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RESEARCH

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A baseline audit of the population groups accessing optometry training clinics in Aotearoa New Zealand: looking towards equity in eye care

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ABSTRACT

Clinical relevance: To improve equity in eye care, optometry training clinics should be accessible to all population groups so that future optometrists develop skills working with different population groups.

Background: In the 2019 *World Report on Vision*, the World Health Organization highlighted a need to improve access to eye care globally. In Aotearoa New Zealand, a renewed focus on equity followed the 2022 health system reform. The School of Optometry and Vision Science (SOVS) at The University of Auckland has an important role in promoting equity within the eye health sector. The aim of this study was to assess whether the SOVS teaching clinics are accessible to a range of population groups.

Methods: The demographics and travel distances of patients accessing the SOVS teaching clinics within the five-year period immediately prior to the New Zealand health system reform (2017–2021) were assessed. The representativeness of patients accessing the main teaching clinic was compared to the wider New Zealand population.

Results: Information describing patient ethnicity was not available for 82% of the 18,981 patients. Compared to the New Zealand population, people who accessed the main teaching clinic were more likely to live in areas with low levels of deprivation, and those who lived in areas of high deprivation travelled the furthest (all $p < 0.01$). Compared to patients accessing the main teaching clinic, a person accessing care at a fully subsidised community-based clinic was 27 times more likely to live in an area with the highest level of deprivation.

Conclusions: Due to its location, the teaching clinic where New Zealand optometrists are trained is less accessible to people who live in areas with high levels of deprivation, and greater focus on collecting patient ethnicity information is required. Funding for routine, community outreach services would address inequities and embed a culture of equity into optometry education.

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Introduction

In its inaugural *World Report on Vision*, the World Health Organization (WHO) highlighted the need to improve access to eye health services globally,[1] and this was reinforced by the Lancet Commission on Global Eye Health.[2] Aotearoa New Zealand (hereafter referred to as New Zealand) has experienced a renewed focus on equity within the healthcare sector following the 2022 health system reform.[3] As part of this reform, the Pae Ora (Healthy Futures) Act[4] enshrined equity as a core principle in the public funding and provision of health services in New Zealand, particularly for Māori. Additionally, improving cultural safety within our workforce is a priority action within the New Zealand Health Strategy this decade.[5,6]

New Zealand has significant room for improvement in the planning and delivery of eye care services.[7,8] Most eye care services are provided by community optometrists working in private practice,[9] and unlike similar high-income countries (e.g. Australia) that have funding for eye examinations and spectacles, in New Zealand there is little public funding for eye care to support people who are unable to pay.[7,8] For this reason, the cost of private optometry services is a leading barrier among people unable to access care.[10] Ethnic disparities in access to eye care are ubiquitous, as New Zealand Māori and Pacific people are consistently underserved by eye health services, and as a result have poorer eye health outcomes.[11]

The School of Optometry and Vision Science (SOVS) at The University of Auckland offers the only domestic optometry training programme in New Zealand – a five-year Bachelor of Optometry (Honours) undergraduate degree.[12] As of 2023, 82% of the 1070 optometrists registered in New Zealand were trained at SOVS.[13] SOVS operates under The University of Auckland 2021–2030 strategy *Taumata Teitei*, which placed a renewed emphasis on equity.[14] Within the optometry programme, theoretical concepts of health equity and cultural awareness are taught during the earlier years of the course (including an immersive 4-day course dedicated specifically to providing care deemed cultural safe by Māori), and students are expected to develop and apply this knowledge during their clinical training.

Presently, most clinical training is provided at an inner-city teaching clinic,[15] and until 2017, students were also rostered to a satellite clinic located ~10 km away in a suburb with high area-level deprivation. Students also attend clinics in public hospitals, private ophthalmology practices, participate in school screening and vision rehabilitation programmes, and spend up to six weeks in private optometry practices around New Zealand. SOVS provides other eye care services to the community via ad-hoc temporary clinics, and most recently

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the Vision Bus Aotearoa,[16] which provide students with additional experiences outside the main teaching clinic.

To assess how SOVS is positioned within *Taumata Teitei*, and to ensure that future optometrists are sufficiently trained to meet the aims of the Pae Ora Act, this analysis reports the population groups accessing the main SOVS teaching clinic and compares this to all population groups living in New Zealand. The aim was to determine whether the University training clinic is accessible to a range of population groups, and how this compares to the former satellite clinic and a temporary community-based clinic operating outside inner-city Auckland. This study also serves as a baseline audit for monitoring how SOVS adapts to the changing healthcare landscape in the future.

Method

Study design and study size

This is a cross-sectional analysis of patients accessing the three teaching clinics operated by the School of Optometry and Vision Science at The University of Auckland within the time period between 1 January 2017 and 31 December 2021 (the five years immediately prior to the passing of the New Zealand Pae Ora (Health Futures) Act).[4] Ethics approval was obtained from Auckland Health Research Ethics Committee (Ref: AH23825 and AH22098). This report was prepared in accordance with the STROBE reporting guideline.[17]

Setting

SOVS operates a main teaching clinic at the Grafton Campus[15] which is within an inner-city area categorised with the lowest level of deprivation.[18] Until November 2017, a permanent satellite teaching clinic operated within the former Tāmaki Innovation Campus located ~10 km to the south-east – an area categorised within the highest level of deprivation.[18] This clinic was closed when The University of Auckland sold the Tāmaki Campus and relocated all teaching and research activities elsewhere. In 2021, the cost of an eye examination at either clinic was competitively priced at NZ $50 (US$32), compared to upwards of NZ$100 elsewhere. In addition, eye care was subsidised (by SOVS or via public funding) for some people, including University of Auckland staff and students, SuperGold cardholders (people aged 65 years and over), and the children of Community Services card holders.

In mid-2021, SOVS operated a temporary, community-based eye clinic for approximately six weeks in the East Auckland suburb of Glen Innes adjacent to the now closed Tāmaki Campus and categorised within the highest level of deprivation[18] as part of a door-to-door research survey of vision impairment in the area. Eye examinations at this clinic were provided at no cost to patients as they were funded through philanthropic support for the research project.

Participants

Eligible participants of this study (hereafter described as 'patients') were those who accessed SOVS services at any of the three included clinics (Grafton, Tāmaki, or Glen Innes). The patients accessed the main Grafton clinic between 2017 and 2021, the Tāmaki satellite clinic during its final year of operation in 2017, and the Glen Innes community clinic over the six-week period it was operational during 2021. Almost 100% of participants received their eye examination from a student optometrist.

Data sources, variables, data access, and cleaning

Data were obtained from two sources: 1/the electronic health record system used by SOVS (VC3), which includes activities from Grafton and Tāmaki clinics, and 2/from an ad hoc database created for the Glen Innes community clinic. The manager of each database provided deidentified data describing the demographics of each patient, whether they were affiliated with The University of Auckland (i.e. as a current staff member or student), and the date and location of their appointments. Only the information describing the most recent appointment from each patient was retained.

Quantitative variables and data analysis

Across the study period, patients were not uniformly asked to specify if they were reporting their gender or sex, and were not uniformly provided a range of options to select their gender. So despite no patient self-reporting a gender other than male or female, we use the term gender/sex here to acknowledge this limitation at the point of data collection. The gender/sex of each patient was categorised as male or female (as no patients self-reported as other gender/s), and Patient age at the time of their appointment was categorised into four groups (<20, 20–39, 40–69, ≥70 years).

Patients attending the Glen Innes community clinic were all older than 40 years of age due to the eligibility requirements of that research project. Ethnicity was defined according to Statistics New Zealand Level 1 groupings (European, Māori, Pacific Peoples, Asian, MELAA [Middle Eastern/Latin American/African], Other ethnicity, not elsewhere included).[19] To compare the demographics of the patients against the population, the NZ.Stat tool[20] was used to collate population-level data describing sex and age from the New Zealand population.[3]

The residential address of each patient was used to 1/ determine the socioeconomic deprivation score of the area in which they lived, and 2/to estimate the shortest distance they travelled to reach eye care. To do this, the address of each patient was geocoded using the Google Geocoding API via the R ggmap package, and batch compared the first 10 characters of each input and geocoded address to ensure accuracy. Non-matching addresses were manually checked using Google maps to retrieve longitude and latitude coordinates. Where it was not possible to find matching locations on Google Maps, addresses were categorised as invalid and removed from this analysis.

Area-level socioeconomic deprivation values were derived by spatially joining the residential location of each patient to the New Zealand Indices of Multiple Deprivation 2018 (IMD18) polygon shapefile.[21] Each valid address was mapped to the corresponding area-level deprivation score, and this 10-level index score was binned into five quintiles, where 1 represents the least deprived and 5 the most deprived areas of New Zealand. The Network Analyst Extension of ArcGIS 10.8.1 was used to calculate the shortest driving distance along the road network between the residential address of each patient and the SOVS eye clinic they attended.

Bias

Each variable (e.g. gender/sex) was reported as the number of patients with missing data, and the number of patients fulfilling each category (e.g. male, female) was described as a percentage of all patients (i.e. including those with missing data). As patients who work or study at the University may have accessed the SOVS clinic without needing to travel specifically for eye care, a subgroup analysis of participant demographics and travel distances was conducted excluding patients affiliated with the University.

Statistical methods

Statistical analysis was performed in R (version 4.2.1) using R studio (version 2023.06.2 www.posit.co). Chi-squared statistics were used to test for: 1/differences in the demographics (gender/sex, age, IMD2018 quintile) between the patients attending the three clinics; and 2/the representativeness of the patients attending the University clinics collectively compared to the wider New Zealand population. The proportion of patients affiliated with The University of Auckland was reported only for Grafton and Tāmaki clinics (combined), as these variables were not requested and not relevant to the patients attending the Glen Innes community clinic.

The likelihood of patients living in areas with higher levels of deprivation was compared between Grafton and Tāmaki or Glen Innes clinics by calculating odds ratios with 95% confidence intervals. The relationship between travel distance with clinic location, gender/sex, age, and IMD2018 quintile was analysed using univariate linear regression. Travel distances between the three clinics were visualised by mapping the residential address of each patient overlaying the greater Auckland region (defined as the three health districts that prior to the 2022 health reform[3] served the wider Auckland region: Auckland District Health Board, Counties Manukau District Health Board, and the Waitematā District Health Board). The threshold for statistical significance was set at $p < 0.05$.

Results

Characteristics of included patients

Of the 18,981 patients identified collectively from the three clinic locations 17,939 accessed the main Grafton clinic, 824 accessed the Tāmaki satellite clinic, and 218 received eye care at the Glen Innes community clinic during the study period (Table 1). Fifty-four per cent ($n = 10,255$) of patients were female and were most commonly aged between 40 and 69 years ($n = 6078$, 32%). Seven per cent and 4% of people accessing eye care at Grafton or Tāmaki clinics ($n = 1310$ and 29 respectively) did not have their gender/sex recorded in their clinical records.

For both Grafton and Tāmaki patients, ethnicity data were not available for 83% of patients ($n = 14,884$ and $n = 680$ respectively), and this variable was excluded from further analysis. Ethnicity data were available for all Glen Innes patients, most of whom identified as Pacific Peoples ($n = 140$, 64%) or Māori ($n = 47$, 22%).

Three per cent ($n = 484$) of the data describing patient residential addresses was missing or invalid (Grafton: $n = 447$, 2%; Tāmaki: $n = 32$, 4%; Glen Innes: $n = 5$, 2%), and two per cent ($n = 373$ patients) resided outside of the greater Auckland region. Of all patients, more than half lived in areas classified within the two lowest area-level

Table 1. Characteristics of included patients who accessed Grafton, Tāmaki, or Glen Innes clinics.

	Total		Location						
			Grafton		Tāmaki		Glen Innes		
	N	col%	n	col%	n	col%	n	col%	p-value*
Total	18981		17939		824		218		
Gender/sex									0.22
Female	10255	54	9672	54	443	54	140	64	
Male	7387	39	6957	39	352	43	78	36	
Not reported	1339	7	1310	7	29	4	0	0	
Age (years)									<0.001
<20	3992	21	3783	21	209	25	–	–	
20–39	5740	30	5614	31	126	15	–	–	
40–69	6078	32	5638	31	285	35	155	71	
70+	3171	17	2904	16	204	25	63	29	
Deprivation Index Quintile									<0.001
1 (least deprived)	5109	27	4856	27	247	30	6	3	
2	4907	26	4732	26	166	20	9	4	
3	3928	21	3774	21	135	16	19	9	
4	2493	13	2379	13	95	12	19	9	
5 (most deprived)	2060	11	1751	10	149	18	160	73	
Address invalid or not reported	484	3	447	2	32	4	5	2	
Ethnicity†									–
European	–	–	–	–	–	–	18	8	
Māori	–	–	–	–	–	–	47	22	
Pacific Peoples	–	–	–	–	–	–	140	64	
Asian	–	–	–	–	–	–	11	5	
MELAA	–	–	–	–	–	–	1	0	
Other ethnicity	–	–	–	–	–	–	1	0	
Not reported	15564	82	14884	83	680	83	0	0	

*p-values report comparisons between groups using a chi-squared test, significant at the 0.05 level; †As >10% of people access Grafton or Tāmaki clinics were missing data describing their ethnicity, this variable was not reported or further analysed; Data describing the age groups under 40 years were irrelevant for the Glen Innes clinic (indicated with the '-'), and for these variables the chi-squared test is performed only for the Grafton and Tāmaki clinics; MELAA = Middle Eastern/Latin American/African.

deprivation quintiles (quintile 1: $n = 5109$, 27%; quintile 2: 4907, 26%).

Twenty-five per cent of patients ($n = 4768$) were recorded as affiliated with the University. For each of the analyses described below, excluding patients affiliated with the University did not change the direction or significance of the reported results, so all outcomes reported below include these patients.

Representativeness of the patients accessing the main Grafton clinic

Compared to the wider New Zealand population, patients accessing the main Grafton clinic over the study period were more likely to be female (58% Grafton vs 49% New Zealand; $p < 0.001$), older (aged ≥70 years: 16% Grafton vs 7% New Zealand; $p < 0.001$), and live in areas with the lowest levels of deprivation (IMD18 quintile 1: 28% Grafton vs 20% New Zealand; $p < 0.001$; Figure 1).

Demographics of the patients accessing Grafton compared to Tāmaki or Glen Innes clinics

There was no significant difference between the three clinics in the proportion of males and females accessing eye care (% female: Grafton $n = 9,672$, 54%; Tāmaki $n = 443$, 54%; Glen Innes $n = 140$, 64%; $p = 0.22$, Table 1). However, the age categories of patients were significantly different between the clinics ($p < 0.001$). Just over half of the patients accessing the Grafton clinic were younger than 40 years ($n = 3783$, 21% and $n = 5614$, 31% aged <20 and 20–39 years respectively), while 60% accessing the Tāmaki satellite clinic were older than 40 years ($n = 285$, 35% aged 40–69 years and $n = 204$, 25% aged ≥70 years). All patients receiving eye care at the Glen Innes community clinic were older than 40 years due to the eligibility requirements of the research study, and most ($n = 155$, 71%) were aged 40–69 years.

The area-level deprivation of patients accessing the three clinic locations varied significantly ($p < 0.001$). About 18% of patients at the Tāmaki satellite clinic ($n = 149$) lived in the most deprived areas (IMD18 quintile 5), compared to 73% at the Glen Innes community clinic ($n = 160$) and only 9.9% at the main Grafton clinic ($n = 1751$). Patients from the Tāmaki clinic were twice as likely to reside in the most deprived areas compared to those from the Grafton clinic (Odds Ratio [OR] = 2.08, Confidence Interval [CI]: 1.7–2.50). This likelihood was higher for the Glen Innes clinic, where patients were 27 times more likely to live in the most deprived areas compared to those accessing the Grafton clinic (OR = 27.14, CI: 19.95–37.49).

Shortest travel distances to reach eye care

Patients who attended the main Grafton clinic travelled the furthest (median: 9.1 km, IQR: 4.9-16.1 km), followed by those attending the Tāmaki satellite clinic (7.2 km, IQR: 3.6–13.1 km), with the shortest travel distances for patients who attended the Glen Innes community clinic (1.7 km, IQR: 1.0-3.1 km; $p < 0.001$, Figure 2). Travel distances were significantly different between the five area-level deprivation quintiles ($p < 0.001$). Compared to those living in the least deprived quintile (IMD18 quintile 1), those living in the three most deprived quintiles (IMD18 quintiles 3, 4, or 5) travelled an estimated 2.0 km, 1.8 km, and 2.5 km further (all $p < 0.001$; Figure 2).

Discussion

The public health system in New Zealand requires a systemic change to the way eye care services are delivered, so that services are both accessible and culturally safe for everyone in the diverse population.[3,5,6] As the sole provider of optometry education in New Zealand, SOVS has a responsibility to embed equity and cultural safety into optometry education,[22,23] so

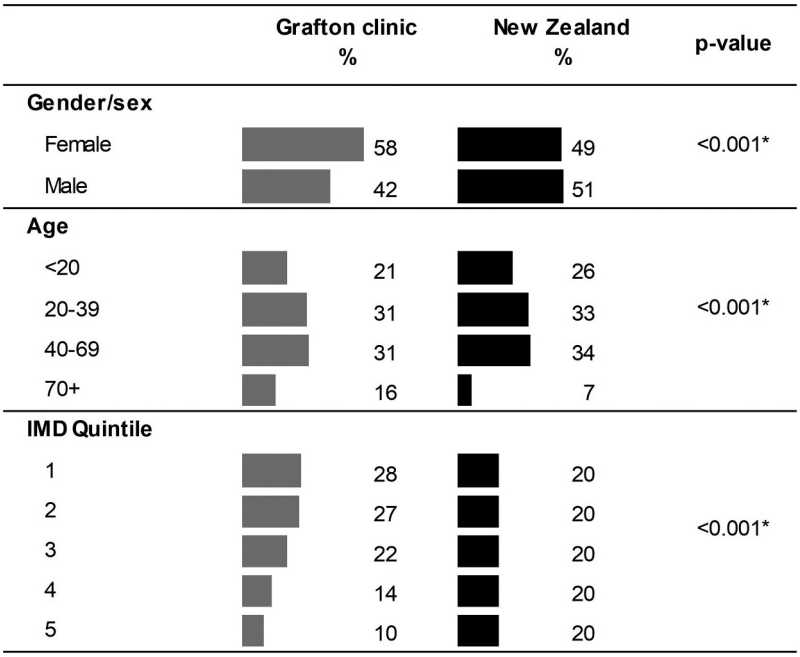

Figure 1. Demographics (gender/sex, age, and IMD18 quintile) of the patients who accessed the main SOVS teaching clinic (grey) compared to the greater New Zealand population (black). *p-values report comparisons between groups using a chi-squared test, significant at the 0.05 level; †numbers are percentages of reported data (excluding missing data).

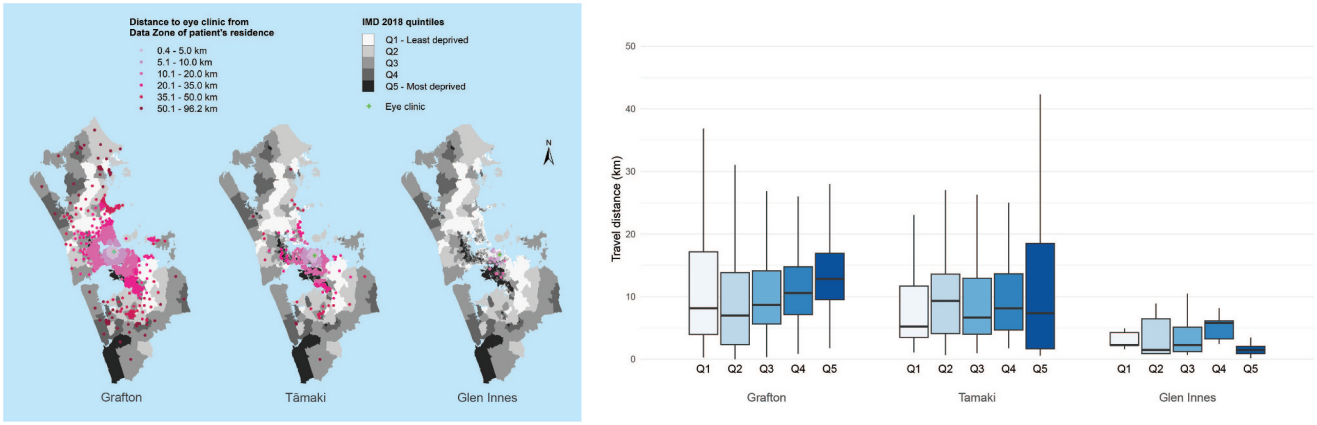

Figure 2. Shortest travel distance from the patient home addresses to the Grafton, Tāmaki, or Glen Innes eye clinics. (left): map of the greater Auckland area illustrating the location of each patient residence (pink circle) relative to the Grafton, Tāmaki, or Glen Innes clinic location (green cross). Different shades of pink indicate relative travel distances, and the IMD18 locations in different regions of the city are underlaid in shades of grey. The map excludes 373 patients whose (valid) addresses fell outside the greater Auckland region. (right): box and whisker plots illustrating the shortest travel distance from the patient home address to the Grafton, Tāmaki, or Glen Innes clinic, by IMD quintile (1 is least deprived).

that future optometrists understand the social causes of health inequity,[24] can surpass the minimum standards of cultural competency,[25] and develop the skills necessary to meet the objectives of the Pae Ora Act.[4] At an operational level, SOVS eye healthcare services should be compatible with the University *Taumata Teitei* strategic plan, and therefore be accessible to all.[14]

This study analysed the demographics of the patients accessing the SOVS teaching clinics in the five-year period immediately preceding the health system reform and the University *Taumata Teitei* strategic plan. The main finding is that compared to the wider New Zealand population, people who accessed the main Grafton teaching clinic lived in areas with lower levels of socioeconomic deprivation. In addition, those living in areas with the highest level of deprivation generally faced the longest travel distances to reach the clinic. This can be explained by the location of the main Grafton training clinic (which out of necessity is adjacent to the University's teaching and learning environment within inner-city Auckland), where access is most convenient for people living in the (generally) affluent surrounding suburbs.

The 2017 closure of the Tāmaki satellite clinic – located within an area with high levels of deprivation – may have decreased diversity within the patient population. Therefore, the central location of the remaining Grafton clinic is providing a service that is likely most accessible for the most socioeconomically privileged people in society.

In pursuit of a more people-centred healthcare system,[3,4] SOVS is considering strategies that make it easier for people living in areas with higher levels of deprivation to access their services. Primarily, physically relocating the service closer to where people live removes the transport and travel costs that may prevent people from accessing eye care.[10,26] These types of services are already available in other countries, and a relevant example is the Australian Visiting Optometrists Scheme that supports the provision of eye care for remote and very remote communities and other communities with an identified need for optometric services, including Aboriginal and Torres Strait Islander people.[27]

In a New Zealand context, this example of the Glen Innes research-led project illustrates how community-based outreach services, provided at no cost for the patient, allow people living in nearby areas with higher levels of deprivation to access the care that they need. Compared to the main Grafton clinic, a patient accessing care at the Glen Innes community clinic was twenty-seven times more likely to live in (nearby) areas with the highest level of deprivation. While this example is a funded, time-limited project, continued efforts such as this to provide accessible services would benefit communities and help SOVS meet strategic goals of *Taumata Teitei*, and the Pae Ora Act more broadly.

Efforts to achieve equity within the clinic are equally important for allowing students to develop an understanding of cultural safety and the needs of different population groups. Recognising that people living in areas with high levels of deprivation are underrepresented within the main Grafton clinic patient population, SOVS has made other efforts to increase community outreach (not described within this analysis). Some examples include the Aotearoa Vision Bus[16] and the SOVS school screening programme that provide mobile, student-led eye care to school children in areas with high levels of deprivation.

Since the 2017 closure of the Tāmaki satellite clinic, SOVS has also increased the duration of external placements – where students gain immersive work experience in a private optometry practice – from three to six weeks. While this analysis could not determine the socioeconomic profile of the patients accessing the 168 external clinics that students have attended since 2017, these clinics are widely distributed across New Zealand. In principle, the patients accessing these clinics are more representative of the national population than those accessing the main Grafton clinic, although evidence to support this is lacking. Where possible, these community outreach initiatives should be continually monitored (e.g. via regular self-audits of patient demographics) and modified or expanded as needed to maximise diversity with the collective patient population.

Efforts to improve access to eye care for underserved groups will need broader support from the government and other funders. Unlike other high-income countries (e.g. Australia, Canada, and the United Kingdom), New Zealand has little funded eye care for adults who are unable to pay,[7] and for this reason cost is a significant barrier to eye care services for people living in underserved communities.[10] SOVS has considered changes to the pricing structure to address this, for example by subsidising eye examinations

for income-tested Community Services Card holders. However, although the clinic operates within The University of Auckland (guided by the *Taumata Teitei* strategic plan), the optometry undergraduate programme is underfunded in comparison to similar health programmes (e.g. dentistry)[28] and SOVS is not funded to provide eye examinations. Therefore, any efforts to subsidise eye examinations for certain groups of people must be supported by the SOVS budget.

Efforts to offset the deficit (e.g. by reducing the subsidy for University staff) may reduce overall patient numbers and would need to be carefully considered to ensure the clinic can remain financially viable and able to provide sufficient patient encounters to meet accreditation requirements. Therefore, while SOVS should continue to explore strategies that increase access for people living in areas with high levels of deprivation, additional funding (from the university, government, or philanthropy) is necessary so that SOVS and other eye care clinics can provide eye care services that are accessible for everyone.

This analysis has provided baseline data to guide future discussions around equity and access within the University training clinics, and these audits of patient demographics should be conducted regularly to identify which population groups are underserved by the University eye care services. Across New Zealand, the evidence to date illustrates that eye care services are consistently less accessible to Māori and Pacific people.[11] Unfortunately, because ethnicity data was not recorded for over 80% of patients attending the clinic and is also not routinely collected for the patients seen during student externships, this analysis was unable to assess whether any ethnicity groups were underrepresented within the teaching clinic or which population groups students had worked with over their entire clinical training.

Similarly, the number of patients holding a Community Services Card (a population group who may benefit from subsidised eye care) could not be identified from this analysis as this information is not routinely collected for adult patients. Collecting more comprehensive demographic information from patients and monitoring access to the clinic will allow SOVS to assess its own performance in meeting the aims of the Pae Ora Act. A review of staff and student practices in collecting ethnicity information within the SOVS training clinics is currently underway with the long-term aim to standardise how this information is collected to maximise patient safety. Highlighting this issue here may encourage other eye clinics in New Zealand to undergo a similar exercise.

This study has several limitations. Without ethnicity data, the level of deprivation in the area in which each person lives was used to comment on the representativeness of the patient population, and this does not address the social determinants of health inequity experienced by people from particular ethnic groups, particularly Māori and Pacific people.[29] Broad comparisons were drawn between the three clinics without controlling for the passage of time or the effects of the 2020 COVID-19 lockdowns, as the main Grafton clinic was operational for the entire five-year period, the former Tāmaki satellite clinic for only one year in 2017, and Glen Innes community clinic during a six-week period during 2021.

The data from Tāmaki and Glen Innes clinics are intended only to illustrate the value of these outreach clinics. Finally, the patients accessing the Glen Innes community clinic were recruited as part of a door-to-door research survey in the area, were offered examinations and follow-up refractive error correction at no cost, and therefore the health seeking behaviour of these patients may vary if this service was provided without this direct recruitment approach.

In conclusion, SOVS is in a unique position to shape a future where eye care services are accessible to all New Zealanders. Beginning with self-reflection, this analysis shows that SOVS requires a greater focus on collecting demographic data from patients in a culturally safe manner, and this ongoing monitoring will help improve these services so that they are more accessible for underserved groups. Community outreach services that relocate eye care providers closer to the people who need them the most are an effective way of improving access to eye care.

However, for SOVS to routinely operate these types of services, financial support from central Government and The University of Auckland is required, and to allow changes to the pricing structure so that subsidised care is given to people who need it the most. These combined efforts across all levels of the eye care sector would set an example for future optometrists and embed a culture of equity and cultural safety into all aspects of education and clinical practice.

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No potential conflict of interest was reported by the author(s). GP is Clinical Director and LKG, JTR, PRKT and JR are employees of the School of Optometry and Vision Science.

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