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Supply-side determinants of cataract surgery output in South Africa

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Background: Cataracts are the leading global cause of blindness. Despite having an adequate number of ophthalmologists, South Africa has not achieved the World Health Organization (WHO) Vision 2020 target of 2000 cataract surgeries per million population annually.

Aim: This study aims to examine supply-side factors influencing cataract surgery output by exploring provider characteristics, perceived barriers, enablers and proposed strategies to increase surgical volume.

Setting: South Africa.

Methods: A cross-sectional survey was conducted on the 399 medically trained members of the Ophthalmology Society of South Africa (OSSA) between May 2024 and June 2024.

Results: The response rate was 19.7% (79/399). In 2023, nearly half of the respondents performed fewer than 200 cataract surgeries, while only 15% performed more than 500. Surgeons performing ≥201 surgeries were more likely to be male (prevalence ratio [PR] = 2.26; 95% confidence interval [CI]: 1.33–3.85), older, particularly 56–65 years old (PR = 5.00; 95% CI: 1.73–14.49), more experienced (>10 years: PR = 6.74; 95% CI: 1.78–25.48), qualified specialists (PR = 10.76; 95% CI: 1.61–72.10), full-time private-sector employed (PR = 4.50; 95% CI: 2.14–9.47) and performing phacoemulsification (PR = 1.35; 95% CI: 1.22–1.84). Common barriers to increased output included non-surgical responsibilities (28%), limited theatre time (25%), poor patient access (24%) and inconsistent consumable supplies (22%), particularly in the public sector. Respondents identified several enablers, such as adequate theatre staff (56%), dedicated eye theatres (49%), functioning equipment (43%) and motivated staff (41%). Proposed included improving theatre utilisation (24%), stabilising consumable supply chains (24%) and strengthening staff motivation (19%).

Conclusion: Cataract surgery rates (CSR) in South Africa remain suboptimal. Addressing provider-identified barriers, leveraging enablers and implementing targeted strategies may enhance surgical output.

Contribution: This study provides insights into supply factors affecting cataract surgery output in South Africa.

Keywords: cataract; South Africa; sub-Saharan Africa; cataract surgery output; cataract blindness.

Introduction

Globally, 295 million people live with moderate and severe visual impairment (MSVI), and 43 million are blind.[1] Cataracts are the leading cause of blindness and the second most common cause of MSVI.[1] Cataracts occur when the eye's normally clear lens becomes opaque.[2] The majority of cataracts are related to ageing and lead to progressive vision loss and blindness.[2] Surgery is the only effective treatment, replacing the opaque lens with an artificial intraocular lens, restoring vision.[2] More than 90% of blind people live in low- and middle-income countries (LMICs), highlighting socioeconomic inequality as a major contributing factor to cataract-related blindness.[3] Sub-Saharan Africa carries a disproportionate share of the global burden, with one of the highest prevalence rates of cataract-related blindness and the lowest density of ophthalmologists worldwide.[1,4] Population-based indicators for cataract surgery show low productivity in sub-Saharan Africa, largely reflecting the shortage of ophthalmologists in relation to the population.[5,6]

South Africa is a sub-Saharan African country with a population of 62 million,[7] and is classified as an LMIC by the World Bank.[8] However, South Africa has the highest income inequality in the

world, reflected by an approximate Gini coefficient of 0.67.[9] Currently, South Africa has parallel private and public health sectors. Most citizens rely on the public sector, with only 15.7% having access to medical aid coverage to use the private sector.[7] The *Vision 2020: Right to Sight* strategy recommended a target of 4 ophthalmologists per million population.[10] South Africa meets the target with 9.3 ophthalmologists per million people registered with the Health Professions Council of South Africa, although not all registered may be clinically active.[11] The Ophthalmology Society of South Africa (OSSA) represents approximately 65% of ophthalmologists in South Africa.[12] However, 85% of ophthalmologists who are OSSA members work in private practice.[12]

Although South Africa meets the *Vision 2020* workforce target, it is unclear whether the country has consistently met the *Vision 2020* target of 2,000 cataract surgeries per million people per year (Cataract Surgery Rate [CSR]).[10] Reported CSR figures appear to have declined over time, from 1226 per million in 2009[5] to 847 per million in 2015,[13] but the data exclude private sector output. No statistics about the private sector's cataract surgery output are publicly available. South Africa is transitioning from the parallel healthcare system to a universal healthcare coverage (UHC) model, specifically through the implementation of National Health Insurance (NHI),[14] which may increase the reported CSR because of the inclusion of the private sector's data. Barriers to performing cataract surgery are reported for both the patient demand and provider supply side in Africa.[6] Patient barriers reported include a lack of awareness about the surgery, limited access to services and patient acceptance of their condition as normal ageing.[6] In South Africa, the public sector faces long cataract surgical waiting lists and large backlogs, indicating substantial unmet demand.[5] Thus, increasing cataract surgical output cannot be achieved through demand generation alone. Supply-side determinants of cataract surgical output are understudied, and providers who work within the health system are uniquely positioned to offer practical insights to improve surgical output. Therefore, this study aimed to explore the supply-side determinants of cataract surgery output by examining provider characteristics and perceived barriers, enablers and strategies to increase surgical volume. Specifically, the study addressed three research questions: (1) What is the annual cataract surgery output among providers in South Africa? (2) Which provider-level factors are associated with higher surgical productivity and (3) What do providers identify as the key supply-side barriers, enablers and implementation strategies to increase cataract surgery volume?

Methods

Between May 2024 and June 2024, a cross-sectional study was conducted on all medically trained members of the OSSA. The 399 members consisted of ophthalmologists, registrars and ophthalmology medical officers. Ophthalmologists are specialists who have completed postgraduate training in ophthalmology and possess the most surgical experience. Registrars are doctors currently undergoing formal postgraduate training in ophthalmology. Ophthalmology medical officers are doctors working within ophthalmology departments who have completed undergraduate medical training. Thus, all medically trained members could potentially perform cataract surgery in South Africa. Participants were not excluded if they did not perform cataract surgery.

An online REDCap questionnaire was developed to collect data about the study objectives.[15,16] The questionnaire was self-administered, anonymous and available only in English. The questionnaire consisted of three sections with 48 questions in total. Demographic and employment environment data, 2023 cataract surgical output, barriers, enablers and implementation strategy data were collected. Cataract surgical output was collected as a categorical variable. The questionnaire was distributed internally by OSSA via email to eligible members. Each participant received an introductory message with a hyperlink to an informed consent form, followed by the questionnaire.

The questionnaire was reviewed by a South African-trained ophthalmologist who was not an OSSA member to enhance the validity of the questionnaire prior to the study's data collection. The experience question was revised to better capture surgical experience, as most participants likely began performing cataract surgery before starting their registrar training. Cataract surgical output was validated by whether the surgeon estimated the number of surgeries, reviewed personal records or reviewed their facilities' records. Only 2023's cataract surgery output was collected to reduce recall bias and minimise low output because of the coronavirus disease 2019 (COVID-19) pandemic.

The response rate was determined by dividing the number of participants who completed all three questionnaire sections by the total number of eligible OSSA members. Data analysis was performed on completed questionnaires using *R* statistical software version 4.2.2.[17] The minimum sample size required to achieve adequate statistical power for a finite population was 78 participants (population: 399; *Z*-score: 1.96; margin of error: 0.1; proportion: 0.5). This represented the minimum number for analysis rather than a recruitment target, as the study aimed to include all 399 members. Frequencies and percentages were used to summarise categorical variables. Continuous variables were summarised as means with standard deviations or medians with interquartile ranges (IQR) according to their data distributions. For further analysis, providers were stratified into two approximately even groups, 'lower' and 'higher' productivity groups relative to each other, by the number of cataract surgeries they performed in 2023 (≤ 200 and ≥ 201, respectively). The cut-off of 200 surgeries was selected arbitrarily to create two comparable groups for statistical analysis and to align with a previous study

that used the same threshold.[18] The Shapiro–Wilk test was used to determine if the data were parametric or nonparametric. The Wilcoxon Rank Sum Exact Test was used to determine which nonparametric continuous variables were associated with performing ≥201 surgeries ($p \leq 0.05$), whereas the Fisher's Exact and Pearson's Chi-squared Tests were used to determine which categorical variables were associated with performing ≥201 surgeries ($p \leq 0.05$). Barriers, enablers and implementation strategies were summarised as the percentage agreement among participants. The free-text responses were classified into the following categories: human resources, equipment, facilities, financial factors and patient-related factors. The responses could be categorised into more than one category.

Permission was obtained from OSSA's research committee to perform the research on its members. Participation was voluntary and anonymous, and there was no financial incentive for participation. These specifications were emphasised to promote honest responses and limit bias.

Ethical considerations

An application for full ethical approval was made to the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee, and ethics consent was received on 19 April 2024. The ethics approval number is HREC REF: 256/2024.

Results

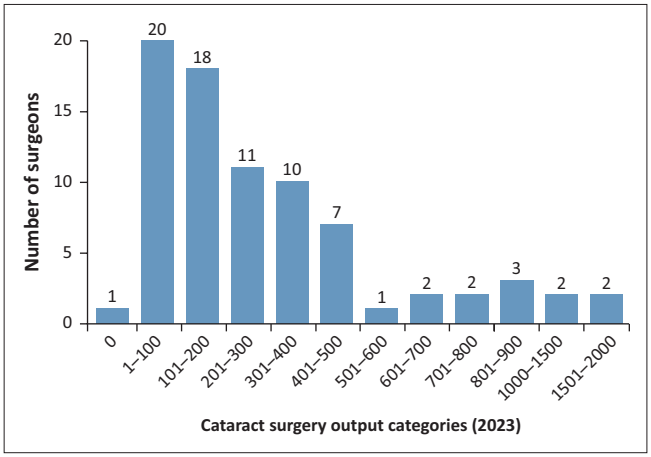
A total of 112 participants (28%) completed the questionnaire, of whom 79 (19.7%) completed all three sections and 33 submitted partial responses. Table 1 presents the demographic and professional characteristics of the sample. The sample's age ranged from 26 to 75 years. The gender distribution was 53% male and 47% female. The majority of the participants were qualified ophthalmologists (72%). Most participants (96%) worked in predominantly urban or peri-urban facilities, and nearly half of the participants (49%) were employed full-time in the private sector.

Objective 1: Determine the cataract surgery output per year among cataract surgery providers in South Africa

The number of cataract surgeries performed per surgeon in 2023 showed a right-skewed distribution (Figure 1). Among the 79 participants, 50% performed 200 or fewer cataract surgeries, and only 12 (15%) performed 500 or more surgeries in 2023. Two participants performed more than 1500 cataract surgeries. Both were experienced ophthalmologists with over 10 years of experience in private practice, one being male and the other female. Notably, one medical officer working in a rural district hospital performed between 801 and 900 cataract surgeries.

TABLE 1: Characteristics of the sample.

Characteristics	Overall, $N = 79$	
	n	%
Age category (years)		
26 – ≤ 35	20	25.0
36 – ≤ 45	21	27.0
45 – ≤ 55	17	22.0
56 – ≤ 65	19	24.0
66 – ≤ 75	2	2.5
Sex		
Male	42	53.0
Female	37	47.0
Qualification		
Specialist General Ophthalmologist	46	58.0
Sub-specialist Ophthalmologist (Performs cataract surgery)	11	14.0
Ophthalmology Registrar	15	19.0
Medical Officer	7	8.9
Employment type		
Full-time public sector	34	43.0
Full-time private sector	39	49.0
Part-time public and part-time private sector	6	7.6
Employment area		
Predominantly urban	61	77.0
Predominantly peri-urban	15	19.0
Predominantly rural	3	3.8



Note: Self reported cataract surgery output.

FIGURE 1: Number of Cataract Surgeons in Each Annual Cataract Surgery Output Category (2023).

Objective 2: Determine which factors were associated with higher cataract surgery output (≥ 201 cataract surgeries in 2023|)

Of the sample, 78 participants performed cataract surgery in 2023. Table 2 compares statistically significant provider and facility factors between two cataract surgery productivity groups in the sample: lower productivity (≤200) and higher productivity (≥201). Older surgeons, particularly those aged 56–65 years (PR = 5.00; 95% CI: 1.73–14.49), those with more than 10 years of experience (PR = 6.74; 95% CI: 1.78–25.48) and male surgeons (PR = 2.26; 95% CI: 1.33–3.85) were more likely to perform at least 201 cataract surgeries. This group was predominantly composed of qualified ophthalmologists (PR = 10.76; 95% CI: 1.61–72.10) working in full-time private practice (PR = 4.50;

TABLE 2: Provider and facility factors by number of cataract surgeries performed in 2023 (≤ 200 and ≥ 201), overall $N = 78$.

Characteristic	Number of surgeries								p^*
	≤ 200, $n = 38$				≥ 201, $n = 40$				
	n	%	Median	IQR	n	%	Median	IQR	
Age category (years)									**< 0.001**
26 – ≤ 35	16	42.0	-	-	3	7.5	-	-	-
36 – ≤ 45	10	26.0	-	-	11	28.0	-	-	-
45 – ≤ 55	8	21.0	-	-	9	23.0	-	-	-
56 – ≤ 65	4	11.0	-	-	15	38.0	-	-	-
66 – ≤ 75	0	0.0	-	-	2	5.0	-	-	-
Sex									**< 0.001**
Male	13	34.0	-	-	29	73.0	-	-	-
Female	25	66.0	-	-	11	28.0	-	-	-
Qualification			-	-			-	-	**< 0.001**
Specialist General Ophthalmologist	13	34.0	-	-	33	83.0	-	-	-
Sub-specialist Ophthalmologist	6	16.0	-	-	4	10.0	-	-	-
Ophthalmology Registrar	14	37.0	-	-	1	2.5	-	-	-
Medical Officer	4	11.0	-	-	2	5.0	-	-	-
Employment type			-	-			-	-	**< 0.001**
Full-time public sector	28	74.0	-	-	6	15.0	-	-	-
Full-time private sector	8	21.0	-	-	31	78.0	-	-	-
Part-time public and part-time private sector	2	5.3	-	-	4	10.0	-	-	-
Cataract surgery technique performed†,‡									
MSICS	29	74.0	-	-	17	43.0	-	-	**0.004**
Phaco	32	82.0	-	-	40	100.0	-	-	**0.005**
Experience performing cataract surgery (years)									**< 0.001**
0–5	18	47.0	-	-	2	5.0	-	-	-
5–10	5	13.0	-	-	7	18.0	-	-	-
> 10	15	40.0	-	-	31	78.0	-	-	-
Number of Cataract surgeons at the facility									**0.001**
1–4	8	21.0	-	-	16	40.0	-	-	-
5–9	1	2.6	-	-	10	25.0	-	-	-
≥ 10	29	76.0	-	-	14	35.0	-	-	-
Separate dedicated eye theatre	35	92.0	-	-	30	75.0	-	-	**0.038**
Surgical microscopes§									-
1 or more in working order	37	97.0	-	-	40	100.0	-	-	0.082
1 or more needing repair	5	13.0	-	-	1	2.5	-	-	**0.026**
Percentage time spent per week (%)†									-
Cataract surgery	-	-	15	10, 20	-	-	20	15, 27	**< 0.001**
Administrative tasks	-	-	20	10, 30	-	-	15	10, 20	**0.019**
Education of other cadres	-	-	10	4, 25	-	-	5	0, 10	**0.004**
In- and out-patient consultations	-	-	61	36, 78	-	-	60	46, 73	0.700

*, Wilcoxon rank sum exact test; Fisher's exact test; Pearson's Chi-squared test.

†, Medain (IQR); ‡, Manual Small Incision Cataract Surgery (MSICS), Phacoemulsification Cataract Surgery (Phaco); §, Participants could select more than one option (mark all that apply).IQR, interquartile range.

95% CI: 2.14–9.47) and performing phacoemulsification cataract surgery (PR = 1.35; 95% CI: 1.22–1.84). Key facility factors contributing to higher productivity included fewer than ten surgeons and no microscopes needing repair. In addition, these surgeons dedicated more time to surgeries and less to administrative and educational tasks than the lower productivity group. Unexpectedly, performing MSICS cataract surgery or having a dedicated eye theatre was statistically significantly associated with the lower productivity group.

Objective 3: Providers' views on perceived barriers, enablers and implementation strategies

Facility and equipment factors were the most agreed upon barriers to increasing cataract surgery output, with competing non-surgical responsibilities most frequently reported (Table 3). No barriers were reported by 24% of the sample, all working in the private sector. The public sector showed greater agreement for barriers related to human resources, equipment and facility factors compared to the private sector and dual employment ($p < 0.05$).

Table 4 ranks the categories in the 18 free-text responses about barriers. Excerpts of responses for barriers are listed in the Table 4. Facility factors were also the most frequently mentioned category in free-text responses, and barriers to patients accessing care were reported by private sector participants.

Human resources and equipment factors were seen as enablers for cataract surgery (Table 5). Having sufficient theatre support staff was the most widely recognised enabler.

TABLE 3: Barriers to increasing cataract surgery output – Overall and by employment type.

Barriers	Overall, N = 79		Employment type						p*
			Full-time public sector, n = 34		Full-time private sector, n = 39		Part-time public and private sector, n = 6		
	n	%	n	%	n	%	n	%	
No barriers experienced	19	24	0	0	19	49.0	0	0	**< 0.001**
Human resources									
Inadequate number of theatre nurses and support staff during cataract surgery	15	19	11	32	2	5.1	2	33	**0.004**
Equipment									
Broken or malfunctioning theatre equipment necessary for cataract surgery	10	13	10	29	0	0.0	0	0	**< 0.001**
A lack of consistent consumables supply, such as intraocular lenses	17	22	16	47	0	0.0	1	17	**< 0.001**
Facility									
A lack of theatre time allocated for cataract surgery	20	25	15	44	3	7.7	2	33	**< 0.001**
Competing non-surgical responsibilities (admin, research, education and clinical work)	22	28	12	35	8	21.0	2	33	0.300
Patients									
Patients' ability to access services is limited by financial, geographical or sociocultural barriers	19	24	4	12	14	36.0	1	17	0.052
Other	15	19	6	6	8	21.0	1	17	> 0.900

*, Fisher's exact test; Pearson's Chi-squared.

TABLE 4: Ranked categories of free-text responses for barriers.

Barriers	Excerpts of responses	Overall, n = 18
Facility	'System failures: loadshedding/generators, linen shortages, admin delays with issuing of files, staff - slow turnaround time between cases, sometimes no porters to bring patients from the ward to theatre, ward delays with prep of cases'.	8
Human resources	'Apathy of nursing and general theatre staff - late arrivals, slow starts in theatre and very slow changeover times, cancellations when there is any danger of the lists continuing past 4 pm'.	6
Financial	'Patients without funding for care in private; limits to the number of pro bono cases that can be accommodated'.	4
Patient factors	'Not enough patients requiring surgery?'	1
Equipment	'Lacking staff, equipment, theatre time. Too much other work'.	1

TABLE 5: Enablers for cataract surgery output – Overall and by employment type.

Enablers	Overall, N = 79		Employment type						p*
			Full-time public sector, n = 34		Full-time private sector, n = 39		Part-time public and private sector, n = 6		
	n	%	n	%	n	%	n	%	
No enablers experienced	7	8.9	1	2.9	6	15.0	0	0	0.200
Human resources									
Having an eye services manager	8	10.0	6	18.0	2	5.1	0	0	0.200
Adequate number of theatre nurses and support staff during cataract surgery	44	56.0	18	53.0	23	59.0	3	50	0.800
Adequate number of medically trained cataract surgery providers	19	24.0	13	38.0	5	13.0	1	17	**0.030**
Having staff who are motivated to perform cataract surgery	32	41.0	14	41.0	15	38.0	3	50	0.900
Equipment									
Having an adequate amount of instrument sets to reduce delays because of sterilisation between cases	33	42.0	11	32.0	18	46.0	3	50	0.500
Having the necessary working theatre equipment for cataract surgery	34	43.0	9	26.0	23	59.0	2	33	**0.018**
Facility									
Having a dedicated eye theatre	39	49.0	17	50.0	18	46.0	4	67	0.700
Performing cataract surgery at outreach cataract surgery camps	16	20.0	11	32.0	4	10.0	1	17	**0.049**
Patients									
Patient demand for cataract surgery is more than the facility's capacity to supply cataract surgery	15	19.0	12	35.0	2	5.1	1	17	**0.003**

*, Fisher's exact test; Pearson's Chi-squared.

The public sector viewed a sufficient number of cataract surgeons and high patient demand as key enablers compared to the private sector and dual employment ($p < 0.05$). The private sector was more likely to report having functioning theatre equipment as an enabler ($p < 0.05$). The public sector's agreement on performing cataract surgery at outreach camps as an enabler was borderline statistically significant compared to the private sector and dual employment ($p = 0.049$).

Equipment and facility strategies were the most frequently recommended to increase cataract surgery output (Table 6). Sixteen per cent of the sample had no opinion on strategies, which was significantly more common in the private sector than in the public sector. The public sector showed greater agreement for securing a stable supply of intraocular lenses, increasing theatre time and improving staff motivation as strategies to increase cataract surgery output compared to the private sector and dual employment ($p < 0.05$). The private sector was more likely to agree on increasing patient demand for cataract surgery than the public sector, which was also reported in the free-text responses.

TABLE 6: Implementation strategies for cataract surgery output – Overall and by employment type.

Implementation strategies	Overall, $N = 79$		Employment type						p^*
	n	%	Full-time public sector, *n* = 34		Full-time private sector, *n* = 39		Part-time public and private sector, *n* = 6		
			n	%	*n*	%	*n*	%	
No opinion about strategies	13	16.0	2	5.9	11	28	0	0	**0.023**
Human resources									
Improve staff motivation to perform or increase the number of cataract surgeries	15	19.0	12	35.0	3	7.7	0	**0**	**0.006**
Task shifting of non-surgical responsibilities to other cadres	12	15.0	6	18.0	5	13.0	1	17	0.900
Equipment									
Acquire a stable supply of consumables such as intraocular lenses	19	24.0	18	53.0	1	2.6	0	0	**< 0.001**
Facility									
Increase theatre time for cataract surgery	19	24.0	11	32.0	6	15.0	2	33	0.200
Perform more cataract screening outreach to refer to the base hospital	8	10.0	2	5.9	6	15.0	0	0	0.300
Perform more cataract screening as well as cataract surgery outreach	4	5.1	1	2.9	3	7.7	0	0	0.700
Financial									
Financial incentives per cataract surgery performed	10	13.0	5	15.0	5	13.0	0	0	> 0.900
Patients									
Strategies to increase patient demand for cataract surgery	6	7.6	0	0.0	5	13.0	1	17	**0.047**

*, Fisher's exact test; Pearson's Chi-squared.

Discussion

This study explored the supply-side determinants of cataract surgery output in South Africa by examining provider characteristics and perceived barriers, enablers and strategies to increase surgical volume. Nearly half of participants performed 200 or fewer cataract surgeries in 2023, with only 15% exceeding 500. Factors associated with higher surgical productivity (≥201 cataract surgeries performed in 2023) included male gender, greater surgical experience, private sector employment, use of phacoemulsification and reduced time spent on non-surgical duties. Commonly reported barriers included non-surgical duties, limited theatre time and inconsistent consumable supplies, with the public sector facing more challenges than the private sector. Enablers were sufficient theatre staff, dedicated theatres, necessary equipment and consumables and motivated teams, with the public sector benefiting from higher patient demand. Participants recommended securing stable consumable supplies, increasing individual theatre time and boosting staff motivation as strategies to improve cataract surgical output.

The study's low surgeon cataract surgery output is consistent with other Sub-Saharan African countries. In a multi-country study, only 20% of ophthalmologists performed more than 500 cataract surgeries annually, with no participants from Zambia exceeding this number.[19] In contrast, high-volume centres such as Aravind Eye Care in India report that 67% of ophthalmologists perform over 500 surgeries per year and 20% exceed 2000.[20] Previously, *Vision 2020: Right to Sight* set the target of 500 or more cataract surgeries per surgeon per year to address cataract blindness.[21] The current World Health Organisation's *Eye Care in Health Systems: Guide for Actio*n emphasises broader goals for integrating eye care into health systems and has a recommended list of eye care indicators to be collected but did not set targets for these indicators.[22] Despite the transition beyond *Vision 2020*, its targets are still useful for guiding efforts to reduce preventable blindness. Performing at least 350 cataract surgeries per year has been associated with improved visual outcomes after surgery compared to surgeons performing fewer surgeries, indicating that increasing surgical output also leads to better outcomes.[18]

Our study reports several demographic and facility factors statistically significantly associated with the higher productivity group (≥201 cataract surgeries performed in 2023). Greater surgical experience was associated with the higher productivity group and correlates with other studies, which reported increased cataract surgical output.[19,20] Male gender was associated with the higher productivity group, consistent with previous studies.[23,24] However, this likely reflects confounding factors, as male participants were generally older, more experienced and more often worked in the private sector in our study. Notably, one of the two most productive surgeons in the study was female. Surgeons practising in the private sector were more likely to perform ≥201 cataract surgeries, possibly reflecting the substantially greater availability of theatre time, functioning equipment, consumables and support staff in private facilities. These resource advantages are consistently associated with higher cataract surgery output in Africa.[18,25] Higher productivity surgeons in the sample surgeries spend more time operating than those in the lower productivity group. Although the difference in time spent doing other tasks was not statistically significantly less, freeing up time to perform more surgeries leads to higher output. The Aravind model uses task shifting of non-clinical responsibilities to other cadres to increase cataract surgical output.[26] Phacoemulsification cataract surgery was associated with the higher productivity group. Because trainees initially perform MSICS before progressing to phacoemulsification, the higher productivity linked to phacoemulsification is probably confounded by surgical experience. However, the *Lancet Commission on Global Eye Health* recommended that low-resource settings continue using the MSICS cataract surgery technique because of its lower cost than phacoemulsification.[3] In many African countries, only half of surgeons have access to

phacoemulsification.[19] In contrast, 92% of South African participants use this technique, reflecting better resource availability. Unexpectedly, a dedicated eye theatre was not associated with a higher cataract surgical productivity group. This may reflect the high baseline access within the sample, as 83% reported having a dedicated theatre compared to 57% in a previous study showing a positive association.[18] The widespread availability of such facilities suggests comparatively better infrastructure in South Africa, yet providers continue to face barriers similar to those elsewhere in Africa.

Previous reported barriers for cataract surgery on the continent focused on patient factors and are mainly based on the Rapid Assessment of Avoidable Blindness methodology.[6] The top three barriers reported by providers in Africa were patients' distance to a cataract facility, a lack of cataract surgery facilities and a lack of equipment for surgery.[19] The provider barriers reported in our study are consistent with barriers previously reported in relation to the low CSR in South Africa: insufficient theatre time, consumable supply chain issues and shortage of ophthalmic nurses, and surgeons performing non-surgical work.[5] However, previously reported shortages of cataract surgeons[5] had low agreement as barriers in our study. In our study, only 7.6% of participants reported a shortage of surgeons as a barrier. Participants in facilities with more than ten cataract surgeons were more likely to perform fewer surgeries, likely because of competition for theatre time. South Africa's relatively high ophthalmologist-to-population ratio compared with other sub-Saharan countries may also explain why a shortage of surgeons was not viewed as a major issue.[4,11] The lack of a stable consumable supply and equipment was a key barrier reported in our study and a known challenge for cataract surgery in LMICs and Africa.[3,19,27]

The enablers and implementation strategies suggested to align with overcoming the barriers participants encountered. A systematic review of interventions for increasing cataract surgery uptake in LMICs reported conducting awareness campaigns, eliminating direct and indirect patient costs, using successfully operated individuals as champions, conducting community outreach and high-quality surgical outcomes.[28] These strategies target increasing demand for the service. A 2017 study reported that capacity-building interventions increased cataract surgeries per surgeon by 54% overall and by 131% in participating African hospitals after 4 years.[29] The capacity-building interventions were a needs assessment visit, a vision-building workshop with a strategic and action plan, ongoing consultation to improve services and monitoring key performance indicators.[29] Thus, addressing specific health system barriers can increase cataract surgical output. Participants recommended increasing theatre time to increase cataract surgery output. A 2023 study reported 62% theatre utilisation and a 16% case cancellation rate at a South African tertiary ophthalmology hospital, mainly because of limited theatre time and equipment shortages.[30] Improving existing theatre efficiency may improve cataract surgical output. Staff motivation was reported as an enabler and strategy to increase productivity. The public and private sectors are remunerated differently, which may act as a financial incentive. In the public sector, employees receive a fixed salary irrespective of the number of cataract surgeries performed. Employees in the private sector are reimbursed per surgery performed. Providers in other African countries have indicated that the private sector provides the best financial reimbursement model for incentivising productivity.[19] South Africa's private sector has the capacity to increase cataract surgery output, as demonstrated by the low number of patients on the waiting list and short waiting times for cataract surgery. The reported national CSR is an underestimate, as it excludes private-sector activity. International experience supports the potential impact of UHC. In Thailand, CSR increased markedly when private-sector capacity was incorporated into national financing, with private providers delivering almost 80% of cataract surgeries.[31] Therefore, transitioning to NHI may improve cataract surgery output in South Africa by increasing patient access to the private sector. However, UHC alone does not guarantee improved access. In Rwanda, only 60% of insured patients attended their cataract surgery appointments.[32] Thus, even in a UHC setting, patients still experience barriers such as indirect costs or co-payments, a lack of an escort and insufficient information about the appointment.[32]

Unexpectedly, patients' barriers to accessing cataract surgery services had low agreement among public sector participants as a barrier for increasing cataract surgery output. Public sector participants also reported demand exceeding the facility's capacity as an enabler for cataract surgery. Although there is significant demand in the public sector, patients likely face similar barriers to care as those reported in other African countries.[6] Most participants (96%) worked in urban or peri-urban areas, similar to other African countries where ophthalmologists are concentrated in major cities.[21] This urban clustering reflects South Africa's centralised public health system, where specialists are employed in tertiary and regional hospitals and the greater financial viability of private practice in densely populated areas. The majority of the rural population don't have permanent eye services and rely on outreach cataract surgery camps for surgery.[33] Despite this, outreach cataract surgery camps and providing transport for patients to the hospital for cataract surgery received low support from participants. Outreach camps and patient transport to the hospital for surgery have been key strategies to increase cataract surgery output and coverage in LMICs and Africa.[18,19,26] Non-surgical duties were commonly cited as barriers, but task-shifting these responsibilities, a strategy shown to increase output in the Aravind model,[26] was not widely endorsed. Furthermore, financial incentives per cataract surgery had low agreement as a strategy for increasing cataract surgery. Other providers in Africa have reported that their current financial reimbursements did not incentivise individual or support staff productivity.[19]

Study's limitations

This study has several limitations. The cross-sectional design cannot establish causality or the directionality of associations. The study used non-randomised sampling, which limits the generalisability of the results to the sample. Furthermore, OSSA only represents two-thirds of ophthalmologists in the country. This, coupled with the study's low response rate, may have resulted in an under-represented group of providers. Non-response bias is possible, as respondents differed from the full OSSA population: they were less often male (53% vs 72%) and more frequently worked in the public sector (43% vs 14%). This suggests over-representation of public-sector and female clinicians, which should be considered when interpreting the findings. Furthermore, the findings may have limited generalisability beyond OSSA-affiliated providers. Only 42% of the participants confirmed their cataract surgery output using records. The remaining 58% of participants estimated their cataract surgery output. Thus, self-reported figures may not accurately reflect actual surgical output. Furthermore, half of the sample worked in facilities where ten or more surgeons performed cataract surgeries, suggesting facility cluster responses, which further limits the study's generalisability. Despite the low response rate, the number of participants (n = 79) met the minimum required sample size of 78 for statistical analysis. However, the low response rate does limit the statistical analysis, as non-parametric tests were needed, resulting in lower precision than parametric tests on a larger sample.

Conclusion

The study highlights the importance of incorporating providers' views of barriers, enablers and implementation strategies to inform health system interventions to increase CSRs. Despite several limitations, the study revealed that cataract surgery output per surgeon in South Africa is low, identified possible reasons contributing to this based on providers' perspectives on barriers, and proposed solutions through enablers and implementation strategies.

Based on our findings, we recommend that key stakeholders engage in discussions with providers to address barriers, advance the proposed enablers and implement suggested strategies to improve cataract surgery in the country. For implementation, recommendations can be organised by feasibility. Short-term measures include improving theatre efficiency, stabilising consumable supply chains and reducing non-surgical duties. Medium-term measures involve strengthening equipment maintenance systems and addressing theatre staff shortages. Long-term measures possibly include integrating the private sector capacity to increase the national CSR through appropriate future implementation of UHC reforms.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

CRediT authorship contribution

Charl F. Marais: Conceptualisation; Formal analysis; Investigation; Methodology; Project administration; Visualisation; Writing – original draft. Robert Geneau: Conceptualisation; Supervision; Writing – review & editing. Deon Minnies: Conceptualisation; Methodology; Supervision; Writing – review & editing. All authors reviewed the article, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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Data availability

The data that support the findings of this study are not openly available because of the confidentiality of participants and are available from the corresponding author, Charl F. Marais, upon reasonable request. The data are securely stored on the University of Cape Town's REDCap server.

Disclaimer

The views and opinions expressed in this article are those of the authors and are the product of professional research. They do not necessarily reflect the official policy or position of any affiliated institution, funder, agency or that of the publisher.

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