The ROYAL COLLEGE of OPHTHALMOLOGISTS

National Ophthalmology Database Audit

Year 1 Annual Report – Piloting of the National Ophthalmology Database Audit Methodology

2016

The ROYAL COLLEGE of OPHTHALMOLOGISTS

NOD
NATIONAL OPHTHALMOLOGY DATABASE AUDIT

HQIP
Healthcare Quality Improvement Partnership

The Royal College of Ophthalmologists (RCOphth) is the professional body for eye doctors, who are medically qualified and have undergone or are undergoing specialist training in the treatment and management of eye disease, including surgery. As an independent charity, we pride ourselves on providing impartial and clinically based evidence, putting patient care and safety at the heart of everything we do. Ophthalmologists are at the forefront of eye health services because of their extensive training and experience. The Royal College of Ophthalmologists received its Royal Charter in 1988 and has a membership of over 4,000 consultants of all grades. We are not a regulatory body, but we work collaboratively with government, health and charity organisations to recommend and support improvements in the coordination and management of eye care both nationally and regionally.

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Healthcare Quality Improvement Partnership (HQIP) is led by a consortium of the Academy of Medical Royal Colleges, the Royal College of Nursing and National Voices. Its aim is to promote quality improvement, and in particular to increase the impact that clinical audit has on healthcare quality in England and Wales. HQIP holds the contract to manage and develop the National Clinical Audit Programme, comprising more than 30 clinical audits that cover care provided to people with a wide range of medical, surgical and mental health conditions. The programme is funded by NHS England, the Welsh Government and, with some individual audits, also funded by the Health Department of the Scottish Government, DHSSPS Northern Ireland and the Channel Islands.

HQIP
Healthcare Quality Improvement Partnership

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Foreword

Cataract surgery is an extremely successful operative procedure that changes the lives of around 330,000 people annually in England alone. Accurately auditing the complications and surgical outcomes helps to provide essential feedback and reassurance for both patients and ophthalmology departments alike. It is incumbent upon us as a profession to record and publish these findings.

Recognising patient characteristics that may affect the final result of surgery, for example pre-operative morbidity or increased risk of complicated surgery, and factoring them into the analysis, makes comparisons fair and equitable and therefore valid.

This is the first step in a process which will be rolled out through England and Wales (and ideally the rest of the UK in the fullness of time) to provide a truly national picture. It will also include other ophthalmic surgical procedures in due course.

This first audit represents an important development and Professor John Sparrow and his team are commended for delivering this programme of work and providing the valuable information in this report.

Professor Carrie MacEwen
President, The Royal College of Ophthalmologists

Executive Summary

Background and aims of the audit

Cataract surgery is the most frequently undertaken surgical procedure on the NHS with approximately 330,000 cataract operations undertaken annually in England and 16,000 in Wales. Surgery aims to reduce visual disability in people with cataracts. The National Ophthalmology Database Audit of Cataract Surgery is designed to use data collected as part of routine clinical practice with a view to establishing an audit that will show current national performance and improve cataract care. All centres providing NHS funded cataract surgery in England and Wales will be eligible to join the audit. As of September 2015, electronic data collection audit tools started being offered to currently 'paper based' cataract surgery centres across England and Wales, to allow such centres to participate in future cycles of this electronically based national cataract surgery audit. Prospective data collection for centres with existing or freshly implemented electronic data collection facilities began in September 2015 and analysis of these data will be the subject of future reporting. In addition the programme will in due course report on the feasibility of electronic audits of macular degeneration treatment, retinal detachment surgery, glaucoma surgery and visual field preservation in people with glaucoma.

At this early stage in the programme a self-selected sample of cataract surgery centres in England have provided data for analysis. Although eligible, there are currently no participating Welsh centres. This first report from the National Ophthalmology Database Audit uses these retrospective 'historic' or 'legacy' data to test the approach for future National Cataract Audit cycles through:

1. Piloting multi-centre data extraction, cleaning, refining and analysis.

2. Assessment of data quality.

3. Updating and testing the way outcomes of surgery should be adjusted to allow for risk and complexities in individual cases.

4. Establishment of benchmark outcome standards and associated ranges of acceptable performance for future audit cycles.

The primary outcomes of the audit are surgical complications and vision loss resulting from surgery. Although the vast majority of cataract operations are uneventful, as with any surgical procedure complications may arise. The most frequent of these occurs when the back of the cataract or its supporting structures are breached and this is called posterior capsule rupture, abbreviated as PCR, with a benchmark overall rate of 2%. The importance of this is that when it happens there is a significantly higher chance of vision loss resulting from the surgery. There are many other reasons for vision loss from cataract surgery and these are reflected in the other main audit outcome, visual acuity loss, which will detect serious visual harm from any cause (including progressive co-morbidities in certain cases). The benchmark rate for this adverse outcome is 1.5% overall. The audit is thus focussed on surgical safety and harm from surgery.

There are a number of secondary outcomes which will be developed and refined as the audit becomes established and progresses through its initial stages. Judging improvement from surgery by measuring postoperative monocular visual acuity (VA) is not a particularly good way to assess overall improvement to a person's vision from cataract surgery and this is therefore not included as a primary outcome of this audit, it is however one of the secondary outcomes, as is access to surgery by deprivation index.

The audit governance structure includes significant patient and public representation. The membership of the audit steering committee includes a patient representative from the Royal College of Ophthalmologists' Lay Advisory Group as well as representation from three relevant national patient support organisations. The committee convenes quarterly to review progress with the audit and to advise the audit provider on the audit procedures and processes. In this initial report however the target audiences remain largely professional and methodological, future reports will include named surgeon and centre outcomes.

Data Collection and Methodology

Included in this first report are 75,827 cataract operations undertaken during the 2014-15 NHS year in 34 English NHS cataract surgical centres. This represents around a quarter of all potentially eligible NHS trusts in England and Wales, and approximately 20% of the eligible cataract surgery undertaken during this period. The centres included in this pilot phase of the audit were self-selected following an invitation to all EMR enabled NHS trusts known to be using an EMR for cataract care. This number of operative procedures should be sufficient for piloting the data extraction procedures and analytical processes required for delivery of future 'prospective' audit cycles, where it is expected that uptake of the audit will increase. The current report contains fully anonymised contextual and outcomes information.

Data completeness was excellent (100%) for the PCR outcome as this is a compulsory operative field in the EMR. An eligible pre-operative distance VA was recorded for 81.0% of eyes and a post-operative VA for 65.2% of eyes, 52.7% of eyes had both a pre-operative and a post-operative VA measurement. There was significant variation between centres for completeness of VA data, a reflection of variations in current modes of use of the EMR in diverse patient pathways.

The likelihood of each of these adverse events occurring varies depending on certain parameters related to individual patients and the state of their eye health. For example, surgery for a hard, brown, advanced cataract has a much higher chance of running into difficulty than an operation for a softer less advanced cataract. In order to ensure as fair a comparison as possible amongst surgeons and centres, statistical models known as 'risk adjustment models' have been developed. These models were developed by reviewing the operations for patients from the NHS years 2011-12 to 2014-15 inclusive to determine the features that most influenced patient outcomes. The key outcome measures being reported in this and future audit cycles will be the risk adjusted rate for the complication of posterior capsule rupture (PCR) during surgery, and the risk adjusted rate of visual acuity (VA) loss from before to after surgery. In this initial report the benchmark values (means) of 2.0% for PCR and 1.5% for Visual Loss were used. All the participating surgeons and centres were found to be within the acceptable range for the 2014-15 NHS year audited.

Recommendations and Next Steps

At this early stage of the audit recommendations will be limited.

1. Surgeons are reminded that risk adjustment can only be successfully applied if the risk indicator data are recorded in the EMR. With these data surgeons can be given appropriate credit for the complexity of their case mix using the risk adjustment model.

2. Centres and surgeons are requested to review their patient pathways in order to maximise the recording of both pre- and postoperative VA data. Returns of VA and refraction from optometrists can be encouraged in a variety of ways, including through use of the electronic data return tool available to all participating centres as part of the free audit tool kit.

3. Centres are reminded that all NCAPOP audits are mandated and a timely response to the audit providers and their subcontractors is expected in regard to arrangements for participation in the audit.

4. Commissioners are reminded that participation in this audit, as part of the NCAPOP, is a requirement of the NHS Standard Contract. They are reminded to check their contracts with all NHS funded providers to ensure that participation in the audit is included in the service specification in order to take full advantage of the quality assurance opportunity for the population they serve.

In conclusion, the piloting of the audit methodology for this National Ophthalmology Database Audit of Cataract Surgery has set the scene for future prospective audit cycles. National audits such as this are mandated and participation with complete data collection are encouraged. Providing electronic audit tools to centres which are currently paper based will avoid duplicate data collection and facilitate uptake and participation. As the audit becomes established, opportunities to include other EMRs and local databases collecting compliant data will be explored. In future audit cycles results for named surgeons and centres will be published. It is anticipated that highlighting performance in this way will facilitate identification of any possible poor practice and act as a quality improvement driver. In future, centres and surgeons with particularly good outcomes may provide opportunities for learning and cascade of best practice.

1. Introduction

Every year, around 330,000 patients in England and 16,000 patients in Wales undergo NHS cataract surgery – the most frequently performed surgical procedure in the UK. A widely accepted indicator of surgical quality is the frequency of rupture of the posterior capsule or the lens zonules with or without vitreous prolapse into the anterior chamber of the eye, abbreviated as PCR. This operative complication arises on average in approximately one operation in 50 but the risk of this event varies by as much as 50 fold depending on preoperative risk factors associated with the patient and their eye. When this surgical complication occurs there is a six fold higher chance of loss of vision in the eye undergoing surgery from pre- to postoperatively.

After cataract surgery most patients are followed up by community optometrists (high-street opticians) for updating of their glasses prescription and only then is the final 'best-corrected' visual acuity established. The results of this follow-up episode are currently inconsistently communicated back to the hospital to allow a definitive measure of visual acuity benefit from surgery.

In this first annual report of the National Ophthalmology Database Audit we will test the methodology for systematically reporting the rates of PCR and monocular visual acuity (VA) loss. This initial report will focus on data completeness for key variables and on refining the methodology for case mix adjusted PCR and Visual Loss results for surgeons and centres. Available data at this early stage of the audit are limited with less than one quarter of potentially eligible NHS cataract surgery providers having contributed data. Increasing participation is anticipated as the audit develops, data collection tools are currently being rolled out to 'paper-based' cataract surgical centres in England and Wales. With the data which has so far been gathered there is an opportunity to road test the audit methodology. In this report where individual surgeon results are reported these are limited to anonymised consultants and non-consultant career grade surgeons. For contributing centres all cataract operations recorded in the centre are included in the results (i.e. for both career grade surgeons and surgical trainees). Data were extracted from 41 NHS trusts, 34 of which provided cataract surgical data, the remainder contributing data towards feasibility audits for other ophthalmological conditions. This methodological refinement phase of the audit is based on these legacy or historic data, from NHS cataract centres using an Electronic Medical Record (EMR) for routine cataract surgery data capture. The data for analysis was extracted in July 2015 (with a further data extraction performed in November 2015 to resolve data cleaning issues) and here we report case mix adjusted results for the 2014-15 NHS year using risk adjustment models based on multi-centre data from a four year time frame. Future reports will include named centre and surgeon results, with only a 20% sample however this initial report cannot be viewed as a national picture and anonymity is maintained.

2. Audit Framework

The legacy data in this report covers all adult phacoemulsification cataract surgical operations recorded on the Medisoft EMR at 34 contributing cataract surgical centres during the 2014-15 NHS year (01 April 2014 – 31 March 2015). Excluded were cataract operations which were not done by phacoemulsification, operations which were done as combined procedures along with another significant intra-ocular procedure (e.g. a trabeculectomy or a pars plana vitrectomy combined with other vitreoretinal procedures) and operations on individuals aged <18 years. Data on privately funded cataract surgery undertaken by participating surgeons in private hospitals were unavailable and are therefore not included in this report (see Appendix 3 for further details).

3. Aims

The primary aim will be to report risk adjusted rates for PCR and VA loss in cataract surgery. In this initial report historic or legacy data are used to refine the methodology and to assess completeness of currently available data. It is expected that data on PCR will have high levels of completeness for all participating centres as recording of the presence or absence of specified operative complications has always been mandatory in ophthalmology EMR systems but the pre-operative risk indicator and follow up VA data are expected to be less complete.

There will be a number of secondary aims developed throughout the life of the audit, in this report for example access (preoperative VA) and deprivation levels for included patients are illustrated by centre, with access also illustrated by level of deprivation.

4. NHS Trust / Health Board and Surgeon Participation

The audit brief is to include all NHS funded cataract surgery in England and Wales. This initial report includes only currently EMR enabled centres for which Caldicott Guardians and Clinical Leads have given permission for extraction of legacy data from their EMR. As part of the prospective audit the cataract module of an EMR is being made available to all currently paper-based, non-EMR enabled units. (In future audit cycles national dataset compliant data from other sources e.g. alternative EMRs or in-house databases will be included where feasible.) All 34 centres reported on here were from England.

5. Methodology

5.1 Context of the data collection

The audit data derive from routine data collection in NHS hospital trust ophthalmology departments. Complications data depend on surgeons recording these faithfully, unlike mortality figures there is no external validation of the reported complications, although certain cross checks are possible within the extracted data. The EMR however requires the surgeon recording the operation note to specifically indicate a Yes/No response to whether a surgical complication occurred and at all centres the EMR record (or its printed copy for the paper notes) constitutes the medicolegal document of the patient's record. Accurate follow up data on VA and refraction often depend on patients attending their optometrist for updating of spectacles following surgery and for this information to then be returned to the EMR. Although some centres have good paper-based systems in place for optometrists to return this information and for staff at the hospital to enter the data into the EMR, it is anticipated that this outcome will be incomplete and the audit team have therefore taken steps to enhance returns from optometrists through encouraging proactive local engagement with community optometrists, an active programme of engagement with optometric professional bodies, and provision of a web based data return tool for the prospective part of the National Ophthalmology Database Audit.

5.2 Limitations of the data

The RCOphth NOD Audit includes data for cataract operations to the first treated eye, the second treated eye and in some cases simultaneous bilateral surgery, but for some patients the record for the first treated eye may be missing, possibly as the operation was performed prior to the centre adopting the EMR or if the first treated eye operation was performed in a different centre. At present the RCOphth NOD Audit cannot link patients' data if collected at different centres; this will be possible if a section 251 exemption

is granted. A similar problem occurs for the surgeon's progression through training, where the linking of individual surgeons who over their career will work in different centres, is not currently an option. This issue will be resolved when surgeon identifying data are included in future audit cycles. Patient's age, and calculation of index of multiple deprivation (IMD) scores[10] rely on data entered directly onto the Hospital's Patient Administration System (PAS) which links into the EMR, hence if this data is not recorded in the PAS it is not present in the data extract.

6. Data Extraction, Cleaning and Statistical Methods

The main data extracted from participating centres that used the Medisoft (Medisoft Ophthalmology, Medisoft Limited, Leeds, UK) EMR took place in July 2015. During the data cleaning procedures certain errors resulting from the extraction process were identified and a further data extraction was performed in November 2015 to eliminate these errors. All analysis was conducted using STATA version 11, (StataCorp. 2009. Stata Statistical Software: Release 11. College Station, TX: StataCorp LP). Centre participation was affirmed by agreement from the Trust Caldicott Guardian and Clinical Lead for Ophthalmology.

Full details regarding eligibility and analysis criteria can be found on the NOD audit website **www.nodaudit.org.uk**

7. Definitions

7.1 Dataset

A minimum cataract dataset has been defined for purposes of the audit **www.nodaudit.org.uk**

These variables include those required for case complexity adjustment of outcomes.

7.2 Surgeon grade

The grade of surgeon was categorised as consultant surgeons, independent non-consultant surgeons (associate specialists, staff grade and trust doctors), experienced trainee surgeons (fellows, registrars, speciality registrars years 3 – 7 and specialty trainees years 3 – 7) and less experienced trainee surgeons (SHO, specialty registrars years 1 – 2, specialty trainees years 1 – 2 and foundation doctors years 1 – 2).

7.3 Posterior Capsular Rupture (PCR)

PCR included posterior capsule rupture or vitreous prolapse or both and was intended to capture significant breach of the lens-zonule barrier. Detailed criteria for case definitions are in Appendix 3.

7.4 Visual Acuity (VA)

VA definitions used were designed to maximise the usefulness of the available data with specified 'time windows' for pre- and postoperative measurements and criteria for preferred choices in terms of corrected VA, unaided VA and pin hole corrected VA. The detailed criteria are given in Appendix 3.

7.5 Mixed effects modelling of PCR and visual loss

The categorisation of each covariate under investigation in the PCR and visual loss mixed effects logistic regression models are detailed on the NOD Audit website (nodaudit.org.uk) and only operations performed in the 2011-12 to 2014-15 NHS years were used to develop the current models.

The same model fitting approach was used for both 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' set using backwards selection and a significance level of 5% to remain in the model. The individual surgeons were considered as the random effect, all other covariates as the fixed effects and an identity matrix was used to model the covariance structure (further details on the model are available at **nodaudit.org.uk**).

The final model equations for PCR and Visual Loss respectively were applied to the 2014-15 NHS year data for the respective results in this report where the case mix adjusted graphs have 95% and 99.8% error lines displayed which are created from benchmark means of 2.0% for PCR and 1.5% for Visual Loss. On surgeon level case mix adjusted funnel plots only consultant surgeons and independent non-consultant surgeons data is displayed (i.e. no trainee surgeons), whilst on the centre level case mix adjusted funnel plots all surgeons data is included (i.e. including trainee surgeons).

8. Results

8.1 Cataract procedures reported to the audit

In total 80,229 operations were submitted during the 2014-15 NHS year (01 April 2014 to 31 March 2015), of these 4,402 (5.5%) operations are excluded from analysis; the reasons for exclusion were as follows:

- 1,440 operations were performed in Scottish NHS Trusts
- 115 operations were performed on patients <18 years old
- 149 operations had no record of phacoemulsification ±IOL
- 1,150 operations had a non-cataract indication for surgery
- 1,545 operations included ineligible combined operative procedures
- 3 operations had no valid surgeon grade recorded

This left 75,827 operations performed in 34 participating centre's eligible for analysis. The operations were performed on 37,346 (49.3%) left eyes and 38,481 (50.7%) right eyes from 61,633 patients. These operations were performed by 870 surgeons where 18 surgeons had performed surgery at more than one grade.

The number of surgeons and operations at each surgeon grade were:

- 359 consultant surgeons performed 46,801 (61.7%) operations
- 78 independent non-consultant surgeons performed 9,157 (12.1%) operations
- 352 experienced trainee surgeons performed 17,245 (22.7%) operations
- 81 less experienced trainee surgeons performed 2,624 (3.5%) operations

The number of operations performed by each grade of surgeon and within each centre varied reflecting catchment area and NHS trust differences within the England, Figure 1.

8.2 Patient characteristics

Summary details of the 61,633 patients undergoing cataract surgery in the 2014-15 NHS year were as follows:

- 26,198 (42.5%) patients were men
- 35,396 (57.4%) patients were women
- The gender was not recorded for 39 (<0.1%) patients

8.3 First eye, second eye and simultaneous bilateral surgery

All cataract operations performed in the 2014-15 NHS year would be in either the patient's first or second treated eye unless simultaneous bilateral surgery was performed. The RCOphth NOD Audit may not have the record for both operations or the first treated eye could have had the operation prior to the 2014-15 NHS year, for these reasons no results on time between operations are provided in this report.

Results for first and second treated eye operations are reported for the 75,631 operations performed that were not simultaneous bilateral operations.

First treated eye cataract surgery;

- First eye cataract surgery was performed for 43,606 (57.6%) operations
- The median age at first treated eye surgery was 76.8 years (range; 18.5 – 112.7)
- 9,103 (20.9%) patients were recorded as having diabetes mellitus at the time of their first cataract operation
- 356 (0.8%) patients were recorded to be unable to lie flat
- 321 (0.7%) patients were recorded to be unable to cooperate during the operation

Second treated eye cataract surgery;

- Second eye cataract surgery was performed for 32,025 (42.3%) operations
- The median age at second treated eye surgery was 77.7 years (range; 18.1 – 105.0)
- 7,145 (22.3%) patients were recorded as having diabetes mellitus at the time of their second treated eye surgery
- 80 (0.2%) patients were recorded as being unable to lie flat
- 142 (0.4%) patients were recorded as being unable to cooperate during the operation

8.4 Index of multiple deprivation

The index of multiple deprivation (IMD) was calculated for 73,085 (96.4%) operations. The IMD scores and the percentage of operations where an IMD score could be calculated both varied considerably between centres, Figure 2.

8.5 Pre-operative visual acuity (VA)

A pre-operative visual acuity was recorded for 61,448 (81.0%) eyes and missing for 14,379 (19.0%) eyes, of which 690 (0.9% of operations) had a Pin Hole Visual Acuity (PHVA) measured but no Corrected Distance Visual Acuity (CDVA) or Uncorrected Distance Visual Acuity (UDVA) measurement.

There was wide variation in the percentage of eyes with missing pre-operative VA by contributing centre, Figure 3.

For the 61,448 eyes with a pre-operative VA measurement, the measurement was CDVA in 44,604 (72.6%) eyes, UDVA in 15,891 (25.9%) eyes and in 953 (1.6%) eyes the CDVA measurement was the same as the UDVA measurement.

The median pre-operative VA was 0.50 LogMAR units (range; -0.30 – NPL); where 2,315 (3.8%) eyes were CF, 1,156 (1.9%) eyes were HM, 274 (0.4%) eyes were PL and 18 (<0.1%) eyes were NPL.

The pre-operative VA was ≤0.30 LogMAR units for 19,657 (32.0%) eyes, ≤0.60 LogMAR units for 42,634 (69.4%) eyes and ≤1.0 LogMAR units for 54,725 (89.1%) eyes.

The median pre-operative VA was 0.50 LogMAR units for each grade of surgeon.

There was variability in the pre-operative VA between contributing centres, although for the majority of centres the median pre-operative VA was approximately 0.50 LogMAR units, Figure 4.

Access to surgery, judged by preoperative VA was uniform regardless of IMD score, Figure 5.

For 9,530 patients who had both eyes undergo cataract surgery in the 2014-15 NHS year and had a pre-operative VA measurement for both eyes (excluding simultaneous bilateral surgery), the mean presenting VA was worse for the first treated eye than for the second treated eye (means = 0.59 and 0.49 respectively, $p < 0.001$).

Of the 98 patients that had simultaneous bilateral surgery, 75 (76.5%) had presenting VA data for both eyes where the median difference in the VA between the right and left eyes was 0.00 LogMAR units and the inter quartile range was -0.20 – +0.20 LogMAR units.

8.6 Ocular co-pathology

The presence or absence of ocular co-pathology was recorded for 100% of operated eyes and was recorded as absent for 42,966 (56.7%) eyes. Of the 32,861 eyes that had at least one ocular co-pathology recorded, 77.0% had only one co-pathology.

Consultant surgeons tended to perform a higher proportion of cataract operations in eyes with any ocular co-pathology than the other grades of surgeon. This trend also applied to specific individual ocular co-pathologies.

The most commonly recorded ocular co-pathologies were age related macular degeneration, glaucoma and diabetic retinopathy which were recorded for 10.8%, 9.9% and 6.8% of operations respectively, Table 1.

8.7 Operation characteristics

Phacoemulsification ± IOL was performed in all eligible cataract operations and for 73,264 (96.6%) operations was the only operative procedure performed. Phacoemulsification ± IOL was combined with 1 other procedure in 2,396 (3.2%) operations, with ≥2 other procedures in 167 (0.2%) operations.

The most frequently performed operative procedures that were combined with phacoemulsification ± IOL were anterior vitrectomy and limbal relaxing incisions / Opposite Clear Corneal Incision (OCCI), which were performed in 0.9% and 0.6% of operations respectively.

The combinations of operative procedures performed with phacoemulsification ± IOL were similar across the grades of surgeon except for anterior vitrectomy where the proportion of operations that included this procedure was higher for less experienced grades of surgeons and limbal relaxing incisions / OCCI which were performed more frequently by consultant surgeons than by independent non-consultant surgeons or trainee surgeons, Table 2.

8.8 Operative complications

One or more intra-operative complication was recorded for 2,311 (3.0%) operations, with the most frequently being PCR which was reported for 1,334 (1.8%) operations. The 'any' intra-operative complication rates were higher for the less experienced grade of surgeons, while the rates for individual intra-operative complications were similar across the grades of surgeon except for PCR which was higher for the less experienced grades, Table 3.

8.9 Post-operative complications

No follow up data was recorded for 17,176 (22.7%) operations. Of the 58,548 operations with follow up data recorded 55,126 (94.2%) had no recorded post-operative complications and 3,422 (5.8%) had at least one post-operative complication. The most frequently recorded post-operative complications were post-operative uveitis, corneal oedema / striae / Descemet's folds and cystoid macular oedema which were recorded for 1.6%, 1.4% and 1.3% of operations respectively. Independent non-consultant surgeons had lower rates of individual post-operative complications than the other grades of surgeon, Table 4.

8.10 Post-operative visual acuity

A post-operative visual acuity was recorded for 49,429 (65.2%) eyes and missing for 26,398 (34.8%) eyes. There was wide variation in the percentage of eyes with missing post-operative VA by contributing centre, Figure 6, although influencing this result are operations performed in the latter part of the 2014-15 NHS year where follow up times may have been too brief for all post op results to be available.

For the 49,429 eyes with a post-operative VA measurement, the best measurement was CDVA in 17,007 (34.4%) eyes, UDVA in 13,381 (27.1%) eyes, PHVA in 9,796 (19.8%) eyes; the best measurement was the same for two of the assessment methods for 8,376 (17.0%) eyes and the same for all three methods in 869 (1.8%) eyes.

The median post-operative VA was 0.10 LogMAR units (range; -0.30 – NPL); where 218 (0.7%) eyes were CF, 127 (0.3%) eyes were HM, 22 (<0.1%) eyes were PL and 3 (<0.1%) eyes were NPL.

The post-operative VA was ≤0.30 LogMAR units for 43,803 (88.6%) eyes, ≤0.60 LogMAR units for 47,373 (95.8%) eyes and ≤1.0 LogMAR units for 48,686 (98.5%) eyes.

The median post-operative VA was 0.10 LogMAR units for each grade of surgeon and the post-operative VA was fairly stable across participating centres, Figure 7.

8.11 Change in visual acuity

Of the 75,827 cataract operations performed in the 2014-15 NHS year, 39,995 (52.7%) eyes had a pre-operative VA and a post-operative VA measurement. The median change in VA from baseline was a 0.40 LogMAR gain (IQR; 0.20 – 0.60 gain). The change in VA was fairly stable between the participating centres, Figure 8.

78% of eyes with a presenting VA of 0.00 LogMAR or better had a post-operative VA of 0.00 LogMAR or better and 97% of eyes with a presenting VA of 0.30 LogMAR or better had a post-operative VA of 0.30 LogMAR or better.

Eyes that had an ocular co-pathology or experienced an intra-operative complication or PCR during surgery had worse post-operative VA than eyes that did not have either of these problems, and >88% of eyes with any of these problems had a post-operative VA of 0.30 LogMAR or better, Table 5.

8.12 Case mix adjusted PCR results

An unadjusted for case mix funnel plot for all consultant and independent non-consultant surgeons is shown in Figure 9.

The final risk model used for case-mix adjusted PCR contained the following variables; surgeon grade, the patients' age, IMD score and ability to lie flat, pupil size, first or second eye surgery and the presence / absence of amblyopia, brunescent / white cataract, diabetic retinopathy, high myopia, no fundal view / vitreous opacities, previous trabeculectomy surgery, previous vitrectomy surgery, pseudoexfoliation / phacodenesis, and 'other' co-pathology.

None of the consultant or independent non-consultant surgeons who had performed ≥50 operations in the 2014-15 NHS year had an adjusted for case mix PCR rate greater than the upper bound of the 99.8% confidence limit, although 4 surgeons were above the upper bound of the 95% confidence limit, Figure 10.

The unadjusted for case mix PCR rates for each participating centre are shown on Figure 11.

None of the participating centre's adjusted PCR rate was above the upper bounds of the 95% or 99.8% confidence limits, Figure 12.

8.13 Case mix adjusted visual loss results

An unadjusted for case mix Visual Loss funnel plot for consultant and independent non-consultant surgeons with data for the 2014-15 NHS year is shown in Figure 13.

The final risk model used for case-mix adjusted visual loss contained the following variables; presenting VA, the patients' age, if PCR occurred during surgery, and the presence / absence of age-related macular degeneration, amblyopia, diabetic retinopathy, glaucoma, corneal pathology, optic nerve / CNS disease, uveitis, other macular pathology, other retinal pathology and 'other' co-pathology.

None of these surgeons who had performed ≥50 operations had an adjusted for case mix visual loss rate above the upper boundaries of the 95% or 99.8% confidence intervals, Figure 14.

The unadjusted for case mix Visual Loss rates for surgeon at each participating centre is shown on Figure 15.

None of the centres' adjusted for case mix Visual Loss rates were above the upper bound of the 99.8% confidence limit, although one centre was above the upper bound of the 95% confidence limit, Figure 16.

The majority of centres case mix adjusted visual loss estimate is below the benchmark mean of 1.5% derived from earlier sets of data. There are likely to be many reasons for this result. The actual observed visual loss result was 0.97% during the reported period which is lower than the benchmark we used and there is variation in the number of operations and the number/experience of surgeons between centres. Some centres will have fewer surgeons than others and if these surgeons are very experienced this will contrast with a teaching hospital that is likely to have more operations performed by junior surgeons. Another influence is the variation in the recording of follow up data which is necessary for visual loss estimation. In light of this apparent reduction in the rate of visual loss the benchmark rate will need to be reconsidered for future audit cycles.

It should also be noted that 52.7% (39,995/75,827) of the sample used for the PCR model was used in the Visual Loss model due to missing presenting and/or post-operative VA measurements. Any improvements in the number of operations with a recorded presenting and post-operative VA would increase the sample for future re-fitting of the Visual Loss model, this in turn would decrease parameter estimation errors due to the increased sample.

9. Summary of Key Points

- The use of historic or legacy data has provided an opportunity to test this innovative EMR approach to ophthalmology audit data collection and to profile the information which will be of importance to the National Ophthalmology Database Audit as this develops. In this initial report on over 75,000 cataract operations from the 2014-2015 NHS year, we comment on participation rates, essentially a reflection of existing EMR use, and completeness and distributions of the data items of importance to auditing the quality of cataract surgical services from 34 'early adopter' sites.
- The aims for this initial report were to test the audit methodology using legacy or historic data from early adopter EMR sites in terms of data extraction, cleaning, statistical analysis, benchmarking and risk adjustment for the primary outcomes PCR and VA Loss, and reporting on secondary outcomes, here patient profile and access to surgery. These initial aims have been achieved and lessons learnt in regard to details of data extraction schemas, case definitions, methods of case complexity adjustment, data completeness and time needed for critical procedures and processes. The experience gained will facilitate smooth running of these piloted activities in future audit cycles where we expect higher levels of uptake as the audit data collection tools are rolled out to NHS funded cataract surgery centres across England and Wales.
- The case complexity adjustment models for the index surgical complication, posterior capsule rupture, and for visual acuity loss have established benchmark means of 2.0% for PCR and 1.5% for Visual Loss. All currently participating surgeons and centres were found to be within the three standard deviations upper limit of acceptability for the 2014-15 NHS year audited.
- A particular challenge for the development of the audit will be the local collection of post-operative VA data and some participating centres may wish to reconsider their patient pathways in order to reliably collect these data.
- Commissioners may wish to strengthen the quality assurance of their contracting through inclusion of participation in the audit in their cataract surgery service specification.
- Looking ahead, there will be much work for the audit provider team and their partners in rolling out the audit tools to participating centres in the next 'prospective' phase of the audit, which will include named surgeon and named centre results for the period September 2015 through to August 2016.

10. Glossary

Abbreviation	Description
CDVA	Corrected distance visual acuity
CF	The ability to count fingers
EMR	Electronic Medical Record
HM	The ability to distinguish hand movements
HQIP	Healthcare Quality Improvement Partnership
HSCIC	Health and Social Care Information Centre
IMD	Index of multiple deprivation
IOL	Intra-ocular lens
IQR	Inter Quartile Range
OCCI	Opposite Clear Corneal Incision
NCAPOP	National Clinical Audit and Patient Outcomes Programme
NICOR	National Institute for Cardiovascular Outcomes Research
NHS	National Health Service
NOD	National Ophthalmology Database
NPL	No perception of light
PAS	Patient Administration System
PCR	Posterior capsule rupture
PHVA	Pin hole visual acuity
PL	Perception light
RCOphth	Royal College of Ophthalmologists
S251 exemption	Approval for exemption from section 251 of the NHS Health and Social Care Act 2006 which allows for certain uses of patient identifiable data
SES	Socio-economic status
UDVA	Uncorrected distance visual acuity
UK	United Kingdom
VA	Visual acuity
Yes/No	Yes or No

11. Graphs and Tables

Interpreting the Graphs

Among the results there are three types of graphs. The labelling of centres is a ranking of the total number of operations contributed by each centre for all years, so that centre one is the centre that contributed the highest number of operations and centre 34 the least. For the one year period in the current report this ordering of centres has been retained for convenience despite volumes varying.

1. **Bar charts** – the horizontal axis consists of the categorical element, either deciles of IMD score or contributing centre. One bar chart is sub-divided by another category. The vertical height of each bar indicates the quantity of interest for that bar chart as read from the vertical axis.

2. **Box and Whisker plots** – the spread for the variable of interest is shown for each of the contributing centres. The central line is the median or 'middle' value. The box outlines the inter quartile range (25% and 75% centiles), and the horizontal lines above and below the inter quartile range display either the position of the furthest value or a value at a 'reasonable' stretch from the middle. Extreme values are the dots beyond that.

3. **Funnel plots** – The spread of dots on these look like a funnel going from left to right. Each dot represents a result for a surgeon or centre as read off the vertical axis (proportion or rate). The funnel effect results from increasing statistical precision as the numbers get higher going along the horizontal axis. Some of the plots have lines on them showing what is expected. A result above the top line (three standard deviations) would be deemed unacceptably high, a dot between the lines is deemed a bit on the high side but not alarmingly so.

Figure 1

The number of operations performed in the 2014-15 NHS year by grade of surgeon and participating centre.

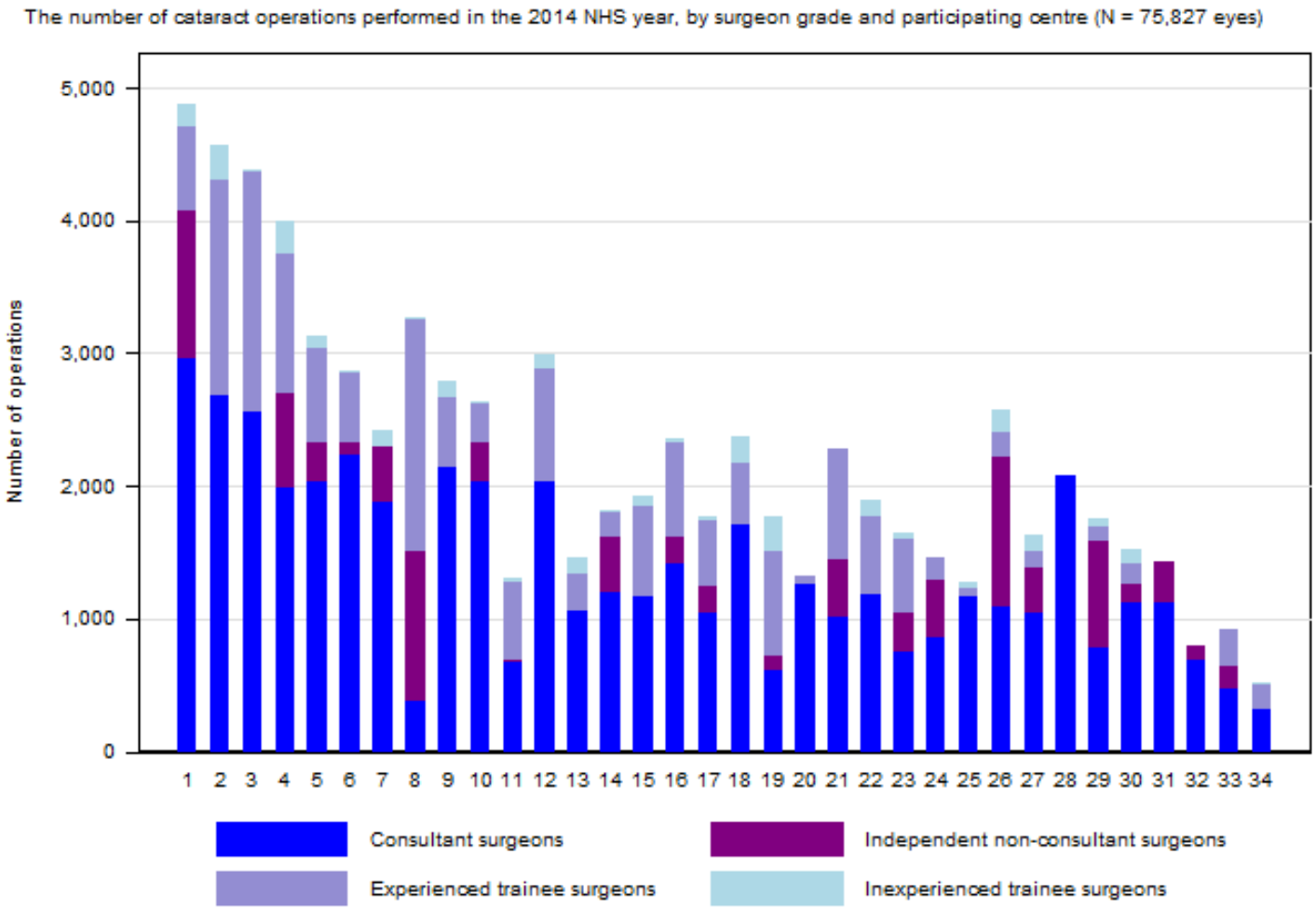

Figure 2

Box and whisker plots of IMD score for patient's undergoing cataract surgery in the 2014-15 NHS year by participating centre.

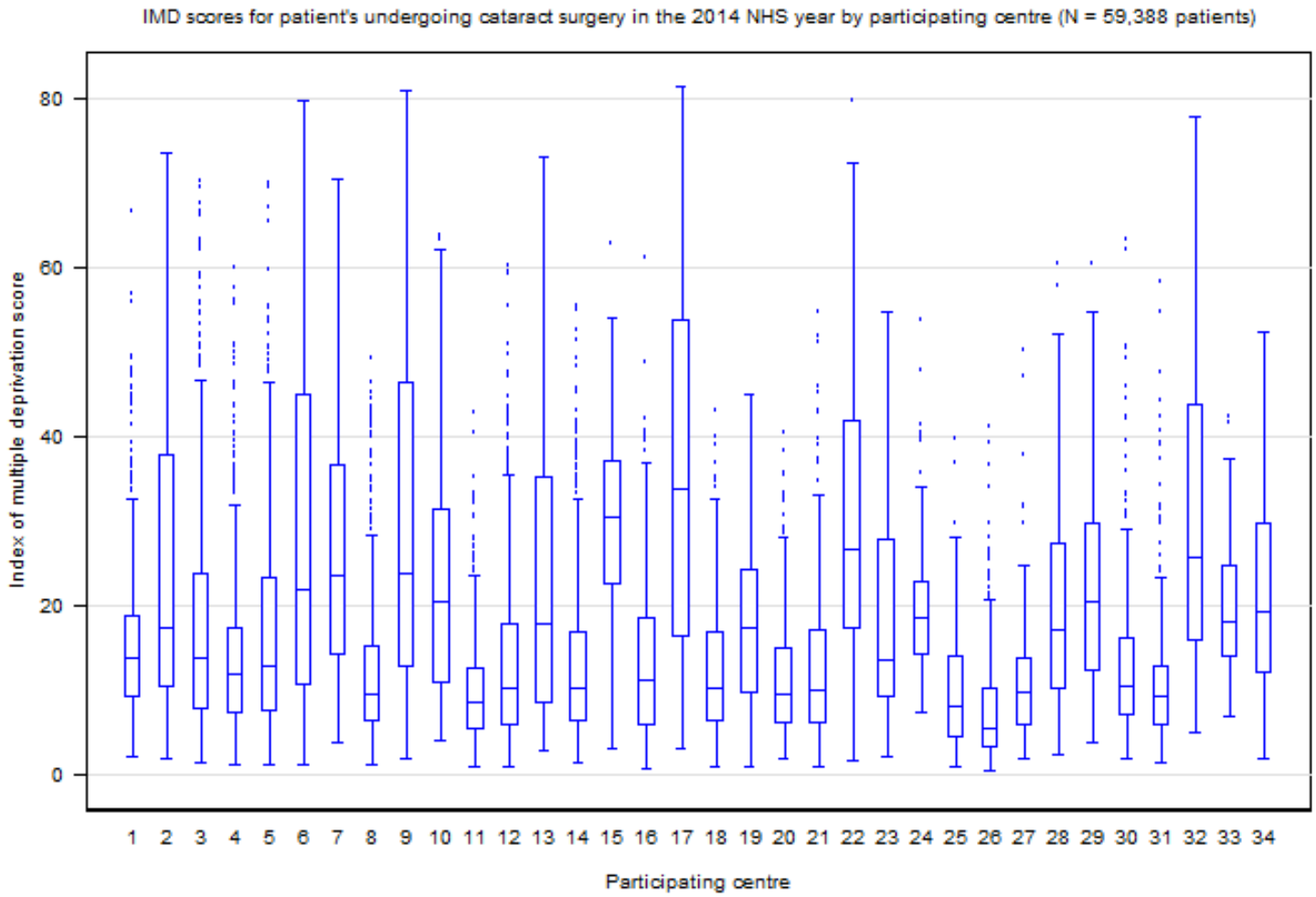

Figure 3

The percentage of cataract operations performed in the 2014-15 NHS year with missing pre-operative VA by participating centre.

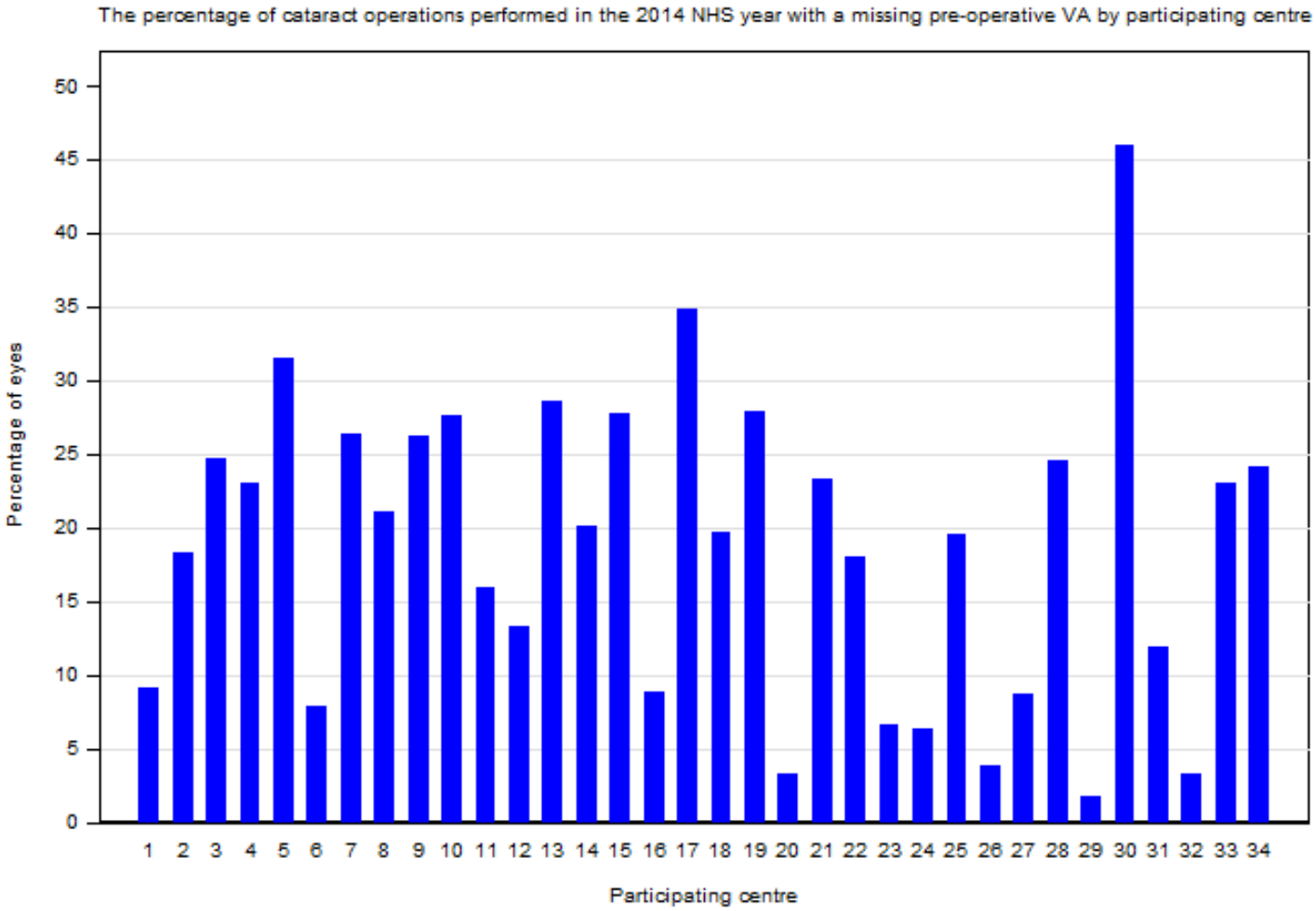

Figure 4

Box and whisker plots of pre-operative LogMAR VA for cataract operations performed in the 2014-15 NHS year by participating centre.

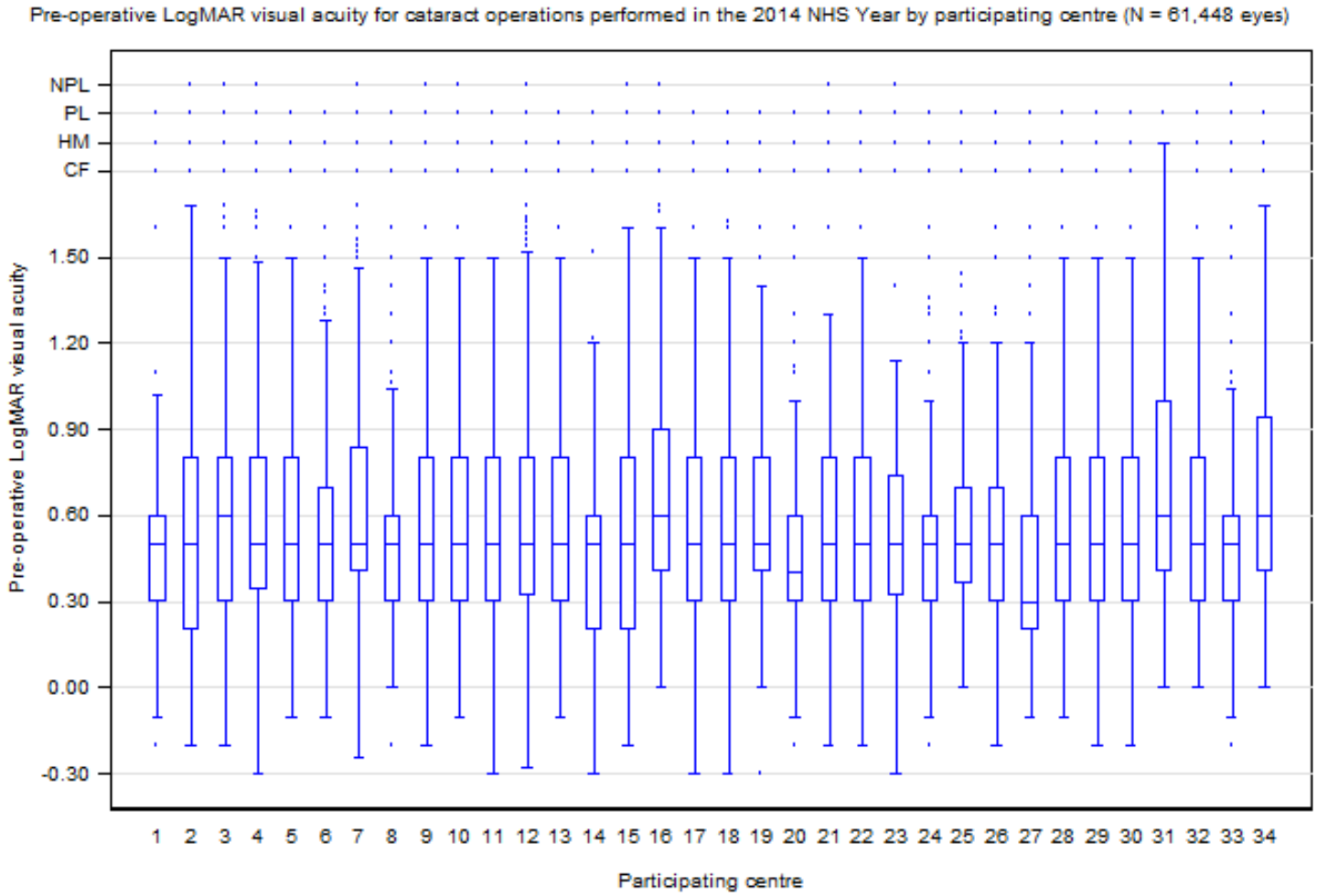

Figure 5

Box and whisker plots of pre-operative LogMAR VA for cataract operations performed in the 2014-15 NHS year by IMD score deciles.

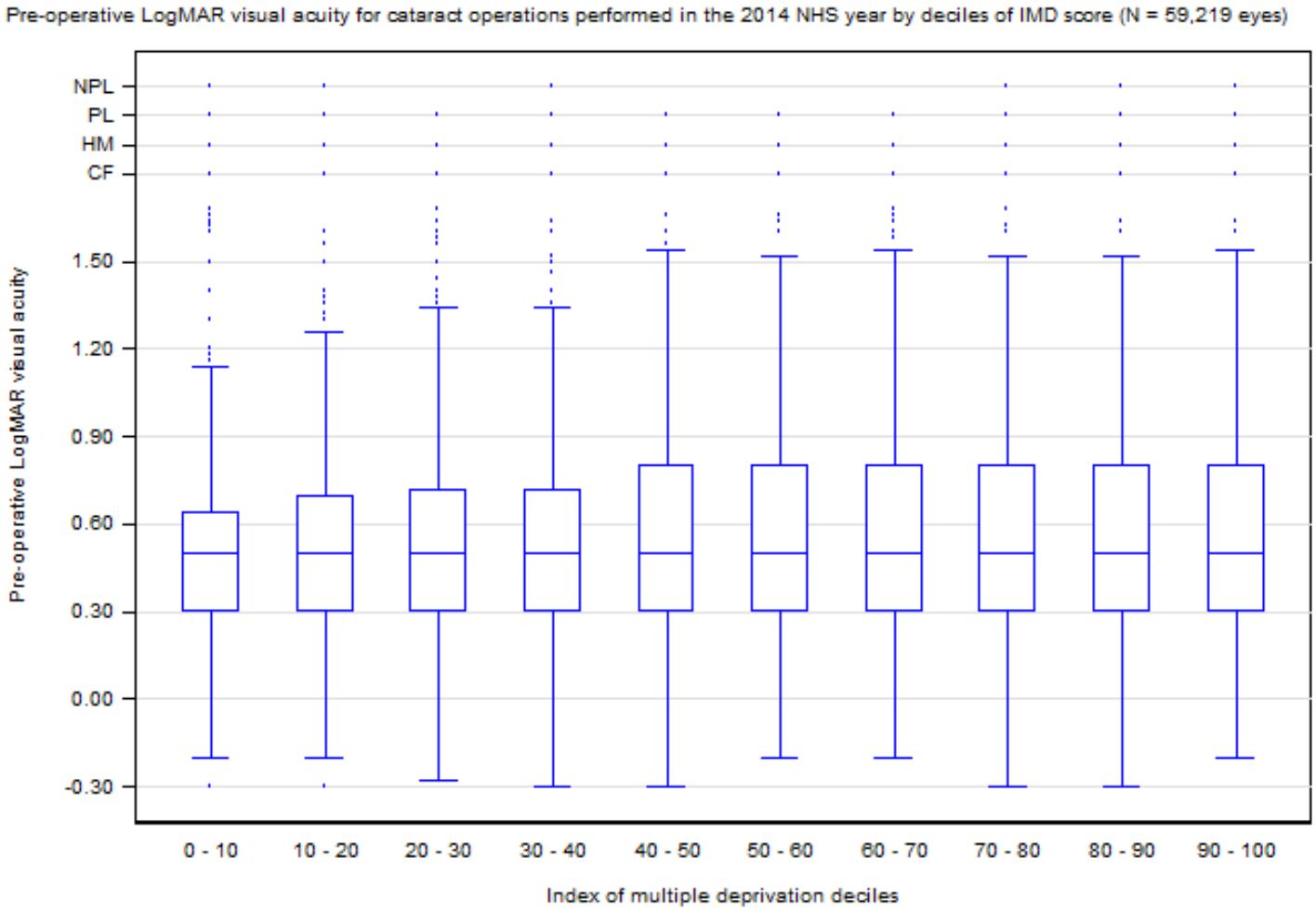

Figure 6

The percentage of cataract operations performed in the 2014-15 NHS year with a missing post-operative VA by participating centre.

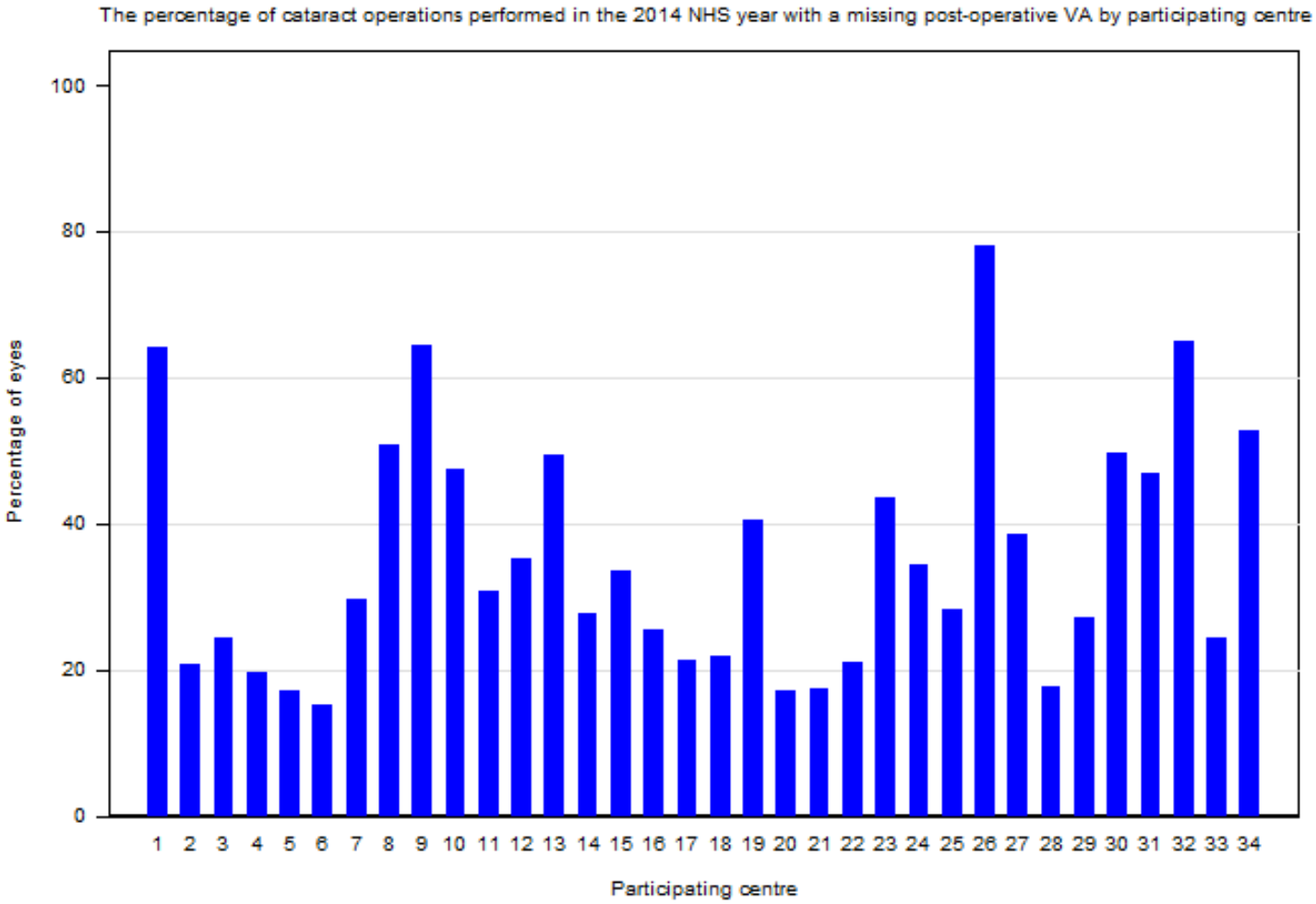

Figure 7

Box and whisker plots of post-operative LogMAR VA for cataract operations performed in the 2014-15 NHS year by participating centre.

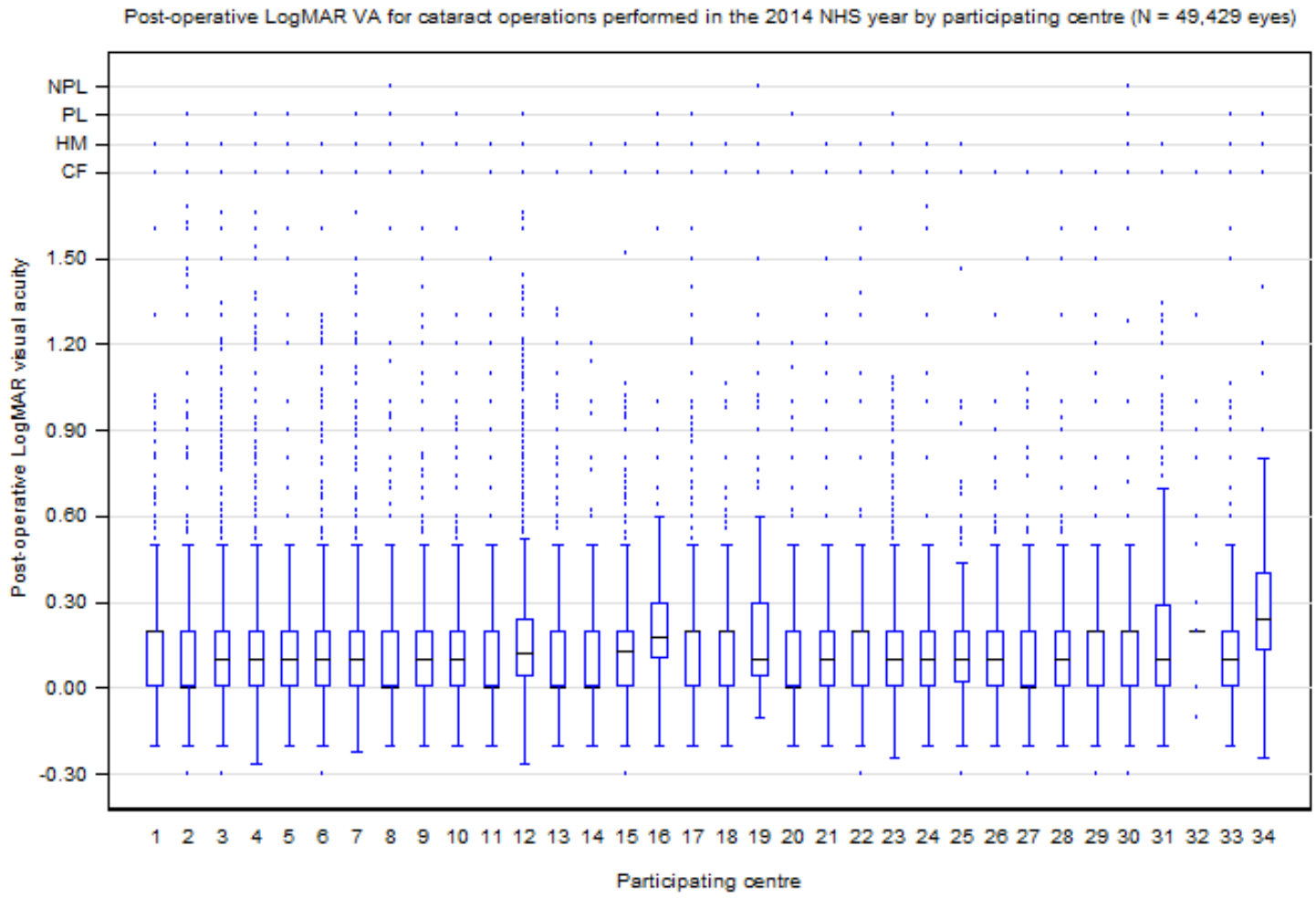

Figure 8

Box and whisker plots of VA change for cataract operations performed in the 2014-15 NHS year by participating centre.

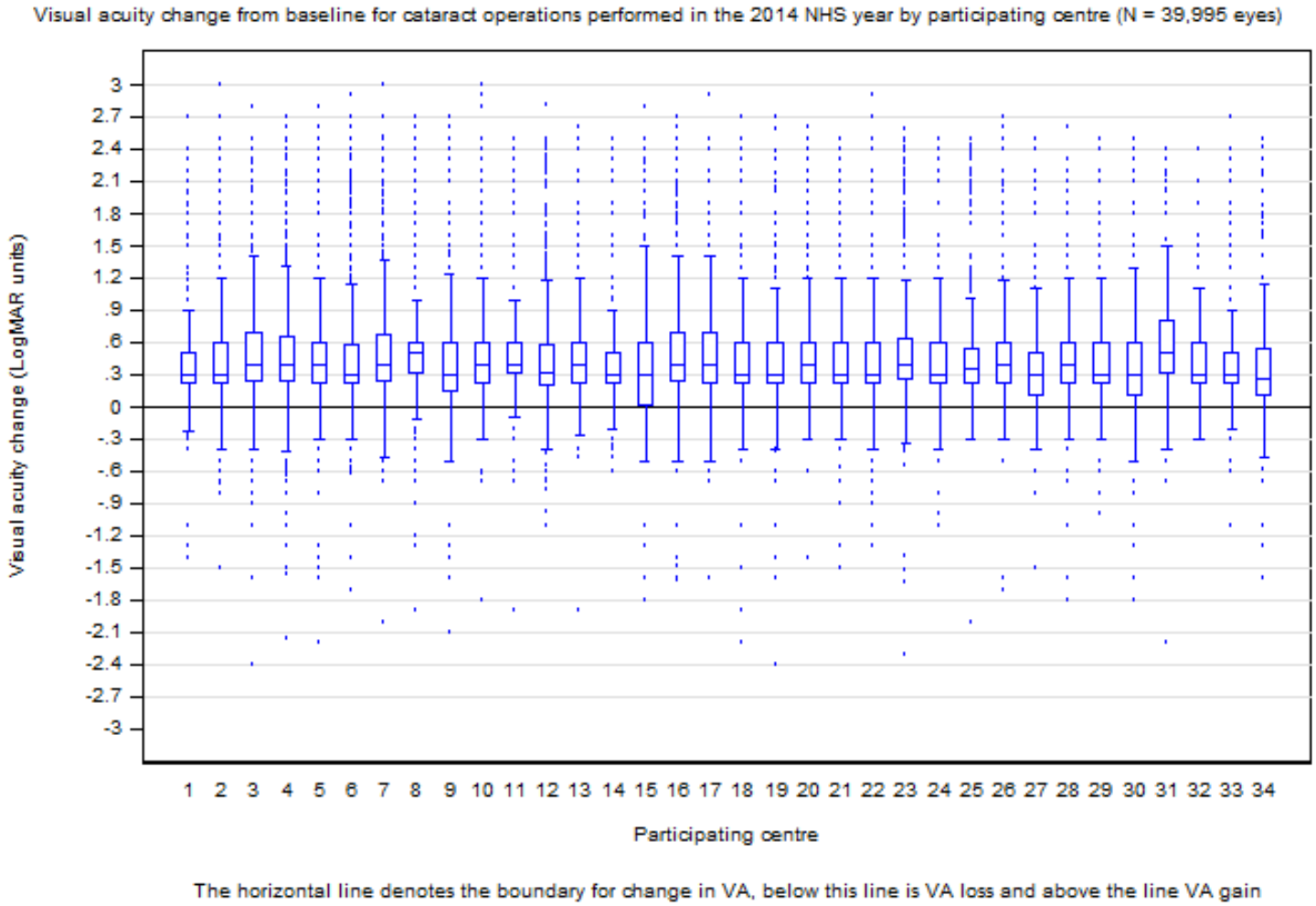

Figure 9

Unadjusted for case mix PCR funnel plot for consultant and independent non-consultant surgeons with data for the 2014-15 NHS year.

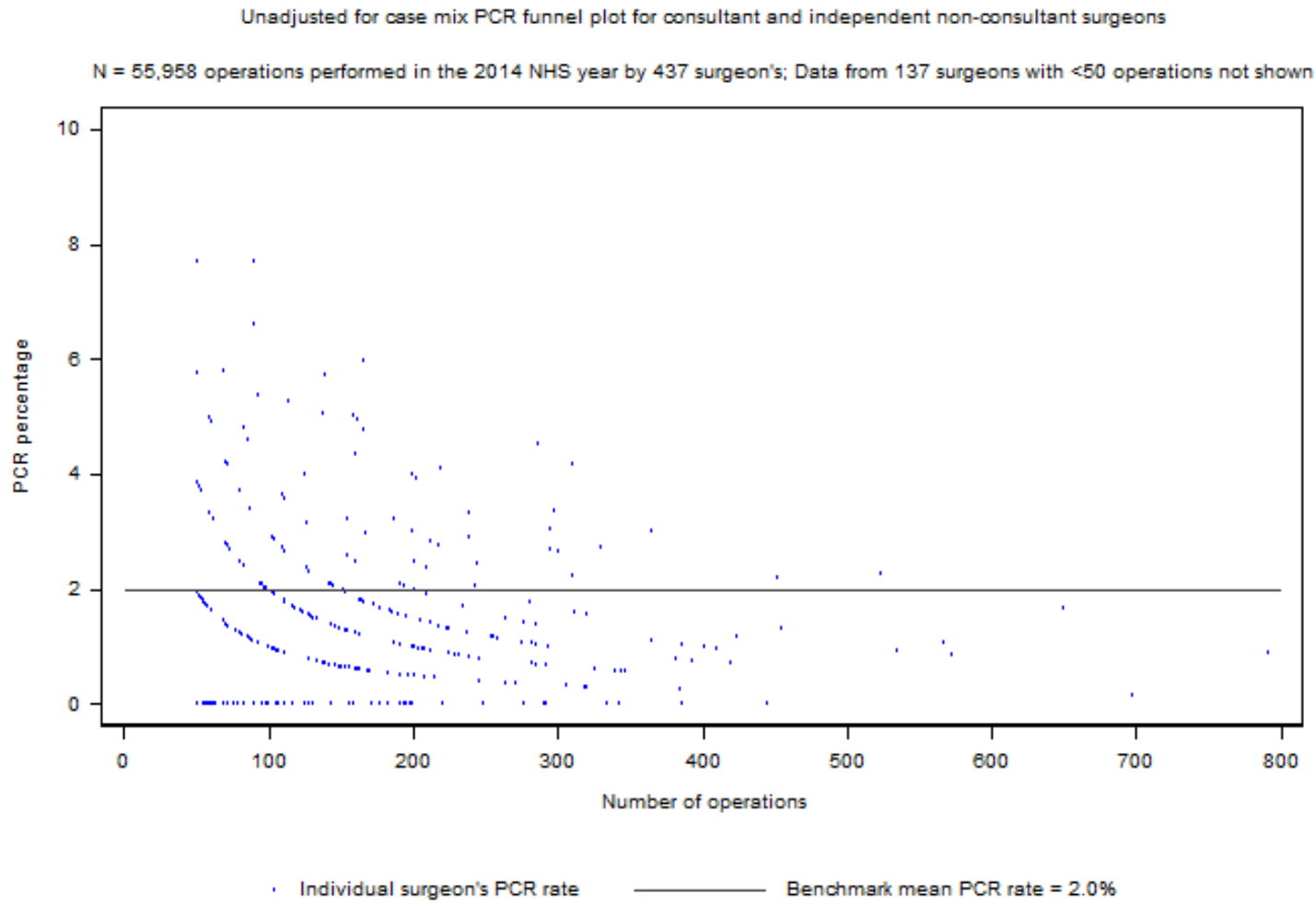

Figure 10

Adjusted for case mix PCR funnel plot for consultant and independent non-consultant surgeons with data for the 2014-15 NHS year.

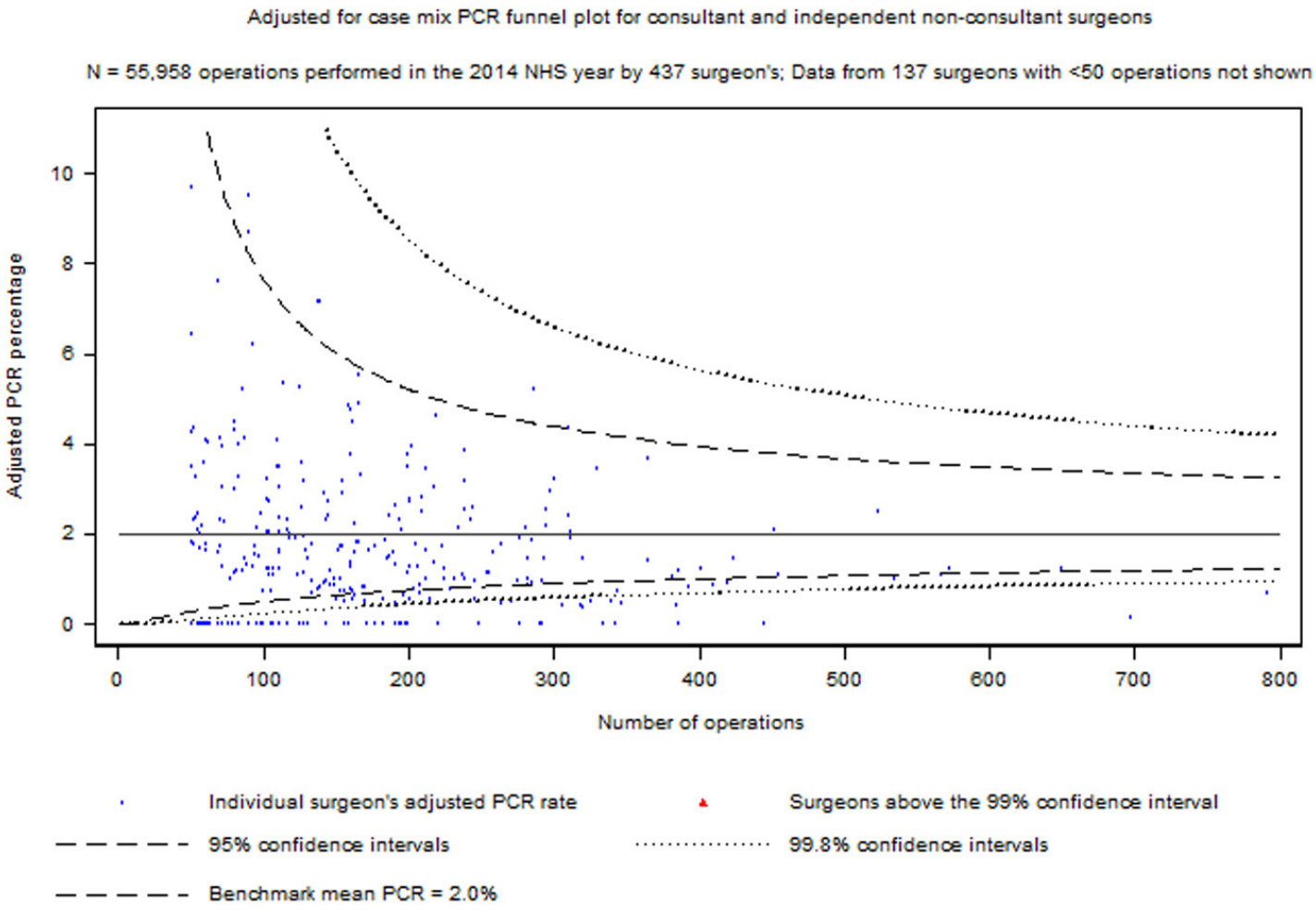

Figure 11

Unadjusted for case mix PCR funnel plot for participating centres, data for all surgeons with data for the 2014-15 NHS year.

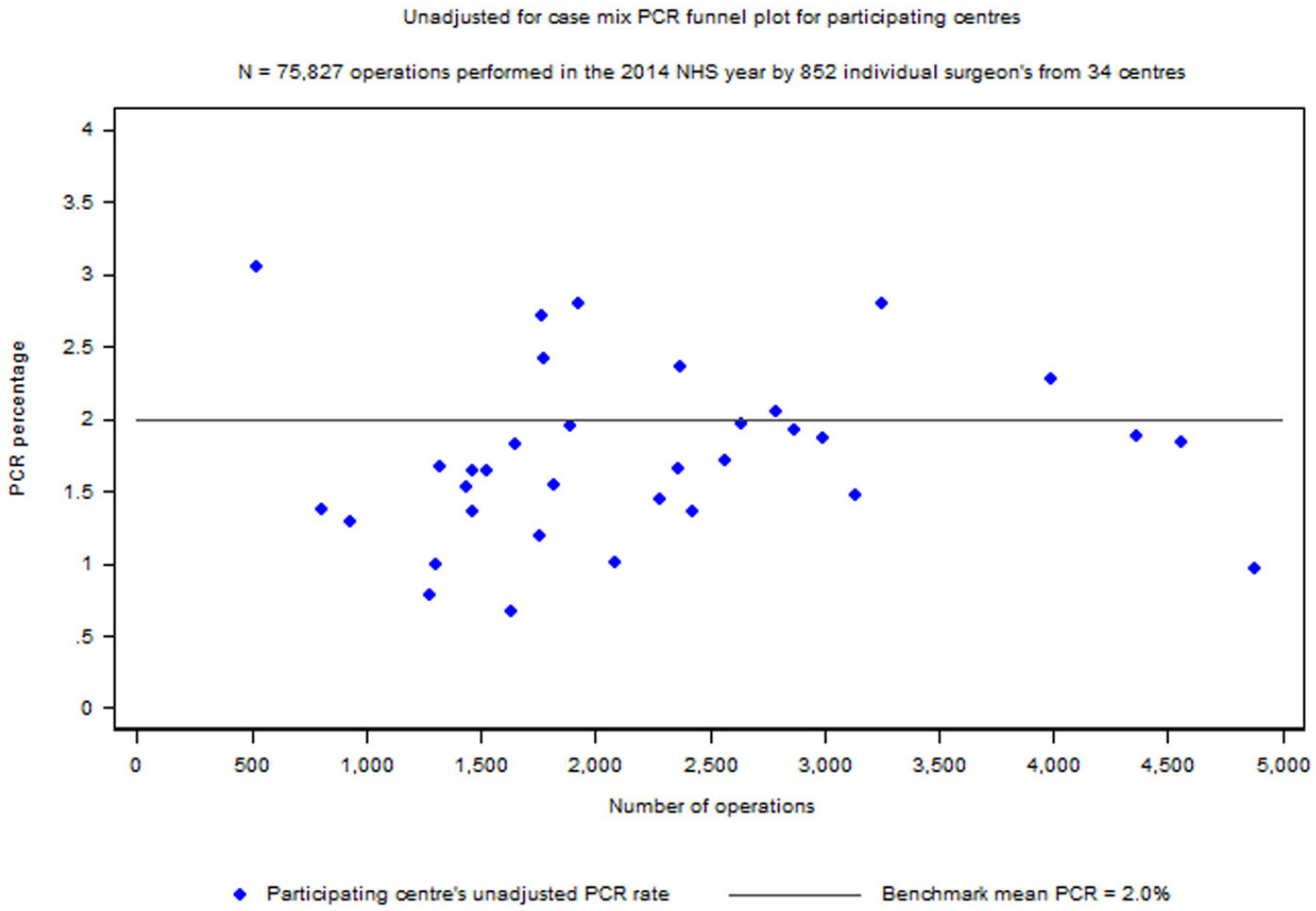

Figure 12

Adjusted for case mix PCR funnel plot for participating centres, data for all surgeons with data for the 2014-15 NHS year.

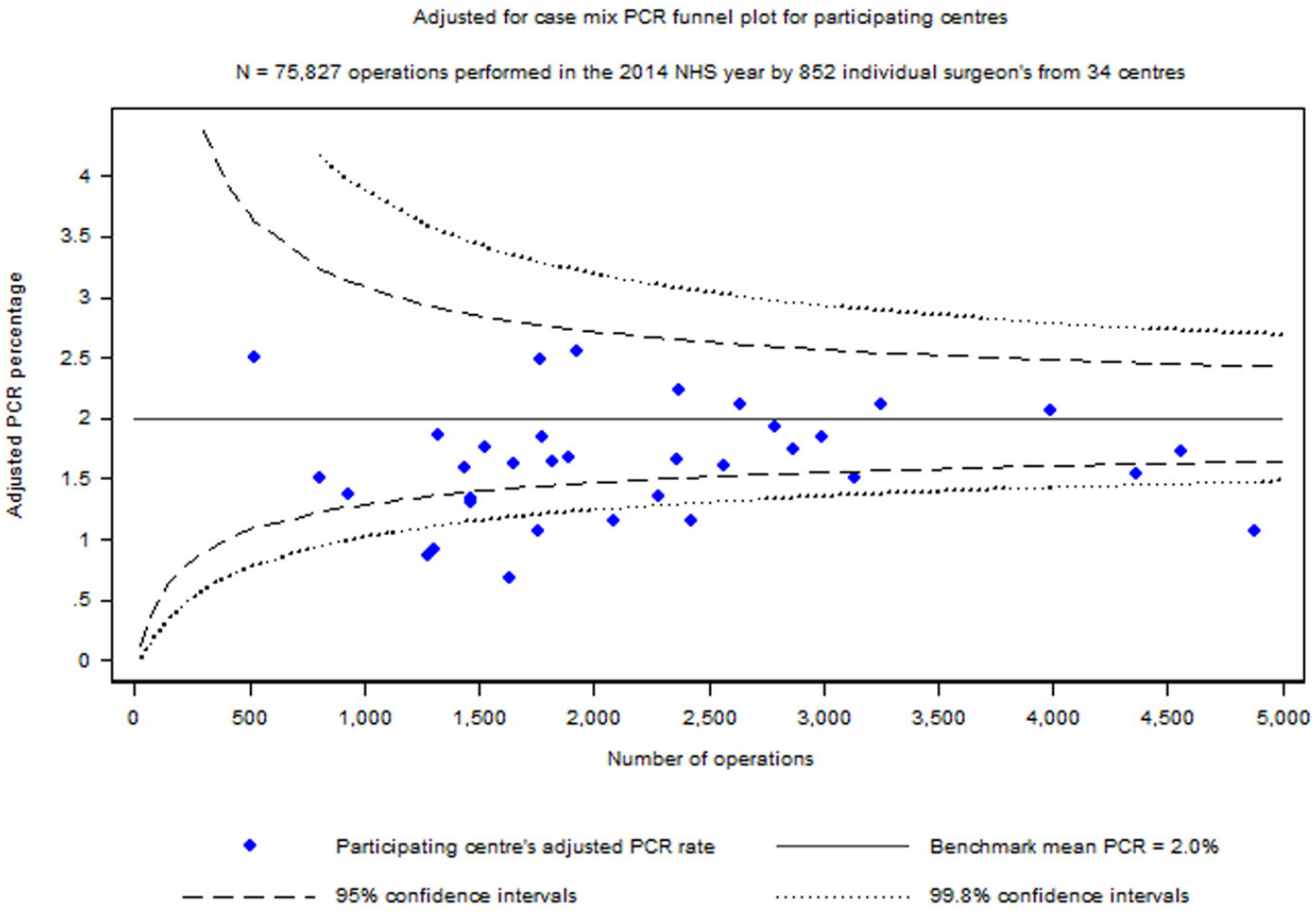

Figure 13

Unadjusted for case mix Visual Loss funnel plot for consultant and independent non-consultant surgeons with data for the 2014-15 NHS year.

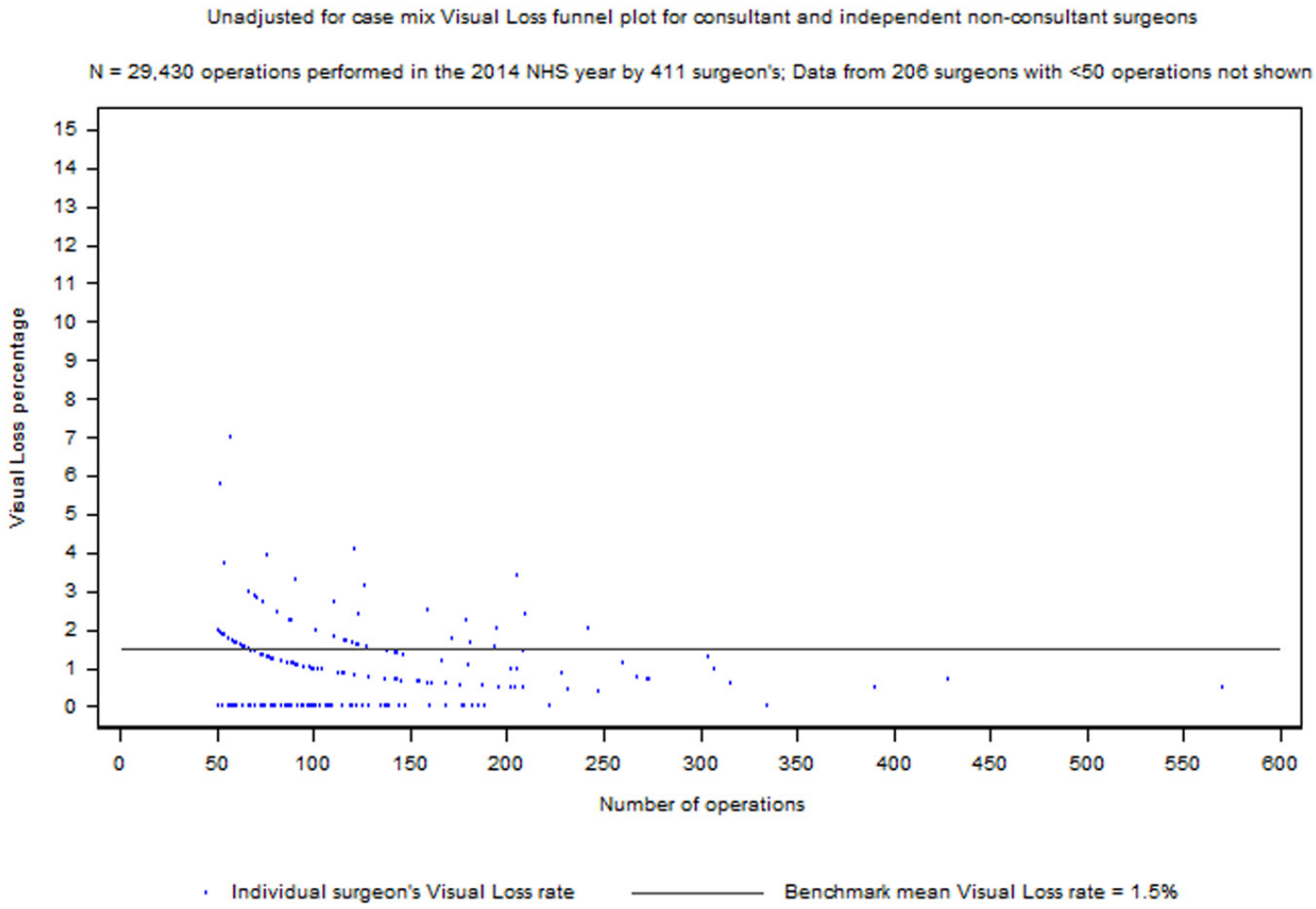

Figure 14

Adjusted for case mix Visual Loss funnel plot for consultant and independent non-consultant surgeons with data for the 2014-15 NHS year.

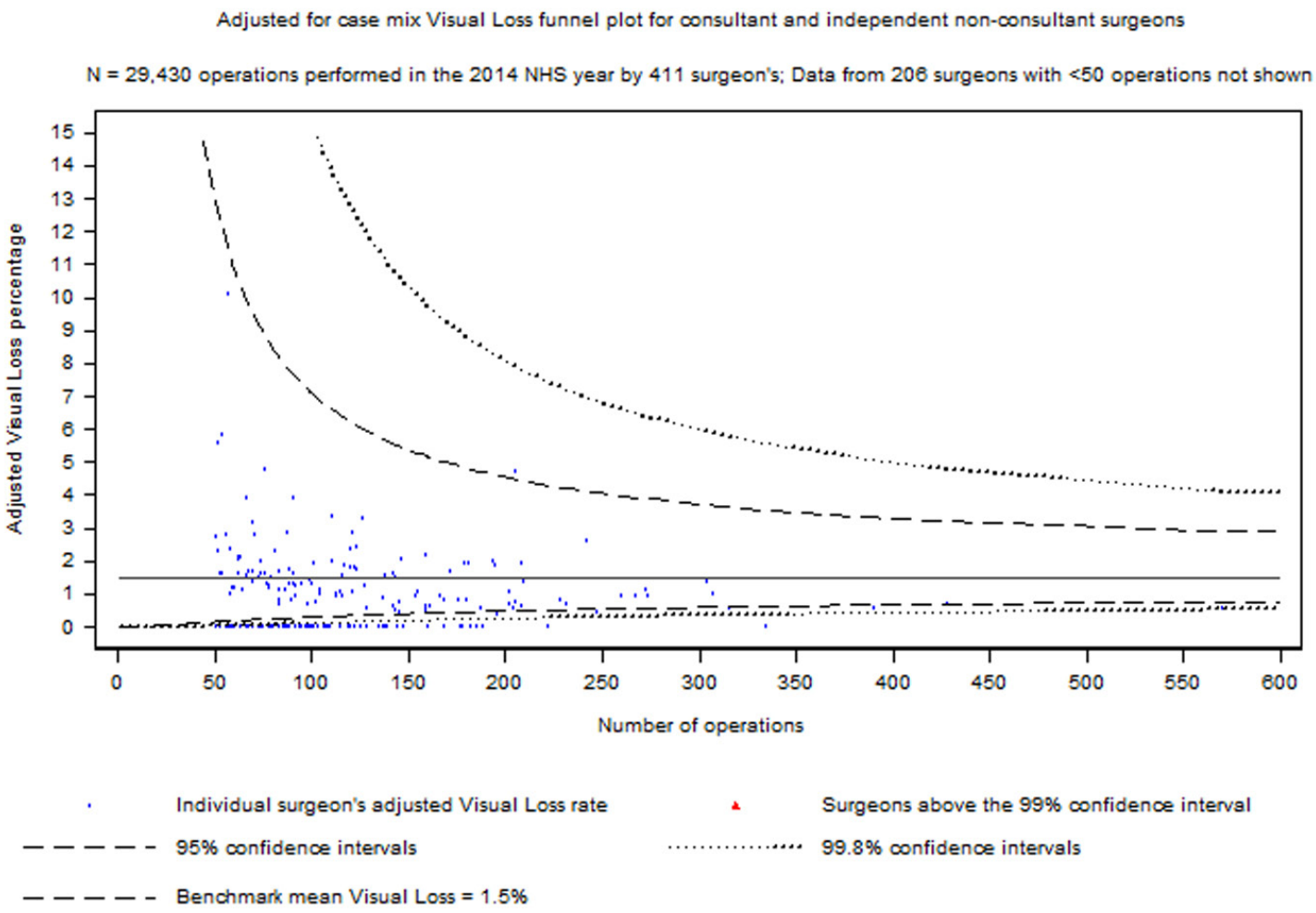

Figure 15

Unadjusted for case mix Visual Loss funnel plot for participating centres, data for all surgeons with data for the 2014-15 NHS year.

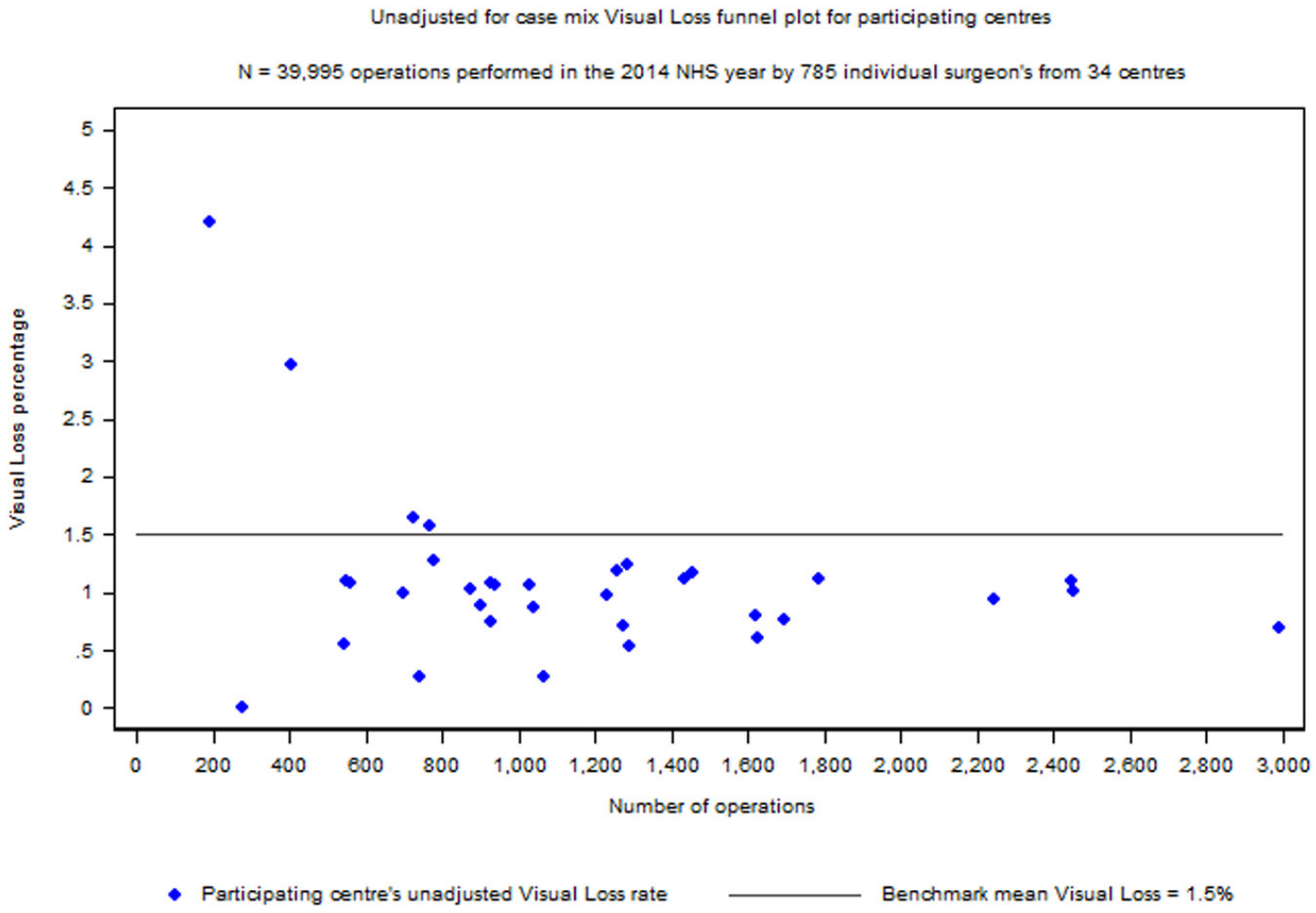

Figure 16

Adjusted for case mix Visual Loss funnel plot for participating centres, data for all surgeons with data for the 2014-15 NHS year.

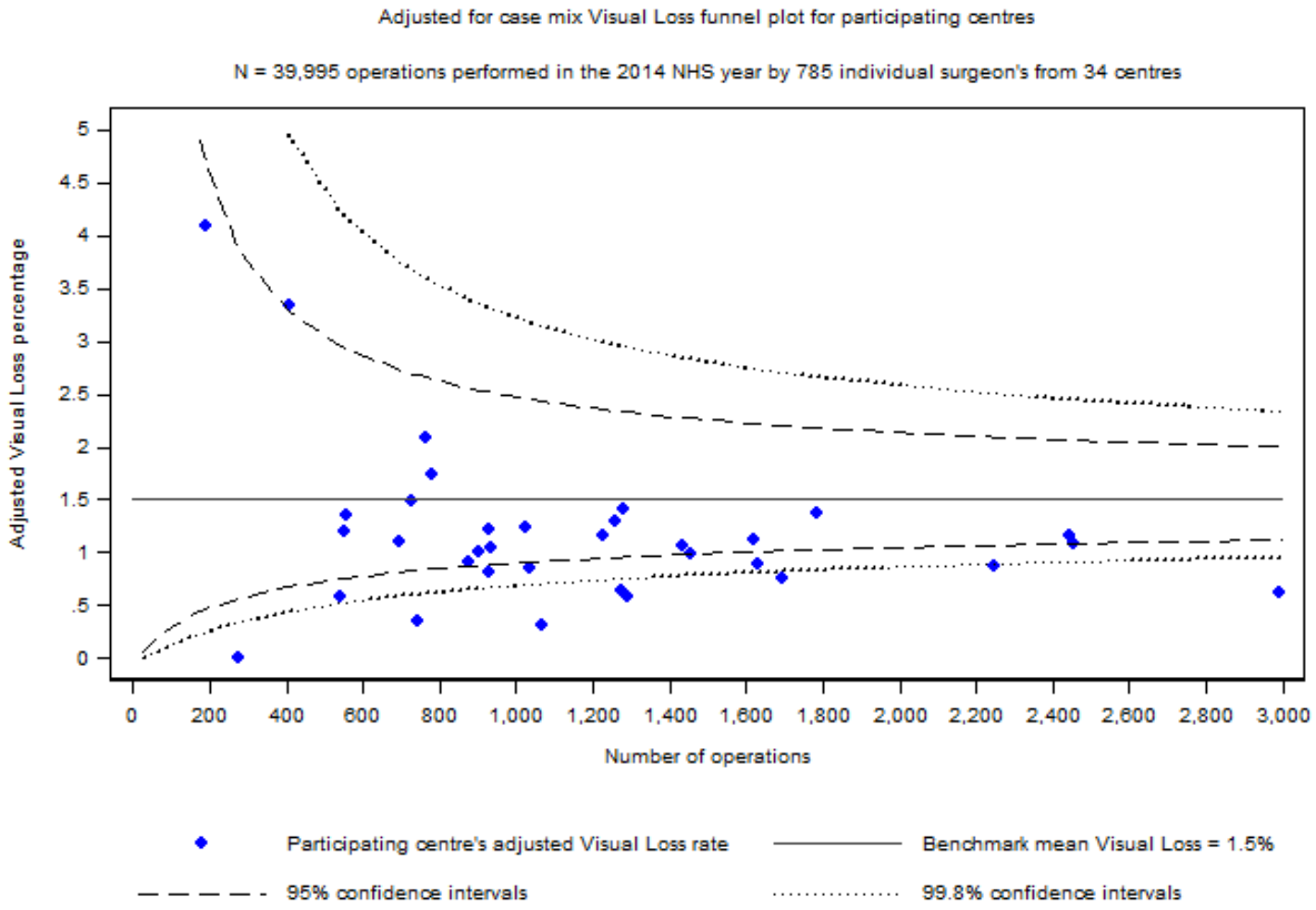

Table 1

Recorded Ocular co-pathologies for cataract operations performed in the 2014-15 NHS year by grade of surgeon.

Co-pathology, n (column %)	Consultant surgeons	Independent non-consultant surgeons	Experienced trainee surgeons	Inexperienced trainee surgeons	Total
Number of operations	46,801	9,157	17,245	2,624	75,827
Number of ocular co-pathologies					
0	25,390 (54.3)	5,809 (63.4)	10,017 (58.1)	1,750 (66.7)	42,966 (56.7)
1	16,127 (34.5)	2,712 (29.6)	5,749 (33.3)	716 (27.3)	25,304 (33.4)
2	4,212 (9.0)	534 (5.8)	1,230 (7.1)	137 (5.2)	6,113 (8.1)
≥3	1,072 (2.3)	102 (1.1)	249 (1.4)	21 (0.8)	1,444 (1.9)
Recorded ocular co-pathology					
Age related macular degeneration	5,113 (10.9)	921 (10.1)	1,835 (10.6)	302 (11.5)	8,171 (10.8)
Glaucoma	4,983 (10.6)	758 (8.3)	1,553 (9.0)	189 (7.2)	7,483 (9.9)
Diabetic retinopathy	3,175 (6.8)	485 (5.3)	1,327 (7.7)	164 (6.3)	5,151 (6.8)
Brunescent / White cataract	2,454 (5.2)	274 (3.0)	534 (3.1)	49 (1.9)	3,311 (4.4)
High myopia	2,278 (4.9)	348 (3.8)	563 (3.3)	55 (2.1)	3,244 (4.3)
Corneal pathology	1,788 (3.8)	227 (2.5)	556 (3.2)	29 (1.1)	2,600 (3.4)
Other macular pathology	1,008 (2.2)	153 (1.7)	416 (2.4)	63 (2.4)	1,640 (2.2)
Previous vitrectomy	908 (1.9)	107 (1.2)	456 (2.6)	27 (1.0)	1,498 (2.0)
Amblyopia	774 (1.7)	138 (1.5)	292 (1.7)	45 (1.7)	1,249 (1.6)
No fundal view / Vitreous opacities	738 (1.6)	75 (0.8)	176 (1.0)	10 (0.4)	999 (1.3)
Other retinal pathology	589 (1.3)	103 (1.1)	237 (1.4)	33 (1.3)	962 (1.3)
Pseudoexfoliation / Phacodenesis	689 (1.5)	81 (0.9)	126 (0.7)	7 (0.3)	903 (1.2)
Uveitis / Synaechiae	529 (1.1)	46 (0.5)	129 (0.7)	9 (0.3)	713 (0.9)
Previous trabeculectomy	311 (0.7)	19 (0.2)	83 (0.5)	5 (0.2)	418 (0.6)
Optic nerve / CNS disease	210 (0.4)	29 (0.3)	58 (0.3)	11 (0.4)	308 (0.4)
Inherited eye diseases	89 (0.2)	11 (0.1)	23 (0.1)	1 (<0.1)	124 (0.2)
Unspecified other	2,374 (5.1)	335 (3.7)	645 (3.7)	55 (2.1)	3,409 (4.5)

Table 2

Recorded operative procedures combined with phacoemulsification ± IOL for cataract operations performed in the 2014-15 NHS year.

Operative procedure, n (column %)	Consultant surgeons	Independent non-consultant surgeons	Experienced trainee surgeons	Inexperienced trainee surgeons	Total
Number of operations	46,801	9,157	17,245	2,624	75,827
Number of procedures					
1 (phacoemulsification ± IOL only)	44,997 (96.1)	8,991 (98.2)	16,735 (97.0)	2,541 (96.8)	73,264 (96.6)
2	1,675 (3.6)	163 (1.8)	475 (2.8)	83 (3.2)	2,396 (3.2)
≥3	129 (0.3)	3 (<0.1)	35 (0.2)	0 (0.0)	167 (0.2)
Additional operative procedures					
Anterior vitrectomy	333 (0.7)	82 (0.9)	211 (1.2)	39 (1.5)	665 (0.9)
Limbal relaxing incisions / OCCI	412 (0.9)	13 (0.1)	47 (0.3)	13 (0.5)	485 (0.6)
Intravitreal / sub-tenon injection	227 (0.5)	38 (0.4)	78 (0.5)	9 (0.3)	352 (0.5)
Insertion of Iris hooks*	194 (0.4)	20 (0.2)	55 (0.3)	11 (0.4)	280 (0.4)
Insertion of pupil ring expander*	195 (0.4)	0 (0.0)	16 (<0.1)	9 (0.3)	220 (0.3)
Capsular tension ring	158 (0.3)	7 (<0.1)	24 (0.1)	1 (<0.1)	190 (0.3)
Injection of bleb	71 (0.2)	0 (0.0)	28 (0.2)	1 (<0.1)	100 (0.1)
Synaechiolysis*	81 (0.2)	7 (<0.1)	7 (<0.1)	0 (0.0)	95 (0.1)
Sphincterotomy*	87 (0.2)	0 (0.0)	8 (<0.1)	0 (0.0)	95 (0.1)
Stretching of the Iris*	83 (0.2)	1 (<0.1)	7 (<0.1)	0 (0.0)	91 (0.1)
Pars plana vitrectomy	44 (<0.1)	1 (<0.1)	43 (0.2)	0 (0.0)	88 (0.1)
Other**	72 (0.2)	0 (0.0)	32 (0.2)	0 (0.0)	104 (0.1)

*All are Iris procedures and may be performed in combinations

**Other included the following operative procedures, (frequency); removal of retained lens fragments (16), vitreoretinal examination under anaesthetic (13), suture of cornea (12), IOL exchange (10), Peripheral iridectomy (10), capsulectomy (8), washout of anterior chamber of the eye (6), other specified operation on the iris (6), IOL removal (4), incision of cornea (4), secondary IOL (4), broad iridectomy (3), removal of suture from cornea (2), scleral fixed IOL (2), injection into anterior chamber (1), orbital floor injection (1), other conjunctiva operation (1), sub-conjunctival injection (1),

Table 3

Recorded intra-operative complications for cataract operations performed in the 2014-15 NHS year.

Intra-operative complications n (column %)	Consultant surgeons (N = 46,801)	Independent non-consultant surgeons (N = 9,157)	Experienced trainee surgeons (N = 17,245)	Inexperienced trainee surgeons (N = 2,624)	Total (N = 75,827)
Eyes with no complications	45,575 (97.4)	8,897 (97.2)	16,536 (95.9)	2,508 (95.6)	73,516 (97.0)
Eyes with ≥1 complication	1,226 (2.6)	260 (2.8)	709 (4.1)	116 (4.4)	2,311 (3.0)
Recorded intra-operative complications					
Posterior capsular rupture	705 (1.5)	149 (1.6)	410 (2.4)	70 (2.7)	1,334 (1.8)
Torn iris / damage from the phaco	104 (0.2)	20 (0.2)	44 (0.3)	10 (0.4)	178 (0.2)
Corneal epithelial abrasion	133 (0.3)	39 (0.4)	63 (0.4)	10 (0.4)	245 (0.3)
Endothelial damage / Descemet's tear	41 (<0.1)	7 (<0.1)	28 (0.2)	2 (<0.1)	78 (0.1)
Corneal oedema	50 (0.1)	3 (<0.1)	21 (0.1)	3 (0.1)	77 (0.1)
Phaco burn / wound problems	13 (<0.1)2 (<0.1)	17 (0.1)	3 (0.1)	35 (<0.1)	
Lens exchange required / other IOL problems	31 (<0.1)	2 (<0.1)	18 (0.1)	2 (<0.1)	53 (<0.1)
Hyphaema	33 (<0.1)	5 (<0.1)	11 (<0.1)	1 (<0.1)	50 (<0.1)
Choroidal / suprachoroidal haemorrhage	11 (<0.1)	2 (<0.1)	10 (<0.1)	3 (0.1)	26 (<0.1)
Iris trauma	8 (<0.1)	1 (<0.1)	4 (<0.1)	1 (<0.1)	14 (<0.1)
Iris prolapse	7 (<0.1)	0 (0.0)	1 (<0.1)	0 (0.0)	8 (<0.1)
Unspecified other	175 (0.4)	43 (0.5)	124 (0.7)	20 (0.8)	362 (0.5)

*Each operation can have more than one intra-operative complication recorded.

**The unspecified other included 1 vitreous haemorrhages and 11 instances when the operation was cancelled.

Table 4

Recorded post-operative complications for cataract operations performed in the 2014-15 NHS year.

Post-operative com plication, n (column %)	Consultant surgeons	Independent non-consultant surgeons	Experienced trainee surgeons	Inexperienced trainee surgeons	Total
Number of operations	36,389	6,676	13,468	2,015	58,548
Number of post-operative complications					
0	34,326 (94.3)	6,413 (96.0)	12,504 (92.8)	1,883 (93.4)	55,126 (94.2)
1	1,745 (4.8)	224 (3.4)	802 (6.0)	104 (5.2)	2,875 (4.9)
≥2	318 (0.9)	39 (0.6)	162 (1.2)	28 (1.4)	547 (0.9)
Recorded post-operative complication					
Post-operative uveitis	579 (1.6)	66 (1.0)	278 (2.1)	38 (1.9)	961 (1.6)
Corneal oedema / striae / Descemet's folds	479 (1.3)	59 (0.9)	238 (1.8)	32 (1.6)	808 (1.4)
Cystoid macular oedema	476 (1.3)	66 (1.0)	196 (1.5)	22 (1.1)	760 (1.3)
Raised IOP (>21 mmHg)	304 (0.8)	46 (0.7)	135 (1.0)	16 (0.8)	501 (0.9)
Posterior capsule opacification	62 (0.2)	5 (<0.1)	18 (0.1)	10 (0.5)	95 (0.2)
Retained soft lens matter	47 (0.1)	2 (<0.1)	26 (0.2)	6 (0.3)	81 (0.1)
Corneal decomposition	51 (0.1)	6 (<0.1)	17 (0.1)	5 (0.2)	79 (0.1)
Vitreous in the AC*	36 (<0.1)	8 (0.1)	20 (0.1)	3 (0.1)	67 (0.1)
Posterior capsule opacification – YAG indicated	33 (<0.1)	6 (<0.1)	16 (0.1)	3 (0.1)	58 (0.1)
IOL decentred	30 (<0.1)	4 (<0.1)	18 (0.1)	2 (0.1)	54 (<0.1)
Corneal epithelial staining	26 (<0.1)	0 (0.0)	22 (0.2)	3 (0.1)	51 (<0.1)
Vitreous to the section	23 (<0.1)	2 (<0.1)	10 (<0.1)	1 (<0.1)	36 (<0.1)
Other**	303 (0.8)	42 (0.6)	154 (1.1)	25 (1.2)	524 (0.9)

*These two post-operative complications indicate that PCR occurred.

** Other included the following post-operative complications, (frequency); iris to the wound (23), choroidal effusion / detachment (20), post-operative eyelid oedema (15), endophthalmitis (14), hypotony (13), leaking wound (Seidel +ve) (12), hyphaemia (11), diplopia (11), post-operative ptosis (8), vitreous haemorrhage (8), iris prolapse (7), retinal tear (5), post-operative eyelid bruising (4), progression of diabetic retinopathy (4), IOL in the vitreous cavity (2), suture induced corneal abscess (2), corneal epithelial defect (2), exposed suture (1), malignant glaucoma (1), pupil block (1).

Table 5

The percentage of eyes with various post-operative visual acuities by presenting visual acuity, ocular co-pathology, intra-operative complications and PCR.

	Post-operative LogMAR visual acuity				
Percentages are row % (Approximate Snellen)	**≤0.00 (6/6 or better)**	**≤0.18 (6/9 or better)**	**≤0.30 (6/12 or better)**	**≤0.60 (6/24 or better)**	**≤1.00 (6/60 or better)**
All eyes (N = 39,995)	40.3	57.0	88.6	95.8	98.4
Presenting LogMAR VA (Snellen)					
≤0.00 (N = 840)	78.3	85.4	98.6	99.6	99.8
≤0.18 (N = 1,398)	69.5	84.4	98.3	99.6	99.8
≤0.30 (N = 12,636)	51.3	66.4	96.9	99.4	99.8
≤0.60 (N = 27,796)	43.2	60.7	93.6	99.0	99.7
≤1.00 (N = 35,716)	41.6	58.7	91.0	97.7	99.5
Ocular co-pathology					
No (N = 22,573)	48.4	65.3	95.3	99.0	99.7
Yes (N = 17,422)	29.8	46.3	79.9	91.7	96.9
Intra-operative complications					
No (N = 38,944)	40.7	57.5	89.0	95.3	97.7
Yes (N = 1,051)	24.2	38.8	72.8	85.0	93.2
PCR					
No (N = 39,393)	40.6	57.4	88.9	96.0	98.6
Yes (N = 602)	20.9	34.1	68.8	81.1	91.4

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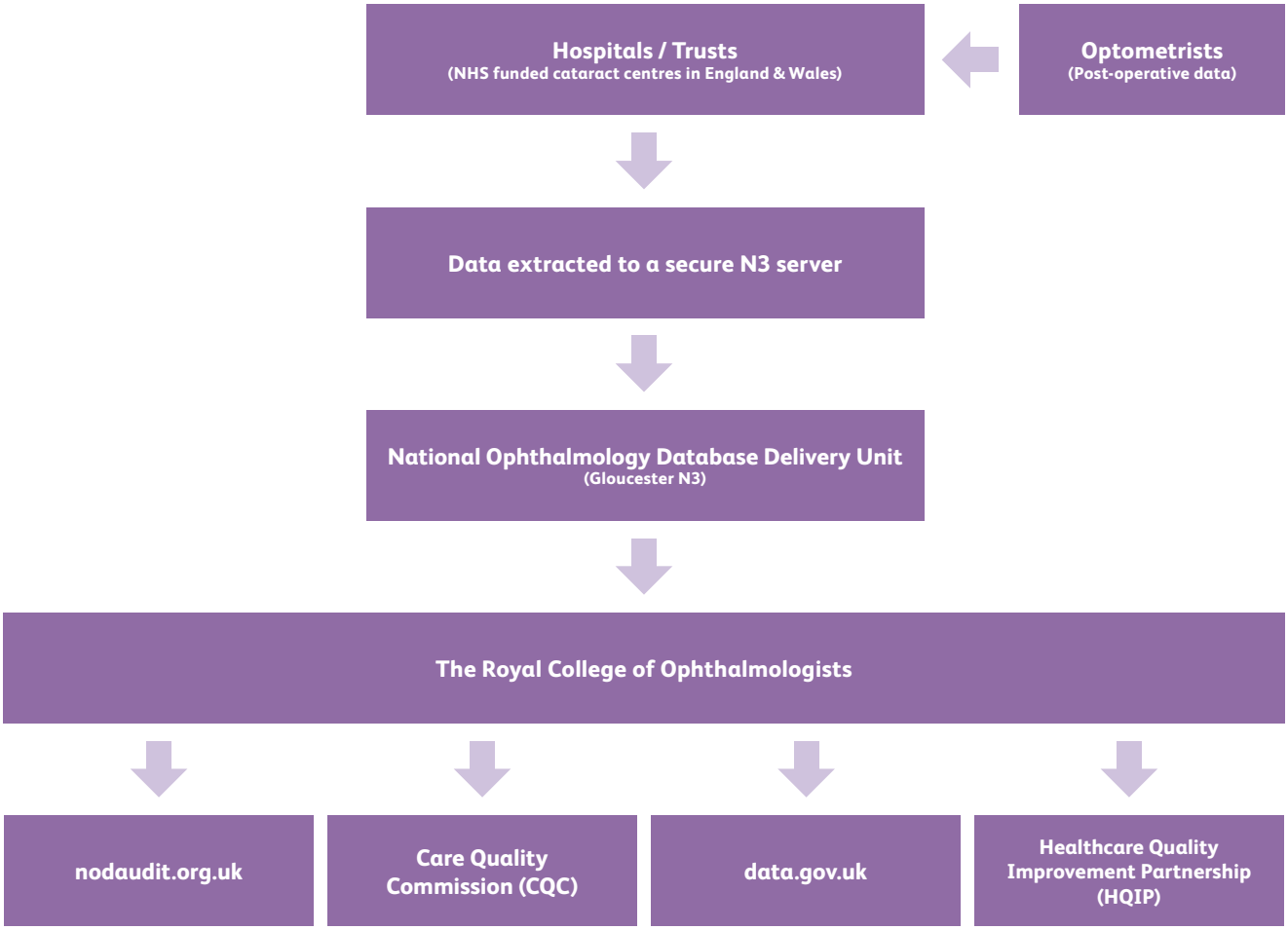
Appendix 1: Governance Structure

National Ophthalmology Database Audit Project Data Flow



Note: The optometrist's submission of post-operative data is part of the prospective cataract audit and this report does not include any data from this source.

Appendix 2: National Ophthalmology Database Audit Project Steering Group Membership

Name	Designation
Andrew Frost	Cataract Representative The Royal College of Ophthalmologists
Anthony King	Glaucoma Representative The Royal College of Ophthalmologists
Beth Barnes	Head of the Professional Standards Department The Royal College of Ophthalmologists
Cathy Yelf	Chief Executive Macular Society
Chris Rogers	Independent Statistician The University of Bristol
Clara Eaglen	Eye Health Campaigns Manager Royal National Institute of Blind People
David Parkins	President The College of Optometrists
David Yorston	Retinal Detachment Representative The Royal College of Ophthalmologists
Helen Doe	Ophthalmic Nurse and Support Groups Manager International Glaucoma Association
John Sparrow	Chairman Clinical Lead for RCOphth National Ophthalmology Database Audit
Kathy Evans	Chief Executive The Royal College of Ophthalmologists
Martin McKibbin	AMD Representative The Royal College of Ophthalmologists
Matt Broom	Lay Group Representative The Royal College of Ophthalmologists and Vision 2020 UK
Melanie Hingorani	Cataract Representative The Royal College of Ophthalmologists
Raghu Ram	Wales Representative The Royal College of Ophthalmologists
Wendy Newsom	The College of Optometrists Practicing as Lead Optometrist for Moorfields at Bedford

Appendix 3: Case Definitions

Eligible Cataract Surgery Criteria

- Operation performed in the 2014-15 NHS year
- Operation performed in an NHS hospital in England or Wales
- Operation performed in adults (aged 18 or above)
- Operation included a phacoemulsification procedure
- Operative data includes a surgeon identifier and valid surgeon grade
- Operation included a "cataract" indication for surgery (see the NOD audit website for details)
- Operation did not include certain operative procedures (see the NOD audit website for details)
- Operations that included a pars plana vitrectomy without any other vitreoretinal procedures

PCR - Posterior Capsule Rupture or Vitreous Prolapse or both

PCR was deemed to have occurred if any of the following intraoperative complications are recorded during surgery; Zonule rupture – vitreous loss, PC rupture ± vitreous loss, Vitreous to the section at end of surgery, Vitreous loss, Nuclear/ epinuclear fragment into vitreous, intra-ocular lens (IOL) into the vitreous, 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 previous or concurrent phacoemulsification procedure
- The operative procedure includes 'Removal of retained lens fragments' combined with a pars plana vitrectomy
- If either of 'vitreous to the section' or 'vitreous in the anterior chamber' were recorded within 8 weeks of cataract surgery, this includes the day of cataract surgery in the time frame
- If there is a record of a dropped nucleus operation with 90 days of cataract surgery, this includes the day of cataract surgery in the time frame

Visual Acuity (VA) criteria

Visual acuity measurements were extracted from the EMR on the LogMAR scale and numeric substitutions of 2.10, 2.40, 2.70 and 3.00 were used for the ability to count fingers (CF), the ability to distinguish hand movements (HM), perception of light (PL) and no perception of light (NPL) respectively.

Pre-operative VA was defined as the better of corrected distance visual acuity (CDVA) and the uncorrected distance visual acuity (UDVA) recorded within a 90 day 'time window' prior to surgery. Where there are multiple occasions of measurement the VA measurement closest to the date of surgery is used and measurements recorded on the same day as cataract surgery are considered as pre-operative measurements.

Post-operative VA was defined as the best measurement of CDVA or UDVA or pinhole visual acuity (PHVA) within the 'time window' of between 14 days and four months of cataract surgery (inclusive).

Visual loss was defined as a loss of ≥0.30 LogMAR (doubling or worse of the visual angle) between the pre-operative and post-operative VA measurements.

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