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1. INTRODUCTION

1.1 Background

Blindness is defined by the World Health Organization (WHO) as a visual acuity of less than 3/60, or corresponding visual field loss to less than 10 degrees, in the better eye with best possible correction. In other words, seeing at 3 meters what a person with normal vision sees at 60 meters. Low vision is defined as a visual acuity less than 6/18 but better than 3/60 with best possible correction. [1, 2] An estimated 246 million people have low vision and 39 million are blind worldwide. Of those, 10 million blind people and 79 million with poor vision live in the Western Pacific Region. Ninety percent (90%) of all blindness is found in developing countries including the islands of the South Pacific. Eighty percent (80%) of visual impairment can be prevented or treated.[3, 4]

Cataract is the leading cause of treatable blindness worldwide, which is also true for the Western Pacific Region. A cataract is the clouding of the crystalline lens which causes gradual visual loss. Cataracts can be associated with ocular and systemic diseases, congenital abnormalities, trauma and certain medications though the most common cause is a natural process that is age related. Cataract surgery is relatively simple operation which replaces the clouded lens with a plastic one. The surgery is highly effective, restoring visual function, improving quality of life for patients, yet many people in the low and middle-income countries do not have access to the surgery.[4, 5]

Uncorrected refractive errors, diabetic retinopathy and glaucoma are other main causes of blindness in the Western Pacific Region. For these diseases, early diagnosis and appropriate management is crucial to avoid irreversible vision loss. All patients accessing their community health system should have access to important information on how to avoid blindness and to a quality referral system that can detect people with potentially blinding eye disease.[4]

Estimated rates of blindness in Pacific island countries range from 5000 per million in Papua New Guinea to 16,220 per million in the Cook Islands. Low vision may be as high as 18,000 per million in Tonga. Cataract and diabetic retinopathy have been listed as the main causes of vision impairment in the Pacific. Other causes of visual impairment include trauma, corneal disease, age related macular degeneration(AMD), trachoma and glaucoma.[6]

There are different techniques of performing cataract surgery. In the developed world phacoemulsification through a 2-3mm wound, with the insertion of a foldable intraocular lens (IOL) is the standard. Prior to this, an extracapsular cataract surgery (ECCE), through an 8-10mm wound requiring sutures and insertion of an intraocular lens was the standard. ECCE's are still performed in many parts of the developing world. [7, 8] Sutureless manual small incision cataract surgery (MSICS) was a modification of ECCE, developed for the developing world especially with high volume surgery as a cheaper alternative to phacoemulsification with comparable surgical outcomes. It is done through a 6 – 8mm self-sealing scleral wound. Intracapsular cataract surgery (ICCE) is when the lens with an intact capsular bag is extracted. This is no longer routinely practiced being replaced by

ECCEs. But it is conducted on a few patients, such as those with an anteriorly dislocated crystalline lens as may happen in trauma, through an ECCE or SICS wound.[9-12]
VISION 2020 is a joint program of the World Health Organization (WHO) and the International Agency for the Prevention of Blindness (IAPB) with an international membership of NGOs, professional associations, eye care institutions and corporations. This global initiative aims to eliminate avoidable blindness; blindness which could be either treated or prevented by known, cost-effective means, including cataracts, which is treated with cataract surgery. [13]

The Pacific Eye Institute (PEI), situated in Suva, Fiji is an initiative of the Fred Hollows Foundation New Zealand (FHFNZ) whose mission is "to overcome avoidable blindness in the Pacific. To achieve this we will collaborate with like-minded partners." One of the PEI's goal is "To meet the eye health needs in Fiji and the region, the Pacific Eye Institute(PEI) will train appropriate numbers of Fijian and Pacific people to be eye health specialists." [14] As a training institute it encourages the reporting of the surgical outcomes especially of trainees as a means of monitoring and improving the quality of surgery conducted, thus ensuring the highest quality of eye care services.

Prospective monitoring of cataract surgical outcomes has demonstrated an improvement in visual outcomes and appears to be associated with a change in the surgeons' attitudes, appropriately addressing factors found to cause poor visual outcomes.[15]

1.2 Statement of the Problem

The quality and patient experience of surgery are important determinants of the uptake and measures of surgical performance. Competent surgeons are a key component in delivery of high quality services. Cataract surgery of inacceptable quality is a serious practical obstacle in some regions.[16-18]

Knowing the quantity of cataract surgery is not an indicator of the quality of cataract surgery. How does a surgeon know they are getting the best possible outcomes? Cataract surgery outcome monitoring is a tool to qualitatively assess the results of cataract surgery. Monitoring surgical outcomes helps improve quality of cataract surgery over time and is increasingly required by donors as an indicator for continued support. As continued professional development, monitoring identifies the causes of poor visual outcomes addressing these factors leads to future improved surgical outcomes. The following standards for Cataract surgical outcomes have been established by WHO.[17, 19-21]

	Post-operative acuity	Final uncorrected visual acuity	Best corrected visual acuity
Good	≥ 6/18	>80%	>90%
Borderline	< 6/18 – 6/60	<15%	<5%
Poor	< 6/60	<5%	<5%

Surgical Complications		
Posterior Capsular Rupture (PCR) No vitreous loss	**Endophthalmitis**	**Vitreous Loss**
<5%	<1%	<5%

1.3 Rationale for this Study

Having commenced my postgraduate diploma in Ophthalmology in 2008, continuing to Masters of Medicine in 2011 to the present, I currently know the number of cataract surgeries I have performed yet my cataract surgical outcomes as compared against the established WHO standards, are not known. As a trainee it is vital to monitor cataract surgical outcomes and thus identify causes of poor visual outcomes. Addressing these factors may improve future outcomes and also developing a lifelong habit of monitoring as a competent cataract surgeon. This then provides a benchmark of the development of a core competency during a training program.

2. LITERATURE REVIEW

Comparisons of various cataract surgeries and their surgical outcomes have been published. An audit of cataract surgical outcomes comparing ECCE with SICS reported 95.3% follow up rate at six weeks postoperatively with 37.3% of the ECCE group 47.9% of MSICS group having an uncorrected visual acuity of 6/18 or better after 6 weeks of follow up. 86.7% of ECCE group and 89.8% of MSICS group had corrected postoperative vision of 6/18 or better. Thus SICS gives better uncorrected visual outcomes compared to ECCE.[22] Studies have found that surgically induced astigmatism in SICS was significantly lower in temporal incision compared with as high as 48.28% more astigmatism in the superior incision.[23, 24]

Cataract surgical outcomes have been reported from many countries with varied results against WHO standards. Ruit S et al. found phacoemulsification and SICS both achieved excellent surgical outcomes with 85% and 89% of patients having uncorrected visual acuities (UCVA) of 6/18 or better at six months postoperative respectively. This improved to 98% of patients having best corrected visual acuities (BCVA) of 6/18 or better for both surgical techniques at six months postoperatively. Both surgeries yielded low complication rates while SICS had a shorter surgical time ($P<0.0001$), was less expensive and was less technology dependent than phacoemulsification. Thus concluding that SICS be recommended for the treatment of advances cataracts in the developing world.[11, 16, 25]

A population-based study in Nepal reported uncorrected and best corrected visual acuities of ≥ 6/18 in 54.4% and 72.4% respectively. After best correction of vision retinal disease (35.5%), surgical complications (27.4%) and posterior capsular opacifications (14.5%) proved to be the principle causes of visual impairment. To improve cataract surgical outcomes, the study concluded that correction of refractive errors, preoperative screening of coexisting ocular pathology, reduction in surgical complications and improved follow up of patient were priority.[26]

Quality assessment of cataract surgical outcomes in the developing world is difficult due to the poor postoperative follow-up. Rates of follow-up of postoperative cataract surgeries range widely from 27% in China to 93% in Latin America. Considering barriers to postoperative care studies suggest financial incentives, reminders and preoperative counselling about the importance of follow up visits as improvements in postoperative follow up.[18, 27, 28]

Little research has been conducted regarding practical, effective approaches to the accurate assessment of cataract visual outcomes in developing world where there is poor follow up.
In a multicentre study spanning 10 countries, Nathan Congdon et al assessed the validity of early postoperative visual assessment (3 or less days postoperative) as a valid a valid measure of the final overall quality of surgery in settings where follow up is poor. They reported that early postoperative visual outcomes closely correlated with the final vision assessed 40 or more days postoperatively

(Spearman's *rs*=0·74, p<0·0001). Additionally, visual outcomes assessed at 40 days or more postoperatively were representative of the overall final outcomes (*rs*=0·86, p<0·0001). This is a significant piece of evidence considering quality of cataract surgical training programmes depend on the accurate assessment of postoperative visual outcomes. [17, 18]

Haripriya A. reported a decrease in intraoperative cataract surgical complications with greater surgical experience. Combined phacoemulsification and SICS complication rates were 0.79% for staff surgeons, 1.19% for fellows, 2.06% for residents and 5% for visiting trainees. He also reported a higher complication rate for phacoemulsification (4.8%) compared with SICS (1.46%), ($P < .001$) among trainees, thus recommending SICS as the procedure of choice in training.[29] Huang W and colleagues reported uncorrected visual acuities 6/18 or better in 74.7% and <6/60 in 16.1% of cataract surgeries performed by trainees in rural China. 86.8% had pinhole visual acuity 6/18 and 10.2% had pinhole visual acuity less than 6/60. The main causes of impaired postoperative vision were uncorrected refractive errors and comorbid ocular diseases including glaucoma, optic atrophy, vitreous haemorrhage and retinal detachment. Among suggestions for improving the visual outcomes are refractive services and more accurate calculations of the intraocular lens calculations.[19]

Within the Pacific little research has been conducted to monitor cataract surgical outcomes. An audit of 309 cataract surgeries performed in Samoa in 2008 reported a 50% rate of follow up at 4 – 11 weeks postoperatively and only 13% (41 eyes) at 12+weeks. Of the patients who returned at 12+weeks follow up70.7% eyes had good outcome (VA 6/6-6/18); 8 (19.5%) eyes had borderline outcome (VA 6/18-6/60); 4 (9.8%) eyes had poor outcome. Pre-existing ocular pathology, particularly ocular trauma and diabetic retinopathy, proved to be the main causes of poor visual outcomes. Refractive errors did not seem to be a significant contributor to poor visual outcomes.[30]

An evaluation of the first 5 years of the Vanuatu National Eye Health program reported visual outcomes exceeding WHO recommended minimum standards, with presenting vision of 6/18 or better in 90.6% of cases and 94.4% attaining this with pinhole, at 12 weeks or later. Only 1.3% had acuity worse than 6/60.[31]

A cataract surgical audit in Papuan New Guinea found intraoperative complications, particularly vitreous loss and retained lens matter, more common in trainees than consultants, though this was not statistically significant. Only 6.3% had a visual acuity of 6/18 or better while 54% had visual acuities worse than 6/60. Only 18% of patients returned for follow up at 12+weeks post operatively. Of these, 41.5% of eyes had 6/18 or better presenting vision improving to 80.5% with best correction, 80.5%.[32]

Cataract and diabetic retinopathy are the main causes of visual impairment in the Pacific island countries. Pacific island countries are among the highest prevalence of diabetes in the world.[33] A recent population based survey reported 27.2% of known diabetics and 4.2% of newly diagnosed diabetics in Fiji have retinopathy. 80.6% of self-reported diabetics claimed regular general diabetes check-ups, yet only 36.5% recalled previous dilated ocular examination. There is some evidence of insufficient management of diabetes and its ocular complications.[34, 35]

2.1 OBJECTIVES

For all consecutive cataract surgeries performed by the principle researcher while a student at the Pacific Eye Institute in 2008 and from 2011 to August 2013, the objectives of this audit are:

1. To measure visual outcomes of cataract surgery, comparing this to the WHO standards
2. To document the surgical complication rate
3. To document the reasons for borderline and poor visual outcomes
4. To provide feedback from this audit that may improve visual outcomes of cataract surgery
5. To make the results of the audit accessible as a benchmark for the surgical learning curve of a trainee ophthalmologist in the developing world

3. METHODOLOGY

3.1 Study type, variables, and data collection techniques

This is a retrospective surgical audit of consecutive cataract surgeries performed by the principle researcher while a student at the Pacific Eye Institute, Suva, Fiji in 2008 and from 2011 to August 2013.

Cataract surgeries performed by the principle researcher will be identified by the researchers' surgical logbook and the operating theatre (OT) register. Patients will be de-identified by the national hospital number (NHN). Cataract surgeries conducted on outreach to other sites in Fiji and the Pacific were de-identified by removing their names.

Patient ID and demographic data, whether they are diabetic, type of operation (ECCE, SICS, ICCE), IOL type (PC, AC, none), preoperative presenting vision, coexisting ocular disease, days to final postop, final postoperative uncorrected vision, final best corrected vision, reasons for final uncorrected borderline and poor vision and surgical complications will be collected from the patients' folders and recorded in an excel spread sheet, the "Cataract Monitoring Tally Sheet."[20, 21] (Annex 1)

The main outcome measure is the final postoperative uncorrected and best corrected visual acuities. Patients' visual acuities are measured by nurses using a Log mar/Snellen's Chart from a distance of 3 meters with the occlusion of the eye that is not being examined. The visual acuity is measured at every visit to the eye department and recorded in the patients' folders.

Failing to return for the postoperative visit at one month, the last postoperative visual acuity measured will be recorded, whether it is at day one or a week postoperatively. Congdon N et al report that early postoperative visual acuity, measured within 3 days after surgery, is closely correlated with vision assessed at final follow-up visits (Spearman's *rs*=0·74, p<0·0001).[17]

The WHO standards for cataract surgical outcomes are stated in the table below. Visual acuities will be classified according to this standard.[20, 36]

	Post-operative acuity	**Uncorrected visual acuity (UCVA)**	**Best corrected visual acuity (BCVA)**
Good	≥ 6/18	>80%	>90%
Borderline	< 6/18 – 6/60	<15%	<5%
Poor	< 6/60	<5%	<5%

Surgical Complications		
Posterior Capsular Rupture (PCR) No vitreous loss	**Endophthalmitis**	**Vitreous Loss**
<5%	<1%	<5%

Final uncorrected vision is defined as the presenting visual acuity without refraction and the best corrected vision is that aided by refraction (or pinhole).

The reasons for postoperative borderline and poor vision will be classified as preexisting ocular pathology, surgery, refraction and postoperative complication. Preexisting ocular pathology are patient related concurrent factors affecting vision, "surgery" indicates intraoperative or immediate postoperative complications, and "refraction" indicates an inadequate optical correction which may include astigmatism or the insertion of an incorrect IOL power. "Postoperative" complication refers to late complication or sequelae.[20]

Complications of cataract surgery of particular interest in this audit, for which WHO has standards, include posterior capsular rupture (PCR), vitreous loss and endophthalmitis. A PCR is a breach in the posterior capsule with an intact vitreous face, without vitreous loss. Vitreous loss is a PCR accompanied by the loss of vitreous requiring an anterior vitrectomy. Endophthalmitis is a severe inflammation associated with pain and marked vision loss.

Diabetic retinopathy was classified according to the Diabetes Retinal Screening, Grading and Management Guidelines for use in Pacific Island Nations. Sight threatening diabetic retinopathy (STDR) is classified M3, M4, R4 and R5 according to the guidelines. M3 is the presence of exudates or retinal thickening within 1DD of the center of the macula without involvement of the fovea and with no reduction in visual acuity. M4 is the presence of exudates and/or retinal thickening involving the fovea with accompanied vision loss. R4 is presence of one or more of definite intraretinal microvascular abmormalities (IRMA), two quadrants or more of venous beading and four quadrants of blot or larger haemorrhages. R5 signifies proliferative diabetic retinopathy which is characterized by the growth of abnormal new vessels and then fibrovascular proliferation on the retinal surface.[37]

3.2 Sampling

This retrospective surgical audit included all consecutive cataract surgeries performed by the principle researcher while studying at the Pacific Eye Institute, Suva, in 2008 and from 2011 to 2013. Cataracts in paediatric patients are managed differently from adults, thus patients less than 20 years of age and patients who the files are missing thus unable to extract data will be excluded from the audit.[20]Patients whose data were missing or incomplete thus did not include the main outcome measure, the postoperative visual acuity, were excluded from the study.

3.3 Data collection

Patients were identified from the operating theatre registry and the principle researchers' surgical logbook. Their outpatient files were retrieved with the help of the eye department clerk and de-identified using their National Hospital Number (NHN). Data were be collected from the patients' outpatient folders and entered into the Microsoft Excel 2010 spreadsheet, the "Cataract Monitoring Tally Sheet." This will include, demographic data, type of operation (ECCE, SICS, ICCE), IOL type (PC, AC, none), preoperative presenting vision, coexisting ocular disease, days to final postop, final postoperative uncorrected vision, final best corrected vision, reasons for final uncorrected borderline and poor vision and surgical complications. (Annex)

3.4 Data processing and analysis

The following will be analyzed using Excel 2010:

1. Patient Demography – Age, gender, ethnicity.
2. Proportion of known ocular pathology in operated eye.
3. Visual acuity in the operated eye pre-operatively.
4. Type of cataract surgery.
5. Type of intraocular lens (IOL) implanted.
6. Percentage of final uncorrected good, borderline or poor visual outcome post-operatively.
7. Percentage of best corrected good, borderline or poor visual outcome post-operatively.
8. Percentage of good, borderline and poor visual outcome by type of surgery.
9. Percentage of good, borderline and poor visual outcome by place of surgery
10. Cause of uncorrected and best corrected poor outcome postoperatively.
11. Causes of uncorrected and best corrected borderline outcome postoperatively.
12. Operative complications and type of complications(PCR, endophthalmitis, vitreous loss)
13. Operative complications by place of surgery.
14. Operative complications by additional ocular pathology.
15. Operative complications by type of surgery.
16. Visual outcomes of complicated surgeries.

The odds ratio, 95% confidence intervals and Fisher exact P values were calculated using the statcalc 2 x 2tables in Epi Info 7.

3.5 Ethical considerations

A proposal was submitted to the Research and Ethics Committee at the Fiji National University for approval of this research.

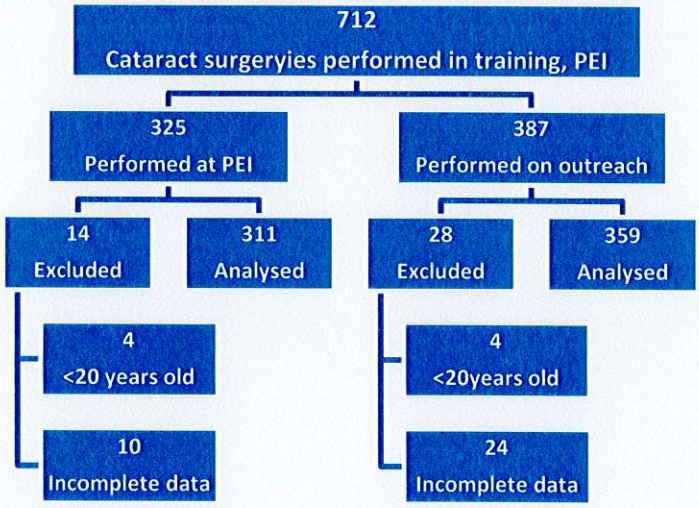
4. RESULTS

A total of 712 cataract surgeries were performed by the prinicple researcher while a trainee at the Pacific Eye Institute(PEI), Suva, Fiji in 2008 (Postgraduate Diploma in Opthalmology) then 2011 to August 2013 (Masters in Medicine, Ophthalmology).

Table 21 Cataract surgeries performed in training, PEI

LOCATION	2008	2011	2012	2013	TOTALS
PEI	94	105	90	36	**325**
OUTREACH	24	76	160	127	**387**
TOTALS	**118**	**181**	**250**	**163**	**712**

325(46.4%) of these cataract surgeries were performed at the Pacific Eye Institute, Suva, Fiji, while 387(53.6%) where performed during surgical outreaches in locations around Fiji and other Pacific island countries, namely Samoa, Solomon Islands, Tonga and Vanuatu. Eight cataract surgeries were performed on subjects less than twenty years of age and a further thirty four had incomplete data thus, forty two surgeries were excluded from this audit.



4.1 Demography

A total of 670 (94.1%) cataract surgeries included in this audit were performed and analyzed by the principal researcher. 356 (53.1%) were female and 314 (46.9%) male. The mean age ± SD was 64.8 ± 11 years. The majority of patients, 268 (40%), were Fijian of Indian decent, 156 (58.2%) of whom were females.

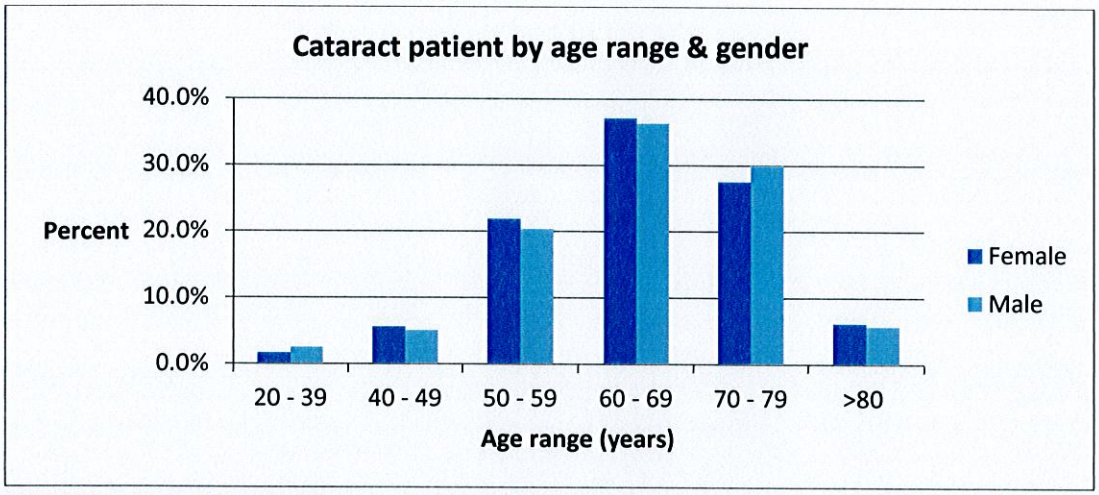


Figure 3 Age range & gender

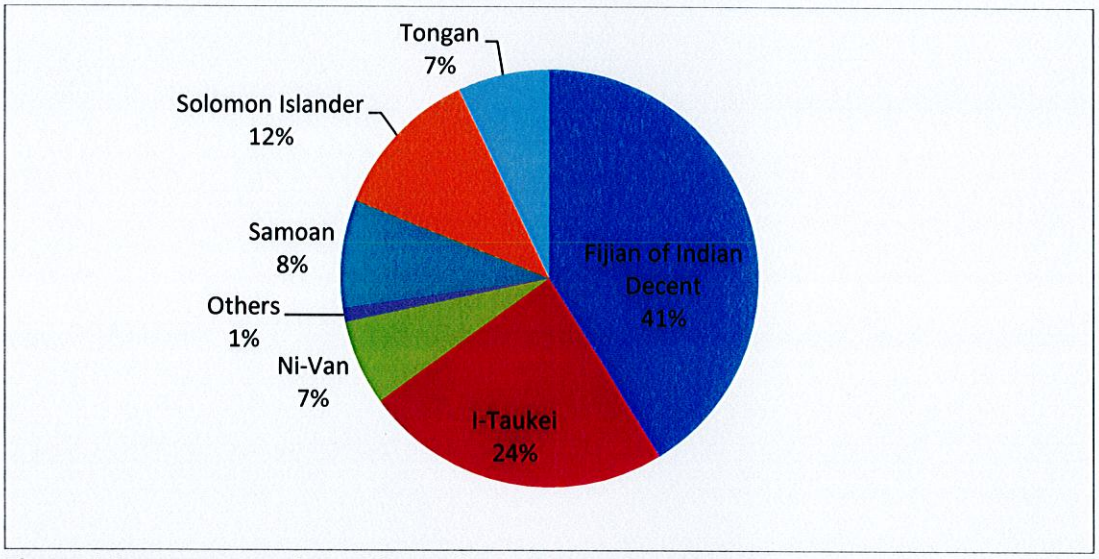


Figure 4 Cataract surgeries performed on outreach by ethnicity

The follow up rates at the Pacific Eye Institute at 30 to 120 days postoperatively was 87.8%. Recorded visual acuities of all cataract surgeries performed on surgical outreach are within one week of surgery.

4.2 Ocular Comorbidities

A total of eighty seven (13.0%) eyes were documented to have co existing ocular comorbidities. Seventy nine (90.8%) of these patients were operated at the Pacific Eye Institute (PEI). The majority, sixty seven (77.9%), of ocular comorbidities were retinal diseases, including diabetic retinopathy. Diabetic retinopathy accounted for fifty (57.5%) of the eighty seven eyes with comorbidities. Other comorbidities included glaucoma, old uveitis, and corneal opacities.

Table 22 Ocular comorbidities in cataract surgical patients

Ocular comorbidities	No (%)
Retinal disease	
Diabetic retinopathy	50(57.5)
Optic atrophy	4(4.6)
Retinal detachment	4(4.6)
Macular scar	2(2.3)
ERM	2(2.3)
Old CRVO	1(1.1)
Macular hole	1(1.1)
Others	3(3.5)
Glaucoma	7(8.0)
Old uveitis	6(6.9)
Corneal scars	4(4.6)
Others	3(3.5)
Total	**87(100)**

4.3 Preoperative Vision

The majority of patients, 589 (87.9%) had preoperative visions of <6/60. Of the 659 eyes with <6/18 preoperative vision, 618(93.8%) had improved postoperative vision. Thirty five with poor (<6/60) and six subjects with borderline (<6/18 – 6/60) preoperative vision continued to have postoperative poor and borderline vision respectively.
Twenty one (60%) subjects with preoperative visions <6/60 which did not improve with surgery had pre-existing comorbidities responsible for the impaired vision while one subject developed postoperative endophthalmitis. Thirteen patients, all of whom were operated on outreach, with postoperative best corrected vision <6/60 had undetermined causes for vision loss.
Pre-existing ocular pathologies (epiretinal membrane and diabetic retinopathy) were responsible for two of the six patients with preoperative vision <6/18 – 6/60 and who did not improve postoperatively. Corneal decompensation complicated one surgery and a further three patients did not have records for the cause of impaired vision.

4.4 Cataract Surgical Techniques & Intraocular Lenses

The majority, 566 (84.5%), of cataract surgeries performed were manual sutureless small incision cataract surgeries (SICS), while 100 (14.9%) and four (0.6%) were standard extracapsular cataract extractions (ECCE) and intracapsular cataract extractions (ICCE) respectively. All four patients who had undergone an ICCE had anterior chamber intraocular lenses (AC IOL) implanted. Indications for ICCE were traumatic anterior dislocation of lens with secondary glaucoma and traumatic cataracts with zonular dehiscence and subluxated lens.

668 (99.7%s) subjects were pseudophakic following cataract surgery. Posterior chamber intraocular lenses (PC IOL) were implanted in 656 (97.9%) eyes, twelve (1.6%) had AC IOLs implanted and two (0.3%) were left aphakic. Both subjects left aphakic had ocular comorbidities namely, old CRVO and retinal detachment.

4.5 Postoperative Cataract Surgical Outcomes

The overall postoperative uncorrected and best corrected visual acuities, compared to the WHO standards, are show in Tables 1 and 2.

Table 23 Postoperative uncorrected visual acuity (UCVA) by year.

Year	Good ≥ 6/18 No. (%)	Borderline <6/18 – 6/60 No. (%)	Poor <6/60 No. (%)	Total % (No.)
2008	63(66.8)	34(33.3)	5(4.9)	102(100)
2011	103 (63.2)	46(28.2)	14(8.6)	163(100)
2012	185 (76.1)	51(21.0)	7(2.9)	243(100)
2013	111 (68.5)	39(24.1)	12(7.4)	162(100)
Total	**462 (69.0)**	**170(25.4)**	**38(5.7)**	**670(100)**
WHO standards (%)	**(80)**	**(15)**	**(5)**	**(100)**

Table 24 Postoperative best corrected visual acuity (BCVA) by year.

Year	Good ≥ 6/18 No. (%)	Borderline <6/18 – 6/60 No. (%)	Poor <6/60 No. (%)	Total No. (%)
2008	88(86.3)	10(9.8)	4(3.9)	102(100)
2011	134(82.2)	15(9.2)	14(8.6)	163(100)
2012	140(90.9)	7(4.6)	7(4.6)	243(100)
2013	141(87.0)	11(6.8)	10(6.2)	162(100)
Total	**583(87.0)**	**52(7.8)**	**35(5.2)**	**670(100)**
WHO standards (%)	**(90)**	**(5)**	**(5)**	**(100)**

The overall postoperative uncorrected visual acuity of 6/18 and better and <6/18 – 6/60 was 69% and 25.4% respectively. The overall best corrected visual acuities improved to 87% and 7.8% within the same categories. Poor postoperative vision, <6/60, was 5.7% and 5.2% for uncorrected and best corrected vision. Of the 170 eyes with uncorrected postoperative vision of 6/18 – 6/60, 120 (70.6%) improved with pinhole or refraction to 6/18 or better. The surgeon's best visual outcomes were recorded in 2012, during the third year of training.

4.5.1 Postoperative visual acuity by place of surgery

Table 25 Postoperative uncorrected visual acuity (UCVA) by place of surgery

Location	Good ≥ 6/18 % (No.)	Borderline <6/18 – 6/60 % (No.)	Poor <6/60 % (No.)	Total % (No.)
Outreach	254(70.8)	85(23.7)	20(5.6)	359(100)
PEI	208(66.9)	85(27.3)	18(5.8)	311(100)
Total	**462(69.0)**	**170(25.4)**	**38(5.7)**	**670(100)**
WHO standards (%)	**(80)**	**(15)**	**(5)**	**(100)**

Table 26 Postoperative best corrected visual acuity (BCVA) by place of surgery

Location	Good ≥ 6/18 % (No.)	Borderline <6/18 – 6/60 % (No.)	Poor <6/60 % (No.)	Total % (No.)
Outreach	87.2(313)	7.2(27)	5.3(19)	100(359)
PEI	86.8(270)	8.0(25)	5.1(16)	100(311)
Grand Total	**87.0(583)**	**7.8(52)**	**5.1(35)**	**100(670)**
WHO standards (%)	(90)	(5)	(5)	(100)

The uncorrected visual outcomes of 6/18 and better was a little higher in cataract surgeries performed on outreaches as compared to those performed at PEI (OR=0.83, CI 0.60, 1.12, P=0.160).

4.5.2 Postoperative visual acuity by cataract surgical technique

The postoperative uncorrected and best corrected visual acuities by surgical technique are presented in Tables 5 and 6.

Table 27 Postoperative uncorrected vision (UCVA) by cataract surgical technique

Surgical technique	Good ≥ 6/18 % (No.)	Borderline <6/18 – 6/60 % (No.)	Poor <6/60 % (No.)	Total % (No.)
ECCE	63(63)	33(33)	4(4)	100(100)
ICCE	25(1)	25(1)	50(2)	100(4)
SICS	70.3(398)	24(136)	5.7(32)	100(566)
Total	**69.0(462)**	**25.4(170)**	**5.7(38)**	**100(670)**
WHO standards (%)	(80)	(15)	(5)	(100)

Table 28 Postoperative best corrected vision (BCVA) by cataract surgical technique

Surgical technique	Good ≥ 6/18 % (No.)	Borderline <6/18 – 6/60 % (No.)	Poor <6/60 % (No.)	Total % (No.)
ECCE	87(87)	10(10)	3(3)	100(100)
ICCE	25(1)	25(1)	50(2)	100(4)
SICS	87.5(495)	7.8(41)	5.3(30)	100(566)
Total	**87.0(583)**	**7.8(52)**	**5.2(35)**	**100(670)**
WHO standards (%)	(90)	(5)	(5)	(100)

The postoperative uncorrected visual acuities of patients undergoing ECCE was 6/18 or better in 63% of patients compared with 70.3% in SICS (OR =0.72; CI 0.46, 1.12; P=0.091). Both surgical techniques, however, had comparable best corrected visual outcomes of 87% and 87.5% respectively. There were also less uncorrected vision <6/18 – 6/60 in SICS, 24% as compared to ECCE with 33%.
218 SICS were performed at the Pacific Eye Institute during the period of audit. Of these 141 (64.7%) and 77 (35.3%) were performed through a superior and temporal incision respectively. The visual outcomes are presented in tables 7 and 8.

Table 29 Uncorrected visual acuity of superior vs temporal approach SICS

SICS approach	Good >6/18 No (%)	Borderline <6/18 – 6/60 No (%)	Poor <6/60 No (%)	Total No (%)
Superior SICS	95(67.4)	39(27.7)	7(5)	141(100)
Temporal SICS	51(66.2)	21(27.3)	5(6.5)	77(100)
Total	**146(67.0)**	**60(27.5)**	**12(5.5)**	**218(100)**

Table 30 Best corrected visual acuity of superior vs temporal approach SICS

SICS approach	Good >6/18 No (%)	Borderline <6/18 – 6/60 No (%)	Poor <6/60 No (%)	Total No (%)
Superior SICS	120(85.1)	14(9.9)	7(5)	141(100)
Temporal SICS	69(89.6)	4(5.2)	4(5.2)	77(100)
Total	**188(86.2)**	**18(8.3)**	**11(5)**	**218(100)**

Both superior and temporal SICS incisions resulted in comparable uncorrected and best corrected postoperative visual acuity (OR 0.85, CI 0.46, 1.58, P=0.362).

4.5.3 Postoperative refractions, PEI

208(66.9%) of eyes had presenting visual acuities of 6/18 or better. 270(86%) patients had best corrected or pinhole visual acuities of 6/18 or better. Eighty-five (27.3%) eyes had borderline presenting VA (>6/18 - ≥6/60). Following pinhole or refractive correction the vision improved in sixty-one (71.8%) eyes from borderline to good (6/6 – 6/18) VA. This was confirmed by refraction in twenty five patients and pinhole vision in the remaining thirty six patients. One patient with poor vision improved to good vision with refraction and another improved to borderline vision. In total, sixty-three (20.3%) eyes had an improvement in vision after best corrected or pinhole vision. Ninety nine patients (31.8%) of the 311 patients with cataract surgery at the Pacific Eye Institute had refractions post operatively. Ninety four of these patients had undergone SICS. Twenty five eyes with uncorrected borderline postoperative vision improved with refraction to 6/18 or better. Of these 12 had an equivalent sphere of 1 - <2D, 6 had <1D and 2-3D each while one had >3D.

Table 31 Postoperative astigmatism by cataract surgical technique

	<1D No.(%)	1 - <2D No.(%)	2 – 3D No.(%)	>3D No.(%)	Total No.(%)
ECCE	3(60)	1(20)	1(20)	0	5(100)
Superior SICS	21(35.6)	18(30.5)	18(30.5)	2(3.4)	59(100)
Temporal SICS	27(77.1)	6(17.1)	2(5.7)	0(0)	35(100)
Total	**51(51.5)**	**25(25.3)**	**21(21.2)**	**2(2.0)**	**99(100)**

There was notably a greater proportion of postoperative refractions with less than one dioptre of astigmatism in patients who had undergone SICS through a temporal incision(77.1%) as compared with SICS through a superior scleral incision (35.6%) OR 0.16 (0.06 – 0.42) P=0.00023.

4.6 Reasons for borderline and poor cataract surgical outcomes

The principal causes of best corrected borderline and poor vision are presented in Table 12.

Table 32 Principal cause of best corrected borderline and poor vision

Principal Cause	Borderline Vision <6/18 – 6/60		Poor Vision <6/60		Total No (%)
	Outreach	PEI	Outreach	PEI	
Pre-existing	1	15	6	14	36(41.4)
Surgery	3	0	0	1	4(4.6)
Endophthalmitis	0	0	0	1	1(1.2)
Refraction	0	1	0	0	1(1.2)
Undetermined	23	9	13	0	45(51.7)
Grand Total (%)	**27(31.0)**	**25(28.7)**	**19(21.8)**	**16(18.4)**	**87(100)**

Table 33 Pre-existing ocular comorbidities causing best corrected borderline and poor vision

Ocular comorbidities	Borderline <6/18 – 6/60	Poor <6/60	Total No (%)
Retinal Pathology			
Diabetic Retinopathy	11	4	15(41.7)
Retinal Detachment	0	4	4(11.1)
Optic atrophy	0	3	3(8.3)
ERM	1	0	1(2.8)
Macular scar	1	1	2(5.6)
Old CRVO	0	1	1(2.8)
Macular hole	0	1	1(2.8)
Corneal pathology	2	0	2(5.6)
Glaucoma	0	2	2(5.6)
Old uveitis	0	3	3(8.3)
Other	1	1	2(5.6)
Total (%)	**16(44.4)**	**20(55.6)**	**36(100)**

Ocular comorbidities accounted for thirty six (41.4%) of the eighty seven eyes with best corrected borderline and poor vision. Retinal pathology was responsible for twenty seven of which fifteen (41.7%) were due to diabetic retinopathy. Ten (66.7%) of the fifteen patients with diabetic retinopathy were Fijians of Indian decent. Twenty nine (80.6%) of the thirty six patients with pre-existing ocular pathology causing poor and borderline postoperative vision were operated at PEI. One patient had irregular astigmatism noted preoperatively and a resultant postoperative borderline vision. During the period of audit, one patient developed endophthalmitis 20 days postoperatively. The subject had a subluxated lens preoperatively and had undergone an intracapsular cataract extraction and AC IOL implantation. Another patient who had undergone an uncomplicated SICS and PC IOL implantation at PEI was admitted within a week postoperatively with diabetic sepsis. At one week postoperative visit, the subject had also developed a severe postoperative inflammation resulting in poor vision and failed to return for further follow up. Three patients undergoing cataract surgery on outreach had best corrected visions of <6/18 – 6/60 resulting from postoperative hyphema and corneal decompensation.

Fourteen patients were 20 to 39 years of age. Five of these patients had ocular comorbidities including diabetic retinopathy, retinal detachments and old uveitis. The latter two comorbidities were responsible for postoperative visions < 6/60 in three eyes. A further two patients in this age range had postoperative visions of <6/18 – 6/60, though the cause of impaired vision was undetermined. Meanwhile nine patients had postoperative BCVA of 6/18 or better.

Table 34 Uncorrected visual outcomes excluding pre-existing causes of postoperative visual impairment

Cataract surgical technique	Good >6/18 No (%)	Borderline <6/18 – 6/60 No (%)	Poor <6/60 No (%)	Total No (%)
SICS	398(73.7)	122(22.8)	16(3.0)	536(100)
ECCE	63(65.6)	33(34.4)	0(0)	96(100)
ICCE	1(50.0)	0(0)	1(50.0)	2(100)
Total	**462(72.9)**	**155(24.4)**	**17(2.7)**	**634(100)**
WHO Standards (%)	(80)	(15)	(5)	(100)

Table 35 Best corrected visual outcomes excluding pre-existing causes of postoperative visual impairment

Cataract surgical technique	Good >6/18 No (%)	Borderline <6/18 – 6/60 No (%)	Poor <6/60 No (%)	Total No (%)
SICS	495(92.4)	27(5.0)	14(2.6)	536(100)
ECCE	87(90.6)	9(9.4)	0(0)	96(100)
ICCE	1(50.0)	0(0)	1(50.0)	2(100)
Total	**583(92.0)**	**36(5.7)**	**15(2.4)**	**634(100)**
WHO Standards (%)	(90)	(5)	(5)	(100)

Minus the thirty six pre-existing causes of impaired postoperative vision, the uncorrected good, borderline and poor vision would be 72.9%, 24.4% and 2.7%, while the best corrected visions would be 92.0%, 5.7% and 2.4% respectively. 120 (77.4%) of the 155 eyes with uncorrected borderline visual acuity, improved with pinhole or refraction to 6/18 or better.

4.6.1 Diabetes and cataract surgical outcomes, PEI

25.4% (79) of cataract surgical patients operated at PEI had documented ocular comorbidities, the majority, fifty nine (76.6%), of which had retinal pathology including diabetic retinopathy. Forty six (61%) patients undergoing surgery by the principal surgeon at PEI with documented ocular comorbidities had diabetic retinopathy.

Of the 311 patients who underwent cataract surgery at PEI, 46.3% (144) were diabetic, 66% (95) of which were Fijian of Indian decent (OR 2.21, 95% CI 1.38 – 3.56, P= 0.000656). 31.9% (46) of all diabetic patients undergoing cataract surgery had diabetic retinopathy. Twenty four (16.7%) had sight threatening diabetic retinopathy (STDR). 67.4% (97) diabetic patients presented for cataract surgery at 50 to 69 years old compared with 54.2% (88) of non-diabetics in the same age range (OR = 1.7; CI 1.09, 2.8; P=0.0133).

4.7 Cataract surgical complications

Table 36 Cataract surgical complications by year

Surgical Complications	2008	2011	2012	2013	Total
Vitreous loss	1	7	8	2	18
PCR	0	4	1	2	7
Endophthalmitis	1	0	0	0	1
Others	5	2	2	12	21
Total	**7**	**13**	**11**	**16**	**47**
% of total cataract surgeries	6.9%	8.0%	4.5%	9.9%	7.0%

A total of forty seven (7.0%) surgical complications were recorded. Vitreous loss complicated eighteen (2.7%) surgeries, seven (1%) had posterior capsular ruptures without vitreous loss and one (0.1%) developed a postoperative endophthalmitis. Other complications include hyphaema, corneal decompensation, iris prolapse, wound leaks, zonular dehiscence, retained cortex and acute raise in intraocular pressure. The least complications were recorded in 2012 during the third year in training. Rates of vitreous loss, as a percentage of the total surgeries was highest, 4.3%, in the second year of training.

4.7.1 Cataract surgical complications by place of surgery

Table 37 Cataract surgical complications by place of surgery

Complication	Outreach	PEI	Total No. (%)
Vitreous loss	3	15	18(38.3)
PCR	0	7	7(14.9)
Hyphaema	4	1	5(10.6)
Acute high IOP	0	4	4(8.5)
Corneal decompensation	2	1	3(6.4)
Iris prolapse	0	3	3(6.4)
wound leak	0	2	2(4.3)
zonular dehiscence	0	2	2(4.3)
Endophthalmitis	0	1	1(2.1)
PCO	0	1	1(2.1)
retained cortex	0	1	1(2.1)
Total (%)	**9(19.1)**	**38(80.9)**	**47(100)**

The majority, thirty eight (80.9%), of complications recorded were on cataract surgeries performed at PEI.

4.7.1 Operative complications by additional ocular pathology

Thirteen patients with pre-existing ocular pathology had complicated cataract surgeries. These include diabetic retinopathy (6), glaucoma (2), retinal disease other than diabetic retinopathy (2), old uveitis (1) and others (2).

4.7.2 Operative complications by surgical technique

Table 38 Cataract surgical complications by surgical technique

Row Labels	ECCE	ICCE	SICS	Total
Acute high IOP	1	0	3	4
Corneal decompensation	1	0	2	3
Endophthalmitis	0	1	0	1
Hyphaema	0	0	5	5
Iris prolapse	3	0	0	3
PCO	0	0	1	1
PCR	0	0	7	7
Retained cortex	0	0	1	1
Vitreous loss	1	1	16	18
Wound leak	0	0	2	2
Zonular dehiscence	0	0	2	2
Total	**6**	**2**	**39**	**47**
% total surgeries	**(6.0)**	**(50.0)**	**(6.9)**	**(7.0)**

There was an equal proportion of complications for both ECCE and SICS.

4.7.3 Visual Outcomes of complicated cataract surgeries

The UCVA and BCVA of cataract surgeries with complications are presented on tables 19 and 20.

Table 39 Postoperative uncorrected visual acuity of complicated cataract surgeries

Surgical complications	Good	Borderline	Poor	Total
Vitreous loss	14	4	0	18
PCR	6	1	0	7
Endophthalmitis	0	0	1	1
Others	10	8	3	21
Total	**30(63.8)**	**13(27.7)**	**4(8.5)**	**47(100)**

Table 40 Postoperative best corrected visual acuity of complicated cataract surgeries

Surgical complications	Good	Borderline	Poor	Total
Vitreous loss	17	1	0	18
PCR	7	0	0	7
Endophthalmitis	0	0	1	1
Other	13	6	2	21
Total (%)	**37(78.7)**	**7(14.9)**	**3(6.4)**	**47(100)**

The majority of patients with complicated cataract surgery had good visual outcomes. Of the ten patients with best corrected borderline and poor postoperative vision, five had pre-existing ocular

comorbidities, two eyes had postoperative hyphema, one with corneal decompensation, one with postoperative endophthalmitis and there was no record of the cause of impaired vision in one eye.

A third (6) of surgeries with vitreous loss had AC IOLs while twelve had PC IOLs implanted. Sixteen surgeries complicated by vitreous loss had undergone manual small incision cataract surgery. Seven patients with vitreous loss were diabetic, two of which had diabetic retinopathy.
Six eyes with PCR without vitreous loss had PC IOLs while one had an AC IOL implanted. Two of the seven subjects with PCR without vitreous loss had ocular comorbidities, namely diabetic retinopathy and glaucoma. Both however had best corrected postoperative vision of 6/18 or better.

4.7.4 Visual outcome of eyes with AC IOLs

A total of twelve eyes were fitted with AC IOLs of which six had an uncorrected vision of 6/18 or better. This increased to eight eyes with best corrected vision. Postoperative endophthalmitis and retinal detachment were responsible for poor visual outcome in two patients. A further two eye had resultant vision of <6/18 – 6/60 both of which had pre-existing ocular comorbidities namely epiretinal membrane and traumatic anterior dislocation of the crystalline lens with secondary glaucoma.

5. DISCUSSION

This audit is the first to report on the cataract surgical outcome of a Pacific Eye Institute (PEI) ophthalmology trainee during the entire period of learning this core competency.

Poor postoperative cataract surgical follow up rates have been documented in developing countries. The follow up rates of cataract surgeries performed by the principal surgeon at PEI at 30 to 120 days postoperatively was 87.8% while all outcomes of surgeries performed on outreach were reported within a week postoperatively. Pathak et al. reported a 49.2% follow up rate for patients undergoing cataract surgeries in Samoa at 4 to 11 weeks postoperatively.[30] Congdon et al assessed the validity of early postoperative visual assessment (3 or less days postoperative) as a valid measure of the final overall quality of surgery in settings where follow up is poor. They reported that early postoperative visual outcomes closely correlated with the final vision assessed 40 or more days postoperatively (Spearman's rs=0·74, p<0·0001). Additionally, visual outcomes assessed at 40 days or more postoperatively were representative of the overall final outcomes (rs=0·86, p<0·0001). This is a significant piece of evidence considering quality of cataract surgical training programmes depend on the accurate assessment of postoperative visual outcomes.[17, 18, 27, 28]

A large majority, 99.7%, of cataract surgeries in this audit were pseudophakic. This is alittle higher than 94% and 90% reported in the Bhaktapur district & Lumbini studies, Nepal. An audit of MSICS performed by trainees in India reported successful IOL implantation in 97.5% of surgeries. [26, 38, 39]

This audit found 13% of all cataract surgical patients had documented ocular comorbidities, 57.5% of which had diabetic retinopathy. Ocular comorbidities have been documented in many cataract surgical outcome audits[39]. Improved preoperative screening may reduce the number of poor outcomes due to ocular comorbidities.

The visual outcomes following cataract surgery did not fulfill the WHO standards. WHO standards state that postoperative uncorrected vision be good (6/6 – 6/18), borderline (<6/18 – 6/60) and poor (<6/60) in 80%, 15% and 5% respectively. [20] The uncorrected vision in the audit was 69%, 25.4% and 5.7% for good, borderline and poor vision respectively. The majority of cataract surgeries did not have formal refraction postoperatively, thus the pinhole vision has also been included as a proxy for best corrected vision. Following best correction, visions improved to 87% with good visual outcome and 7.8% and 5.2% borderline and poor vision respectively. This was comparable to the WHO standard for best corrected vision of 90%, 5% and 5% for good, borderline and poor vision respectively.

The visual outcomes presented in this audit are better than those reported in Papua New Guinea where 41% of patients at 12 weeks or more postoperatively had uncorrected vision of 6/18 or better compared to 69% in this audit. [32] A population based study of the outcome of cataract surgery in Nepal also reported uncorrected and best corrected vision of 6/18 or better in 57.5% and 76.2% respectively.[26] Cataract surgical outcomes reported at 4 – 11 weeks postoperatively in Samoa were better than those presented in this audit at 73.7% and 92.8% for uncorrected and best corrected vision of 6/18 or better[30]. Huang W. et al, in a retrospective study of trainee surgeons in rural Chinese county hospitals, reported uncorrected visual acuity ≥6/18 in 74.7% and <6/60 in 16.1%, while 86.8% had pinhole visual acuity ≥ 6/18 and 10.2% had pinhole visual acuity < 6/60.[19] The trainees had better uncorrected visual outcome compared to this audit but outcomes <6/60 were better in this audit at 5.7%.

Manual small incision cataract surgeries performed at the PEI were initially done through a superior incision and subsequently through a temporal approach. The visual outcomes of both approaches were comparable 67.4% & 66.2% (OR 0.85, CI 0.46, 1.58, P=0.362). In the comparison of postoperative refractions though, there was notably a greater proportion of postoperative refractions with less than one diopter of astigmatism in patients who had undergone SICS through a temporal incision(77.1%) as compared with SICS through a superior scleral incision (35.6%) OR 0.16, CI 0.06, 0.42, P=0.00023.). This was statistically significant. It is a desired outcome to minimize astigmatism as it is well recognized as this improves the uncorrected visual function of the patient and has been documented in literature. Improving biometry technique also ensures minimal postoperative refractive error.[40] Surgically induced astigmatism was not assessed in this audit.

This audit reported an uncorrected visual acuity <6/18 which fell short of the WHO standards. Of the 170 eyes with uncorrected postoperative vision of 6/18 – 6/60, 120 (70.6%) improved with pinhole or refraction to 6/18 or better. This indicated a large proportion of patients had a postoperative refractive error. This is higher than uncorrected refractive errors causing postoperative visual impairment in trainees, 63.9%, recorded in a study in China. A study in India recorded postoperative uncorrected and best corrected visual acuity of 6/18 or better in 43.9% and 94.4% respectively. [41] A cataract surgical audit in Samoa revealed that refractive errors were not a major cause of postoperative impaired vision. [30] Twenty five subjects in this audit, who presented with postoperative uncorrected borderline vision, had refractions postoperatively resulting in best corrected vision 6/18 or better. Of these, 76% had equivalent spheres of ≥1 diopters. Surgically induced astigmatism was not measured in this audit.

Coexisting ocular comorbidities were responsible for 36 (41.4 %) of best corrected postoperative borderline and poor vision in this audit. Retinal diseases including diabetic retinopathy were responsible for the majority, 27 (75%), of postoperative visions <6/60. Major ocular comorbidities reported in this audit include diabetic retinopathy, retinal detachment, optic atrophy, old uveitis, macular scars, corneal opacities and advanced glaucoma. This is similarly reported, but to a lesser extent in cataract surgical outcomes of trainees in other countries. Huang W et al reported comorbid eye diseases a main cause of visual impairment in 24.5% of surgeries performed by trainees in rural China. Comorbid eye diseases included glaucoma, other optic nerve atrophy, vitreous haemorrhage and retinal detachment.[19] Ocular comorbidities and cataract surgical complications were reported as the major cause for postoperative visual impairment in cataract surgeries in other studies including those performed by trainees at the L V Prasad Eye Institute, India. [39, 41]

Cataract surgery in diabetic patients may cause a rapid acceleration of retinopathy, induce rubeosis or lead to macular changes, such as macular edema or cystoid macular edema. The worst outcomes may occur in operated eyes with active proliferative retinopathy and/or preexisting macular edema. It is preferable to initiate treatment for diabetic retinopathy prior to cataract surgery but in many instances the density of cataract at presentation prevents this. Thus patients require surgery to enable assessment of retinopathy and appropriate laser treatment postoperatively.[42]

The high prevalence of diabetes among Pacific island nations has been documented. Six of the top ten countries for diabetes prevalence globally, are Pacific Islands. Kiribati has been recorded as having the world's highest prevalence of diabetes at 25.7% with other island nations Marshall islands (22.2%), Nauru (20.7%), Tuvalu (19.5%) and Vanuatu (16.4%) following.[43] With 46.3% of the patients undergoing cataract surgery at the Pacific Eye Institute by the principle surgeon, being diabetic, it is not surprising that diabetic retinopathy accounts for 61% of ocular pathology at PEI and 57.5% overall PEI and outreach. Brian G et al. documented evidence of failure of the management of diabetes and its eye complications in Fiji. Improved management of diabetes and accessibility to

diabetes screening services, with early diagnosis and appropriate management is crucial to avoid irreversible vision loss.[4, 35]

A surgical complication rate of 7.0% was recorded in this audit. Vitreous loss complicated eighteen (2.7%) surgeries, seven (1%) had posterior capsular ruptures (PCR) without vitreous loss and one (0.1%) developed a postoperative endophthalmitis. This is comparable to the WHO standards which states vitreous loss, PCR and endophthalmitis rates to be <5%, <5% and <1% respectively.[20, 36] The least complications, 4.5%, were recorded during the third year in training while the majority (9.9%) of complications occurred in the final year of training with more complex cases with poor visual prognosis. There was a similar proportion of complications for both ECCE (6.0%) and SICS (6.9%). A study comparing MSICS and phacoemulsification in trainees of the L V Prasad Eye Institute recorded a complication rate of 15.1% and 7.1%, $p<0.001$ respectively.[39] Another study in Aravind Eye Hospital, India reported the intraoperative complication rate decreased with greater surgeon experience. It was 0.79% for staff surgeons, 1.19% for fellows, 2.06% for residents and 5% for visiting trainees.[29] The majority of complicated surgeries in this audit occurred at PEI, the majority of which had postoperative best corrected vision of 6/18 or better.

7. CONCLUSION

In conclusion, the postoperative uncorrected visual outcomes fell short of the WHO standards while the best corrected visual outcomes were comparable with the WHO standards. Uncorrected refractive errors were responsible for the uncorrected visual outcomes while ocular comorbidities, particularly diabetic retinopathy were responsible for best corrected borderline and poor vision. Cataract surgical complication rates were within WHO standards. Reducing the refractive errors with improved biometry technique, and the systemic control of diabetes with early detection and treatment of retinopathy would greatly improve cataract surgical outcomes. Nevertheless, this audit presents the comprehensive picture of the surgical learning curve of a trainee ophthalmologist in the developing world. As such, it may be of value as a benchmark in similar circumstances.

8. LIMITATIONS & RECOMMENDATIONS

Missing files and data was a limiting factor. Data collection on outreach was initially done by the registrar accompanying the team. Recognizing the importance and time consuming duty, an administrator has now been assigned the task of data collection. I would recommend improved documentation on outreach with the clinician checking to make sure that the clinical aspects are captured. There have been improvements in documentation during outreach and for this we are grateful.

Co-management of diabetic patients with physicians and general practitioner and strengthening the diabetes screening program is important early detection and treatment which has been proven to help avoid the vision impairing consequences of diabetes.

To further validate the trends reported in this study, a combined audit of like surgeons is recommended.

Doing this audit has helped highlight the need to improve my biometry technique and improved preoperative screening. I would encourage all my training colleagues to strive to audit your own cataract surgical outcomes, a worthy exercise in becoming a competent surgeon. Ultimately, our patients benefit from quality cataract surgical services fulfilling their right to sight.

9. ANNEX

Annex 1. List of abbreviations

MSICS	Manual Small Incision Cataract Surgery
SICS	Small Incision Cataract Surgery
ECCE	Extracapsular Cataract Extraction
ICCE	Intracapsular Cataract Extraction
IOL	Intraocular Lens
PC IOL	Posterior Chamber Intraocular Lens
AC IOL	Anterior Chamber Intraocular Lens
WHO	World Health Organization
AMD	Age related Macular Degeneration
PEI	Pacific Eye Institute
FHFNZ	Fred Hollows Foundation New Zealand
NHN	National Hospital Number
UCVA	Uncorrected visual acuity
BCVA	Best corrected visual acuity
ERM	Epiretinal membrane
STDR	Sight threatening diabetic retinopathy

Annex 2. Data-collection instruments

#	Year	Location	Patient ID	Age	Gender	Ethnicity	Diabetes	Pre-existing ocular pathology	Operation type	IOL type	Pre-operative presenting vision	Days to final postop	Final postop uncorrected vision	Final postop best corrected vision	Reason for final uncorrected borderline or poor	Intraop or postop complication	Refraction	
																	Sphere	cylinder

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