



The ROYAL COLLEGE *of*
OPHTHALMOLOGISTS



NATIONAL OPHTHALMOLOGY DATABASE
AUDIT

Statistical Analysis Plan for the HQIP Funded RCOphth NOD Cataract Analysis

Second year of the prospective cataract audit version

March 2018

Document authors

Paul HJ Donachie

John M Sparrow

Document Location

The master copy of the document can be found in the RCOphth shared drive

Version History

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
0.1	PD	26/06/2015			First draft
0.2	JS	30/06/2015			Amendments
0.3	PD	02/07/2015			Amendments
0.4	PD	24/03/2016			Amendments
0.5	RJ	07/04/2016			Amendments
0.6	PD	01/06/2017			Updated for the first year of the prospective audit
0.7	PD	23/01/2018			Updated for the second year of the prospective audit
0.80	PD	19/02/2018			Updated with revised VA loss definition
0.90	PD	20/03/2018			Updated with revised eligibility

Distribution

This document has been distributed to:

Version #	Name	Date	Reason
0.3	Steering Group	08/07/2015	Approval
1.0	HQIP	28/07/2015	Comments

Contents

Section	Page number	
1	The RCOphth NOD audit team	4
2	Abbreviations	5
3	Acknowledgements	6
4	Introduction	7
5	Cataract Inclusion/Exclusion criteria	8
6	Eligible “Cataract” indications for surgery	9
7	Ineligible “Cataract” indications for surgery	10
8	Ineligible operative procedures	14
9	Labelling of contributing centres on graphs	19
10	Index of multiple deprivations score	20
11	Pupil size	21
12	Operative complications	21
13	Posterior Capsular Rupture (PCR) definition	22
14	Visual acuity criteria	23
15	Diabetic status	24
16	Ocular co-pathology	25
17	Posterior Capsular Rupture (PCR) and visual loss analysis	26
18	Changes for the prospective national cataract audit	35
19	Audit reporting destinations	38
20	Risk model reviewing	39
Appendix 1	Indications for surgery and diagnostic records that can infer the presence of an ocular co-pathology	40

1 The RCOphth NOD audit team

RCOphth project clinical lead

Professor John M Sparrow - Consultant Ophthalmologist and Honorary Professor of Ophthalmic Health Services Research and Applied Epidemiology

RCOphth project executive lead

Ms Kathy Evans – Chief Executive, Royal College of Ophthalmologists

The RCOphth NOD audit project office:

Ms Beth Barnes – Head of professional standards

Ms Martina Olaitan – RCOphth NOD audit project support officer

The Royal College of Ophthalmologists

18 Stephenson Way

London

NW1 2HD

Tel: +44 (0) 20 7935 0702

Fax: +44 (0) 20 7383 5258

Email: noa.project@rcophth.ac.uk

The RCOphth NOD delivery unit:

Mr Paul Henry John Donachie – Medical Statistician

Ms Irene M Stratton – Medical Statistician

Professor Peter Scanlon – Consultant Ophthalmologist

Gloucestershire Retinal Research Group office

Above Oakley Ward

Cheltenham General Hospital

Gloucestershire

GL53 7AN

Phone: 03004 22 2852

Email: ghn-tr.nod@nhs.net

2 Abbreviations

Abbreviation	Description
AC	Anterior chamber
AMD	Age-related Macular Degeneration
CDVA	Corrected distance visual acuity
CNS	Central nervous system
COP	Clinical Outcomes programme
CQC	Care Quality Commission
DR	Diabetic Retinopathy
EMR	Electronic Medical Record
GMC	General Medical Council
HQIP	Healthcare Quality Improvement Partnership
IMD	Index of multiple deprivations
IOL	Intra-ocular lens
NCAPOP	National Clinical Audit and Patient Outcomes Programme
NHS	National Health Service
NOD	National Ophthalmology Database
PCR	Posterior capsule rupture
PHVA	Pin hole visual acuity
PPV	Pars plana vitrectomy
RCOphth	Royal College of Ophthalmologists'
UDVA	Uncorrected distance visual acuity
VA	Visual acuity
VR	Vitreoretinal

3 Acknowledgment

The National Ophthalmology Audit (NOA) is commissioned by the Healthcare Quality Improvement Partnership (HQIP) and is part of the National Clinical Audit and Patient Outcomes Programme (NCAPOP) and the Consultant Outcomes Programme (COP).

We would like to acknowledge the support and guidance we have received from the National Audit Steering Committee which includes professional members, ophthalmologists and optometrists, and patient and public representatives with individual lay members as well as patient support groups being represented. We thank the steering committee for reviewing this report.

We also acknowledge the support of the hospitals that are participating in the national ophthalmology audit and thank our medical and non-medical colleagues for the considerable time and effort devoted to data collection. All participating centres are listed on the RCOphth NOD website (www.nodaudit.org.uk).

It is with deep regret that we note the death of our friend and colleague Robert Johnston, who sadly died in September 2016. Without his inspirational vision, determination and career long commitment to quality improvement in ophthalmology this work would not have been possible

4 Introduction

The Healthcare Quality Improvement Partnership (HQIP) commissioned The Royal College of Ophthalmologists (RCOphth) to perform the National Ophthalmology Audit building on the work of the RCOphth's National Ophthalmology Database (NOD) project. The national cataract audit is conducted on data concerning cataract surgery performed under the National Health Service (NHS) in England and Wales. The data is collected as part of routine clinical care on electronic medical record (EMR) systems and the analysis is performed by the RCOphth NOD Audit statisticians based in Cheltenham General Hospital.

The initial 3 year grant from HQIP funded a 'legacy' analysis of cataract data to establish the methodology for the prospective cataract audit, the implementation of the national cataract audit and feasibility studies into outcomes of wet age-related macular degeneration, trabeculectomy surgery & visual field preservation in eyes with glaucoma and rhegmatogenous retinal detachment surgery. The feasibility studies have been completed and the national cataract audit has received funding from HQIP for a further 2 years. This document concerns the statistical analysis plan for the 'legacy' and prospective cataract audit analysis.

The 'legacy' analysis was performed on retrospective data collected as part of routine clinical care and recorded on existing EMR systems, whilst the prospective audit analyses are performed on data collected on existing EMR systems and the RCOphth commissioned audit tools, which started collecting data in September 2015 and are available to all centres that deliver NHS cataract surgery that do not already have an EMR system.

Results are published on the RCOphth's NOD website (www.nodaudit.org.uk), supplied to the Clinical Outcomes Programme, NHS choices and the Care Quality Commission. Results are also produced for peer review journals and each year an annual report is published by the RCOphth NOD and HQIP. At the completion of an audit cycle the data sets used to produce the results published in the annual report are uploaded to data.gov.

5 Cataract Inclusion/Exclusion criteria

Cataract operations are included in the analysis if they comply with the conditions listed below; if not then they are excluded from all cataract analyses;

- Operation performed in either England or Wales.
- Operation performed in adults (aged 18 or above).
- Operation included a phacoemulsification procedure.
- Operation has a recorded date of surgery.
- Operative data includes a surgeon identifier.
- Operative data includes a valid grade of surgeon.
- Operation included a “cataract” indication for surgery.
- Operation without any of the ineligible cataract indications for surgery (section 6)
- Operations that included a pars plana vitrectomy (PPV) with no vitreoretinal indication for surgery and no other vitreoretinal (VR) procedures except for sponge and scissor vitrectomy or automated anterior vitrectomy.
- Operation did not include any operative procedures listed in section 7.

6 Eligible “Cataract” indications for surgery

An eligible cataract operation must have at least one of the “cataract” indications for surgery, if no “cataract” indication for surgery is recorded then the operation is excluded.

The following indications for surgery from the available EMR data are classified as “cataract” indications for surgery;

- 1+ cortical cataract
- 1+ nuclear sclerotic cataract
- 1+ posterior subcapsular cataract
- 2+ cortical cataract
- 2+ nuclear sclerotic cataract
- 2+ posterior subcapsular cataract
- 3+ cortical cataract
- 3+ nuclear sclerotic cataract
- 3+ posterior subcapsular cataract
- age-related cataract
- aniseikonia
- anisometropia
- anterior subcapsular cataract
- brunescant cataract
- cataract
- cataract extraction for anisometropia
- cataract extraction for refractive reasons
- cataract extraction for other reasons
- cataract extraction for unknown aetiology
- cataract extraction for visual improvement
- cataract extraction to improve fundal view
- cataract secondary to uveitis
- clear lens extraction for anisometropia
- clear lens extraction for refractive reasons
- congenital cataract
- cortical cataract

- diabetic cataract
- dropped nucleus
- dropped nucleus / retained lens fragments
- drug induced cataract
- hypermature cataract
- IOL in vitreous cavity
- mature / white cataract
- Missing (No indication for surgery recorded)
- Morgagnian cataract
- nuclear sclerotic cataract
- phacomorphic cataract
- post-vitrectomy cataract
- posterior subcapsular cataract

7 Ineligible “Cataract” indications for surgery

If any of the following indications for surgery are recorded as the indication for the cataract surgery then the operation is excluded from analysis.

- adhesions and disruptions of iris and ciliary body
- anterior polar cataract
- blow out fracture of orbit
- blunt injury of eye
- cataract following rupture of capsule
- closed fracture of orbit
- congenital ectopic lens
- congenital polar cataract
- congenital posterior polar cataract
- ectopia lentis
- ectopia lentis associated with anterior uveal tumour
- ectopia lentis associated with homocysteinuria
- ectopia lentis associated with hyperlysinaemia

- ectopia lentis associated with a hypermature cataract
- ectopia lentis associated with a large globe
- ectopia lentis associated with Marfan syndrome
- ectopia lentis associated with Weill-Marchesani syndrome
- ectopia lentis - dislocated cataractous crystalline lens
- ectopia lentis - dislocated clear crystalline lens
- ectopia lentis et pupillae
- ectopia lentis simple (no systemic conditions)
- ectopia lentis - subluxed cataractous crystalline lens
- ectopia lentis - subluxed clear crystalline lens
- ectopic pupil
- enophthalmos due to trauma
- foreign body in anterior chamber
- foreign body in anterior segment of eyeball
- foreign body in sclera
- hyphaema completely filling anterior chamber
- injury due to explosion
- injury of globe of eye
- intraocular foreign body in vitreous
- magnetic foreign body penetrating eyeball
- Marfan's syndrome
- microphthalmos
- microphthalmos with cyst
- open wound of eyeball
- open globe injury
- orbital foreign body
- penetrating eye injury
- penetrating eye injury (entry wound)
- penetrating injury by sharp object
- penetrating injury by unknown object
- penetrating injury due to glass
- penetrating wound of eye

- perforating corneoscleral wound
- perforating eye injury (entry and exit wound)
- perforating scleral wound
- Peter's anomaly
- polar cataract
- recession of chamber of eye
- retained foreign body in the eyelid
- retained magnetic intraocular foreign body
- retained non-magnetic intraocular foreign body
- Rieger syndrome
- rupture of globe
- scleral rupture
- sequelae of injury of eye and orbit
- spherophakia
- traumatic
- traumatic aniridia
- traumatic cataract
- traumatic cicatrisation of the conjunctiva
- traumatic corneal abrasion
- traumatic ectopia lentis
- traumatic enophthalmos
- traumatic enucleation
- traumatic iridodialysis
- traumatic iritis
- traumatic macular hole
- traumatic mydriasis
- traumatic optic neuropathy
- traumatic / perioperative choroidal detachment
- traumatic retraction of the eyelid
- traumatic subluxation of lens
- traumatic telecanthus
- trauma to the head

If any of the following vitreoretinal indications for surgery are recorded as the indication for the cataract surgery and combined with a record of a pars plana vitrectomy performed during cataract surgery, then the operation is excluded from analysis.

- 1 quadrant of retina detached
- 2 quadrants of retina detached
- 3 quadrants of retina detached
- 4 quadrants of retina detached
- central serous retinopathy associated with retinal detachment
- chronic rhegmatogenous retinal detachment
- chronic rhegmatogenous retinal detachment - macula off
- chronic rhegmatogenous retinal detachment - macula on
- epiretinal membrane
- epiretinal membrane associated with a macular hole
- epiretinal membrane with macular pseudohole
- epiretinal membrane with vitreomacular traction
- idiopathic epiretinal membrane
- lamellar macular hole
- macular hole
- macular hole associated with high myopia
- pseudo-macular hole
- retinal detachment
- retinal detachment associated with myopia
- retinal folds associated with epiretinal membrane
- rhegmatogenous retinal detachment
- rhegmatogenous retinal detachment - macula off
- rhegmatogenous retinal detachment - macula on
- rhegmatogenous retinal detachment (> 2 previous operations for RD)
- rhegmatogenous retinal detachment (1 previous operation for RD)
- rhegmatogenous retinal detachment (2 previous operations for RD)
- rhegmatogenous retinal detachment (primary)

- rhegmatogenous retinal detachment associated with myopia
- stage I macular hole
- stage II macular hole
- stage III macular hole
- stage IV macular hole
- unsuccessfully treated retinal detachment
- untreated retinal break caused failed retinal detachment surgery

8 Ineligible operative procedures

If any of the operative procedures listed below were performed during cataract surgery then the operation is excluded from analysis.

- Amniotic membrane transplant to cornea
- Anterior chamber tap
- Anterior lamellar keratoplasty
- Argon laser peripheral iridoplasty
- Artificial iris
- Aspiration of lens ± IOL
- Biopsy of lesion of cornea / conjunctiva / iris / sclera
- Biopsy of retina / choroid – external approach
- Biopsy of retina / choroid – internal approach
- Bleb needling
- Bleb resuture / conjunctival suture
- Bleb revision
- Botulinum toxin to extraocular muscles
- Cautery of lesion of cornea / conjunctiva / sclera
- Chelation of cornea
- Conjunctiva tumour excision
- Corneal collagen cross-linking
- Cryotherapy to lesion of retina
- Cyclodialysis surgery

- Cyclodiode
- Debridement of lesion of cornea
- Deep lamellar keratoplasty
- Deep sclerectomy with spacer
- Deep sclerectomy without spacer
- Drainage of choroidal effusion
- Drainage of subretinal fluid through retina
- Ectropion repair other
- Entropion repair other
- Entropion repair sutures
- Epiretinal membrane peel
- Excision of lesion of eyelid
- Excision of lesion of iris
- Extracapsular cataract extraction ± IOL
- Excision of skin lesion
- Eyelid excisional / miscellaneous biopsy
- Eyelid miscellaneous excisional biopsy
- Eyelid scar revision
- Eyelid surgery miscellaneous (other)
- Eyelid trauma full thickness laceration repair
- Facial palsy repair tarsorrhaphy
- Fibrovascular membrane delamination
- Fibrovascular membrane segmentation
- Fixation of iris
- Flap lift – replacement
- Free conjunctival autograft
- Glaucoma examination under anaesthesia
- Goniosynaechiolysis
- Goniotomy
- Incisional keratectomy
- Insertion of posterior segment sustained release device
- Insertion of Xen implant

- Internal limiting membrane peel
- Internal tamponade – Air
- Internal tamponade – C2F6 gas
- Internal tamponade – C3F8 gas
- Internal tamponade – Heavy liquid
- Internal tamponade – Heavy silicone oil (Densiron)
- Internal tamponade – SF6 gas
- Internal tamponade – Silicone oil
- Intracapsular cataract extraction ± IOL
- Iridocyclectomy
- iStent trabecular micro-bypass
- Lamellar keratoplasty
- LASEK
- Laser peripheral iridotomy
- Limited macular translocation
- Macular laser
- Macular translocation 360 degrees
- Other cornea operation
- Other destruction of ciliary body
- Other specified excision of iris
- Other specified operation on ciliary body
- Other specified operation on iris
- Panretinal photocoagulation
- Panretinal photocoagulation - endolaser
- Panretinal photocoagulation – indirect laser
- Penetrating keratoplasty
- Phakic IOL
- Posterior capsule capsulorhexis
- Posterior capsulotomy (intended)
- Posterior endothelial keratoplasty
- Posterior segment globe repair
- Pterygium excision

- PVR membrane peel
- Radial optic neurotomy
- Recession of medial rectus muscle and resection of lateral rectus muscle of eye
- Removal of foreign body from conjunctiva / cornea / iris
- Removal of intraocular foreign body
- Removal of releasable suture following glaucoma surgery
- Removal of silicone oil
- Removal of tamponading agent
- Repair of iridodialysis
- Retina vascular sheathotomy
- Retinal pigment epithelium translocation
- Retinectomy
- Retinopexy – 360 degree laser
- Retinopexy – cryotherapy
- Retinopexy – endolaser
- Retinopexy – indirect laser
- Retinopexy - other
- Retinotomy – drainage / relieving
- Retrobulbar injection into orbit
- Revision of aqueous shunt to extraocular reservoir
- Sclera imbrication / graft / suture / repair
- Scleral buckle – circumferential
- Scleral buckle – encircling
- Scleral buckle – radial
- Scleral buckle – revision / replacement
- Strabismus & Paediatric examination under anaesthesia
- Subretinal injection (Avastin / tPA / Alteplase)
- Subretinal membrane / band removal
- Superficial keratectomy
- Surgical anterior capsulotomy
- Surgical iridoplasty
- Suture of conjunctiva

- Tarsorrhaphy – Central / lateral / medial
- Therapeutic contact lens / placement on to cornea
- Trabeculectomy
- Trabeculotomy
- Trabectome
- Trans-scleral retinal diode laser
- Tube implant
- Unspecified excision of iris
- Unspecified operation on iris
- Visco canalostomy
- Visco goniotomy
- Vitreoretinal examination under anaesthesia
- Vitreous biopsy
- YAG anterior capsulotomy
- YAG posterior capsulotomy

If “Examination under anaesthesia” is recorded for an operation conducted under general anaesthesia then this operation would be deemed ineligible for analysis.

9 Labelling of contributing centres on graphs

All contributing centres are allocated and audit centre identifier which is a number generated as 1 – n based on the volume of operations contributed to the analysis, for the audit year that the RCOphth NOD first receives at least 50 eligible operations from the centre, this number is then fixed for the centre in all RCOphth NOD publications.

For the first prospective audit year this assigned numbers 1- 56 to the centres with at least 50 eligible cataract operations, where centre 1 was the centre with the most operations and second 56 the centre with the fewest operations.

For the second prospective audit year centres 1 – 56 remain as assigned, newly contributing centres are assigned numbers 57 – n based on the number of operations they have eligible for the second audit year. This approach will be followed in subsequent audit years using $n+1 - m$ within each subsequent audit year.

These 'numeric tags' are used on all centre graphs to refer to the centre and for certain graphs there will be two figures, one for the centres that were in the first audit year report (centres 1 – 56) and another for the centres with sufficient eligible data first received for the second audit year (centres 57 – n), this will allow the maintaining of surgery volume within the figures display, so that reading across the x-axis corresponds to centres with decreasing surgery volume, separated on the audit year that the centre first contributed at least 50 eligible operations. This arrangement also separates centres where a full year of data are expected as opposed to recent joiners which may have only contributed data for a portion of the year determined by the date when EMR implementation occurred.

10 Index of multiple deprivations score

The Index of Multiple Deprivations (IMD) score, national ranks and national deciles are calculated during the data extraction. For patients treated in English centres, the English Indices of Deprivation 2015 (<https://data.gov.uk/dataset/index-of-multiple-deprivation>) are used, and for patients treated in Welsh centres the Welsh Index of Multiple Deprivation 2014 (<http://gov.wales/statistics-and-research/welsh-index-multiple-deprivation>) are used.

Reasons for missing IMD data are the non-recording of a patient's postcode on the hospital admission system or a patient's postcode not recognisable in the IMD conversions.

While the RCOphth NOD does not have permission to receive the patient's full post code, the calculation of IMD data is reliant on the contributing data supplier. Currently the RCOphth NOD only receives IMD data for centres using the Medisoft EMR, the OpenEyes EMR team have indicated that in future submissions, data for centres using the OpenEyes system could include IMD data, but for centres using an in-house database, the RCOphth NOD can only receive IMD data if the centre calculates this and includes it in the data submission. This has not yet been implemented by any non-EMR contributing centre.

In preparation for the third prospective year of the NOA, the RCOphth NOD team will produce a document explaining how a centre can calculate and submit IMD data for their patients. If section 251 exemption is granted, the RCOphth NOD will be able to receive the patients full post code and calculate the IMD data for any centre that supplies a full post code instead of the IMD data.

11 Pupil size

Certain operative procedures are conducted on small pupils, thus the recording of the procedures can infer the eye has a small pupil, these operative procedures are as follows;

- Broad iridectomy
- Healon GV
- Insertion of iris hooks
- Insertion of pupil ring expander
- Sphincterotomy
- Stretching of the iris
- Synaechiolysis

12 Operative complications

On the supplying data systems to the RCOphth NOD, intra-operative complications are a mandated field. If a surgeon indicates that an intra-operative complication has occurred then on some systems they have to select from a pre-populated list of complications specific to the type of surgery being performed, on other systems they record the intra-operative complication using free text.

Post-operative complications can be recorded in clinic, but not all centres using EMR systems have the EMR in use in all areas of the hospital eye service, and patients do not always return for follow up assessments, thus post-surgery data can be missing. Analysis is limited to post-operative complications recorded within 3 months of cataract surgery in centres that have recorded post-operative data, either 'none' or a specified post-operative complication.

13 Posterior Capsular Rupture (PCR) definition

Posterior capsular rupture is defined as occurring if:

Any of the following intraoperative complications are recorded during surgery:

- IOL into the vitreous
- Lens fragments into vitreous
- Nuclear/ epinuclear fragment into vitreous
- PC rupture - vitreous loss
- PC rupture – no vitreous loss
- Vitreous loss
- Vitreous to the section at end of surgery
- Zonule rupture – vitreous loss

Or if any of the following occurred:

- The operation includes any of 'Sponge and scissors vitrectomy', 'Secondary IOL', 'Automated anterior vitrectomy' or 'Scleral fixed IOL'.
- The operative procedure includes 'Fragmatome lensectomy ± IOL' with a combined phacoemulsification procedure.
- The operative procedure includes 'Removal of retained lens fragments' combined with a vitrectomy and phacoemulsification procedures.
- If either of 'vitreous to the section' or 'vitreous in the AC' are recorded within 8 weeks of cataract surgery, (including the day of cataract surgery).
- If there is a record of a dropped nucleus operation with 90 days of cataract surgery, note this is to include the day of cataract surgery in the time frame.

14 Visual Acuity criteria

Visual Acuity (VA) abbreviations

- Corrected distance visual acuity = CDVA
- Uncorrected distance visual acuity = UDVA
- Pin hole visual acuity = PHVA

Preoperative VA

- Uses the VA measurement closest to the date of surgery, including the day of surgery and within 4 months prior to surgery. This interval has been extended from 90 days prior to surgery which was the time period used for the 'legacy' analysis and first year of the prospective audit.
- Uses the better of CDVA and UDVA. PHVA measurements are not eligible pre-operatively.

Postoperative VA

- Uses VA measurements within 14 days and 4 months (inclusive) of cataract surgery.
- Uses the best measurement of CDVA, UDVA or PHVA within the time period.

Visual loss

- For eyes with a pre-operative VA of <1.00 LogMAR, VA loss is defined as a loss of ≥ 0.30 LogMAR (doubling or worse of the visual angle) between the preoperative and postoperative VA measurements.
- For eyes with a pre-operative VA of ≥ 1.00 LogMAR and $<CF$, VA loss is designated if the post-operative VA is HM, PL or NPL.
- For eyes with a pre-operative VA of CF, VA loss is designated if the post-operative VA is PL or NPL.
- For eyes with a pre-operative VA of HM, VA loss is designated if the post-operative VA is NPL.
- For eyes with a pre-operative VA of PL or NPL no VA loss is considered.

Where, CF = count fingers, HM = hand movements, PL = perception of light and NPL = no perception of light.

15 Diabetic status

It is possible for an eye to have a record of DR as an ocular co-pathology while the patient is not recorded as having diabetes mellitus, the DR ocular co-pathology data can therefore be used to infer diabetic status as follows;

For single eye operated patients, if the eye has a record of DR as an ocular co-pathology then the patient can be considered to have diabetes mellitus.

For both eye operated patients;

- If the first operated eye has a record of DR as an ocular co-pathology then the patient can be considered as having diabetes mellitus for both operations.
- If the first operated eye has no record of DR as an ocular co-pathology, but the second operated eye does the patient can be considered as having diabetes mellitus for the second cataract operation.

16 Ocular co-pathology

Ocular co-pathology data at the time of surgery can be inferred by using other sources of data as follows:

- If the eye has a record of a surgery that included a PPV prior to cataract surgery then the ocular co-pathology for this eye includes “Previous vitrectomy”.
- If the eye has a record of a trabeculectomy surgery prior to cataract surgery then the ocular co-pathology for this eye includes “Previous trabeculectomy” and “glaucoma”.
- If an eye has records prior to cataract surgery of operations that included any of “bleb needling”, “injection of bleb (antimetabolite or autologous blood)” or “bleb revision” then the ocular co-pathology for this eye includes “Glaucoma”.
- If the most recent DR grading assessment prior to cataract surgery records an eye to have DR then the ocular co-pathology for this eye is DR.
- If there is a pre-cataract surgery axial length measurement of ≥ 28 mm then the ocular co-pathology for this eye includes “high myopia”.
- A recorded ocular co-pathology of “vitrectomy” or “retinal detachment” should be classified as “Previous vitrectomy”.
- Eligible eyes can have multiple indications for surgery (“cataract” + another indication) and multiple diagnostic records, this data can be used to infer ocular co-pathology, see appendix 1.

Note: a recorded ocular co-pathology of “glaucoma suspect” does not imply the eye has glaucoma and ocular hypertension is not considered as an ocular co-pathology for the cataract analysis.

17 Posterior Capsular Rupture (PCR) and visual loss analyses

PCR and visual loss graphs

The RCOphth NOD Audit website displays both unadjusted and adjusted for case complexity PCR and visual loss results for surgeons and centres using funnel plots. The unadjusted graphs do not have confidence limits plotted, whilst the adjusted for case complexity graphs have 95% and 99.8% confidence limits plotted using the logit transform and benchmark means of 1.1% for PCR and 0.9% for visual loss. The benchmarks have been lowered for the second year of the prospective audit from 2.0% for PCR and 1.5% for visual loss which were used for the 'legacy' analysis and the first prospective year of the audit. These updated benchmarks reflect the current average rates for the reference group, the consultant surgeons.

The case complexity adjustment models used were developed from the 'legacy' data analysis, which was reported to HQIP in the first annual report. This report included anonymised funnel plots showing all non-trainee surgeons' data, and separately, anonymised plots of centres' data which includes all contributing surgeons (non-trainees and trainees). Examples of both unadjusted and adjusted for case complexity PCR graphs are shown in Figures 1 and 2.

Individual surgeons who have contributed data to the RCOphth NOD will have access to funnel plots on the RCOphth NOD Audit website allowing a surgeon to view their personal data in the context of their anonymised peers and to view their centre's data in the context of all other contributing centres.

As surgeons progress through training, they can have data at more than one grade, can work in multiple contributing centres use more than one of the audit data collection systems. In the prospective cataract audit the surgeon's general medical council (GMC) number is used as part of the registration for the RCOphth NOD website. This allows the matching of records for surgeons who have data for more than one centre or more than one contributing data collection system.

The results on the RCOphth NOD website include a filter for the surgeon grade which allows a surgeon to view their results for the different grades they have had in their career. The same approach allows for the centre results to be filtered by surgeon grade, this then shows the clinical staff in a contributing centre where their surgeons on a specific grade relate to other centres surgeons on the same grade, for example trainees surgeons.

The confidence intervals are derived from the number of operations and the benchmark. The upper boundaries of the 95% and 99.8% confidence intervals equate to alert and alarm levels in public reporting and these are displayed in Table 1 for the benchmark values used in the NOA.

Figure 1: An example of an unadjusted for case mix PCR graph

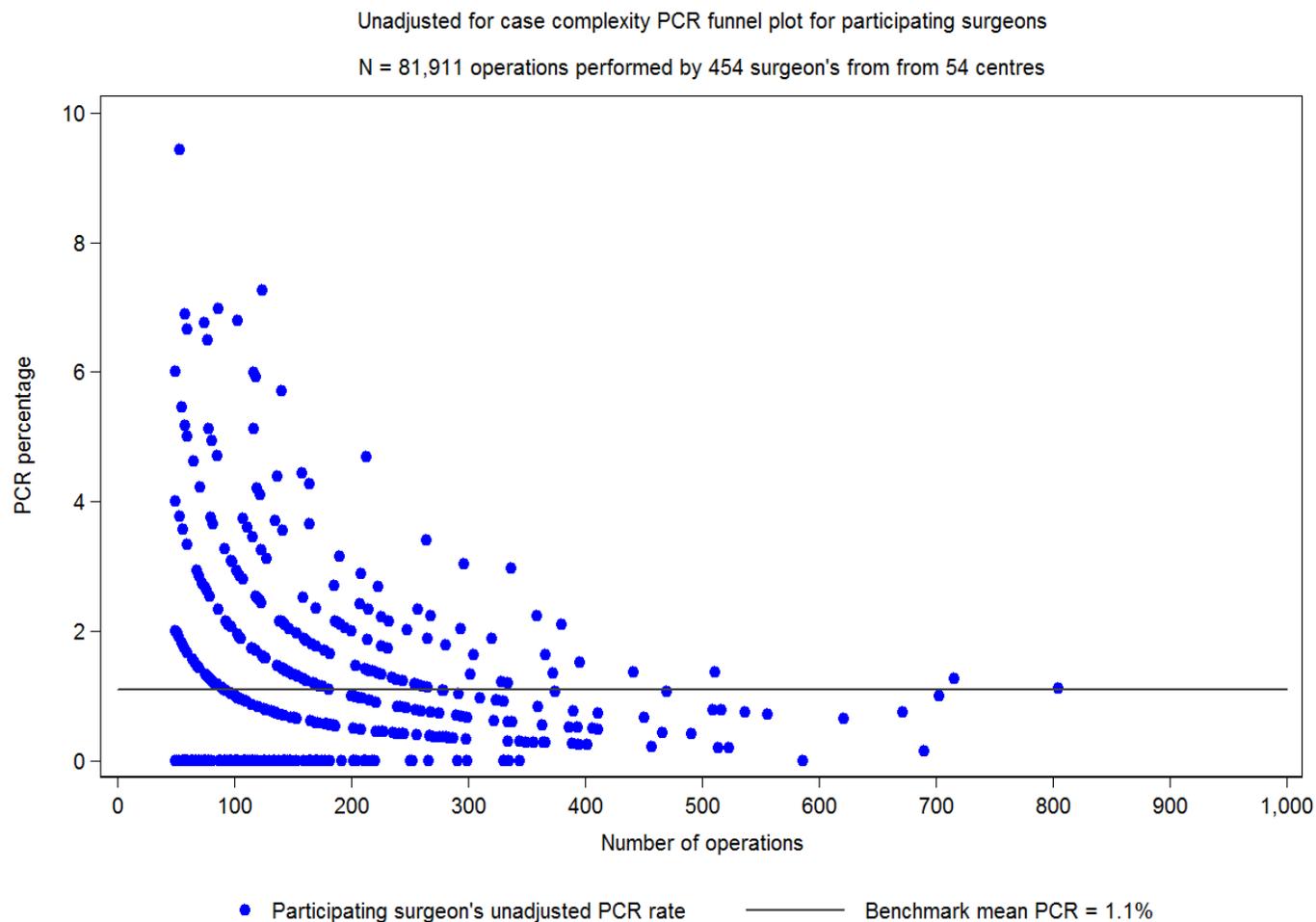


Figure 2: An example of an adjusted for case mix PCR graph

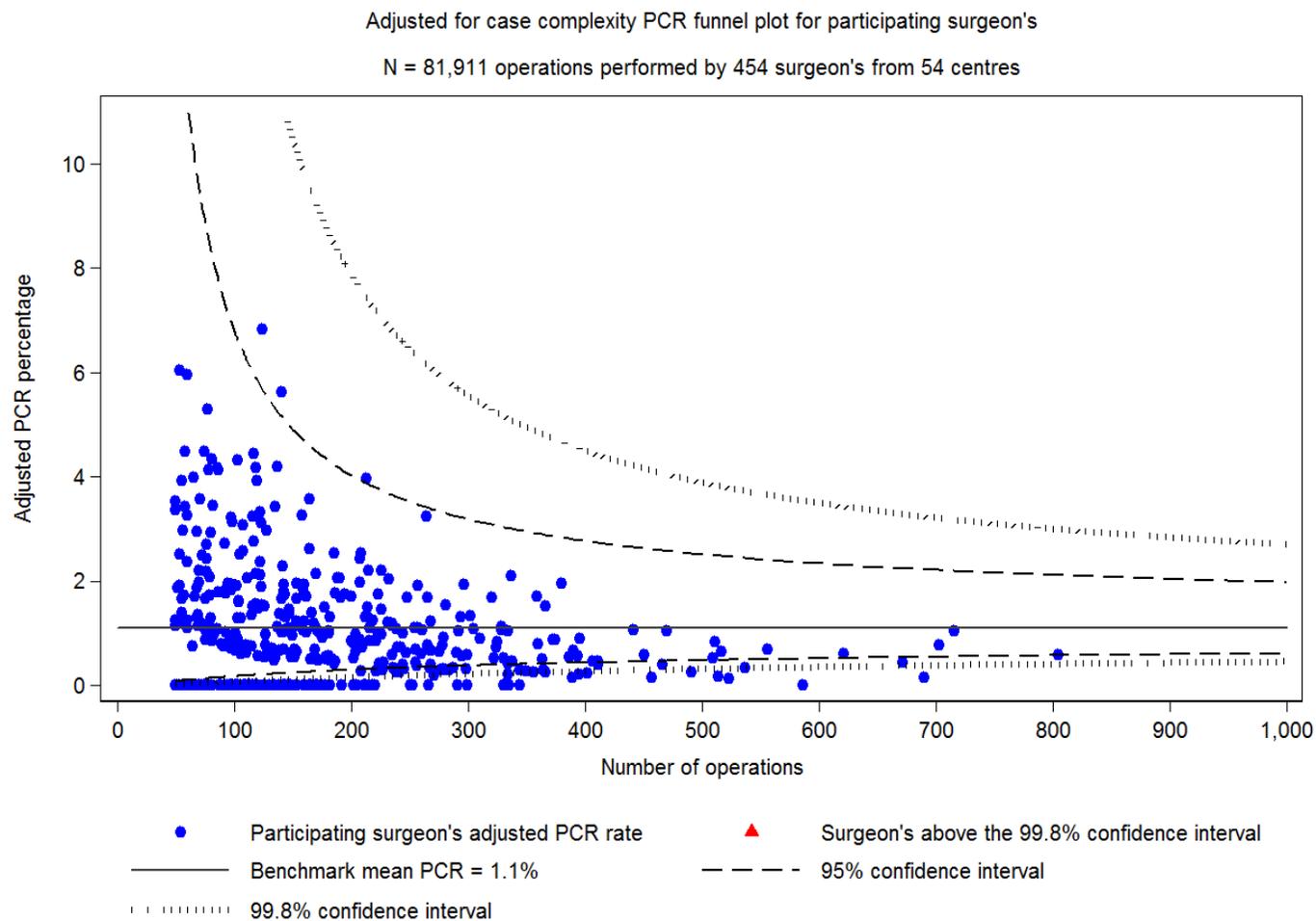


Table 1: Upper boundaries of the 95% (alert level) and 99.8% (alarm level) confidence intervals for the NOA benchmarks

Number of operations	PCR (benchmark = 1.1%)		VA loss (benchmark = 0.9%)	
	Alert level (+2 SD)	Alarm level (+3 SD)	Alert level (+2 SD)	Alarm level (+3 SD)
50	13.69	39.71	14.60	45.16
100	6.79	16.62	6.75	18.03
150	4.91	10.50	4.71	10.92
200	4.03	7.88	3.79	7.96
300	3.19	5.56	2.92	5.41
400	2.77	4.50	2.50	4.28
500	2.51	3.89	2.25	3.64
600	2.34	3.49	2.08	3.23
700	2.21	3.20	1.95	2.94
800	2.12	2.99	1.86	2.73
900	2.04	2.83	1.78	2.56
1,000	1.98	2.70	1.72	2.43
1,100	1.92	2.59	1.67	2.32
1,200	1.88	2.49	1.63	2.23
1,300	1.84	2.42	1.59	2.15
1,400	1.80	2.35	1.56	2.08
1,500	1.77	2.29	1.53	2.03
2,000	1.66	2.08	1.42	1.82
3,000	1.54	1.85	1.31	1.60
4,000	1.47	1.73	1.25	1.48
5,000	1.43	1.65	1.20	1.41
6,000	1.40	1.59	1.17	1.35
7,000	1.37	1.55	1.15	1.31
8,000	1.35	1.51	1.13	1.28
9,000	1.34	1.49	1.12	1.25
10,000	1.32	1.46	1.11	1.23
15,000	1.28	1.39	1.06	1.16

PCR and visual loss model fitting

The categorisation of each covariate considered for the PCR and visual loss mixed effects logistic regression models are detailed in Table 2. The models were fitted on the sample of all eligible operations performed in the 2011-12 to 2014-15 NHS years. The prospective audit reports yearly periods between 1st September and 31st August and uses the models developed from the 'legacy' data.

The same model fitting approach was used for both PCR and visual loss models, where covariates of interest were first investigated on the univariate level using Pearson's Chi-squared tests. Covariates that were significant at the 10% level were fitted into the multivariate models on a 'test sample' using backwards selection and a significance level of 5% to remain in the model. The individual surgeons were considered as the random effect and all other covariates were fitted as fixed effects. An identity matrix was used to model the covariance structure, this sets equal variances for the random effects and all covariance's to be zero and is the appropriate structure to use when factor variables are specified in a model.

To create the 'test sample' and the 'validation sample' a random number generating allocation from a multivariate normal distribution was used, where negative random numbers allocated an operation to the 'test sample' and positive random numbers allocated an operation to the 'validation sample'. Before the random number allocation was performed the data was sorted (ordered) on all covariates under consideration. The random allocation was performed separately for the PCR and Visual Loss models to remove the potential imbalances that could arise if operations in either the 'test sample' or 'validation sample' for the PCR model did not have the required VA data for inclusion in the Visual Loss model.

Model diagnostics utilised were comparing the deviance residuals to the model predicted values and a comparison with a fixed effects logistic regression model. The final model was then applied to a 'validation sample' for further validation.

The data used to fit the PCR and visual loss models was shared with an existing collaboration as part of an NIHR funded cataract research programme for assessment of stability over time.

Table 2: Variables for consideration in a logistic regression model

Variable	Categorisation	Additional information
PCR occurred	No Yes	The dependant variable in the PCR model and an independent variable in the visual loss model
Visual loss occurred	No Yes	The dependent variable in the visual loss model and not considered in the PCR model
Pre-operative VA (LogMAR)	<0.00 0.00 – 0.30 >0.30 – 0.60 >0.60 – 0.90 >0.90 – 1.20 >1.20	An independent variable in the visual loss model and not considered in the PCR model
Age at surgery	<70 years 70 – 74 years 75 – 79 years 80 – 84 years 85 – 89 years ≥90 years	If missing data constitutes <2% of the sample, then impute the mean age of patients with data using first treated eyes for missing first treated eye age and second treated eyes for missing second treated eye age. If missing age constitutes ≥2% of the sample then fit into the models as a variable level.
Gender	Female Male	If missing gender or gender recorded as “Not Specified” allocate as “Female” unless missing data constitutes ≥2% of the sample, if so fit as a variable level in the models
Index of multiple deprivations (IMD) score	Quintiles	If missing, infer within each centre the mean IMD score for that centre.
Patient ability to lie flat	No Yes	If missing, assume “Yes”
Patient ability to co-operate	No Yes	If missing, assume “Yes”
Patient taking any alpha-blockers	No Yes	“No” if no medication recorded or “Not taking medication” is recorded “Yes” if patient taking any of; Alfuzosin Doxazosin Indoramin Parazosin Tamzolosin Terazosin

Axial length	<20 mm 20 – 28 mm >28 mm	If missing data constitutes <2% of the sample allocate to “20 – 28 mm”, if ≥2% of the sample fit as a variable level in the models.
Pupil size	Large Medium Small	If missing, assume “Large”
Surgeon grade	Consultant Career grade non-consultant Experienced trainee Inexperienced trainee	Staff grade associate specialists trust doctors Fellows registrars specialty registrars’ years 3 - 7 specialty trainees’ years 3 – 7 SHO specialty trainees’ years 1-2 specialty registrars’ years 1 - 2 foundation doctors years 1 - 2
First eye surgery	No Yes	Bilateral surgery can be included with “Yes” for both eyes under the assumption that any difference in PCR likelihood between a first and second eye operation from the patients age and grade of operating surgery do not apply to bilateral surgery. If missing and only one operated eye per patient, assume “Yes”
Ocular co-pathology	Amblyopia	
	AMD	In the legacy data Wet AMD and Dry AMD cannot be separated, in the prospective data this will be possible
	Brunescent / White Cataract	
	Corneal Pathology	
	DR	
	Glaucoma	
	High Myopia	
	Inherited eye disease	

	No fundal view / Vitreous Opacities	
	Optic nerve / CNS disease	
	Other Macular pathology	Including 'Epiretinal Membrane' and 'Macular Hole' as recorded ocular co-pathology.
	Other Retinal pathology	
	Previous Trabeculectomy	
	Previous Vitrectomy*	Any previous operation that included a Pars Plana Vitrectomy, plus 'Retinal Detachment' as a recorded ocular co-pathology.
	Pseudoexfoliation / Phacodonesis	In the legacy analysis these cannot be separated, in the prospective data this will be possible
	Uveitis / Synaechiae	
	Other	

*In the legacy data used to create the case complexity adjustment models, Epiretinal Membrane, Macular Hole and Retinal Detachment were recorded as ocular co-pathologies without specifying if with or without a previous vitrectomy surgery. For the case complexity adjustment models both Epiretinal Membrane and Macular Hole were classified as "Other macular pathology" while Retinal Detachment was classified as "Previous vitrectomy". In the prospective analysis these terms can be recorded and specified with a previous vitrectomy surgery or not to allow better modelling of these complex eye conditions in any future re-fitted risk model using the prospective data.

18 Changes for the prospective national cataract audit

Posterior capsule rupture

Three of the covariates used in the development of the PCR case complexity adjustment model are not currently used in the calculation of reported adjusted PCR rates in the prospective national cataract audit, these are;

- the presence of optic nerve / CNS disease
- the presence of macular pathology
- Index of multiple deprivation (IMD)

The two ocular co-pathologies are not used due to concerns raised by surgeons that the PCR risk model suggested a protective effect against PCR. This view is considered to be counter-intuitive by many ophthalmologists and as these results were based on small numbers, it is possible that the seemingly protective effect was an artefact of the rareness of the conditions in the model sample. The IMD is not used as this data is only currently supplied by one contributing data system.

The benchmark used for the case complexity adjustment of PCR has been lowered from 2.0% used in the 'legacy' analysis and the first prospective year of the audit to 1.1% for the second prospective year of the audit, this decision has been made after considering the decreasing rates of PCR for the equivalent audit year periods from 2010 to 2017. The chosen value closely reflects the current average for the reference group, i.e. consultant surgeons.

Visual loss

Two of the covariates used in the development of the visual loss case complexity adjustment model are not used in the calculation of reported adjusted visual loss rates for the prospective national cataract audit, these are;

- the presence of high myopia
- the occurrence of PCR

The presence of high myopia is not used due to concerns raised by surgeons that the VA loss risk model suggested a protective effect against visual acuity loss. This view is considered to be counter-intuitive by many ophthalmologists and as this result was based on small numbers, it is possible that the seemingly protective effect was an artefact of the rareness of the condition in the model sample.

Adjustment for the occurrence of PCR in the VA Loss model is not been made as doing so would artificially reduce the adverse VA impact of this event on VA outcome. A further stipulation on the VA loss risk adjusted results is a criterion for at least 40% of operations to have a pre- and post-operative VA.

The benchmark used for the case complexity adjustment of visual loss has been lowered from 1.5% used in the 'legacy' analysis and the first prospective year of the audit to 0.9% for the second prospective year of the audit, this decision has been made after considering the fairly stable rates of visual loss for the equivalent audit year period from 2010 to 2017. The chosen value closely reflects the current average for the reference group, i.e. consultant surgeons.

Visual acuity

For the second prospective year of the audit, the pre-operative VA time period has been extended from 90 days prior to surgery to 4 months prior to surgery; this is to increase the sample of eyes with a pre-operative VA from centres that might have longer times between original assessment and listing for surgery to the actual day of surgery. In the official HQIP report information will be provided for each centre on the proportion of eyes that would have had a pre-operative VA measurement if using different time period prior to cataract surgery, for example 3 months, 4 months, 5 month and 6 months.

Ocular co-pathology

The prospective cataract audit allows both Stickler syndrome and Fuch's endothelial dystrophy to be recorded as an ocular co-pathology. Currently in the prospective national cataract audit results, both of these ocular co-pathology's are combined with "unspecified other" due to the infrequency of the recording of these conditions.

In the case complexity models the national cataract audit analysis has to assume that absence of any record of ocular co-pathology data equates to the absence of the ocular co-pathology in the eye. In the HQIP report, information will be provided for each centre on the proportion of eyes that had ocular co-pathology data recorded (either present or none), the proportion of eyes where the ocular co-pathology was inferred from other clinical records and the proportion of eyes where no ocular co-pathology data was recorded or inferred.

The most recent data submission for Open Eyes centres included a description of the terms allocated to 'unspecified other' ocular co-pathology; these descriptions included existing ocular co-pathology's, cataract subtypes and systemic diseases or eye conditions that are not an ocular co-pathology for cataract surgery. This information has been used to improve the accuracy of the ocular co-pathology data for centres using the Open Eyes EMR and the rules applied to this data have been sent to the Open Eyes team for their internal use.

19 Audit reporting destinations

Reporting destinations

The prospective national cataract audit results are shared with HQIP, COP, NHS choices, the Care Quality Commission (CQC) and on the RCOphth NOD website, with different formats for each destination. Audit data sets are also uploaded to data.gov.

For HQIP – Centre only adjusted PCR and VA loss results are provided for all operations performed in a centre including operations performed by trainee surgeons. A minimum of 50 eligible operations per centre is required for inclusion. Case complexity adjusted graphs display the 99.8% confidence interval, but not the 95% confidence interval.

For COP and NHS Choices – Both surgeon and centre adjusted PCR and VA loss results are provided. A minimum of 50 eligible operations is required for inclusion. Centre results include operations performed by all grades of surgeon. Surgeon results are provided only for consultant and career grade non-consultant surgeons where the GMC number is known, thus surgeon results can be aggregated across all centres where they have performed operations. Operations performed by surgeons who have relinquished their licence to practice, had their licence withdrawn, have an administrative reason affecting their licence to perform surgery in the UK, have died during the audit period or where the GMC number is unknown are included in the centre results, but not the surgeon results. This allows the accurate reflection of a centres case load, while not reporting results for an individual who may no longer be performing surgery. The RCOphth NOD does not know the date that a licence was relinquished or withdrawn and it is possible that the operative record for a surgeon in this situation concerns the period when they were licenced, thus justifying inclusion in centre results. In addition, centres are responsible for all the surgery they deliver, which includes responsibility for employment of suitably skilled surgeons. In the first year of the audit the site of surgery for centres with multiple locations where cataract surgery is performed was not consistently supplied. For the COP and NHS choices results there is a requirement for reporting at the surgery site level and for the second prospective year of the audit all data suppliers have been asked to provide this information. This data has been supplied by all data suppliers except for centres using the Open Eyes EMR.

For the CQC - Centre only adjusted PCR and VA loss results are provided for all operations performed in a centre including operations performed by trainee surgeons. A minimum of 50 eligible operations per centre is required for inclusion. The CQC will have the data for displaying both the 95% and 99.8% confidence intervals.

For the RCOphth NOD website:

Behind the secure log-in - Centre and surgeon unadjusted and adjusted PCR and VA loss results will be available behind a secure log-in for access by relevant staff in participating centres. Date searching functionality is available when the data covers a period longer than the official prospective audit period. Filtering by surgeon grade is available as previously described. The adjusted graphs display the 95% and 99.8% confidence intervals. The aim is for clinical staff from participating centres to be able to use these results for internal audits and revalidation.

Public facing – The RCOphth NOD website has a public facing section where centres and individual surgeons adjusted PCR and VA loss results for the audit period are available, this mirrors the results submitted to COP and NHS choices where all surgeons data is included in the centres results, while named surgeons results do not include trainee surgeons.

For data.gov – Once reporting of the data to all sources has been completed the audit data sets are uploaded to data.gov.

20 Risk model reviewing

The RCOphth NOD aims to use case complexity adjustment models that reflect current practice as accurately as we can, we aim to adequately adjust for the risk factors that the models indicate are significant. For this to be achieved requires periodic reviewing of the benchmarks and the model risk factors, the benchmarks have been lowered for the second year of the prospective audit, the VA loss definition has been revised, and when time is available the RCOphth NOD plan to re-fit the risk models, but at the time of writing the precise timing for this work has yet to be determined.

Appendix 1: Indications for surgery and diagnostic records that can infer the presence of an ocular co-pathology

The following terms can be recorded on the contributing EMR systems as either a diagnosis or an indication for surgery. The RCOphth NOD uses the recording of either to infer the ocular co-pathology that the term is listed under. All wording is as in the information that has been supplied to the RCOphth NOD.

Age-related macular degeneration (AMD)

- < 50 % of lesion is CNV
- >50 % of lesion is CNV
- ≥2 disc areas of geographic atrophy
- 1 disc area of geographic atrophy
- 1-2 disc areas of geographic atrophy
- 1/2 disc area of geographic atrophy
- adult vitelliform macular dystrophy
- age-related macular degeneration
- atrophic macular change
- atrophy (non-geographic atrophy)
- basal laminar drusen
- choroidal neovascular membrane (type not specified)
- choroidal neovascular membrane associated with a chorioretinal scar
- choroidal neovascular membrane associated with a retinal dystrophy
- choroidal neovascular membrane associated with juxtafoveal telangiectasia
- classic choroidal neovascular membrane
- clinically avascular (serous) PED
- clinically avascular PED
- CNV (type not specified)
- CNV outside posterior pole
- cuticular drusen
- degenerative drusen
- disciform scar

- dominant basal laminar drusen
- dominant drusen
- drusen
- drusen stage macular degeneration
- drusenoid PED
- dry age-related macular degeneration
- early AMD
- extra foveal intraretinal haemorrhage
- extra foveal subretinal haemorrhage
- extrafoveal CNV
- extrafoveal fibrosis
- extrafoveal intraretinal haemorrhage
- extrafoveal subretinal haemorrhage
- extrafoveal sub RPE haemorrhage
- extramacular drusen
- exudative age-related macular degeneration
- exudative retinal detachment associated with age-related macular degeneration
- few drusen
- fibrosis < 25% of lesion
- fibrosis < 50% of lesion
- fibrosis < 75% of lesion
- fibrosis > 50% of lesion
- fibrovascular PED
- focal macular hyperpigmentation
- focal macular hypopigmentation
- foveal intraretinal haemorrhage
- foveal involving atrophy
- foveal sub RPE haemorrhage
- foveal subretinal haemorrhage
- geographic atrophy
- haemorrhagic PED
- idiopathic choroidal neovascular membrane

- juxtafoveal CNV
- large drusen
- macular drusen
- Malattia Leventinese (dominant basal laminar drusen)
- medium drusen
- multifocal CNV
- neovascular AMD (classic no occult CNV)
- neovascular AMD (idiopathic polypoidal choroidal vasculopathy)
- neovascular AMD (minimally classic CNV)
- neovascular AMD (occult no classic CNV)
- neovascular AMD (predominantly classic CNV)
- neovascular AMD (retinal angiomatous proliferation)
- neovascular AMD (subtype not specified)
- nodular drusen
- non-exudative age-related macular degeneration
- non-foveal involving atrophy
- numerous drusen
- occult choroidal neovascular membrane
- PED
- peripapillary choroidal neovascular membrane
- peripapillary CNV
- peripheral CNV
- peripheral drusen
- RPE changes
- RPE rip / tear
- small / hard drusen
- sub RPE haemorrhage
- sub-foveal CNV
- sub-foveal fibrosis
- subretinal fluid
- subretinal haemorrhage
- suspected neovascular AMD

- turbid PED
- vascularised (notched) PED
- vitreous haemorrhage secondary to age-related macular degeneration
- wet age-related macular degeneration
- widespread retinal pigment epithelium (RPE) atrophy

Amblyopia

- anisometropic amblyopia
- amblyopia
- occlusion for amblyopia
- refractive amblyopia
- strabismic amblyopia
- toxic amblyopia

Brunescent / white cataract

- brunescent cataract
- hypermature cataract
- mature / white cataract

Corneal pathology

- alkaline chemical burn of cornea and/or conjunctival sac
- alkaline chemical burn of cornea and conjunctival sac
- Axenfield-Rieger syndrome
- band-shaped keratopathy
- bullous keratopathy
- calcific band keratopathy
- central corneal ulcer
- central opacity of cornea
- central pterygium
- chemical injury to cornea
- clouding of corneal stroma
- congenital keratoconus
- congenital macular corneal dystrophy
- corneal allograft rejection
- corneal chemical injury
- corneal congenital anomaly
- corneal decompensation
- corneal degenerations
- corneal deformity
- corneal deposit
- corneal dystrophy
- corneal endothelial allograft rejection
- corneal endothelial dystrophy
- corneal endothelial wound
- corneal epithelial allograft rejection
- corneal epithelial degeneration
- corneal epithelial defect
- corneal epithelial dystrophy
- corneal epithelial wound
- corneal erosion
- corneal graft

- corneal graft astigmatism
- corneal graft disorder
- corneal graft failure
- corneal graft infection
- corneal graft rejection
- corneal graft vascularisation
- corneal haze due to herpes simplex
- corneal herpetic disease
- corneal laceration
- corneal lesion
- corneal leukoma interfering with central vision
- corneal melting disorder
- corneal melt / keratolysis
- corneal neovascularisation
- corneal non-healing epithelial ulcer
- corneal oedema
- corneal opacity
- corneal perforation
- corneal scarring
- corneal scars and opacity
- corneal stromal abscess
- corneal stromal wound
- corneal thinning
- corneal trauma
- corneal ulcer
- corneal vascularisation
- corneal wound burn
- decompensated cornea
- dermoid cyst or cornea
- fine corneal oedema
- fungal keratitis
- gelatinous droplike corneal dystrophy

- giant keratoacanthoma
- granular corneal dystrophy
- herpes simplex disciform keratitis
- herpes simplex keratitis
- herpes simplex keratouveitis
- herpes zoster keratitis
- hypertrophy of corneal epithelium
- infectious crystalline keratopathy
- infective corneal ulcer
- interstitial keratitis
- keratitis
- keratoconus
- keratopathy due to corneal stem cell failure
- lattice corneal dystrophy Type 1
- lattice corneal dystrophy, isolated form
- limbal stem cell deficiency
- lipid keratopathy
- Meesman's corneal dystrophy
- Megalocornea
- Neuropathic corneal ulcer
- Neuropathic keratitis
- Perforated corneal ulcer
- Perforation of cornea
- Phthisical cornea
- Primary failure of corneal graft after penetrating keratoplasty
- Recurrent erosion of cornea
- Reis-Buckler's corneal dystrophy
- Rejection of corneal graft after penetrating keratoplasty
- Rheumatoid melting disorder of cornea
- Rosacea keratitis
- Salzmann's nodular dystrophy
- Schnyder crystalline cornea dystrophy

- Stromal corneal dystrophy
- Thiel-Behnke corneal dystrophy
- Traumatic corneal abrasion
- Visually significant corneal scar

Diabetic retinopathy

- advanced diabetic retinopathy
- advanced diabetic retinal disease
- advanced proliferative diabetic retinopathy
- angle neovascularisation associated with diabetic retinopathy
- anterior hyaloid face neovascularisation associated with diabetic retinopathy
- background diabetic retinopathy
- clinically significant macular oedema
- combined tractional / rhegmatogenous retinal detachment associated with diabetic retinopathy
- diabetic macular ischaemia
- diabetic macular oedema
- diabetic macular oedema unresponsive to anti-VEGF drugs
- diabetic macular oedema unresponsive to IVTA
- diabetic macular oedema unresponsive to laser
- diabetic macular oedema without clinically significant macular oedema
- diabetic maculopathy
- diabetic maculopathy ungradable
- diabetic maculopathy with no clinically significant macular oedema
- diabetic papillopathy
- diabetic retinopathy associated with type I diabetes mellitus
- diabetic retinopathy associated with type II diabetes mellitus
- diabetic retinopathy (grade not specified)
- diabetic retinopathy ungradable
- diabetic traction retinal detachment
- fibrovascular proliferation associated with diabetic retinopathy
- high risk proliferative diabetic retinopathy

- high risk proliferative diabetic retinopathy not amenable to photocoagulation
- iris neovascularisation associated with diabetic retinopathy
- ischaemic diabetic maculopathy
- low risk proliferative diabetic retinopathy
- macular off tractional retinal detachment associated with diabetic retinopathy
- macular on tractional retinal detachment associated with diabetic retinopathy
- macular retinal oedema
- mild diabetic macular oedema
- mild non-proliferative diabetic retinopathy
- mild proliferative diabetic retinopathy
- mild stromal corneal oedema
- minimal non-proliferative diabetic retinopathy
- mixed diabetic retinopathy
- mixed diabetic macular oedema + ischaemia (not clinically significant macular oedema)
- moderate diabetic macular oedema
- moderate non-proliferative diabetic retinopathy
- moderate proliferative diabetic retinopathy
- non-high risk proliferative diabetic retinopathy with clinically significant macular oedema
- non-high risk proliferative diabetic retinopathy with no macular oedema
- non-proliferative diabetic retinopathy
- pre-proliferative diabetic retinopathy
- pre-retinal haemorrhage associated with diabetic retinopathy
- proliferative diabetic retinopathy
- proliferative diabetic retinopathy – high risk
- proliferative diabetic retinopathy – high risk with clinically significant macular oedema
- proliferative diabetic retinopathy – high risk with no macular oedema
- proliferative diabetic retinopathy – non-high risk
- proliferative diabetic retinopathy - quiescent
- proliferative diabetic retinopathy with high risk new vessels at the disc

- proliferative diabetic retinopathy with high risk new vessels at the disc and elsewhere
- proliferative diabetic retinopathy with high risk new vessels elsewhere
- proliferative diabetic retinopathy with low risk new vessels at the disc
- proliferative diabetic retinopathy with low risk new vessels at the disc and elsewhere
- proliferative diabetic retinopathy with low risk new vessels elsewhere
- scatter (PRP) retinal laser scars visible
- severe diabetic macular oedema
- severe non-proliferative diabetic retinopathy
- severe non-proliferative diabetic retinopathy with clinically significant macular oedema
- stable treated proliferative diabetic retinopathy
- traction detachment of retina
- tractional retinal detachment associated with diabetic retinopathy
- tractional retinal detachment associated with diabetic retinopathy - fovea detached
- tractional retinal detachment associated with diabetic retinopathy - fovea not threatened
- tractional retinal detachment associated with diabetic retinopathy - traction on fovea
- tractional retinal detachment involving macular
- tractional retinal detachment sparing macular
- very mild non-proliferative diabetic retinopathy
- very severe non-proliferative diabetic retinopathy
- vitreous haemorrhage associated with proliferative diabetic retinopathy

Epiretinal membrane

- epiretinal membrane
- epiretinal membrane with macular pseudo hole
- epiretinal membrane with vitreomacular traction
- idiopathic epiretinal membrane
- pseudo-macular hole
- retinal folds associated with epiretinal membrane

Fuch's endothelial dystrophy

- Fuchs' endothelial dystrophy

Glaucoma

- absolute glaucoma
- acute angle closure
- acute angle closure glaucoma
- advanced open angle glaucoma
- angle closure
- angle closure glaucoma
- angle recession glaucoma
- aqueous humour misdirect
- blebitis
- childhood glaucoma associated with acquired condition
- childhood glaucoma associated with non-acquired ocular anomalies
- childhood glaucoma associated with non-acquired systemic disease or syndrome
- childhood glaucoma following cataract surgery
- childhood glaucoma of unknown aetiology
- chronic angle closure glaucoma
- chronic open angle glaucoma
- clear lens extraction for glaucoma
- closed angle glaucoma (aniridia)
- closed angle glaucoma (aphakic pupil block)

- closed angle glaucoma (aqueous misdirection)
- closed angle glaucoma (ciliary body cyst)
- closed angle glaucoma (congenital anomaly)
- closed angle glaucoma (epithelial ingrowth)
- closed angle glaucoma (gas in vitreous)
- closed angle glaucoma (ICE syndrome)
- closed angle glaucoma (inflammatory membrane)
- closed angle glaucoma (intumescent lens)
- closed angle glaucoma (iris cyst)
- closed angle glaucoma (lens dislocation)
- closed angle glaucoma (neovascular)
- closed angle glaucoma (plateau iris)
- closed angle glaucoma (posterior polymorphous dystrophy)
- closed angle glaucoma (ROP)
- closed angle glaucoma (silicone oil)
- closed angle glaucoma (uveal effusion - increased choroidal venous pressure)
- closed angle glaucoma (uveal effusion - other)
- closed angle glaucoma (uveal effusion - scleritis)
- closed angle glaucoma (uveal effusion – tumour related)
- closed angle glaucoma (uveitis)
- closed angle glaucoma (wound leak)
- congenital glaucoma (Broad thumb syndrome)
- congenital glaucoma (chromosomal anomaly)
- congenital glaucoma (other)
- disorder of filtering bleb
- glaucoma
- glaucoma associated with anterior segment anomaly
- glaucoma associated with ocular disorder
- glaucoma associated with systemic syndromes
- glaucoma associated with vascular disorder
- glaucoma due to combination of mechanisms
- glaucoma due to perforating injury

- glaucoma due to silicon oil
- glaucoma of childhood
- glaucoma (other / undetermined)
- glaucomatous atrophy of optic disc
- juvenile open angle glaucoma
- leaking filtering bleb
- lens particle glaucoma
- low tension glaucoma
- malignant glaucoma
- neovascular glaucoma
- normal pressure glaucoma
- normal tension glaucoma
- open angle glaucoma
- open angle glaucoma (aniridia)
- open angle with cupping of optic discs
- phacoanaphylactic glaucoma
- phacolytic glaucoma
- phacomorphic
- phacomorphic (secondary glaucoma)
- pigmentary glaucoma
- primary acute angle closure glaucoma
- primary angle closure
- primary angle closure glaucoma
- primary congenital glaucoma
- primary congenital glaucoma with infantile onset (>1-24 months)
- primary congenital glaucoma with neonatal or newborn onset (0-1 months)
- primary glaucoma due to combination of mechanisms
- primary open angle glaucoma
- pseudoexfoliation glaucoma
- rubeotic glaucoma associated with branch retinal vein occlusion
- rubeotic glaucoma associated with central retina artery occlusion
- rubeotic glaucoma associated with central retinal vein occlusion

- rubeotic glaucoma associated with diabetic retinopathy
- rubeotic glaucoma associated with hemi-retinal vein occlusion
- secondary angle closure glaucoma
- secondary angle closure glaucoma – synechial
- secondary angle closure glaucoma with pupillary block
- secondary glaucoma
- secondary glaucoma due to combination mechanisms
- secondary open angle glaucoma
- secondary open angle glaucoma (acute anterior uveitis)
- secondary open angle glaucoma (chronic anterior uveitis)
- secondary open angle glaucoma (Fuchs heterochromic cyclitis)
- secondary open angle glaucoma (haemolytic)
- secondary open angle glaucoma (intermediate uveitis)
- secondary open angle glaucoma (ocular surgery or laser)
- secondary open angle glaucoma (panuveitis)
- secondary open angle glaucoma (raised episcleral venous pressure)
- secondary open angle glaucoma (retinal detachment)
- secondary open angle glaucoma (siderosis)
- secondary open angle glaucoma (steroid induced)
- secondary open angle glaucoma (trauma)
- secondary open angle glaucoma (trauma, other)
- secondary open angle glaucoma (traumatic angle recession)
- secondary open angle glaucoma (tumour infiltration)
- steroid induced glaucoma glaucomatous stage

Inherited eye diseases

- autosomal dominant retinitis pigmentosa
- autosomal recessive optic atrophy
- cone dystrophy
- congenital hereditary endothelial dystrophy
- congenital hypertrophy of retinal pigment epithelium
- hereditary haemorrhagic telangiectasia
- hereditary macular dystrophy
- hereditary retinal artery tortuosity
- hereditary vitreoretinopathy
- Leber hereditary optic neuropathy
- retinitis pigmentosa
- retinitis pigmentosa associated with deafness
- Usher syndrome
- Usher syndrome type 2
- X-linked carrier of retinitis pigmentosa
- X-linked retinitis pigmentosa

Macular hole

- Degeneration of macular due to cyst, hole or pseudohole
- epiretinal membrane associated with a macular hole
- lamellar macular hole
- macular hole
- macular hole associated with high myopia
- stage I macular hole
- stage II macular hole
- stage III macular hole
- stage IV macular hole

Myopia

- axial myopia
- choroidal neovascular membrane associated with myopia
- degenerative progressive high myopia
- Forster-Fuchs spot (myopia)
- high myopia
- high myopia (6 or more dioptres)
- index myopia
- low myopia < 6 dioptres
- myopia
- myopic chorioretinal dystrophy
- myopic macular degeneration
- pathologic myopia
- punctate inner choroidopathy associated with myopia
- retinal detachment associated with myopia
- retinal hole associated with myopia
- retinal tear associated with myopia
- severe myopia
- staphyloma (myopia)

No fundal view

- cataract extraction to improve fundal view
- no fundal view
- no fundal view and red reflex absent
- no fundal view but red reflex present

Ocular hypertension (This is not used in the cataract analysis as an ocular co-pathology)

- Primary ocular hypertension

Optic nerve / CNS disease

- abnormal vision as a late effect of cerebrovascular disease
- anterior ischaemic optic neuropathy
- anterior ischaemic optic neuropathy secondary to giant cell arteritis
- arteritic anterior ischaemic optic neuropathy
- atrophy of sector of optic disc
- congenital nystagmus
- drusen of optic disc
- ischaemic optic neuropathy
- Leber's amaurosis
- meningioma of optic nerve sheath
- multiple sclerosis
- optic atrophy
- optic atrophy secondary to vitamin B12 deficiency
- optic disc neovascularisation
- optic disc structural anomaly
- optic disc vascular anomaly
- optic nerve infarction
- toxic optic neuropathy
- traumatic optic neuropathy

Other macular pathology

- acquired peripheral telangiectasia
- Best disease
- Best disease (atrophic stage)
- Best disease (choroidal neovascular membrane stage)
- Best disease (cicatricial stage)
- Best disease (vitelliform stage)
- bilateral juxtafoveal telangiectasia
- central serous retinopathy
- central serous retinopathy associated with corticosteroid use
- central serous retinopathy associated with hyperopia
- central serous retinopathy associated with idiopathic polypoidal choroidal vasculopathy
- central serous retinopathy associated with retinal / choroidal folds
- central serous retinopathy associated with retinal detachment
- central serous retinopathy with pit of optic disc
- chronic central serous retinopathy
- cystoid macular oedema
- disorder of macular retina
- group 1A: unilateral congenital juxtafoveal telangiectasia
- group 1B: unilateral idiopathic focal juxtafoveal telangiectasia
- group 1B: unilateral, idiopathic, focal juxtafoveal telangiectasia
- group 2A: bilateral idiopathic acquired juxtafoveal telangiectasia
- group 2A: bilateral, idiopathic, acquired juxtafoveal telangiectasia
- group 2B: juvenile occult familial idiopathic juxtafoveal telangiectasia
- group 3A: occlusive idiopathic juxtafoveal telangiectasia
- group 3B: occlusive idiopathic juxtafoveal telangiectasia associated with central nervous system vasculopathy
- fibrovascular macular scar
- idiopathic juxtafoveal telangiectasia
- intraretinal haemorrhage
- intraretinal haemorrhage at edge of lesion

- intraretinal haemorrhage in centre of lesion
- intraretinal haemorrhage involving fovea
- juxtafoveal telangiectasia
- juxtafoveal telangiectasia associated with choroidal neovascularisation
- juxtafoveal telangiectasia associated with systemic disease
- juxtafoveal telangiectasia with retinal ischaemia
- macular laser scars visible
- macular retinoschisis
- solar maculopathy
- Stargardt disease
- Stargardt disease (atrophic maculopathy with flecks)
- Stargardt disease (atrophic maculopathy)
- unilateral juxtafoveal telangiectasia
- vitreomacular traction
- vitreomacular traction with incomplete posterior vitreous detachment
- vitreomacular traction syndrome

Other retinal vascular pathology

- avascular retinal pigment epithelial detachment
- branch retinal artery occlusion
- branch retinal artery occlusion with a visible embolus
- branch retinal vein occlusion
- branch retinal vein occlusion with disc collaterals
- branch retinal vein occlusion with macular ischaemia
- branch retinal vein occlusion with macular oedema
- branch retinal vein occlusion with neovascularisation
- branch retinal vein occlusion with no neovascularisation
- branch retinal vein occlusion with retinal collaterals
- central retinal artery occlusion
- central retinal artery occlusion with a visible embolus
- central retinal vein occlusion
- central retinal vein occlusion – ischaemic

- central retinal vein occlusion – non-ischaemic
- central retinal vein occlusion with disc collaterals
- central retinal vein occlusion with macular ischaemia
- central retinal vein occlusion with macular oedema
- central retinal vein occlusion with neovascularisation
- central retinal vein occlusion with retinal collaterals
- central serous chorioretinopathy
- chronic central serous chorioretinopathy
- Coats syndrome
- Coats-like syndrome
- Exudative retinopathy
- hemi-retinal vein occlusion
- hemi-retinal vein occlusion with disc collaterals
- hemi-retinal vein occlusion with macular ischaemia
- hemi-retinal vein occlusion with macular oedema
- hemi-retinal vein occlusion with retinal collaterals
- hemispheric retinal vein occlusion
- hemispheric retinal vein occlusion with macular oedema
- hemispheric retinal vein occlusion with neovascularisation
- hyphaema associated with central retinal vein occlusion
- idiopathic polypoidal choroidal vasculopathy
- macular branch retinal vein occlusion
- multiple retinal artery aneurysms
- neovascularisation of the angle associated with branch retinal vein occlusion
- neovascularisation of the angle associated with central retinal vein occlusion
- neovascularisation of the angle associated with hemi-retinal vein occlusion
- neovascularisation of the disc associated with branch retinal vein occlusion
- neovascularisation of the disc associated with hemi-retinal vein occlusion
- neovascularisation of the iris associated with branch retinal vein occlusion
- neovascularisation of the iris associated with central retinal vein occlusion
- neovascularisation of the iris associated with hemi-retinal vein occlusion

- neovascularisation of the optic disc associated with central retinal vein occlusion
- neovascularisation of the retina associated with branch retinal vein occlusion
- neovascularisation of the retina associated with central retinal vein occlusion
- neovascularisation of the retina associated with hemi-retinal vein occlusion
- peripheral retinal degeneration
- peripheral retinal neovascularisation
- photocoagulation burn to retina
- retinal artery macroaneurysm
- retinal exudates
- retinal neovascularisation
- retinal telangiectasia
- retinal vascular proliferation
- retinal vascular vasculitis
- retinitis
- rubeotic glaucoma associated with branch retinal vein occlusion
- rubeotic glaucoma associated with central retina artery occlusion
- rubeotic glaucoma associated with central retinal vein occlusion
- rubeotic glaucoma associated with hemi-retinal vein occlusion
- venous retinal branch occlusion
- vitreous haemorrhage associated with branch retinal vein occlusion
- vitreous haemorrhage associated with central retinal vein occlusion
- vitreous haemorrhage associated with hemi-retinal retinal vein occlusion

Previous laser refractive surgery

- Unsatisfactory outcome of laser surgery

Previous retinal detachment surgery

- extrusion of scleral buckle
- low buckle indent
- no visible buckle indent
- old partial retinal detachment
- old subtotal retinal detachment
- old total retinal detachment
- partial recent retinal detachment with retinal dialysis
- PVR caused failed retinal detachment surgery
- PVR grade CA10
- recent subtotal retinal detachment
- recent total retinal detachment
- rhegmatogenous retinal detachment (1 previous operation for RD)
- rhegmatogenous retinal detachment (2 previous operations for RD)
- rhegmatogenous retinal detachment (>2 previous operations for RD)
- rhegmatogenous retinal detachment (primary) – if prior to cataract surgery
- rhegmatogenous retinal detachment associated with myopia
- successfully treated retinal detachment
- unsuccessfully treated retinal detachment
- untreated retinal break caused failed retinal detachment surgery

Previous trabeculectomy surgery

- trabeculectomy bleb
- trabeculectomy bleb flat
- trabeculectomy bleb formed

Previous vitrectomy surgery

- 20% air fill of vitreous cavity
- 20% gas fill of vitreous cavity
- 30% air fill of vitreous cavity
- 30% gas fill of vitreous cavity
- 40% air fill of vitreous cavity
- 40% gas fill of vitreous cavity
- 50% air fill of vitreous cavity
- 50% gas fill of vitreous cavity
- 60% air fill of vitreous cavity
- 60% gas fill of vitreous cavity
- 70% gas fill of vitreous cavity
- 80% air fill of vitreous cavity
- 80% gas fill of vitreous cavity
- 90% air fill of vitreous cavity
- 90% gas fill of vitreous cavity
- gas in vitreous cavity
- good fill of vitreous cavity with silicone oil
- glaucoma due to silicon oil
- heavy liquid in AC
- heavy silicone oil
- macular hole - status postoperative
- macular hole closed after surgery
- macular hole open & elevated after surgery
- macular hole open after surgery
- macular hole open but flat on the RPE after surgery
- post-vitrectomy cataract
- removal of silicone oil
- silicone oil droplets on intraocular lens
- silicone oil filling anterior chamber
- silicone oil in vitreous cavity
- vitrectomised eye

Retinal detachment

- 1 quadrant of retina detached
- 2 quadrants of retina detached
- 3 quadrants of retina detached
- 4 quadrants of retina detached
- central serous retinopathy associated with retinal detachment
- chronic rhegmatogenous retinal detachment
- chronic rhegmatogenous retinal detachment - macula off
- chronic rhegmatogenous retinal detachment - macula on
- giant retinal tear
- new partial retinal detachment with giant retinal tear defect
- new partial retinal detachment with multiple defects
- retinal detachment
- retinal detachment associated with myopia
- retinal detachment – subretinal fluid
- retinal detachment with retinal defect
- rhegmatogenous retinal detachment
- rhegmatogenous retinal detachment - macula off
- rhegmatogenous retinal detachment - macula on
- rhegmatogenous retinal detachment (1 previous operation for RD)
- rhegmatogenous retinal detachment (2 previous operations for RD)
- rhegmatogenous retinal detachment (>2 previous operations for RD)
- rhegmatogenous retinal detachment (primary)
- rhegmatogenous retinal detachment associated with myopia
- serous retinal detachment
- unsuccessfully treated retinal detachment
- untreated retinal break caused failed retinal detachment surgery

Synaechiae

- anterior synechiae
- complete posterior synechiae
- incomplete posterior synechiae
- peripheral anterior synechiae
- posterior synechiae

Uveitis / synaechiae

- 1+ vitreous inflammation
- 2+ vitreous inflammation
- 3+ vitreous inflammation
- 4+ vitreous inflammation
- acute anterior uveitis
- anterior uveitis
- anterior uveitis in juvenile idiopathic arthritis
- cataract secondary to uveitis
- choroidal neovascular membrane associated with uveitis
- choroiditis
- chronic anterior uveitis
- disseminated chorioretinitis
- Fuch's heterochromic cyclitis
- herpes simplex keratouveitis
- herpes zoster iridocyclitis
- herpetic iridocyclitis
- idiopathic uveitis
- intermediate uveitis
- iritis
- macular oedema associated with uveitis
- panuveitis
- panuveitis in Bechet's syndrome
- posterior uveitis

- post-operative uveitis
- sarcoid uveitis
- sarcoidosis uveitis
- subacute anterior uveitis
- toxocariasis
- toxocariasis uveitis
- toxoplasmosis
- toxoplasmosis chorioretinitis
- toxoplasmosis uveitis
- tuberculous chorioretinitis
- tuberculous uveitis
- uveal effusion syndrome
- uveitis related cystoid macular oedema
- uveitis glaucoma hyphema syndrome
- uveitis rheumatoid arthritis syndrome
- vitreous inflammation
- vitreous inflammation - red reflex present

Other co-pathology

- apraxia of eyelid
- blepharitis
- cellulitis
- exudative retinal detachment
- steroid induced