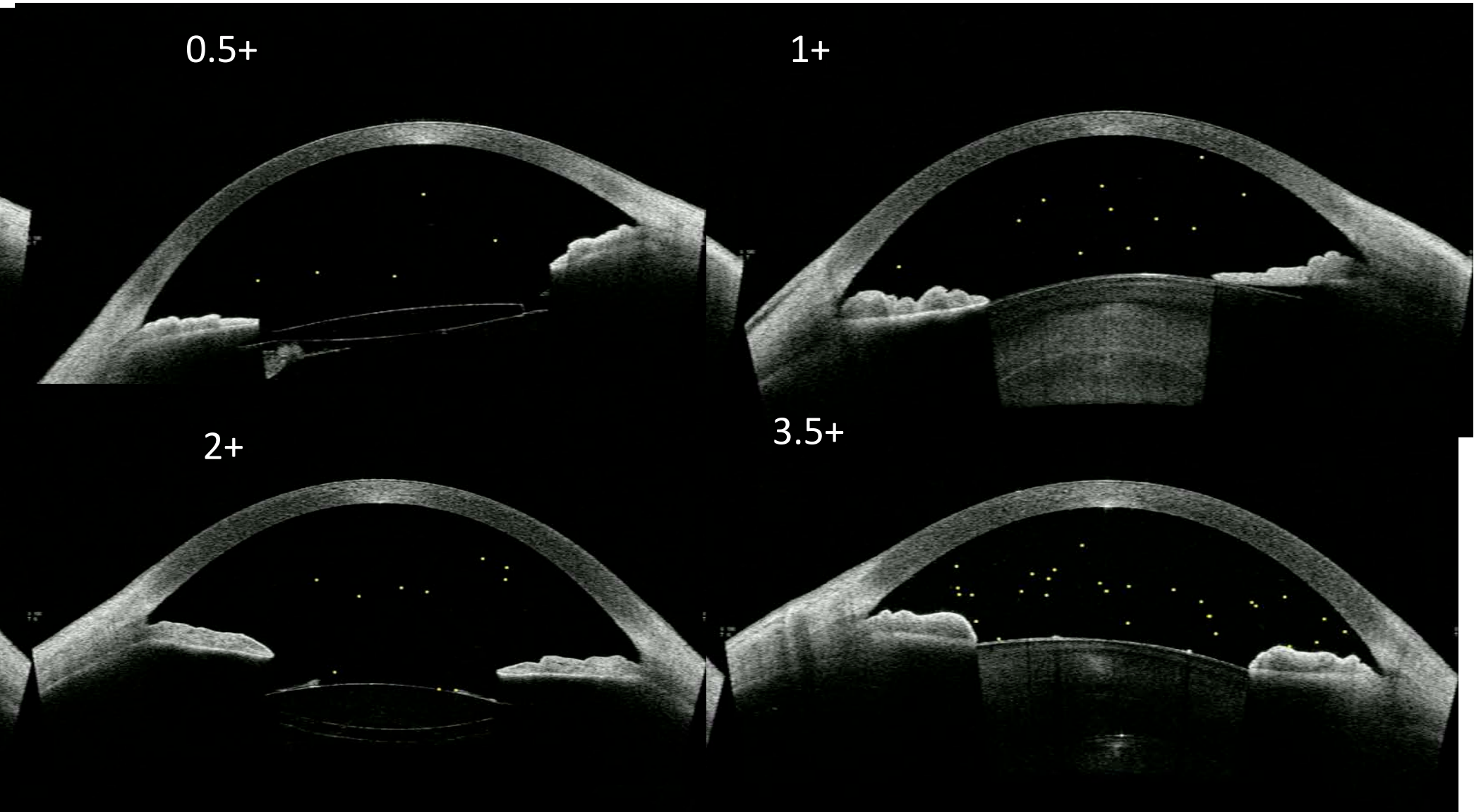
1. Liu X, Solebo AL, Faes L, Beese S, Braithwaite T, Round ME, Panthagani J, Kale AU, McNally TW, Abdulla D, Keane PA, Moore DJ, Denniston AK. Instrument-based Tests for Measuring Anterior Chamber Cells in Uveitis: A Systematic Review. Ocul Immunol Inflamm. 2019 Aug 16:1-12

0.5+

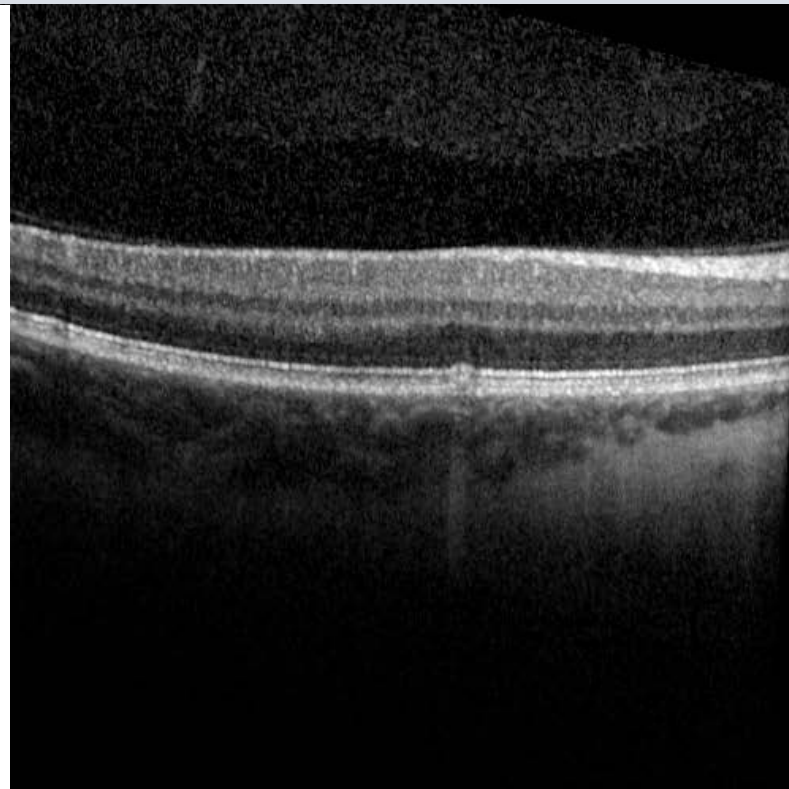
1+

2+

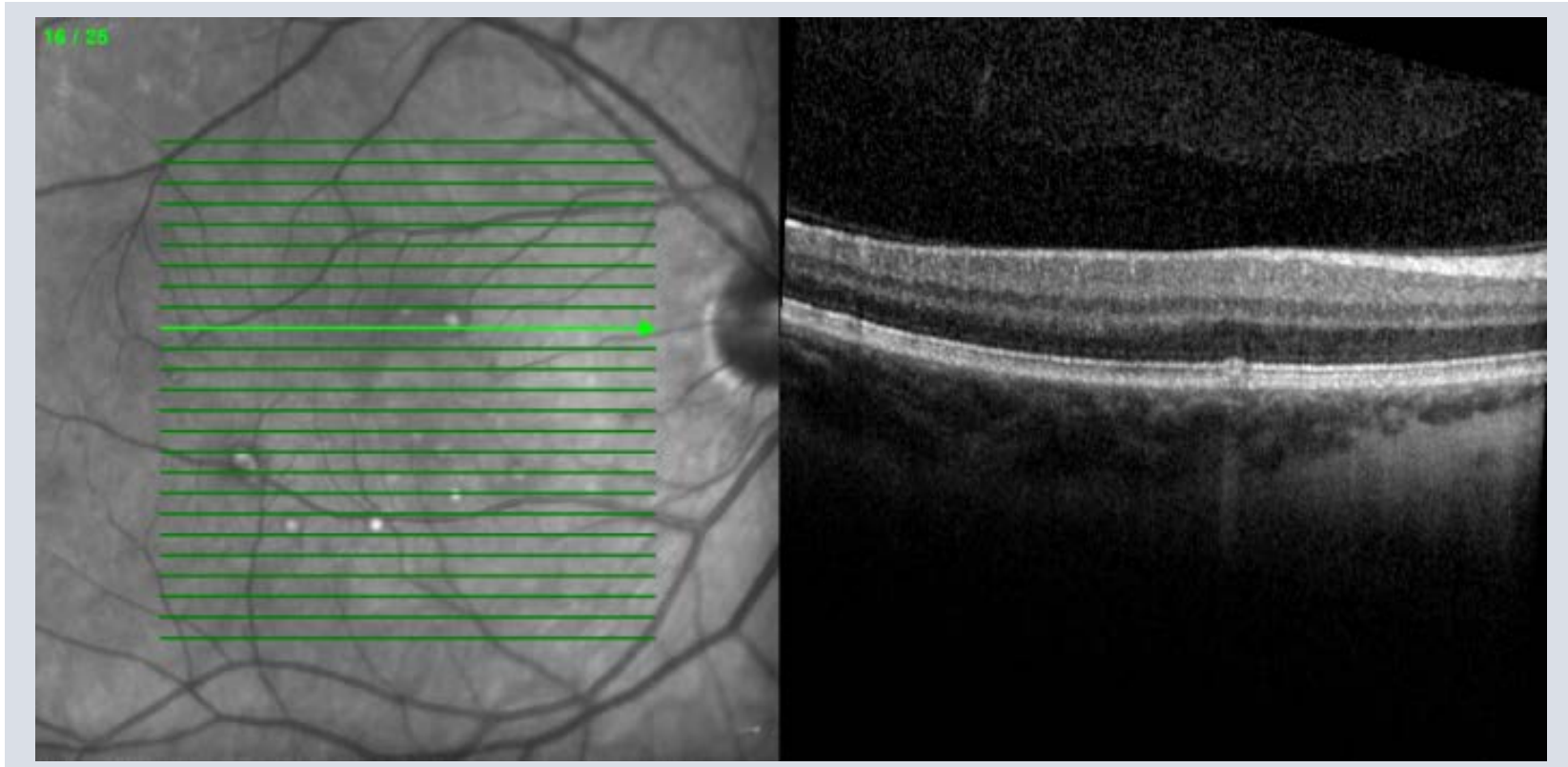
3.5+



Retinal/Choroidal Inflammation

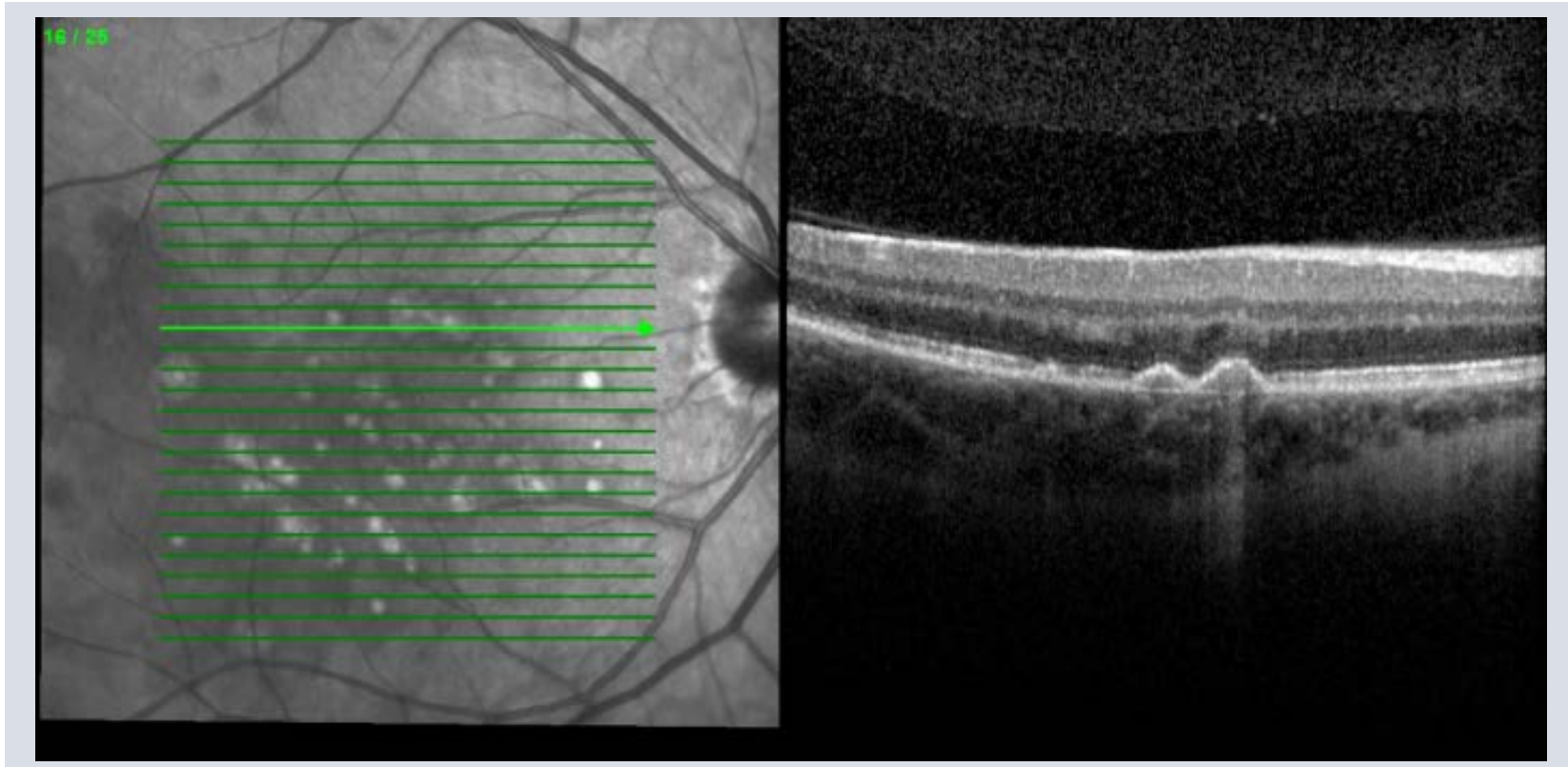


Retinal/Choroidal Inflammation



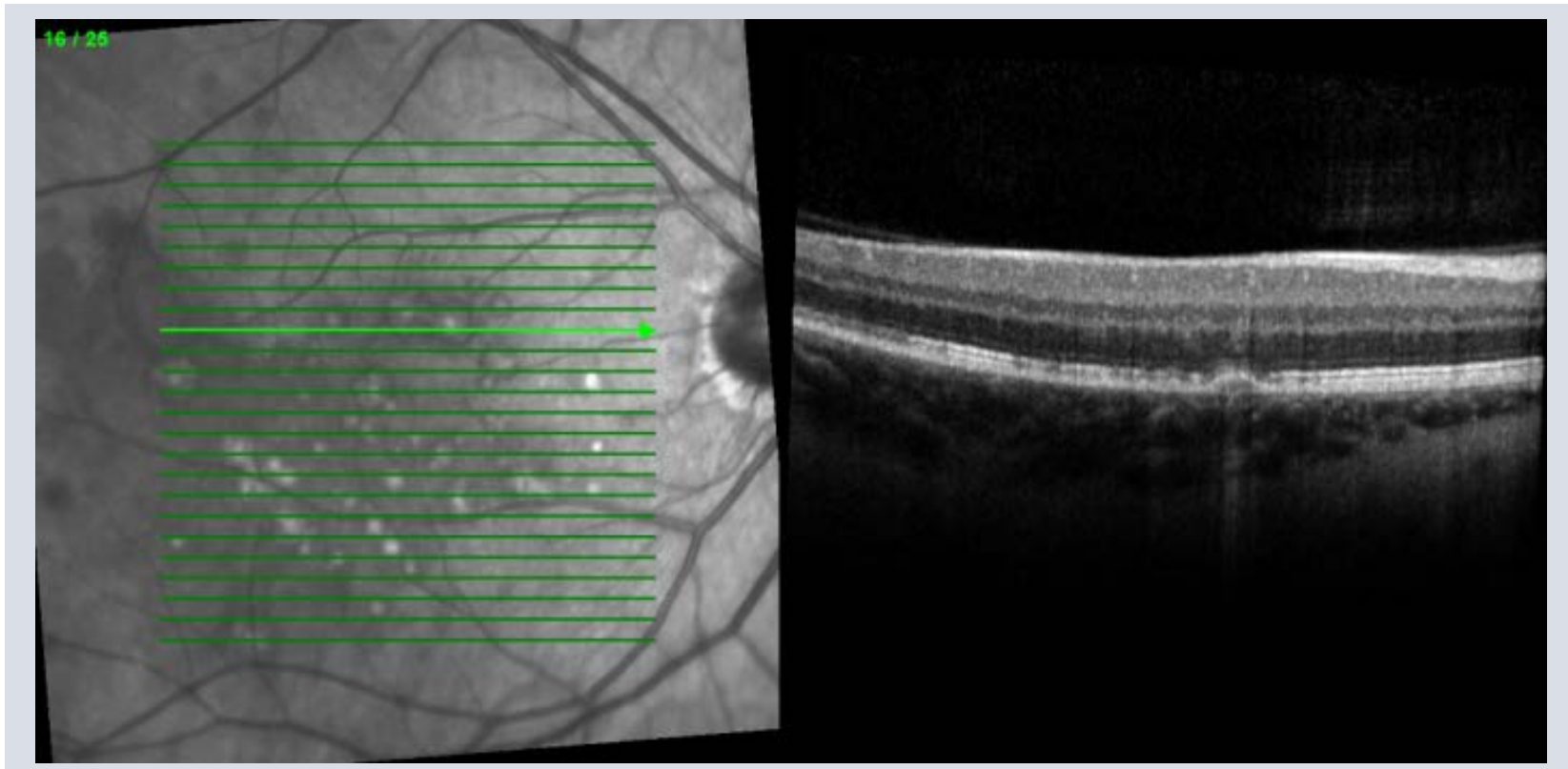
DETECTING ACTIVITY

Retinal/Choroidal Inflammation



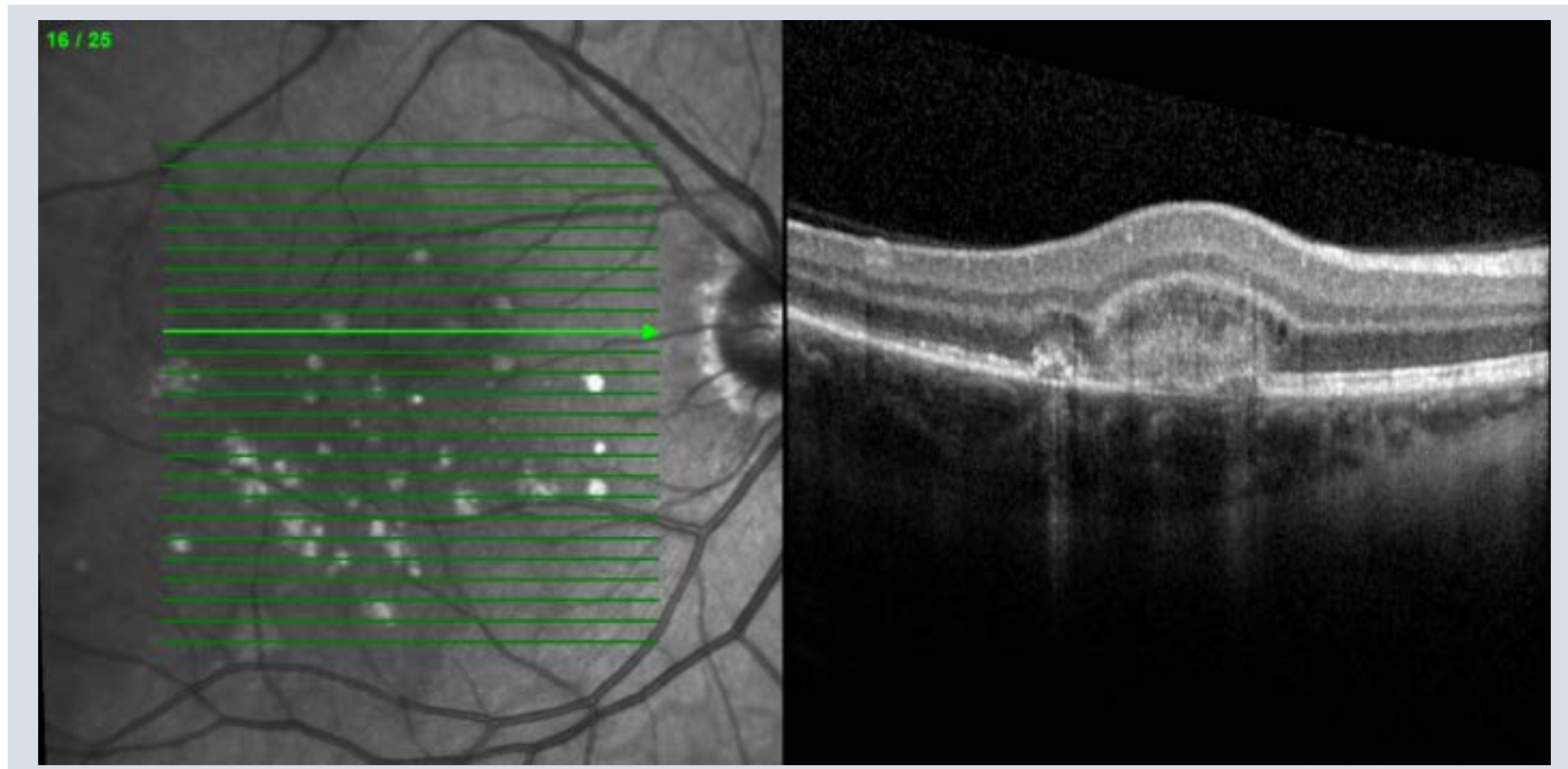
DETECTING ACTIVITY

Retinal/Choroidal Inflammation



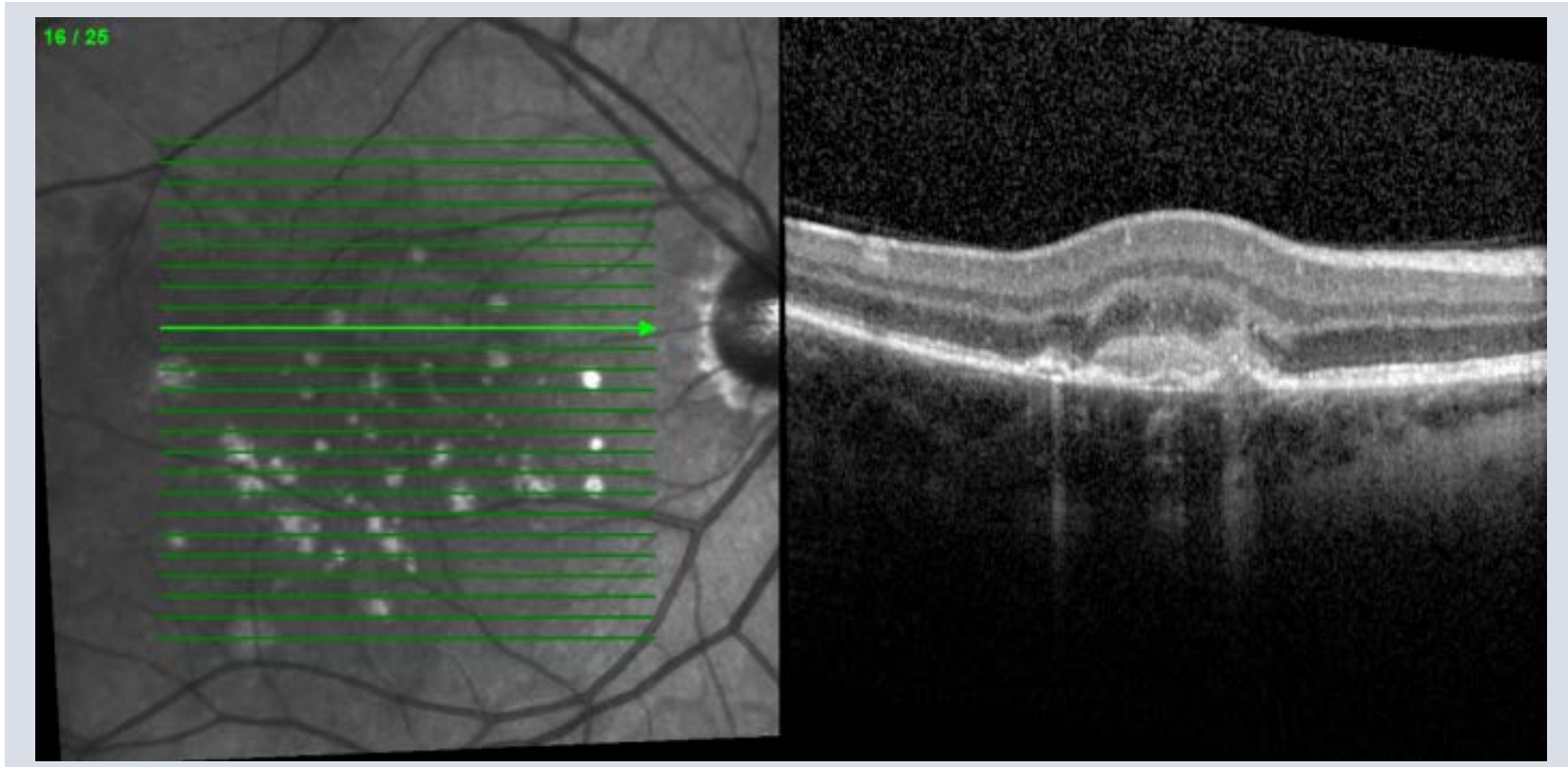
**DETECTING ACTIVITY
(RESPONSE TO RX)**

Retinal/Choroidal Inflammation



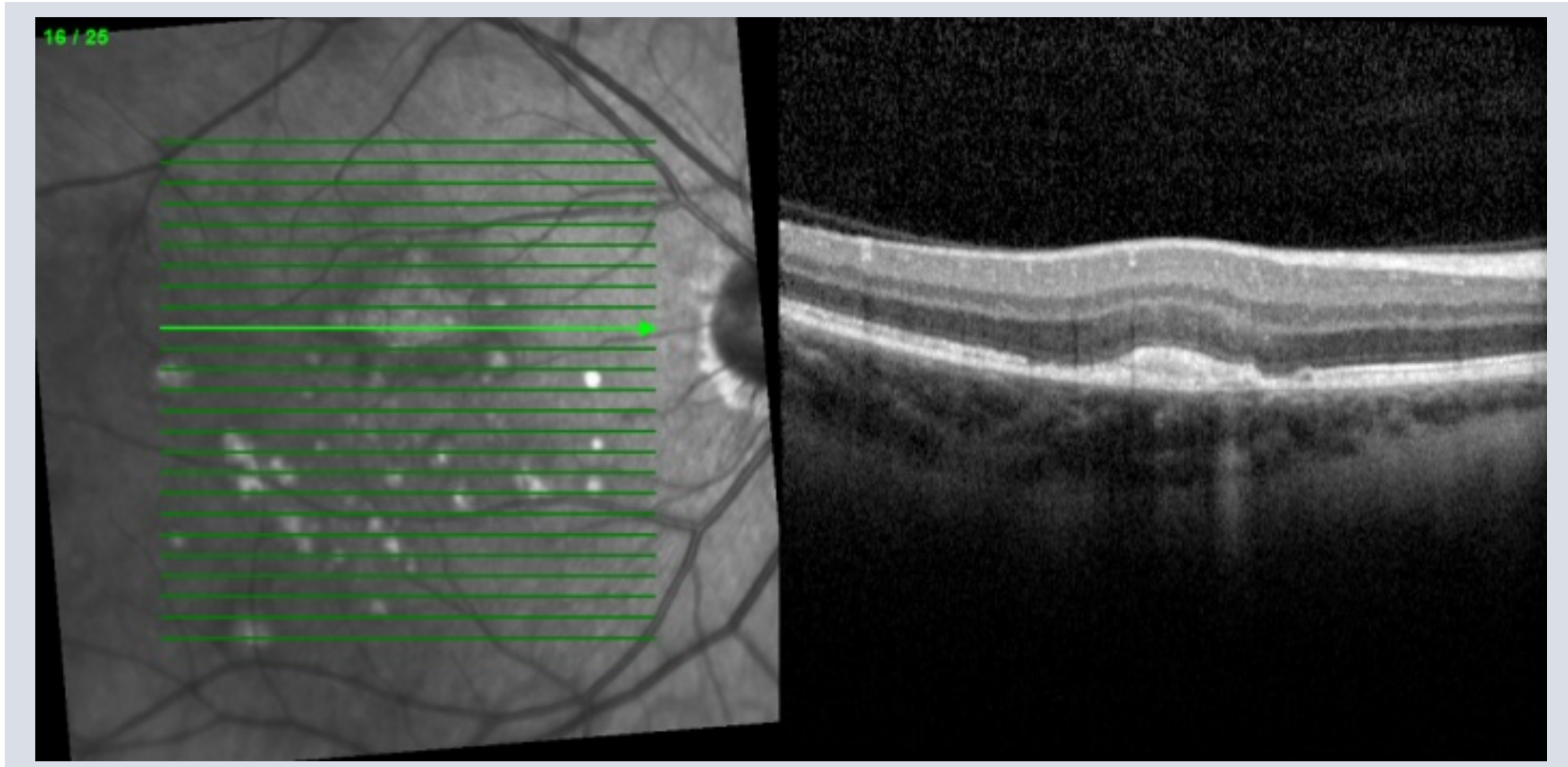
DETECTING COMPLICATIONS

Retinal/Choroidal Inflammation



**DETECTING COMPLICATIONS
(RESPONSE TO RX)**

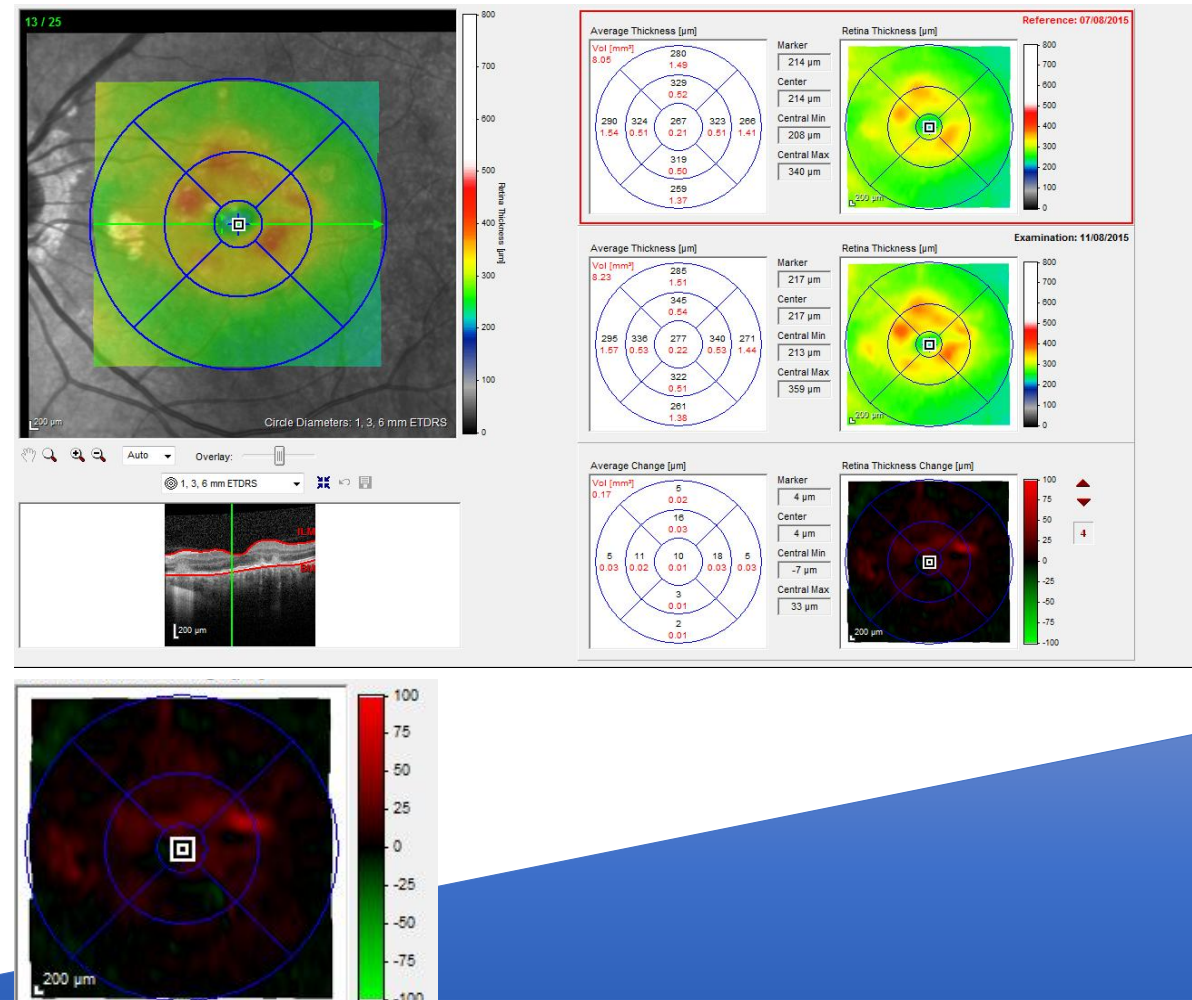
Retinal/Choroidal Inflammation



**DETECTING COMPLICATIONS
(RESPONSE TO RX)**

Retinal/Choroidal Inflammation

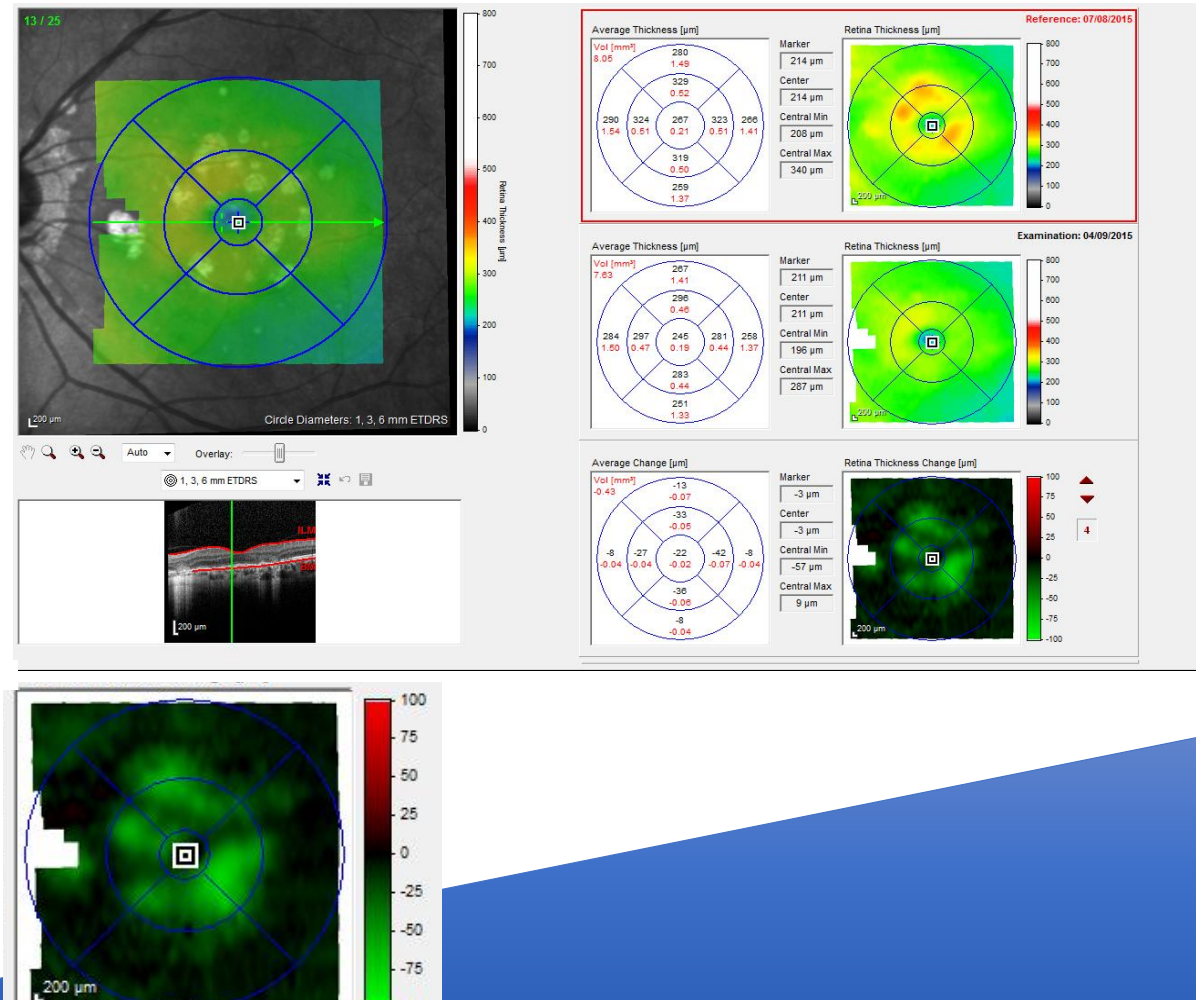
Utilising existing software
(eg HEYEX; Heidelberg Engineering)



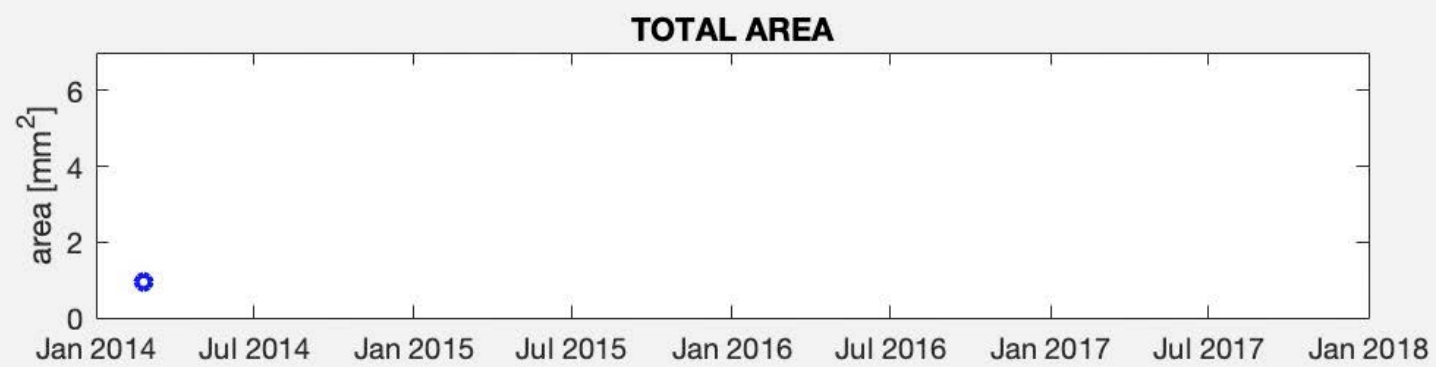
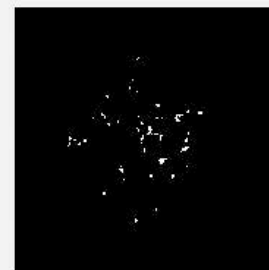
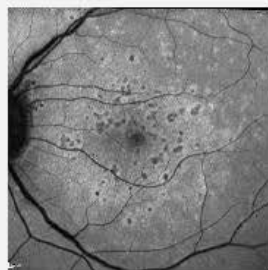
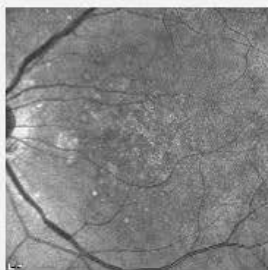
1. Madhusudhan S et al.
J Ophthalmic Inflamm Infect. 2016
2. Denniston A et al IOVS 2017

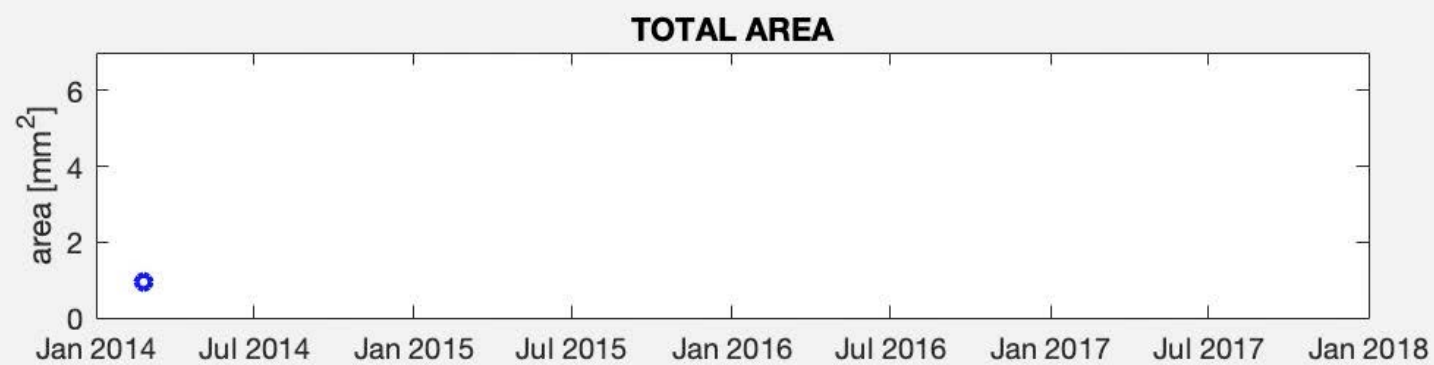
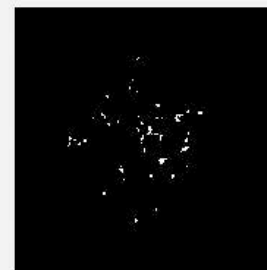
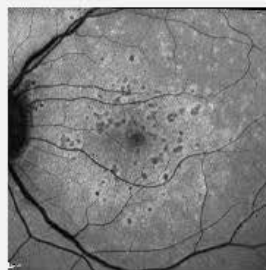
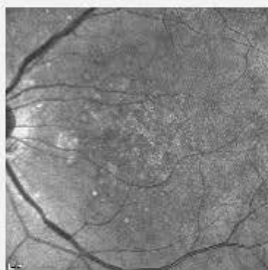
Retinal/Choroidal Inflammation

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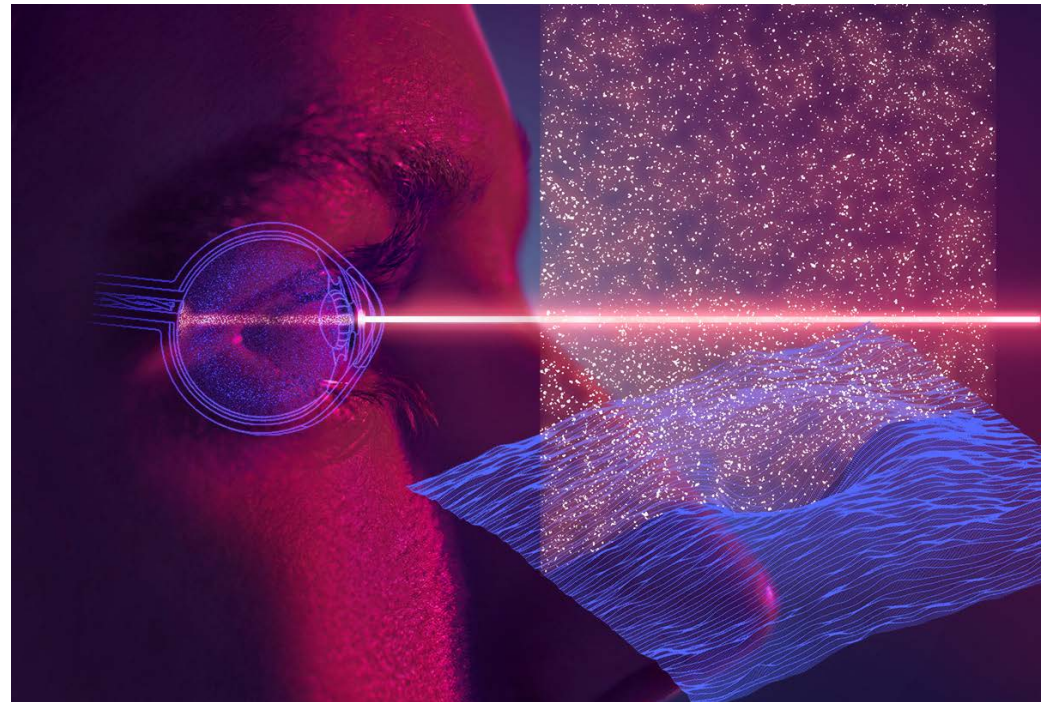
1. Madhusudhan S et al.
J Ophthalmic Inflamm Infect. 2016
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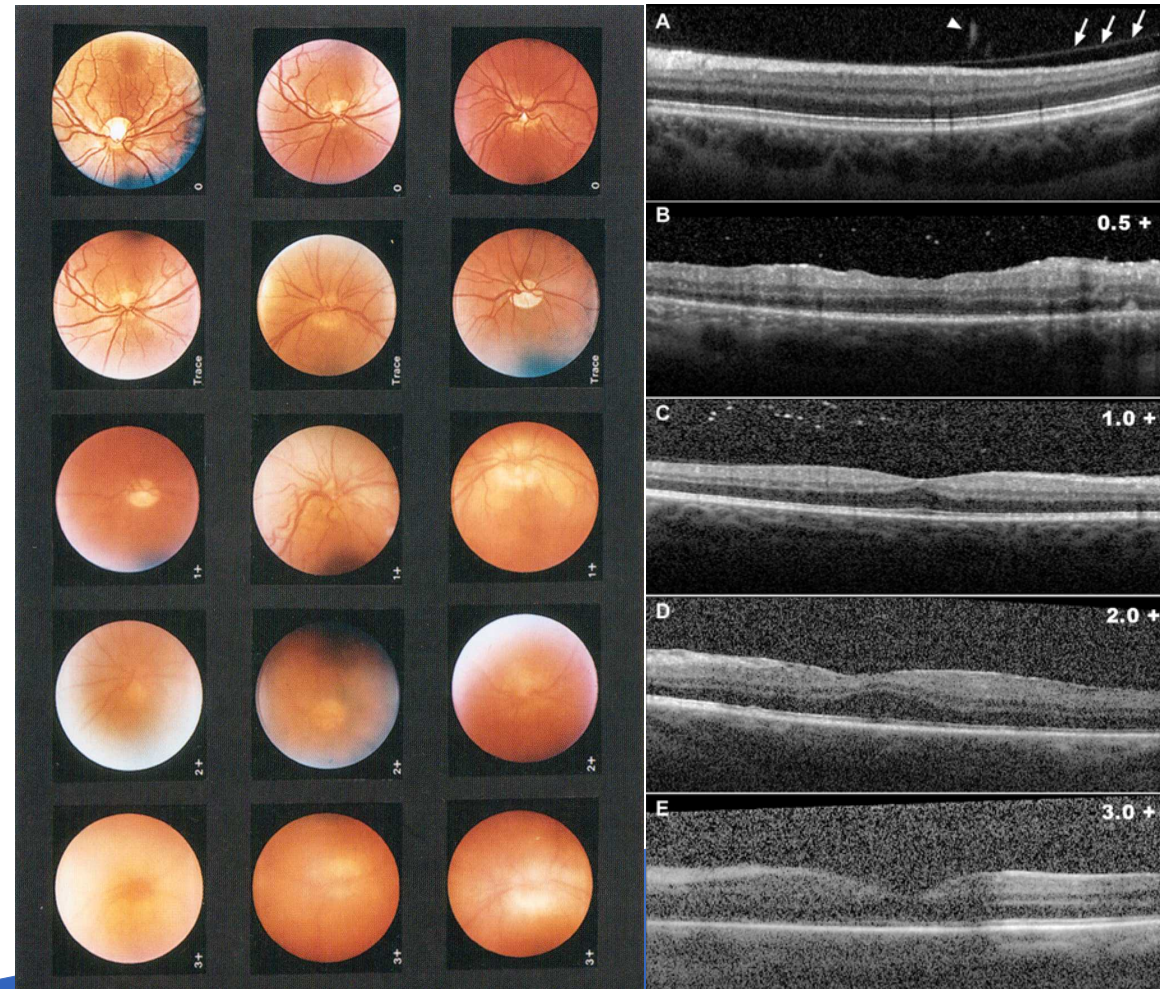
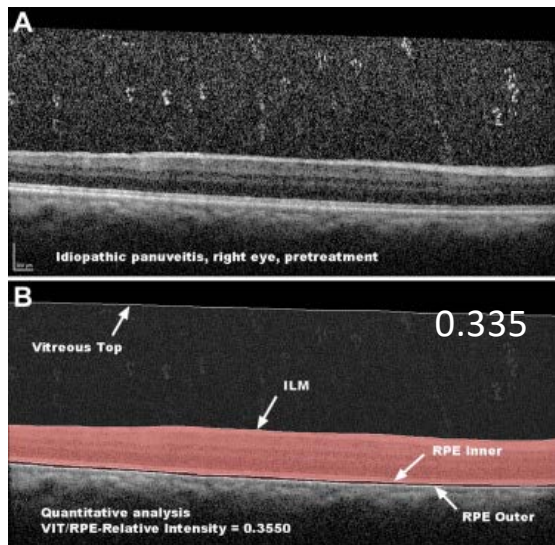
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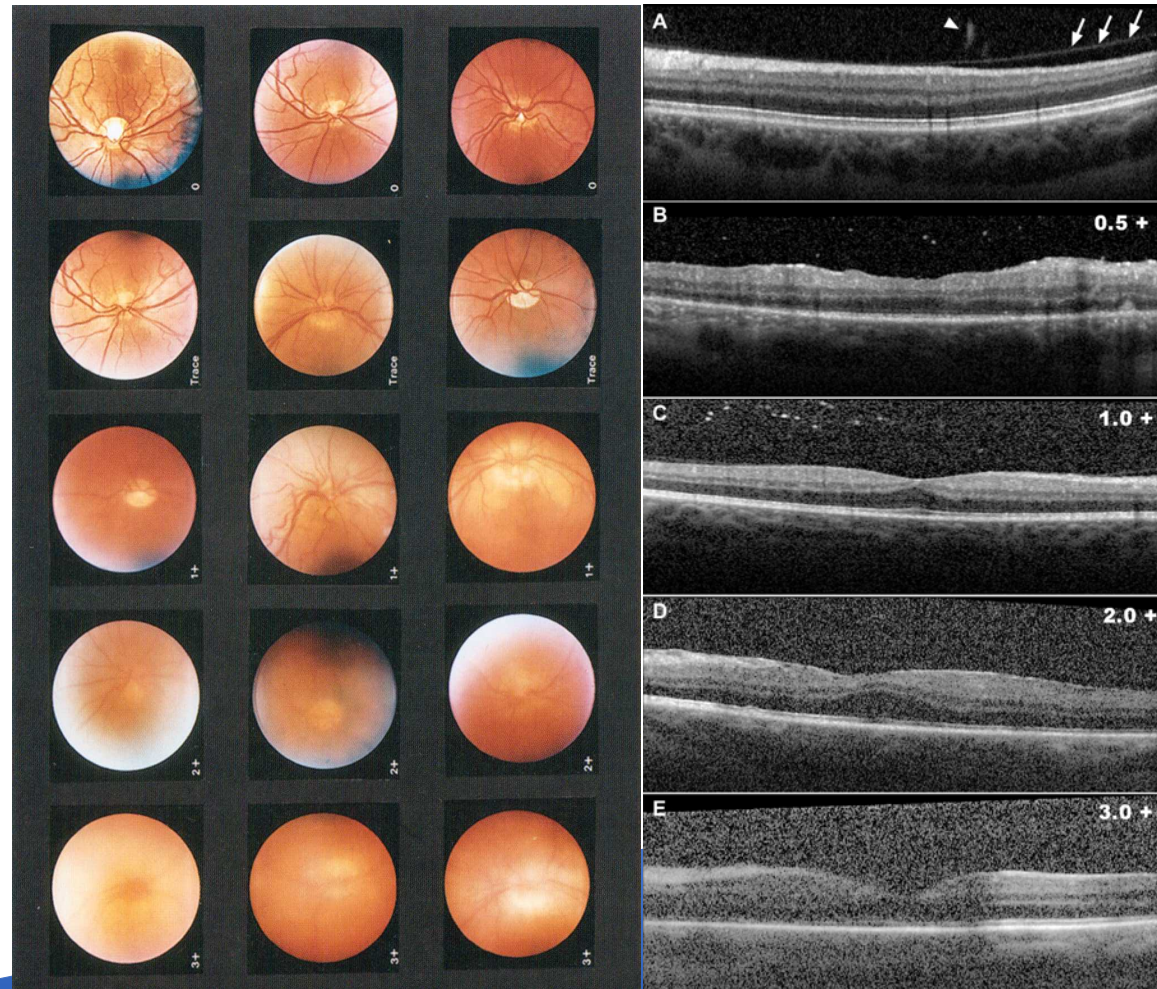
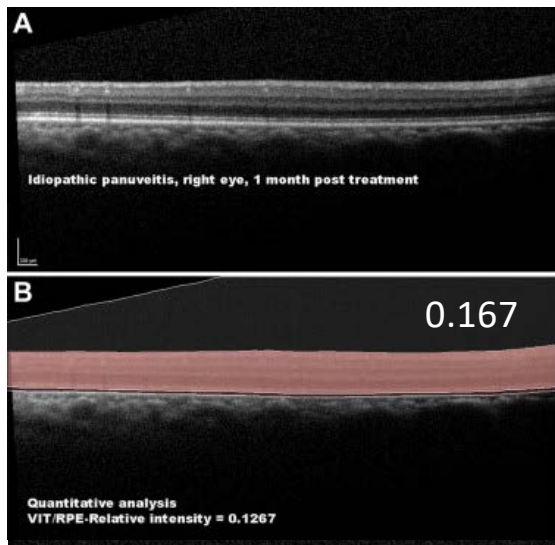
Proof-of-Concept

Vitreous:RPE Relative Intensity (VIT:RPE)



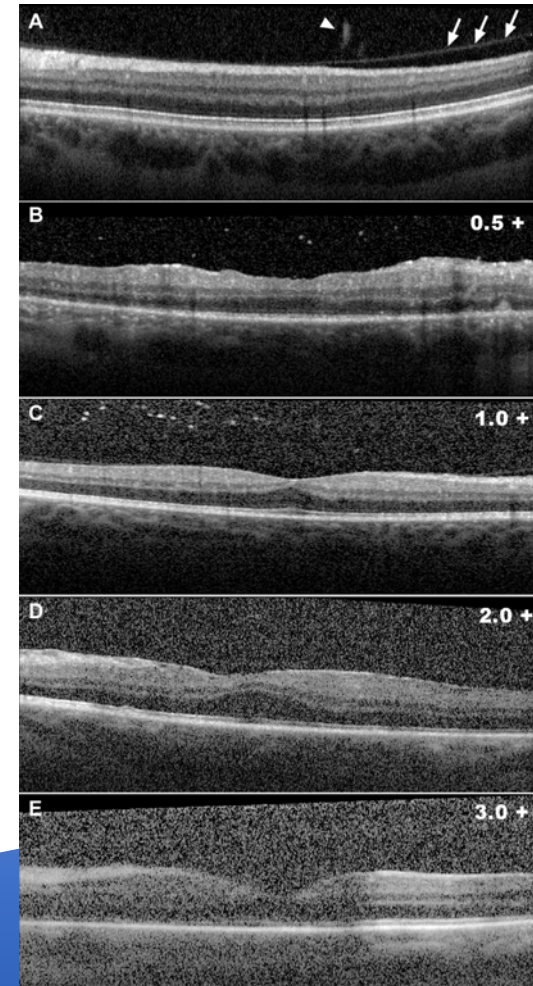
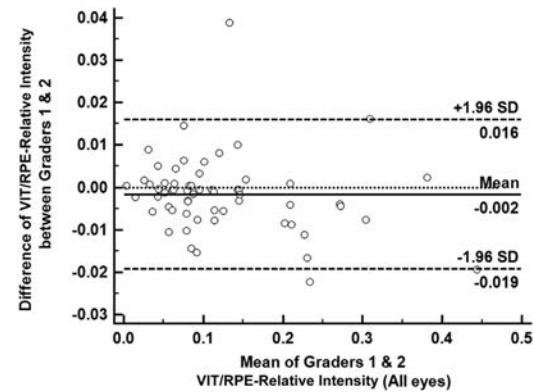
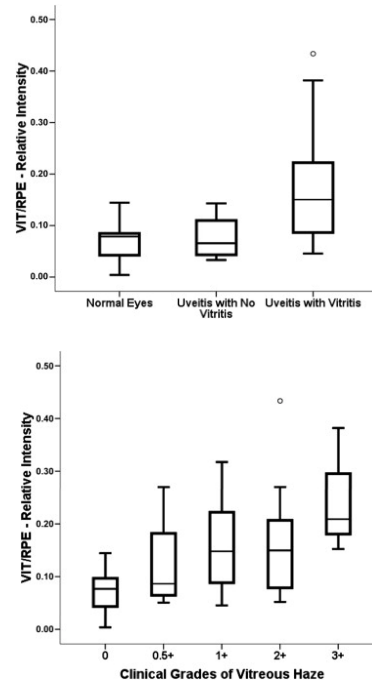
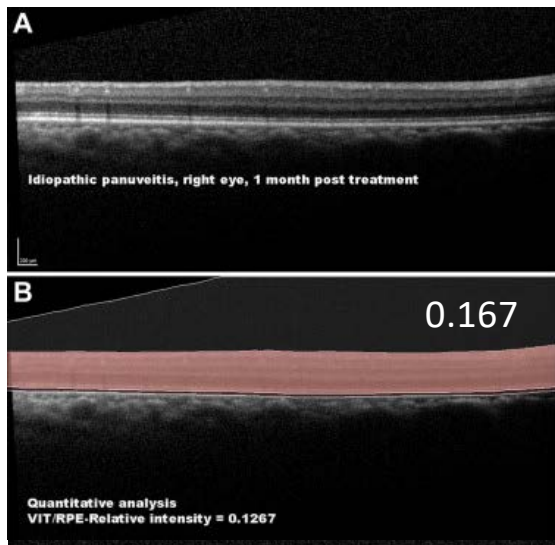
Proof-of-Concept

Vitreous:RPE Relative Intensity (VIT:RPE)



Proof-of-Concept

Vitreous:RPE Relative Intensity (VIT:RPE)



1. Keane PA...Denniston AK. *Ophthalmology* 2015 [PMID 2483579]

Just the start...

Proof-of-
concept¹



CLINICAL
DEPLOYMENT

1. Keane PA...Denniston AK. *Ophthalmology* 2015 [PMID 2483579].

First Automation

Proof-of-
concept¹

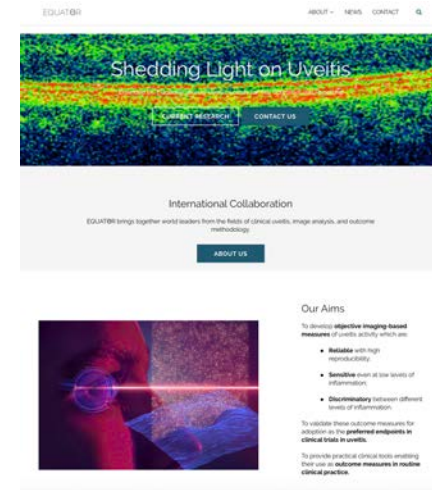


University Hospitals **NHS**
Birmingham
NHS Foundation Trust



Moorfields Eye Hospital **NHS**
NHS Foundation Trust

University Hospitals Bristol **NHS**
NHS Foundation Trust



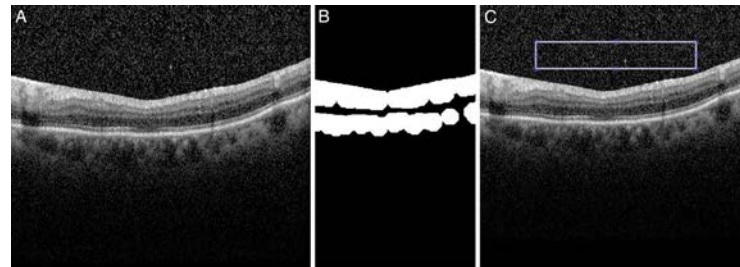
Established
EQUATOR
collaboration²

www.equator.vision

1. Keane PA...Denniston AK. *Ophthalmology* 2015 [PMID 2483579]. 2. www.equator.vision 3. Keane PA... Denniston AK, Aslam TA for EQUATOR. *TVST* 2015 [PMID 26396930]

First Automation

First Automation³



Scan analysis time reduced from:
5 minutes/scan (semi-automated) to
5 seconds/scan (automated)

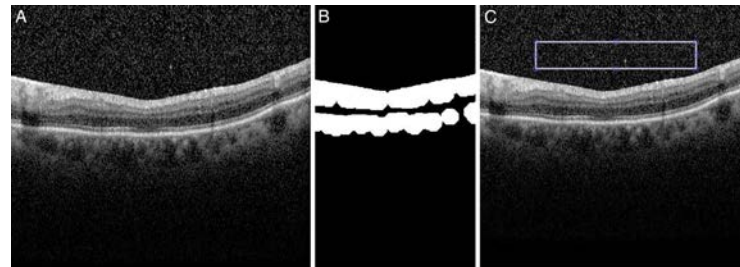
Proof-of-
concept¹

Established
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Cross Platform Validation

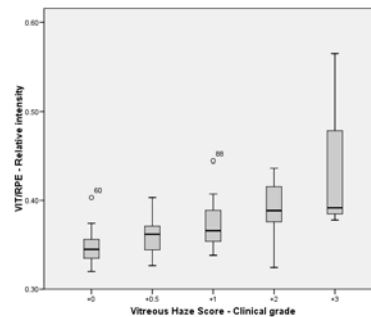
First Automation³



Scan analysis time reduced from:
5 minutes/scan (semi-automated) to
5 seconds/scan (automated)

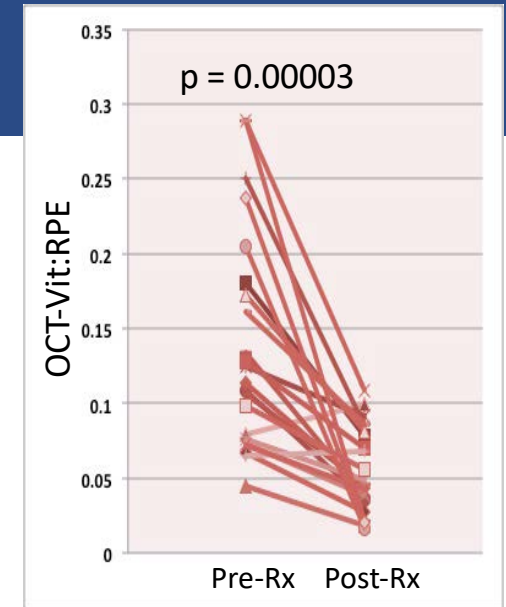
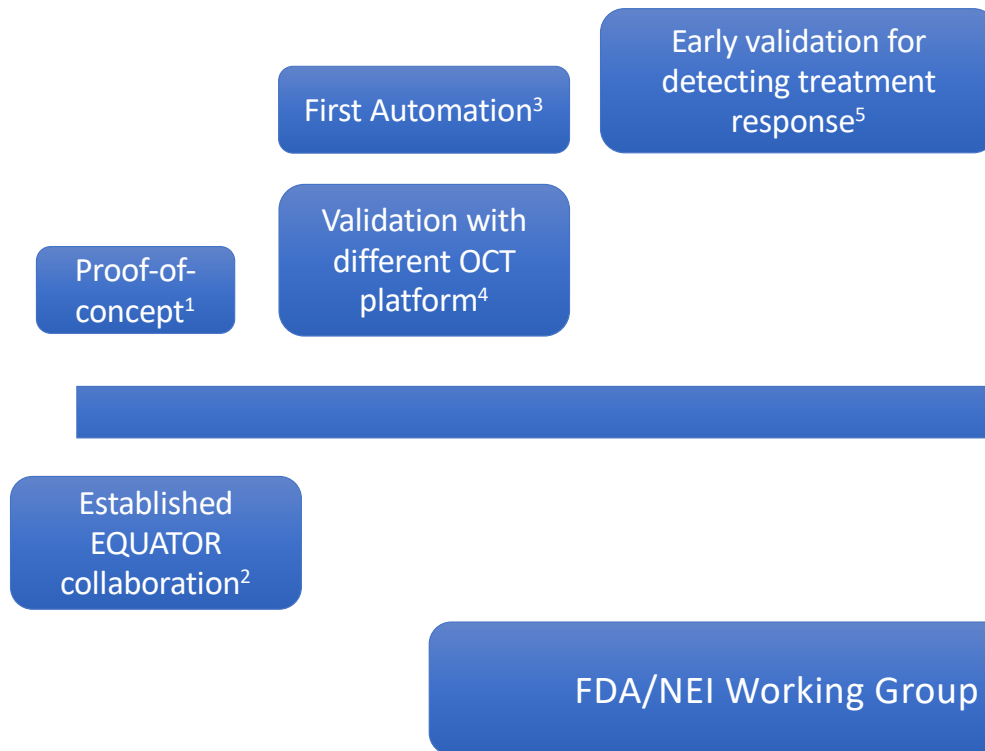
Proof-of-
concept¹

Established
EQUATOR
collaboration²



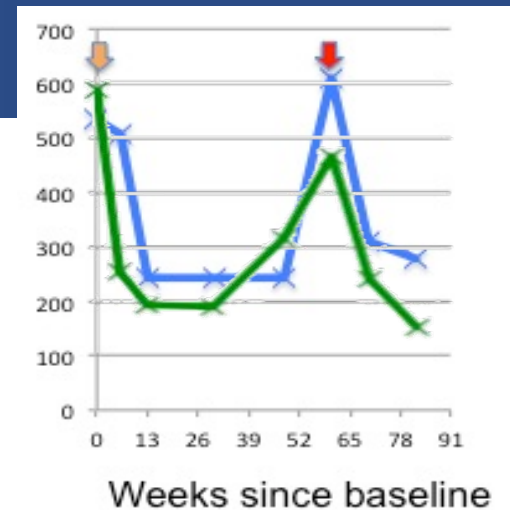
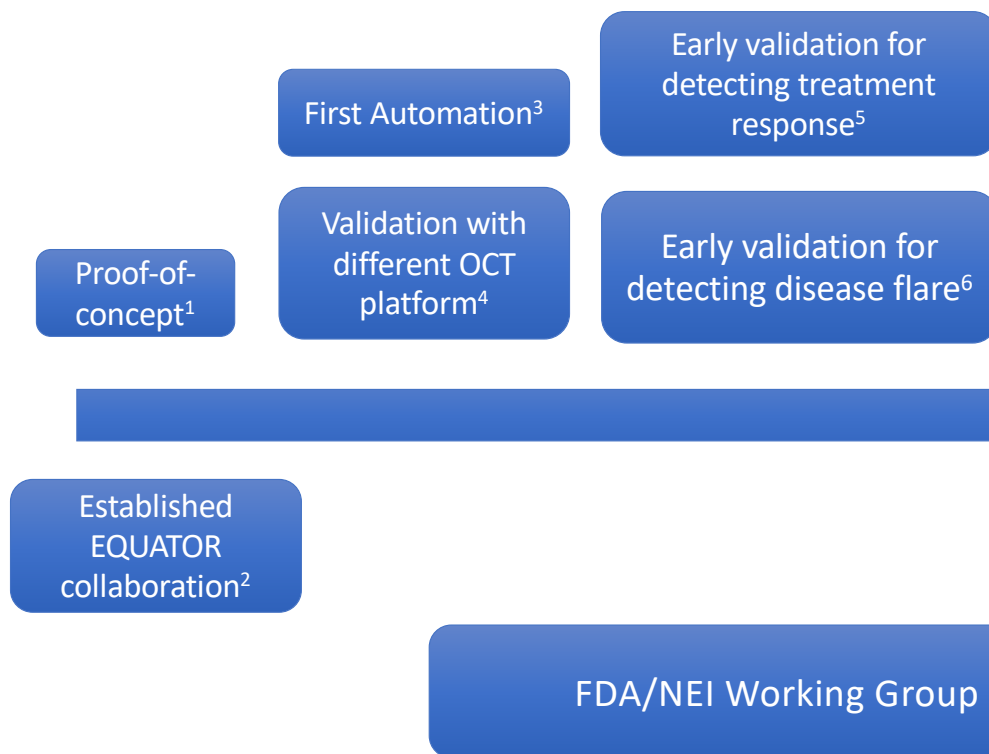
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Detect Treatment Response



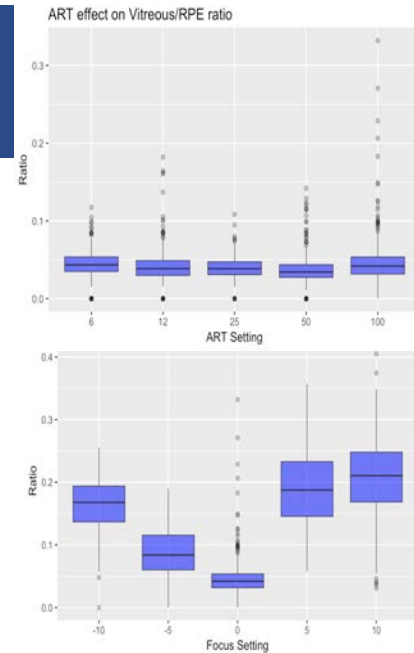
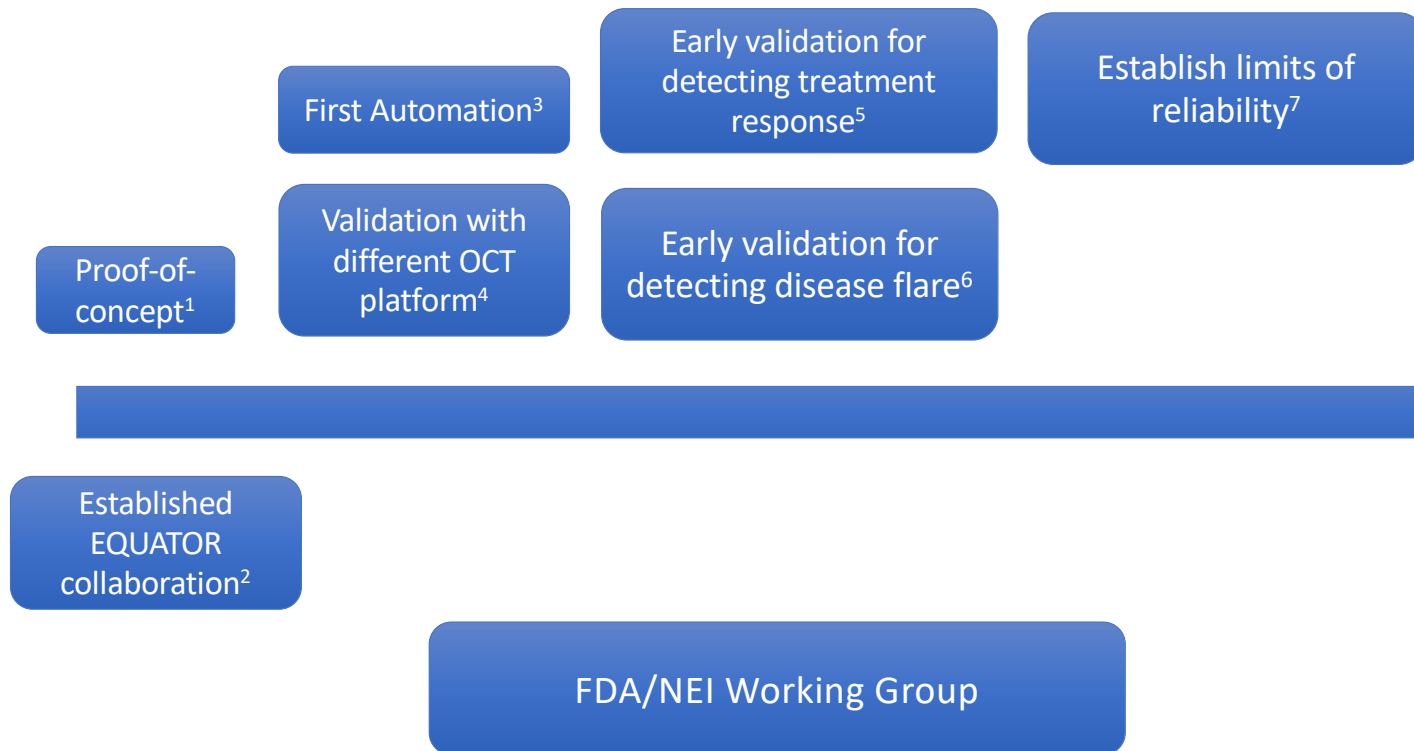
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Detect Disease Flare



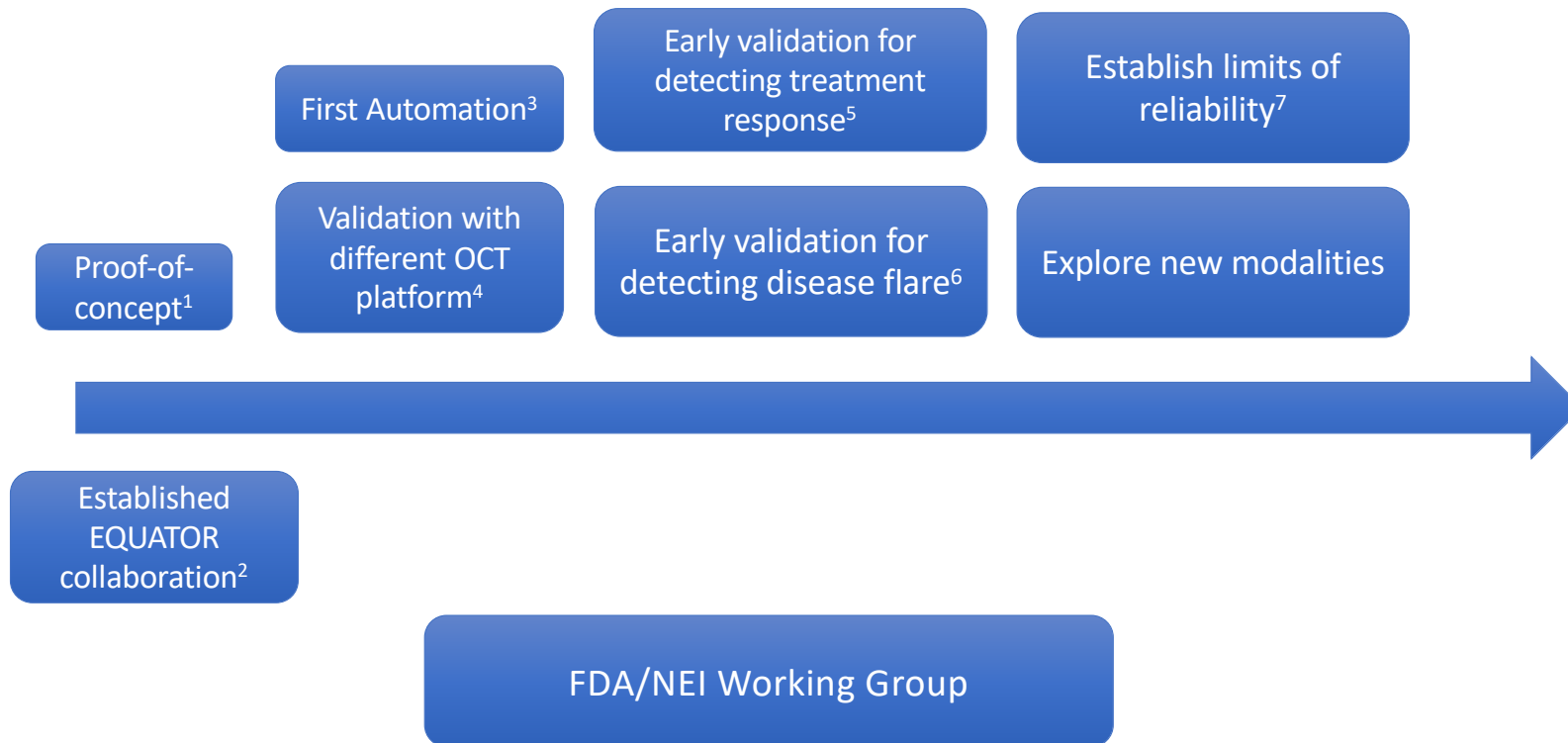
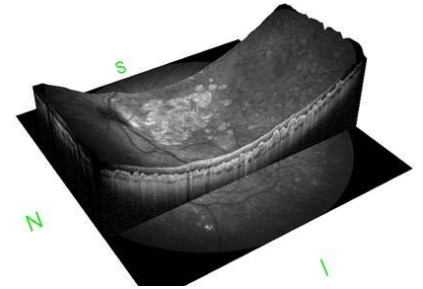
1. Keane PA...Denniston AK. *Ophthalmology* 2015 [PMID 2483579]. 2. www.equator.vision 3. Keane PA... Denniston AK, Aslam TA for EQUATOR. *TVST* 2015 [PMID 26396930]. 4. Zarranz-Ventura J... Denniston AK, Adan A for EQUATOR. *Am J Ophthal* 2015 [PMID 26476212]. 5. Sreekantam S et al. *Br J Ophthalmol*. 2017. 6. Denniston AK. FDA/Pharma Symposium, Isopt (Berlin) 2015.

Establish Limits



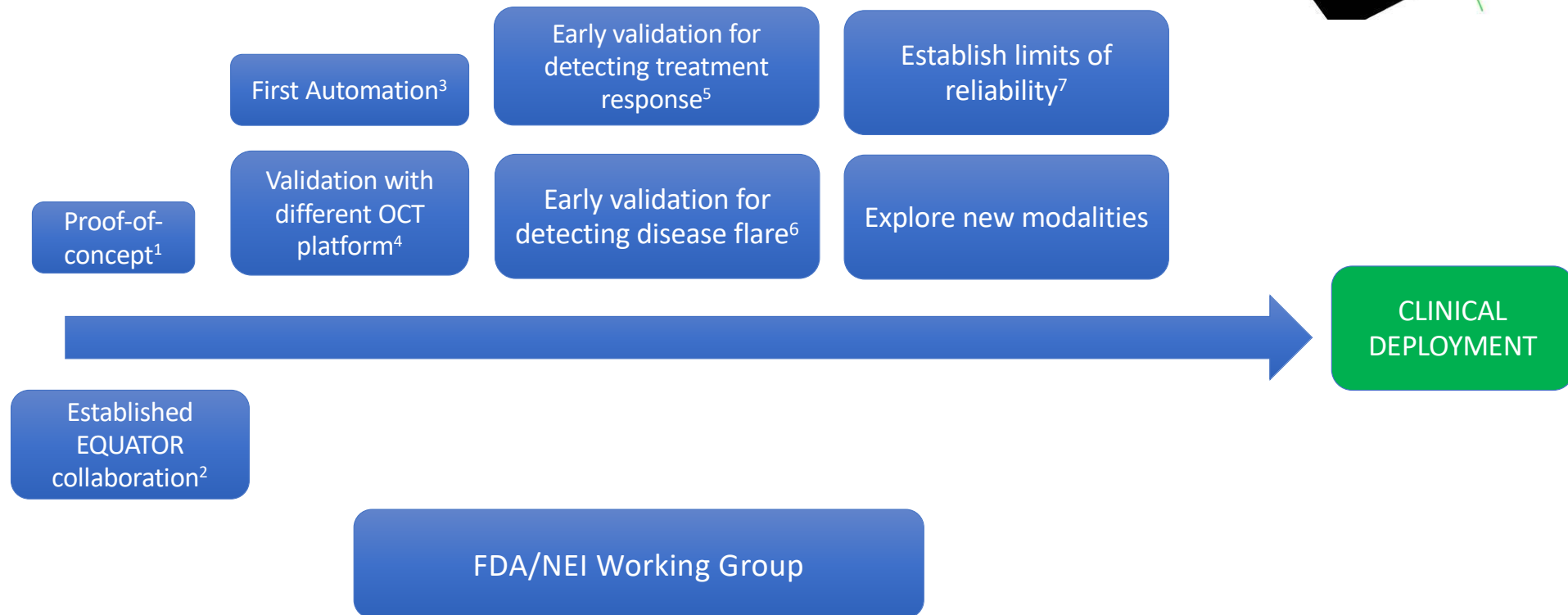
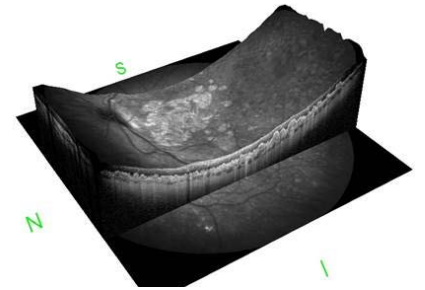
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Establish Limits



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Develop User Interface



1. Keane PA...Denniston AK. *Ophthalmology* 2015 [PMID 2483579]. 2. www.equator.vision 3. Keane PA... Denniston AK, Aslam TA for EQUATOR. *TVST* 2015 [PMID 26396930]. 4. Zarranz-Ventura J... Denniston AK, Adan A for EQUATOR. *Am J Ophthal* 2015 [PMID 26476212]. 5. Sreekantam S et al. *Br J Ophthalmol*. 2017. 6. Denniston AK. FDA/Pharma Symposium, Isopt (Berlin) 2015. 7. Montesano G,et al. *Sci Rep*. 2018

www.relayer.online

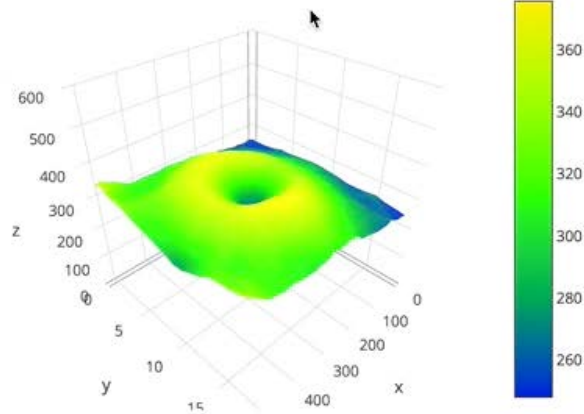
Relayer Results

Surface plot

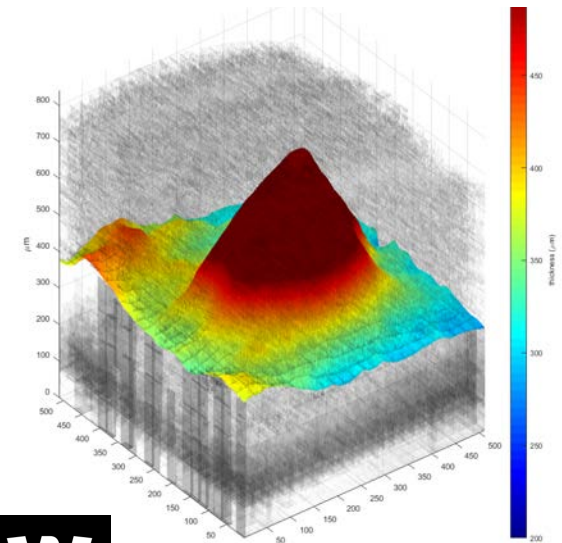
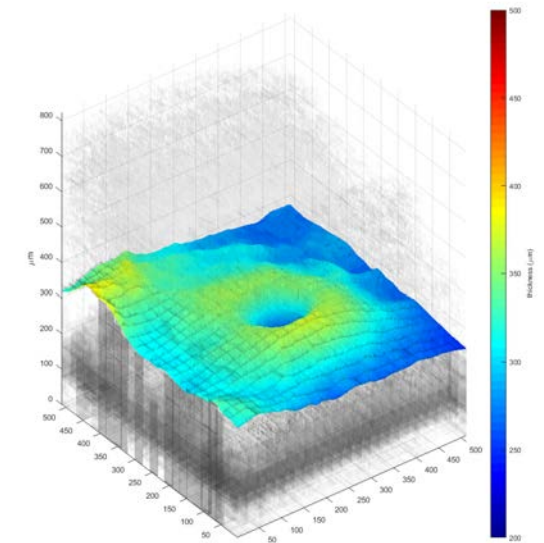
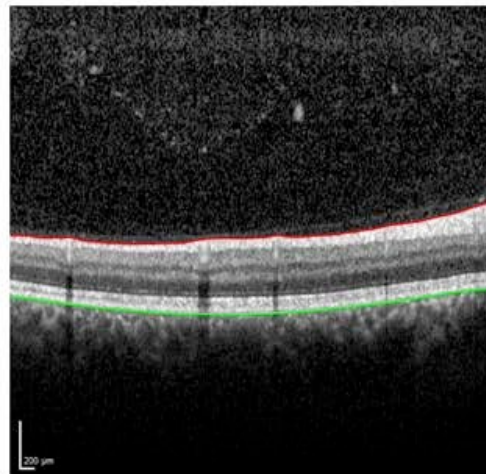
Retinal thickness: distance in micrometers between ILM (Inner Limiting Membrane) and RPE (Retinal Pigment Epithelium) layers.



Thickness (μm)

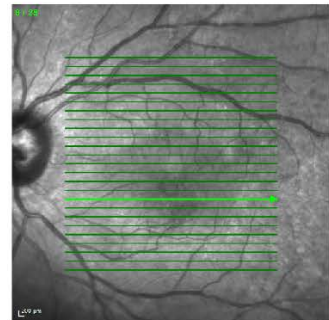
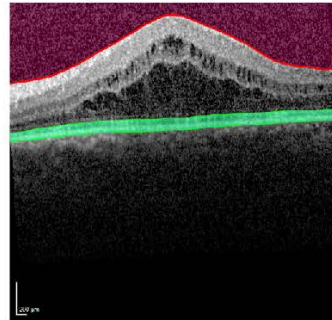
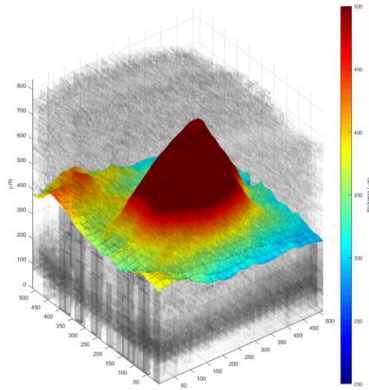


Segmentation for B-scan 19

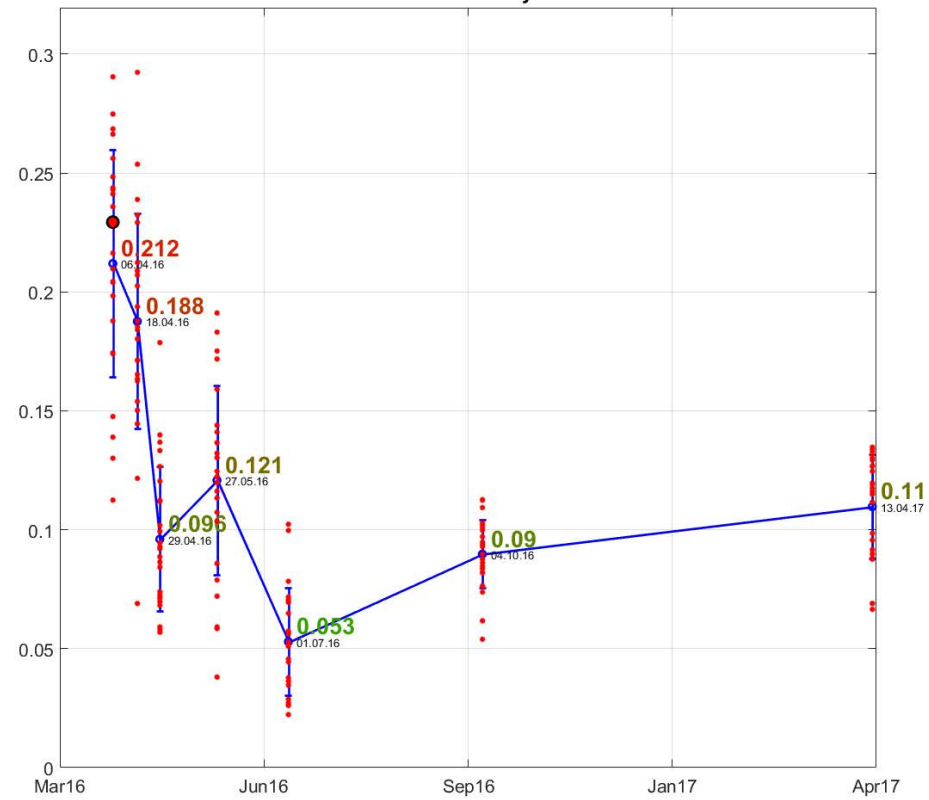


EQUIP: User Interface

Visit 1 (date: 060416) - Scan: 9/25

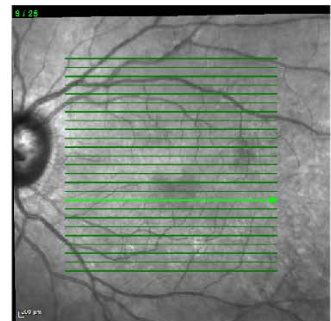
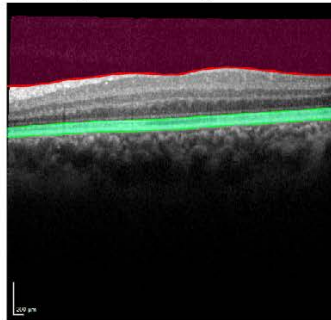
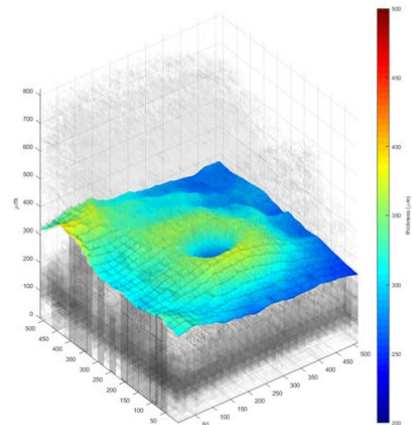


VGel/RPE intensity ratio

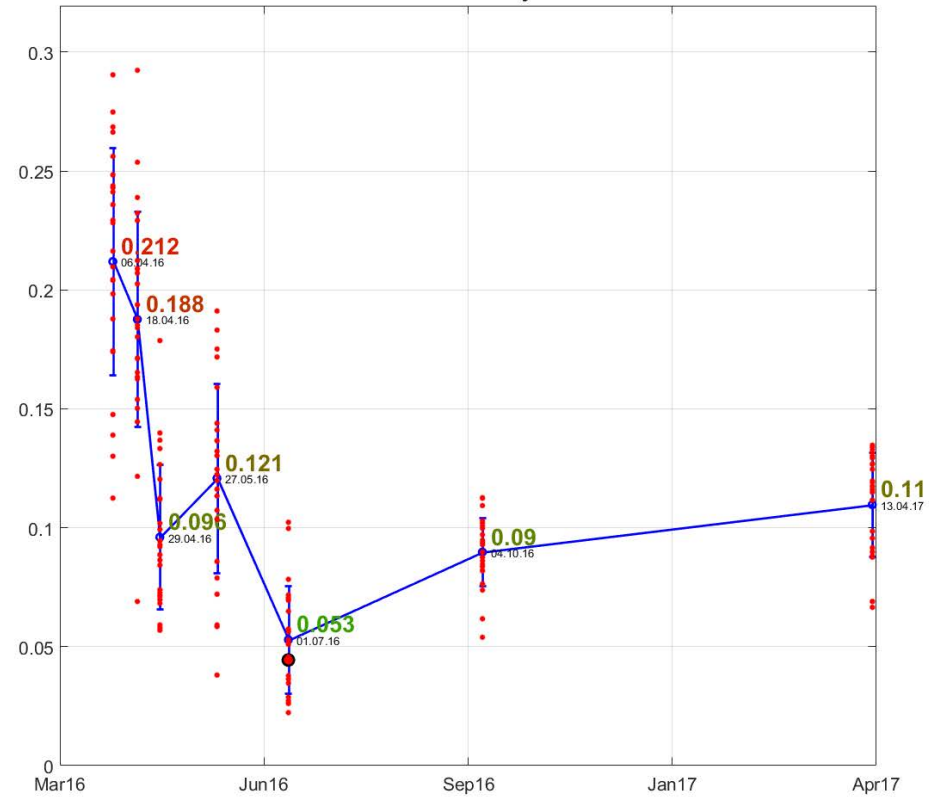


EQUIP: User Interface

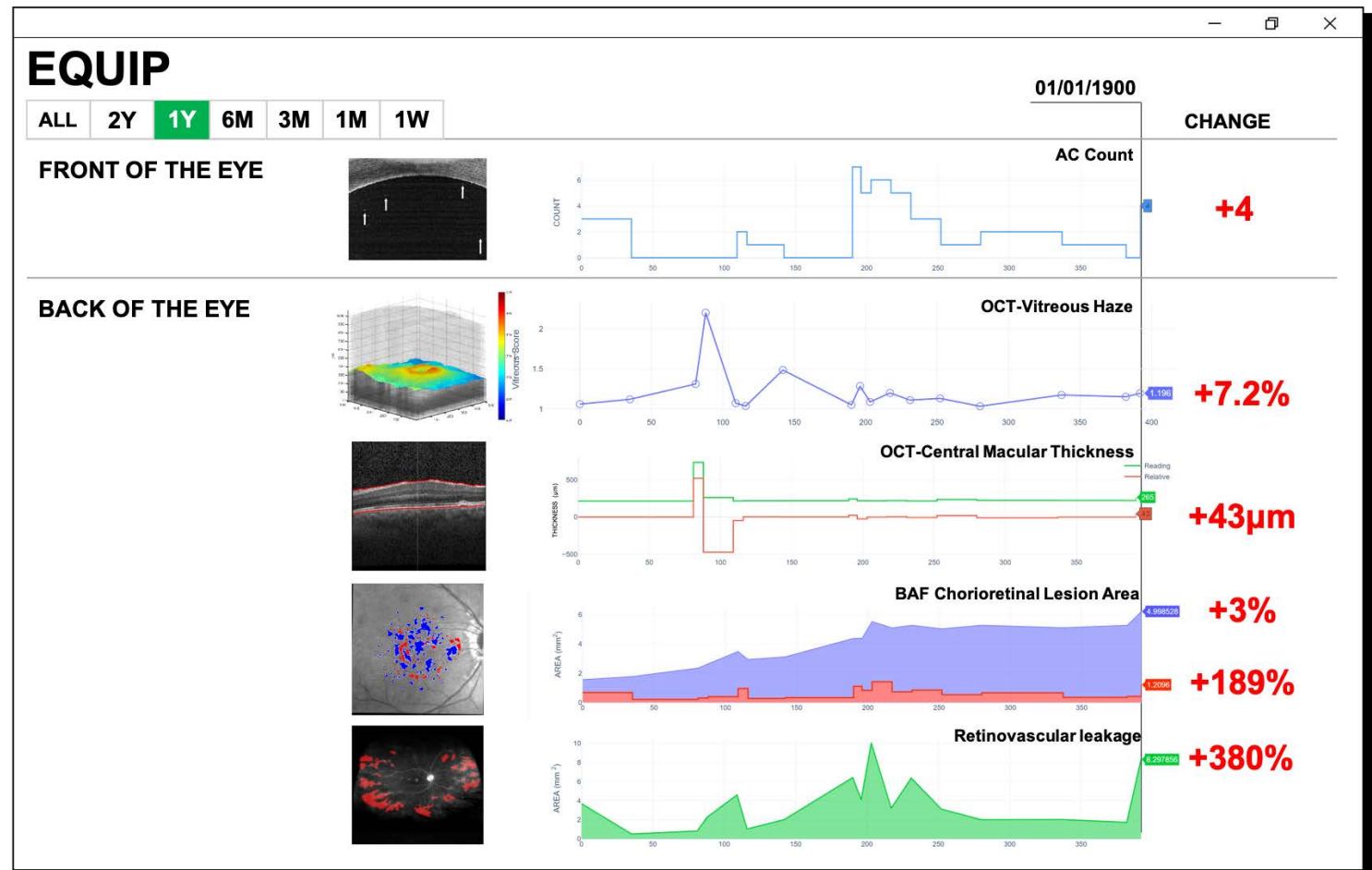
Visit 5 (date: 010716) - Scan: 9/25



VGel/RPE intensity ratio



What next?





**Better
Understanding
of Disease**

**Better
Treatment**



**Better
Evaluation**



Insights from Scale



**Better
Understanding
of Disease**

**Better
Treatment**



**Better
Evaluation**



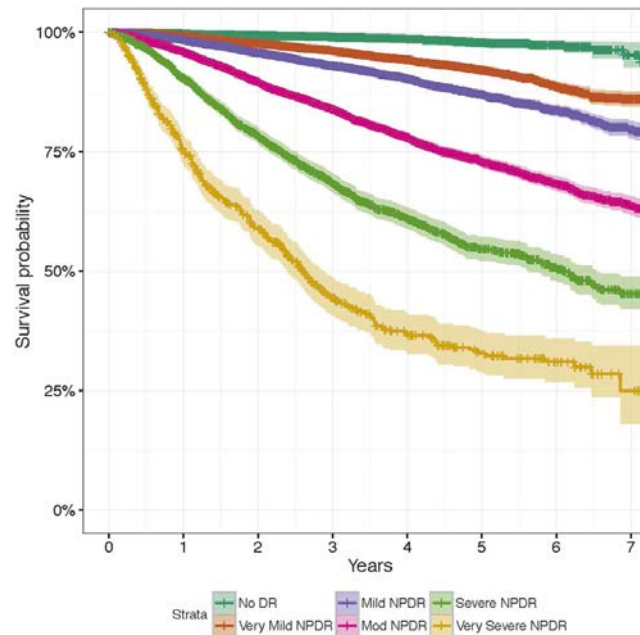
Insights from Scale: Biological - Diabetic Retinopathy

United Kingdom Diabetic Retinopathy
Electronic Medical Record (UK DR EMR)
Users Group

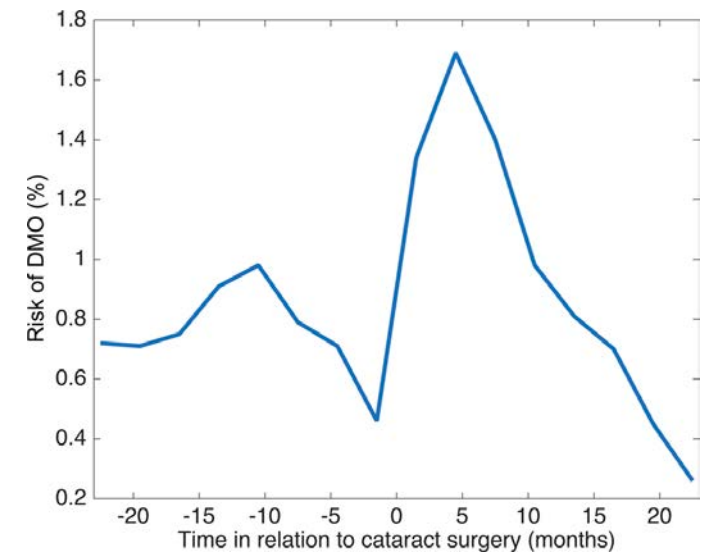
Egan C... UK DR EMR Users Group.
Report 1: baseline characteristics and visual
acuity outcomes in eyes treated with
intravitreal injections of ranibizumab for
diabetic macular oedema. *BJO* 2017

Denniston A...Al-Husainy S...Tsaloumas M...
UK DR EMR Users Group. Report 2: real-
world data for the impact of cataract
surgery on diabetic macular oedema. *BJO*
2017

>50 000 eyes
Progression to PDR



Risk of DMO related to Surgery



UNIVERSITY OF
BIRMINGHAM

Insights from Scale: Social - Diabetic Retinopathy

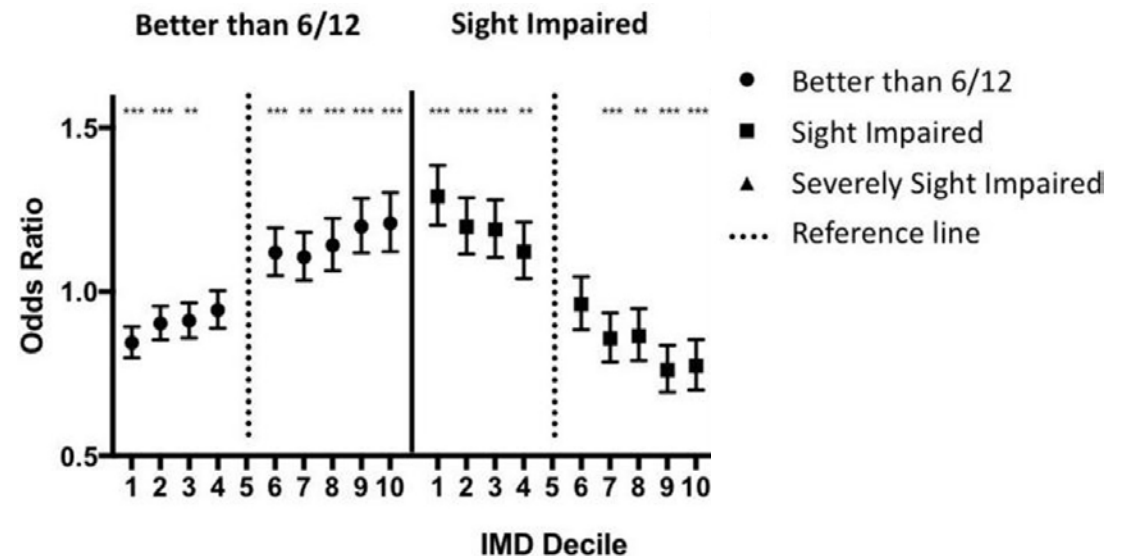
United Kingdom Diabetic Retinopathy
Electronic Medical Record (UK DR EMR)
Users Group

>50 000 eyes

DR-related sight loss at presentation vs social deprivation

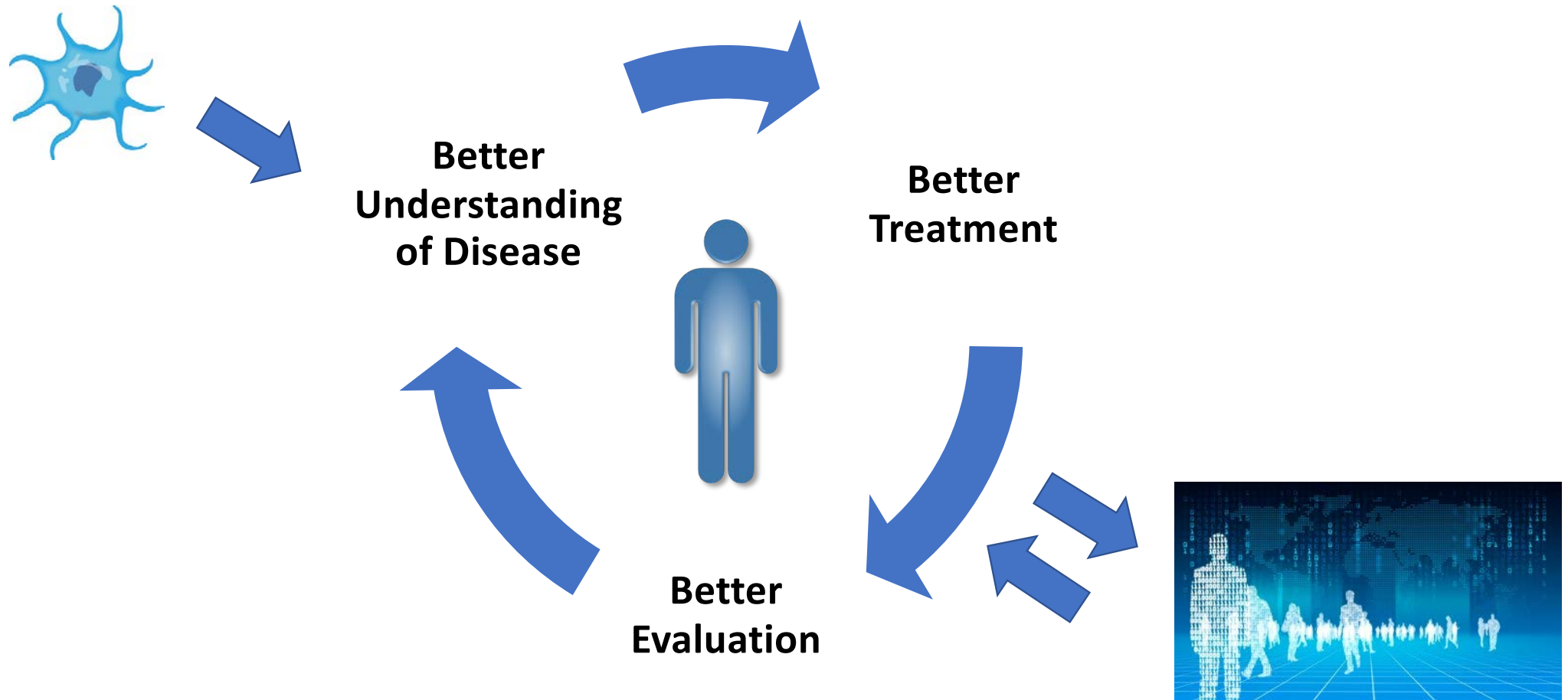
Lee CS...UK DR EMR Users Group. Report 3:
Baseline Retinopathy and Clinical Features
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AJO 2017

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Egan CA; UK DR EMR Users Group. Report
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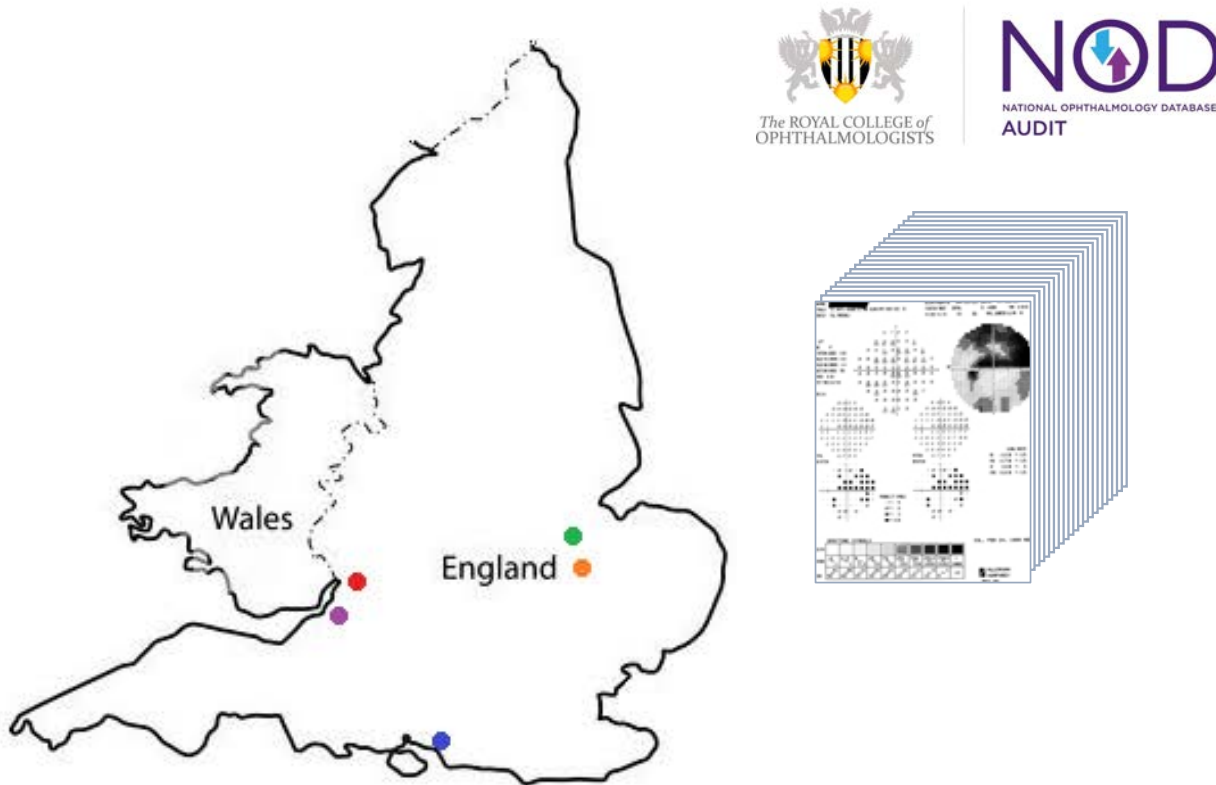


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Insights from Scale Informing Personalised Care



Insights from Scale Informing Personalised Care

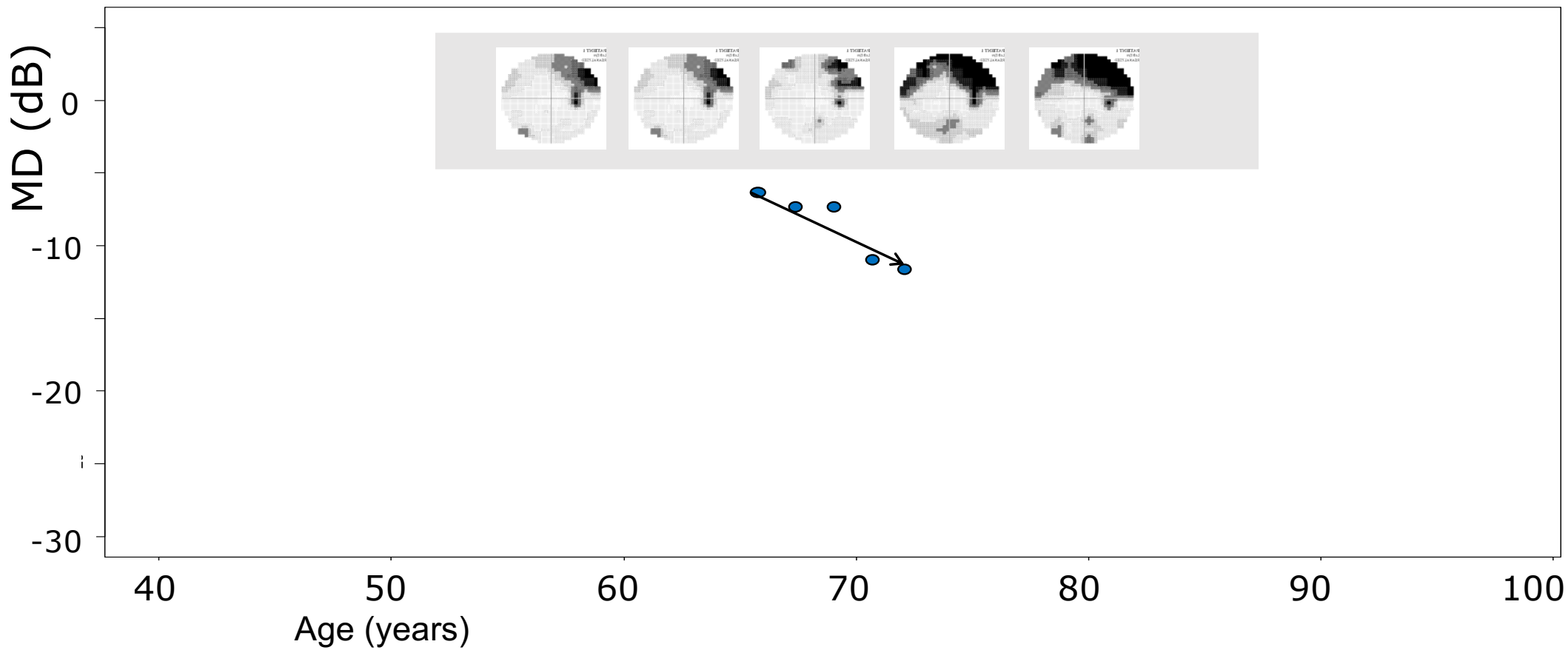


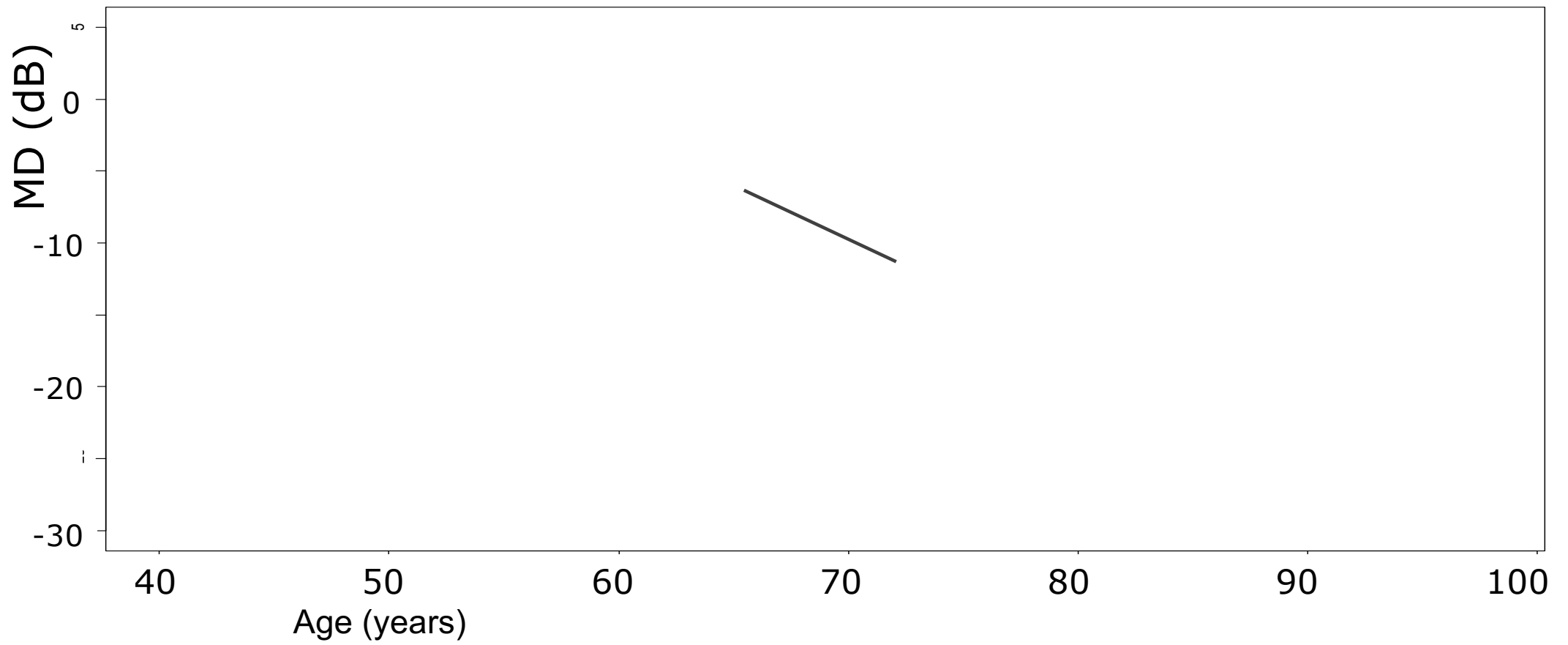
Real world glaucoma study of:

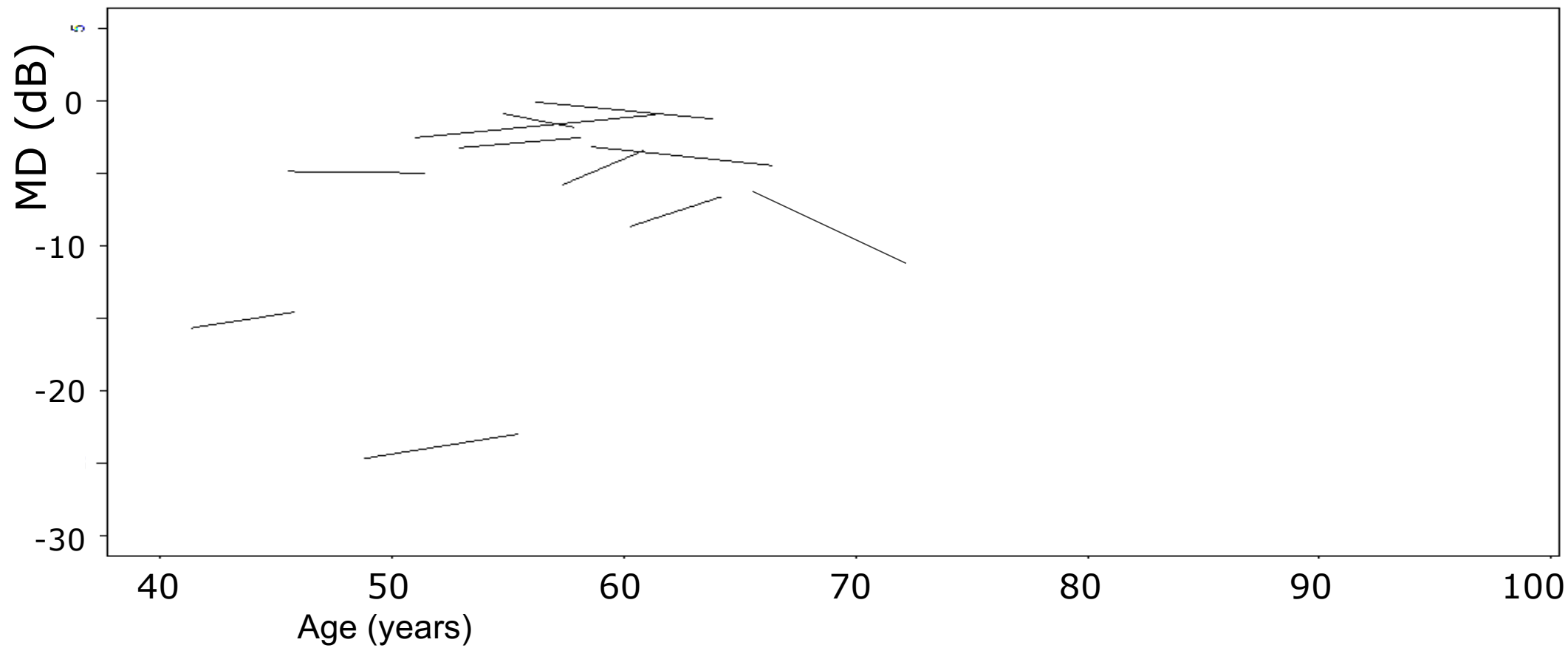
- **73 994 patients**
- **473 252 visual fields**
- Matched diagnostic labels and IOP data

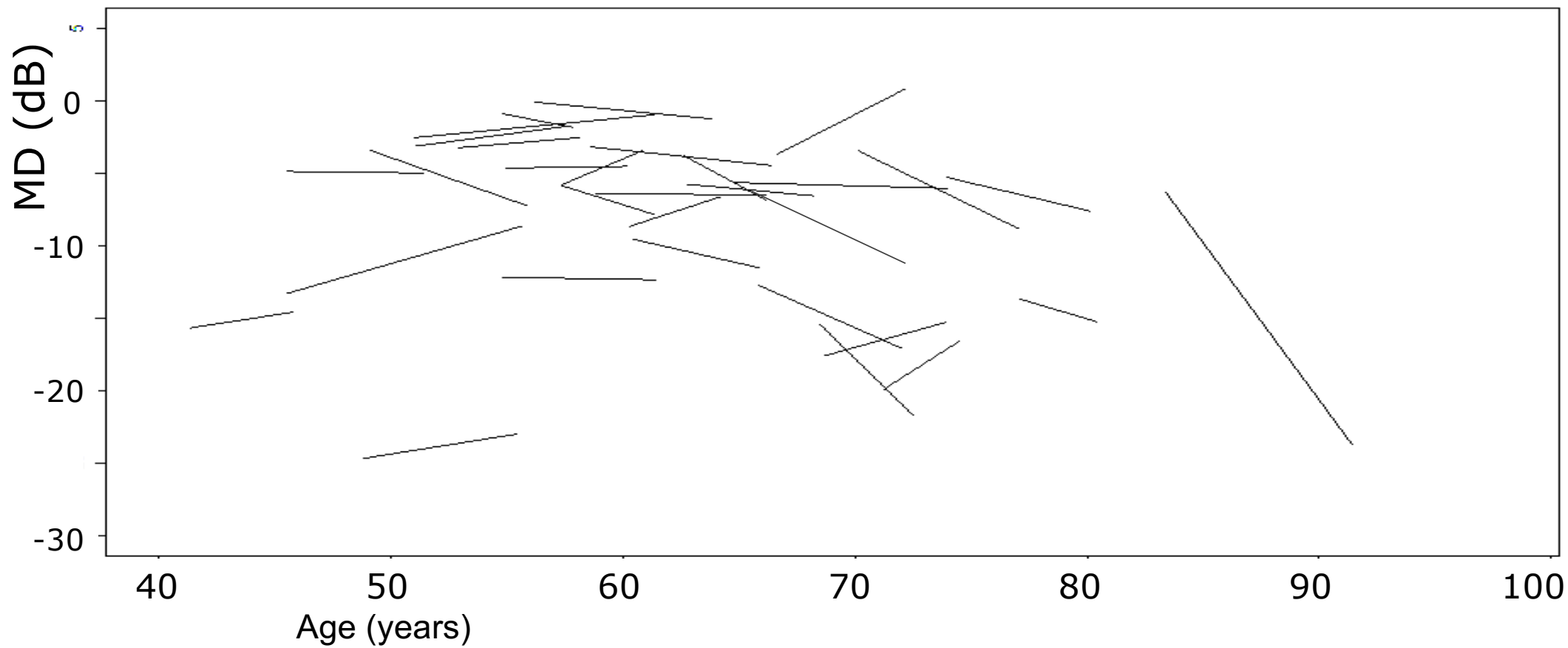
Liu X, Kelly SR, Montesano G, Bryan SR, Barry RJ, Keane PA, Denniston AK, Crabb DP.

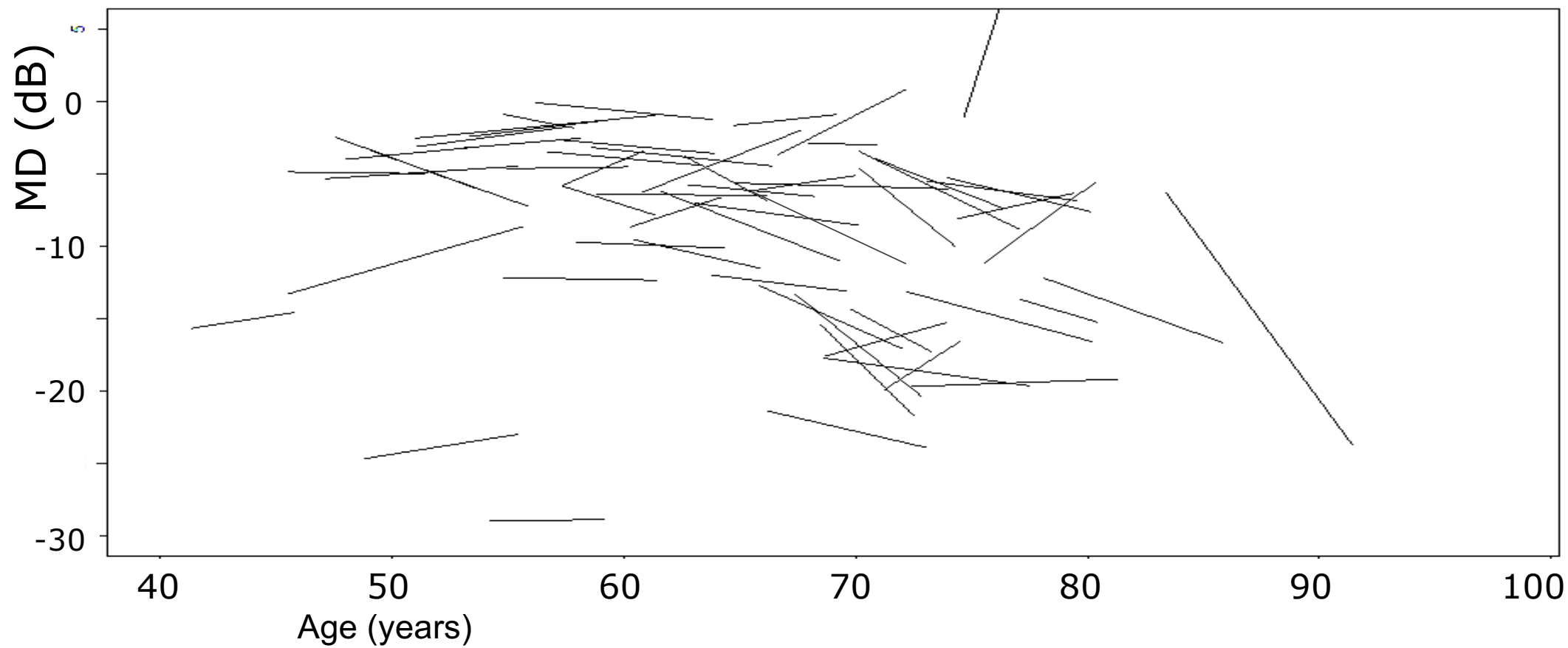
Evaluating the Impact of Uveitis on Visual Field Progression Using Large Scale Real-World Data. Am J Ophthalmol. 2019

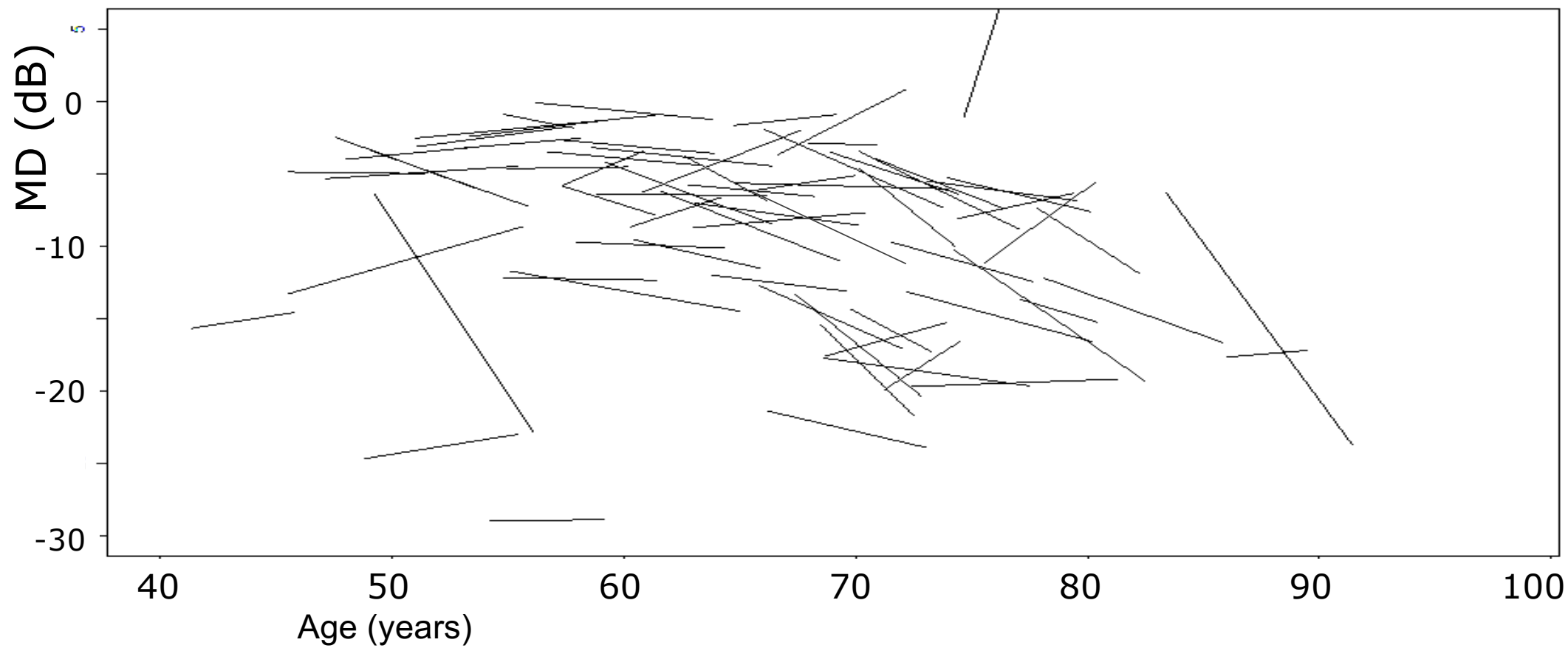


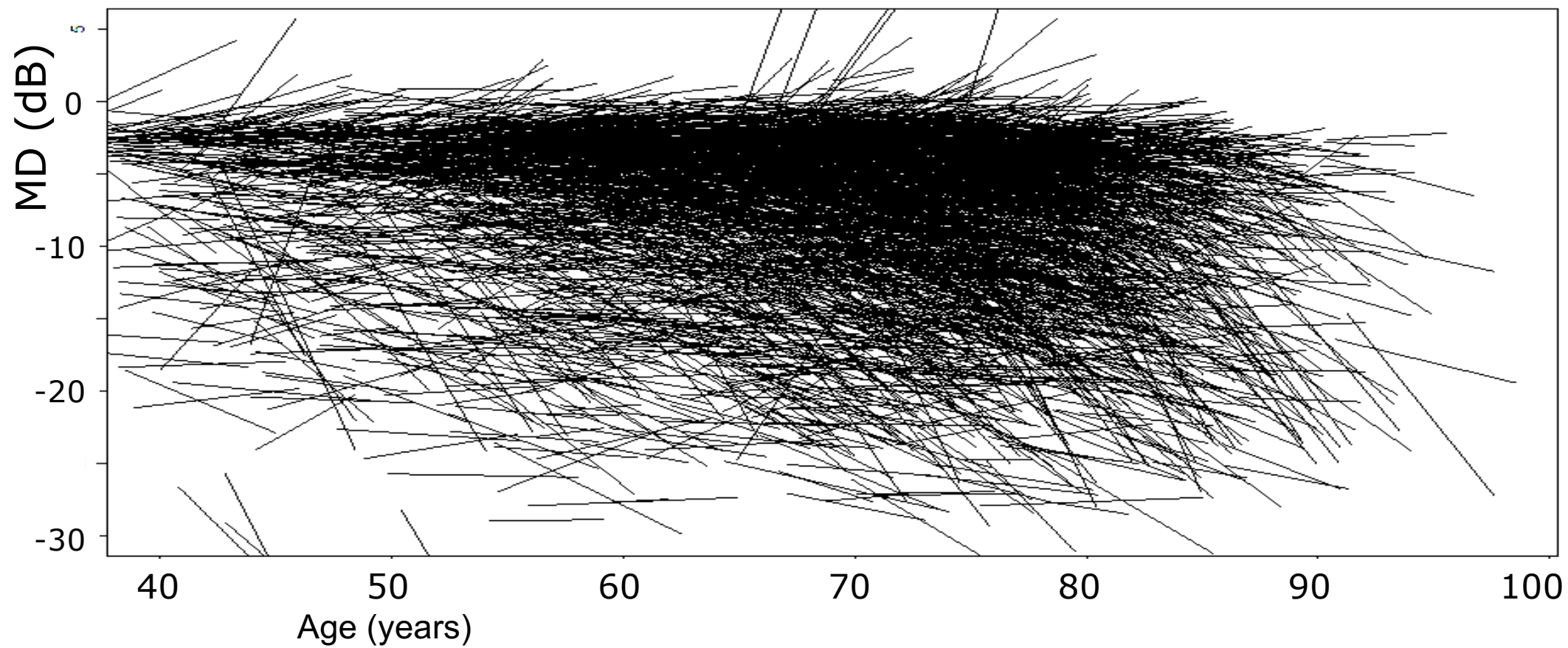


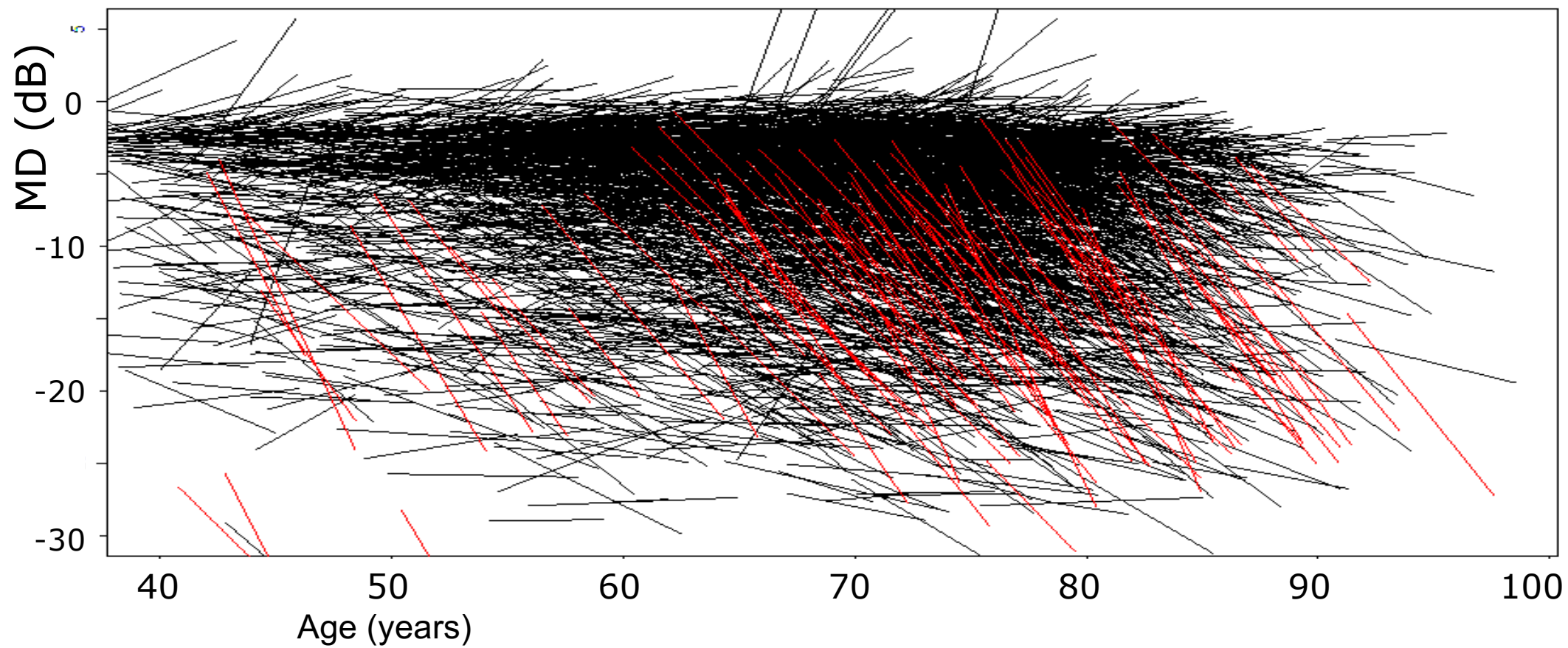


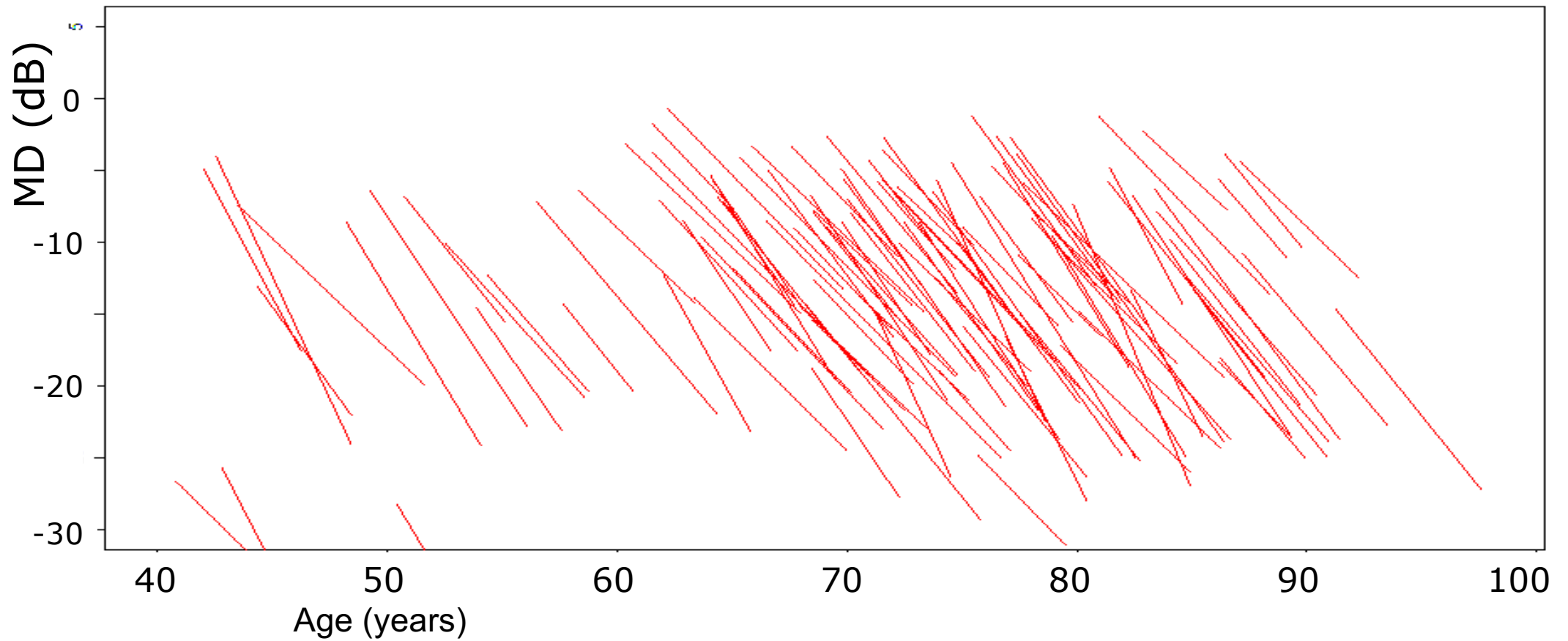








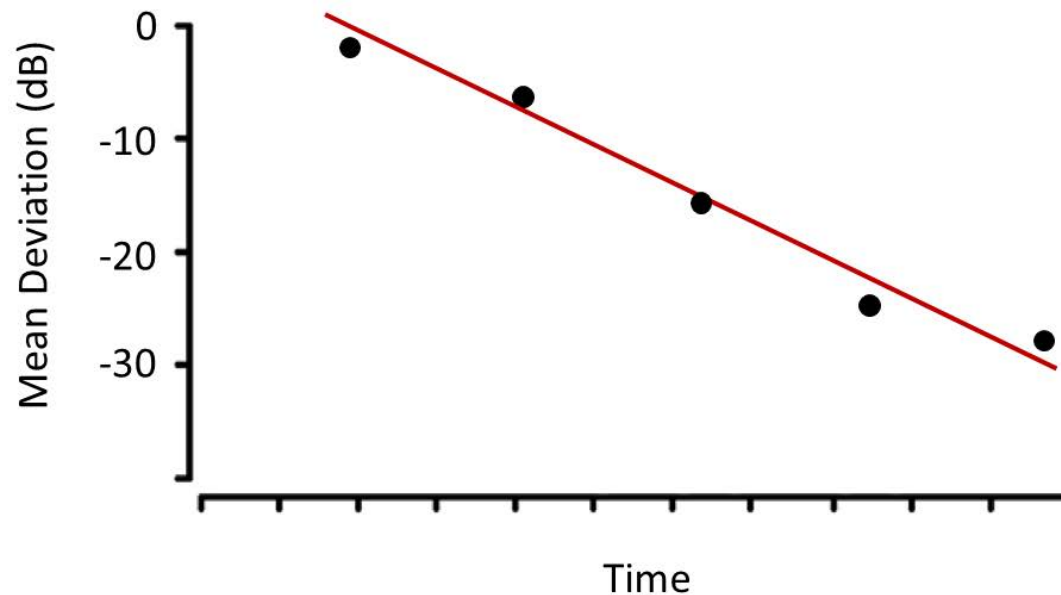
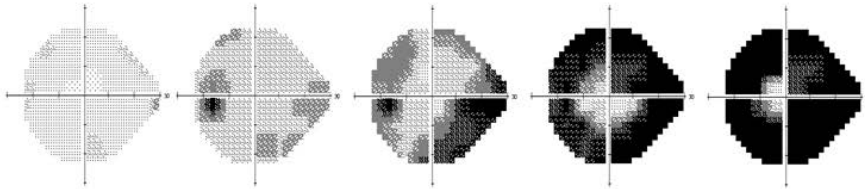




- Identify the rapid progressors: $-1.5 \text{ dB/year} \sim 3\%$

(95% confidence interval is smaller than $\pm 2\%$)

Ophthalmology & Big Data: Rare conditions



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	POAG only	Uveitic Glaucoma
Median Age (IQR)	71 (63, 77)	63 (53, 73)
Median MD of 'first' VF (IQR)	-3 (-7, 1)	-4 (-10, -1)

Liu X et al. Evaluating the Impact of Uveitis on Visual Field Progression Using Large Scale Real-World Data. *AJO* 2019



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Rate of Progression: POAG vs Uveitic Glaucoma

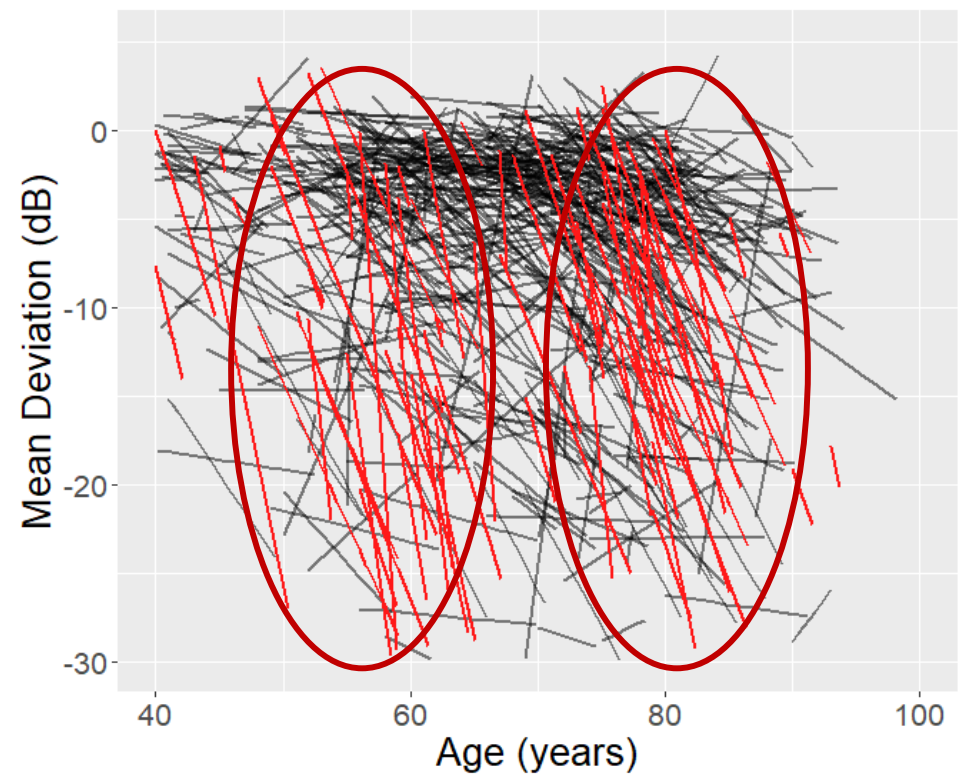
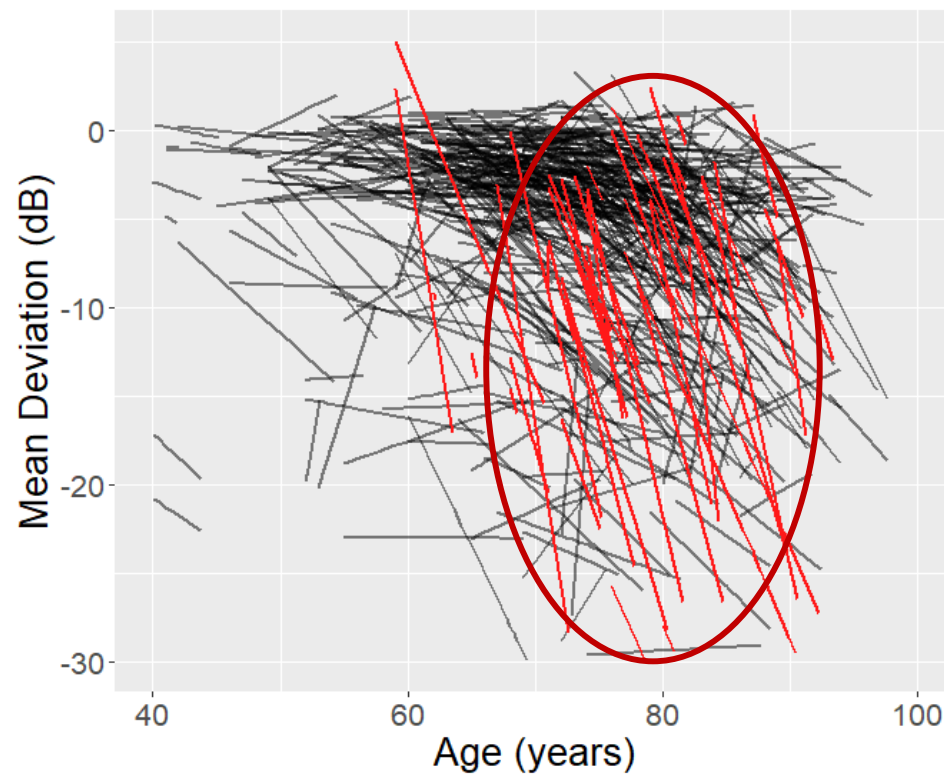
POAG

6.8%

Rapid Progressors
-1.5dB/year or more

Uveitic Glaucoma

12.3%



Rate of Progression: Uveitic Glaucoma

Risk Ratio for a patient with uveitis being a fast progressor:

Crude risk ratio: 1.71 (95% CI: 1.2-2.5)

But uveitic glaucoma population are younger...

Age-adjusted risk ratio: 1.89 (95% CI: 1.84-1.95)



Better Data



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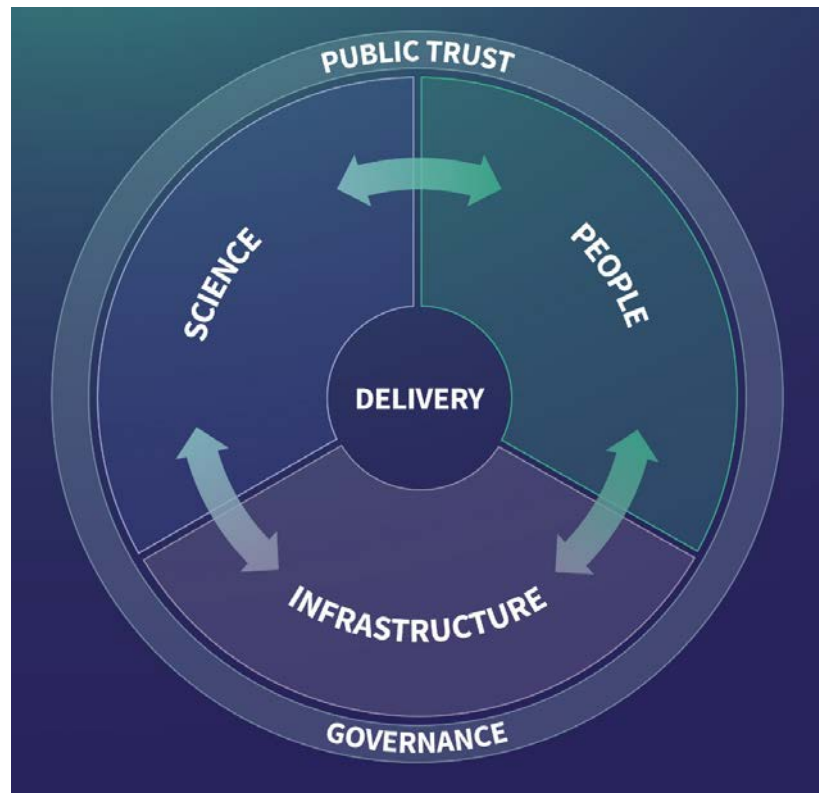
About

Welcome to Health Data Research UK – the national institute for health data science.

Health Data Research UK is uniting the UK's health data to make discoveries that improve people's lives.



Better Data



Midlands Site

Birmingham, Leicester,
Nottingham, Warwick



This work uses data provided by
patients and collected by the NHS
as part of their care and support.

#datasaveslives

UNITING THE UK'S HEALTH DATA TO MAKE DISCOVERIES THAT IMPROVE PEOPLE'S LIVES

← TRUSTWORTHY USE OF DATA →



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On 12th September 2019...

Better Data

On 12th September 2019...

INSIGHT

Health Data Research Hub for Eye Health

INSIGHT is focused on eye disease and its application to wider health, including diabetes and dementia. It will use anonymised large-scale data and advanced analytics, including artificial intelligence, to develop new insights in disease detection, diagnosis, treatments and personalised healthcare.



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UK Research
and Innovation



Better Data

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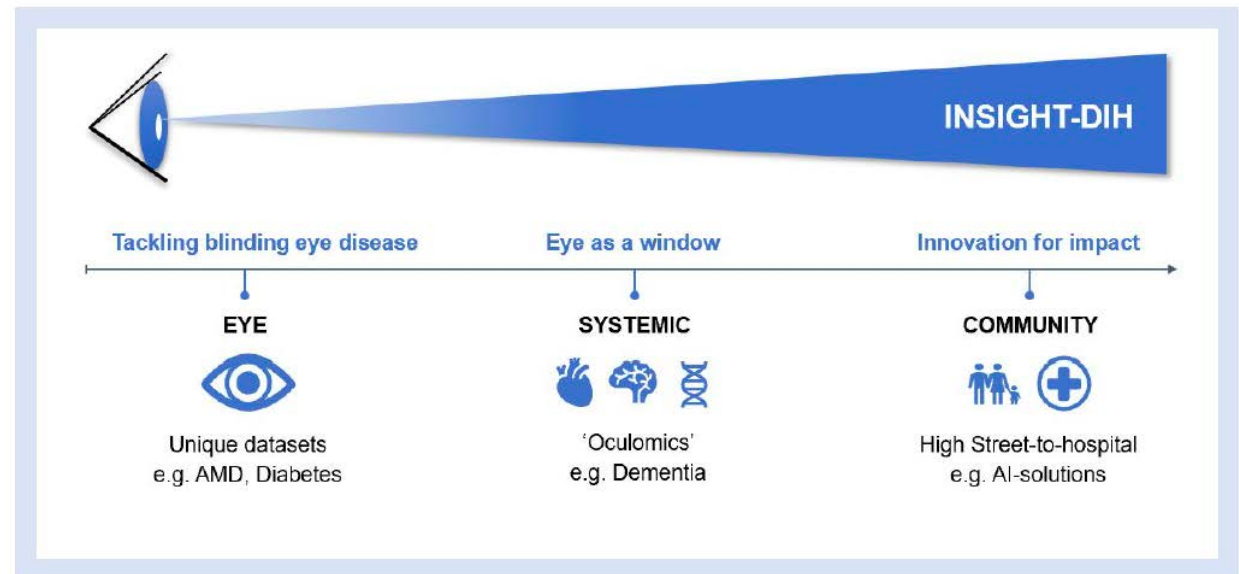


Health Data Research UK

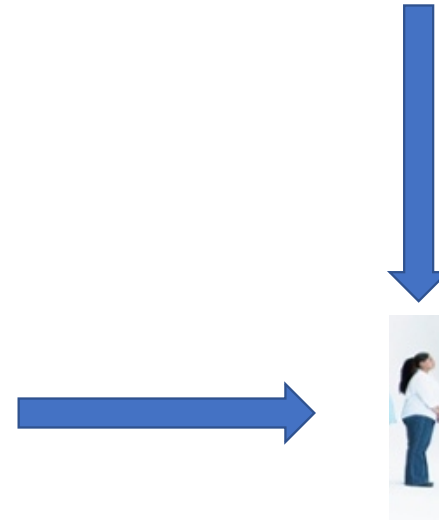
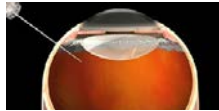
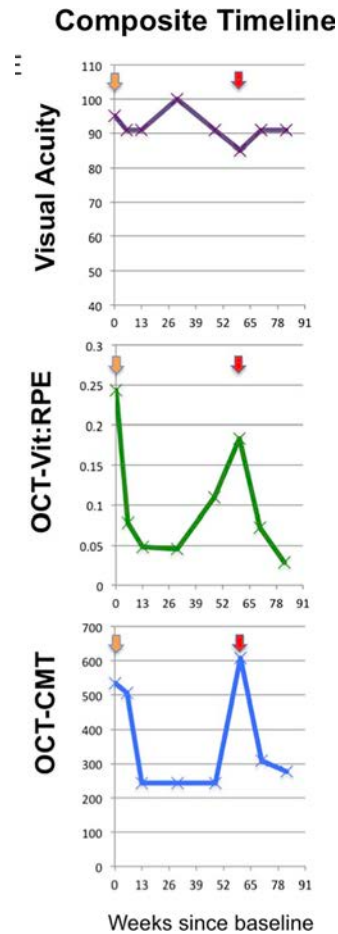
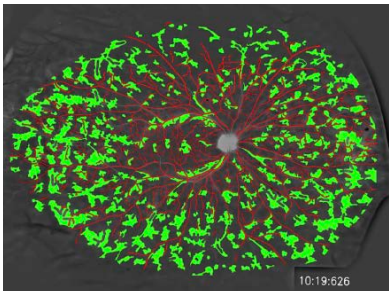
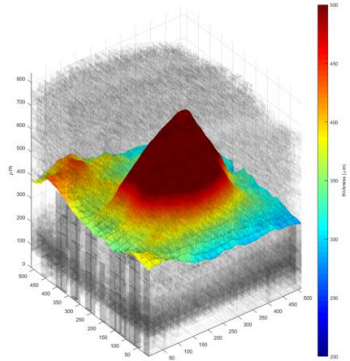
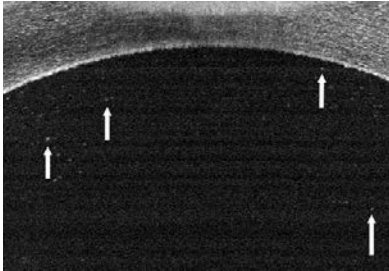


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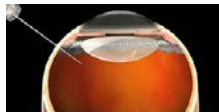
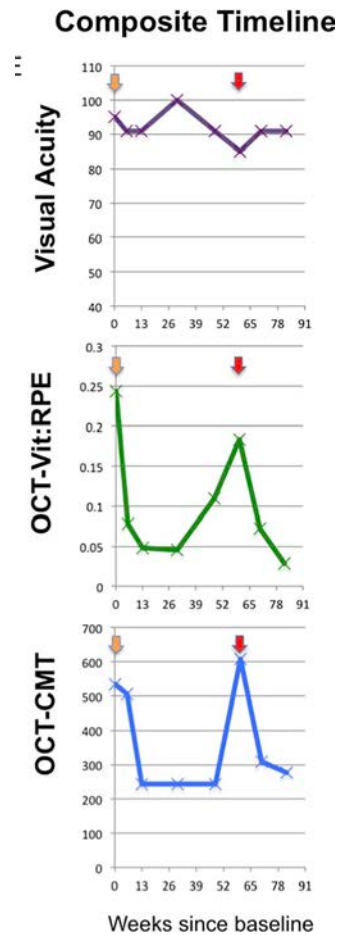
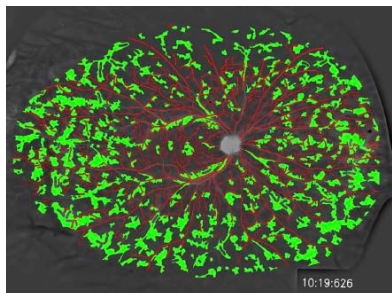
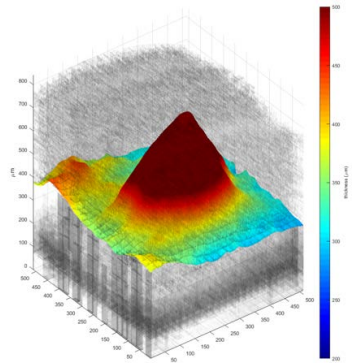
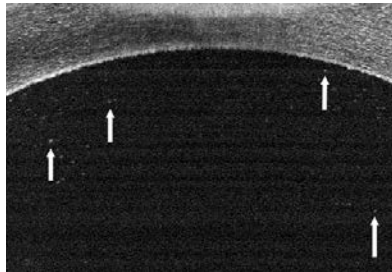


Better Understanding - Treatment – Evaluation – Scale -



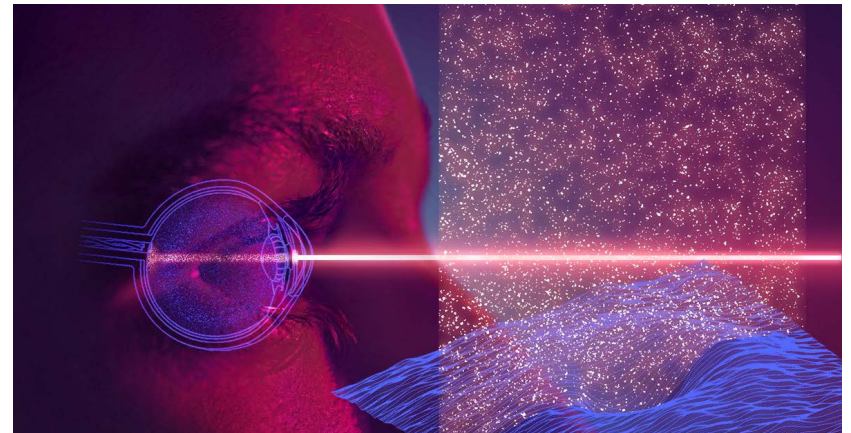
Personalised prediction and Rx

Better Understanding - Treatment – Evaluation – Scale - AI

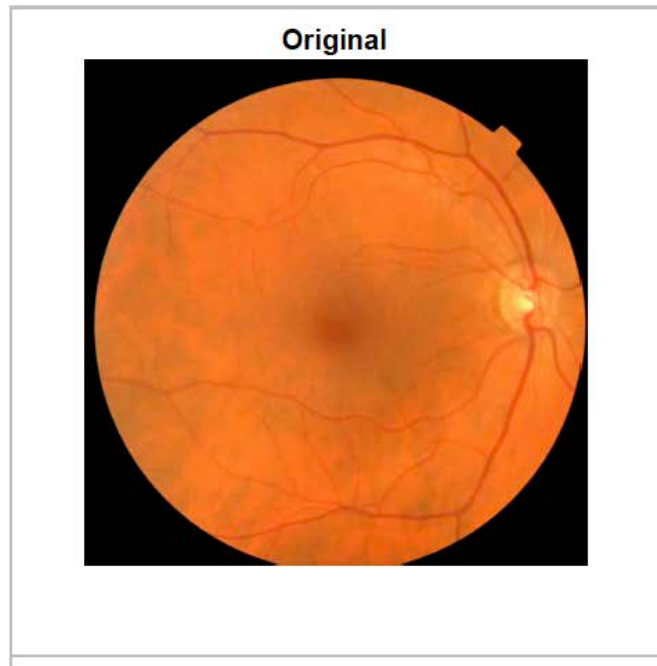


Personalised prediction and Rx

And finally... Introducing *Oculomics*

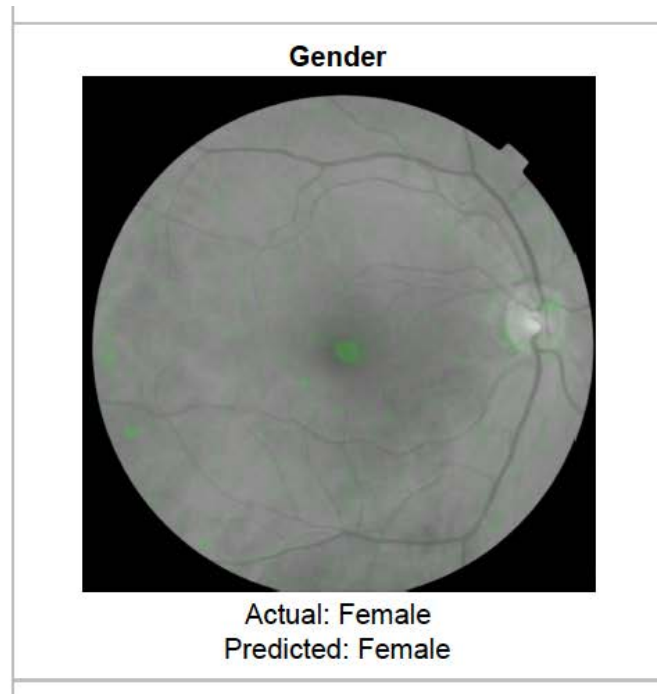


Oculomics – the eye as a window in the AI era



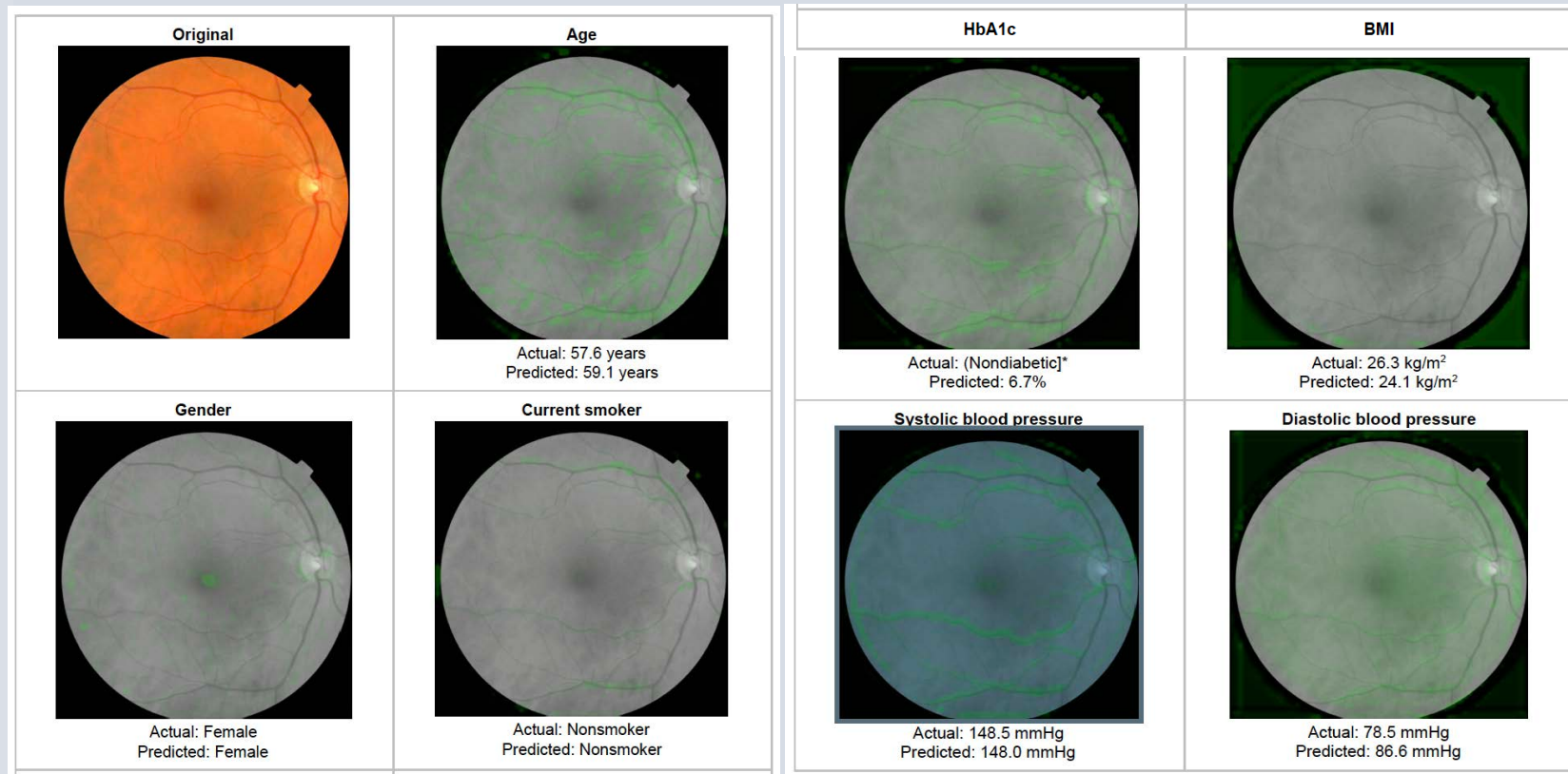
?

AI: Predicting demographics and systemic health



This is a woman.
She is 58 years old, non-smoker, not
diabetic with a BMI of around 25,
and a BP of 150/85mmHg

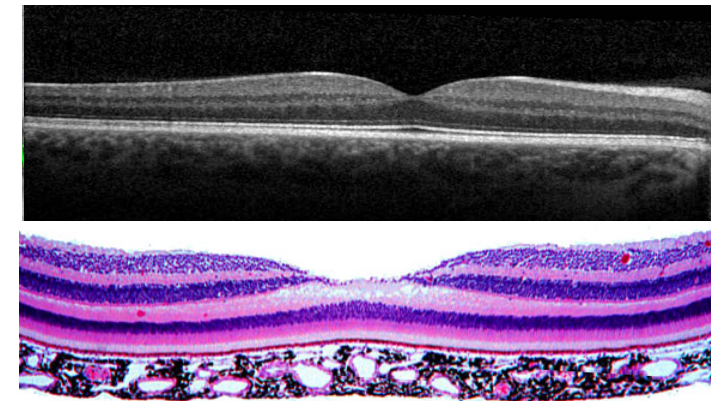
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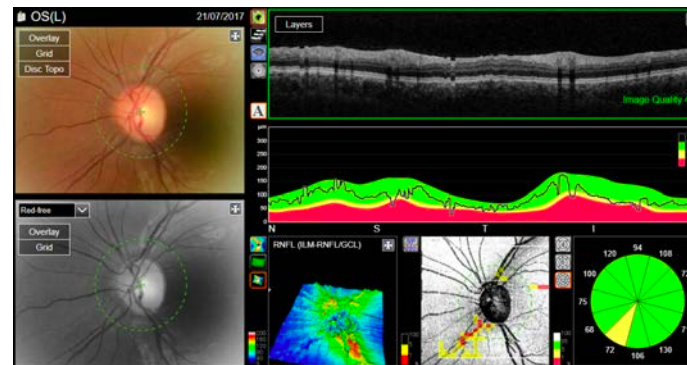
AI & Oculomics: Predicting and classifying dementia

The eye is **the** location for detecting early CNS changes

A number of studies have suggested a link between standard OCT-measurements of ocular structures and development of dementia



32, 038 people with OCT and cognitive testing; 1251 with follow-up
JAMA Neurol 2018; 75(10): 1256-63



Variable	Model 1	
	Hazard Ratio (95% CI) ^a	P Value
All dementia		
Retinal nerve fiber layer ^c		
Per SD decrease	1.51 (1.25-1.82)	<.001
Per 1- μ m decrease	1.03 (1.01-1.04)	<.001
Ganglion cell-inner plexiform layer ^d		
Per SD decrease	1.13 (0.89-1.42)	.31
Per 1- μ m decrease	1.02 (0.99-1.05)	.33
Alzheimer disease		
Retinal nerve fiber layer ^e		
Per SD decrease	1.49 (1.20-1.84)	<.001



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A comparison of deep learning performance against health-care professionals in detecting diseases from medical imaging: a systematic review and meta-analysis

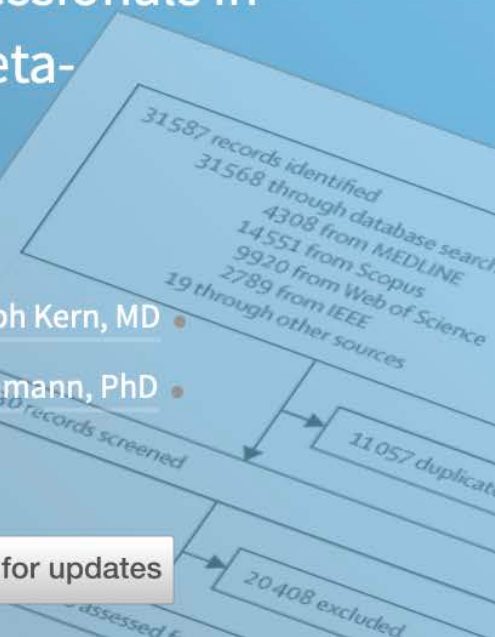
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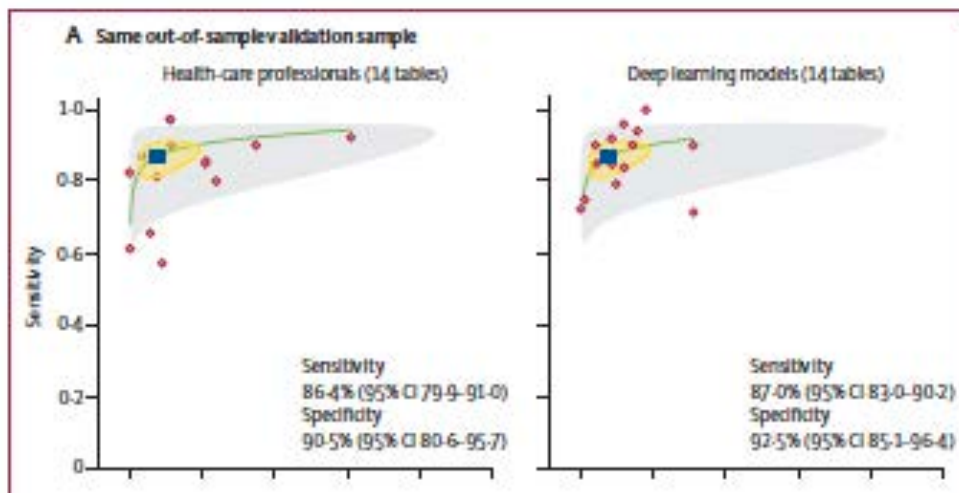
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A comparison of deep learning performance against health-care professionals in detecting diseases from medical imaging: a systematic review and meta-analysis



20500 studies identified

<1% were High Quality

Only 14 were high quality and AI vs HCP

Sensitivity (can correctly detect disease):

AI 87% of cases vs 86% HCP

Specificity (can correctly rule out disease):

AI 93% vs 91% HCP

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Artificial intelligence (AI)

AI equal with human experts in medical diagnosis, study finds

Research suggests AI able to interpret medical images using deep learning algorithm

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Artificial intelligence (AI)

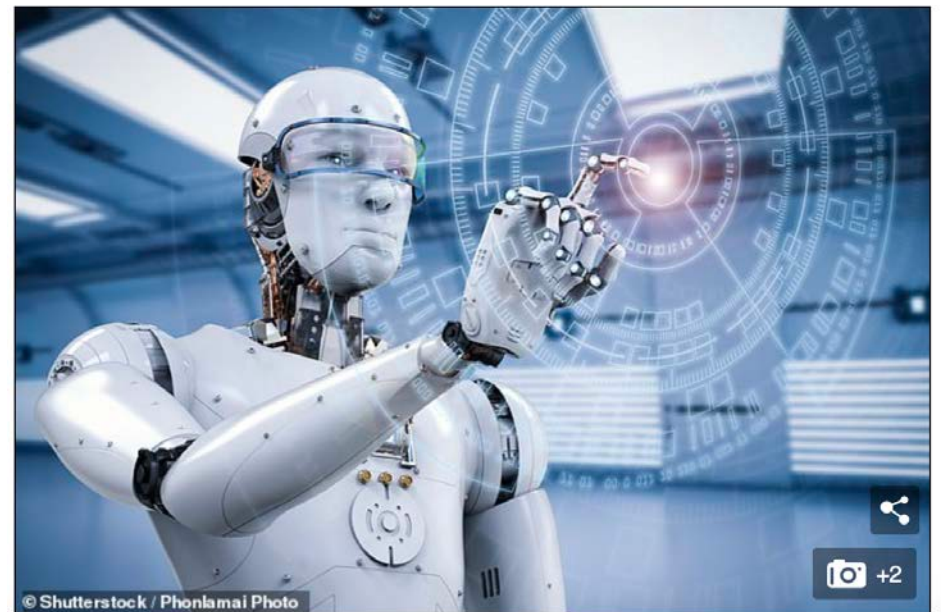
AI equal with human experts in medical diagnosis, study finds

Research suggests AI able to interpret medical images using deep learning algorithm

MailOnline

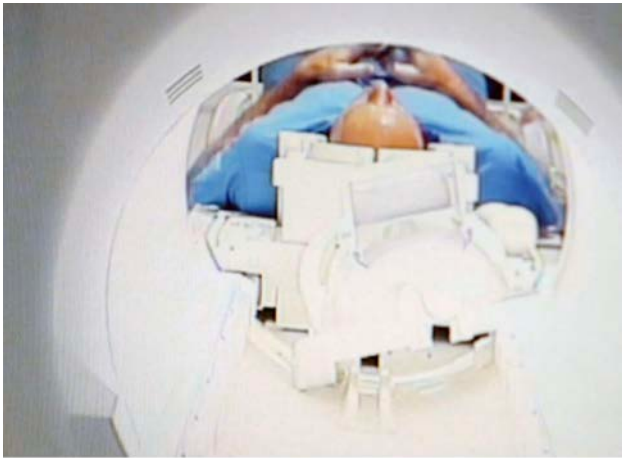
Artificial intelligence is just as accurate as trained DOCTORS at spotting illnesses from cancer to rare eye conditions

- AI spotted host of conditions from cancer to eye diseases with 87% precision
- Using deep learning it slightly outperformed medical experts who scored 86%
- Findings bolster Health Secretary's grand plans of a 'digital revolution' for NHS



News Politics Sport Business Money Opinion Tech

AI ... now 'as good' as doctors



If widely used, the technology could save thousands of days of doctors' time CREDIT: TELEGRAPH

Professor Alastair Denniston said: “Within those handful of high-quality studies, we found that deep learning could indeed detect diseases ranging from cancers to eye diseases as accurately as health professionals.

“But it’s important to note that AI did not substantially out-perform human diagnosis.”

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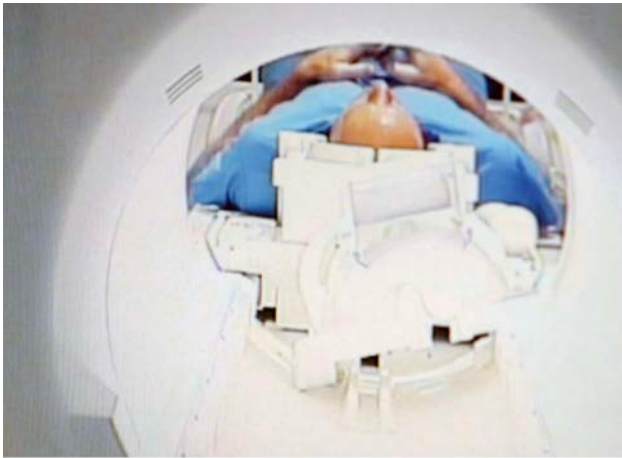


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This has "enormous potential" for improving the precision and speed of diagnosis, according to scientists from University Hospitals Birmingham NHS Foundation Trust.

By pooling data from 14 trials, the team showed that deep learning correctly detected disease in 87% of cases - compared to 86% achieved by doctors.

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Artificial intelligence has been hailed as the next big thing in medicine. But does it really live up to the hype? Xiao Liu and Alastair Denniston from the University of Birmingham reveal their findings.

Health Check was presented by Claudia Hammond

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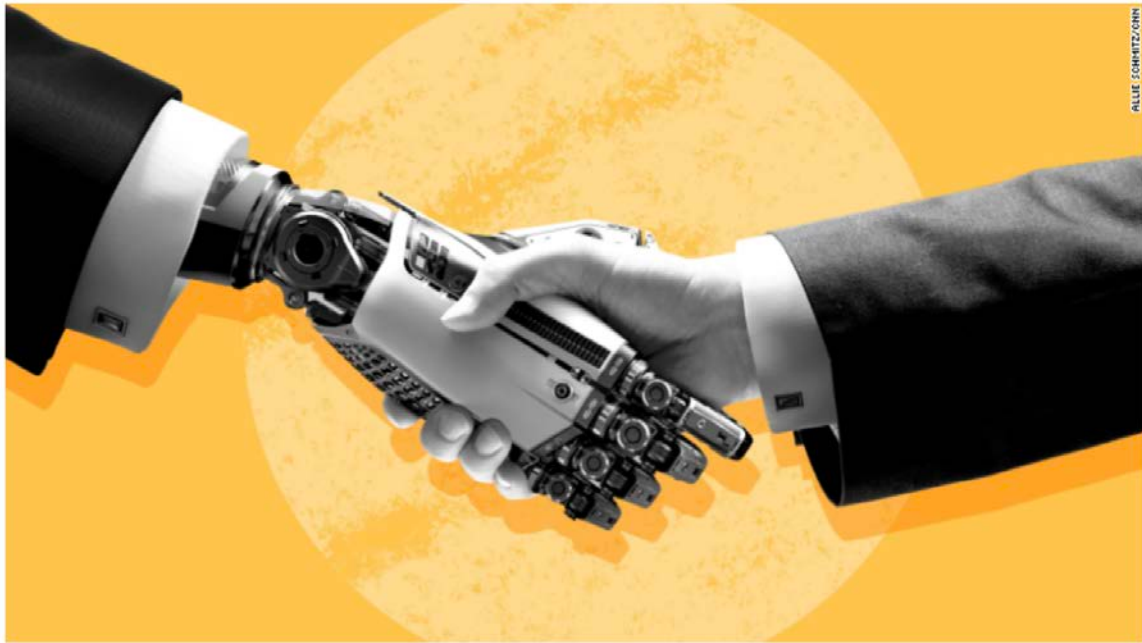
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CNN health

AI may be as effective as medical specialists at diagnosing disease

By Jack Guy, CNN

Updated 1123 GMT (1923 HKT) September 25, 2019



(CNN) — A new scientific review has concluded that [artificial intelligence](#) (AI) may be able to diagnose [disease](#) as successfully as human healthcare professionals, but a lack of quality studies means the real potential of the technology is unclear.

Researchers carried out the first systematic review of existing research into AI in the health sector and published their findings in The Lancet Digital Health journal.

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AI equal with human experts in medical diagnosis based on images, suggests new study, which found deep learning systems correctly detected disease state 87% of the time, compared with 86% for healthcare professionals, and correctly gave all-clear 93% of the time, compared with 91% for human experts.

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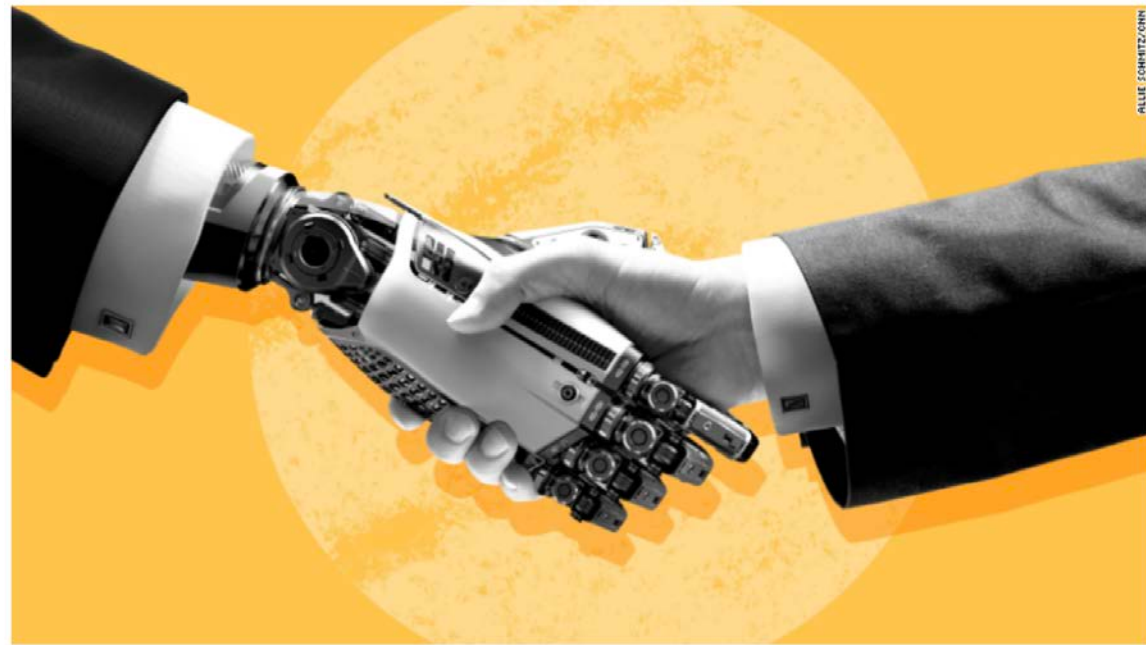
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But if we want to make impact...

YES WE SCAN Computers can be 'better than doctors at spotting disease' study finds

YES WE SCAN Computers can be ‘better than doctors at spotting disease’ study finds

Nick McDermott, Health Editor

25 Sep 2019, 0:44 | Updated: 25 Sep 2019, 0:44



4 COMMENTS

COMPUTERS are better than doctors at spotting illnesses from scans, a study shows.

Artificial Intelligence correctly diagnoses disease in 87 per cent of cases – one per cent more than medics.



Doctors have been outperformed by a computer program at spotting illnesses

Credit: Getty - Contributor

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Nick McDermott, Health Editor

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Doctors have been outperformed by a computer program at spotting illnesses

Credit: Getty - Contributor

B

baldie bloke · 25 Sep

thats good there are a few good doctors out there will spot things , but there is also a hell of a lot of crap ones out there ..so its nice to hear that there is so thing better

Reply



G

goho · 25 Sep → baldie bloke

Ye some of them can't even log into a pc with their user name and password.

Reply



M

Mark Thomas · 25 Sep

I'm regularly in hospital and most of the doctors I have met couldn't diagnose a decapitation let alone cancer or a brain tumour! They all think they know your body better than you do and just fob you off!

Reply



F

Freddy Ready · 25 Sep · Edited

AI makes a much better DJ on Spotify than the useless radio DJs we've had to put up with so perhaps it will provide some relief from useless doctors who prescribe antibiotics for virus infections too.

Reply



Automated deep learning design for medical image classification by health-care professionals with no coding experience: a feasibility study

[Livia Faes, MD](#) [†] • [Siegfried K Wagner, BMBCh](#) [†] • [Dun Jack Fu, PhD](#) • [Xiaoxuan Liu, MBChB](#) • [Edward Korot, MD](#) •
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Pollard et al 2019 Lancet Digital Health

‘The work is compelling because it suggests that expert-level results in image classification are now achievable by anyone with cursory training.’

So, are we still needed?

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THE LANCET
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FEATURE

"Deep learning advances in health care ultimately has to be driven by clinicians and has to be patient-centred...We need to know this is not magic."

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So, are we still needed?

Commentary



Journal of the Royal Society of Medicine; 2018, Vol. 111(4) 113–116
DOI: 10.1177/0141076818762648

Time to regenerate: the doctor in the age of artificial intelligence

Xiaoxuan Liu^{1,2,3}, Pearse A Keane^{1,4} and Alastair K Denniston^{1,2,3,4}

‘[We want to] put the spotlight back on the human doctor: their role and their unique gift – to be human, when a perfect algorithm is not enough.’



Thank You



NHS
*National Institute for
Health Research*

Investigators & Research Team

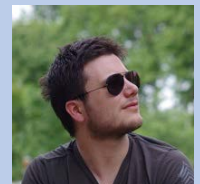
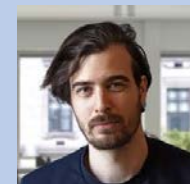
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