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Access to Cataract Services and the Eye Care System in Turkana County, Kenya: A RAAB-HSM-Based Situational Analysis

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Abstract
Background: Access to eye care remains limited in low- and middle-income countries, particularly in rural and arid regions such as Turkana County in Kenya. The 2023 Turkana RAAB reported 6.6% blindness among adults aged ≥50 years, with cataract as the leading cause. Cataract surgical coverage (CSC) was 40.2%, while effective CSC (eCSC) was only 6.2%.
Objectives: To evaluate Turkana's eye health system and services for cataract, refractive error, and diabetic retinopathy; compare postoperative cataract outcomes with the 2023 RAAB; and assess patient-reported access to cataract services at Lodwar County Referral Hospital.
Methods: A situational analysis using the pilot RAAB Health Systems Module was conducted in 13 facilities in 2023. Facility data were combined with interviews of 50 cataract patients at Lodwar County Referral Hospital in July 2024. Descriptive statistics and RAAB7 comparisons were applied.
Results: The cataract surgical rate was 781/million. Only 16.5% of operated eyes achieved ≥6/12 vision, compared with 23.8% in RAAB7. Median waiting time was 90 days. Refractive coverage was 0%, with only six distance spectacles dispensed in 2023. Diabetic retinopathy screening was available at two hospitals, but treatment was unavailable. Although 60% of patients accessed care within an hour, transport, accommodation costs, and low insurance coverage (37.5%) hindered access.
Conclusion: Turkana requires increased surgical capacity, improved outcomes, expanded refractive and diabetic retinopathy services, equitable distribution, quality monitoring, and stronger financing mechanisms.
Keywords: Cataract surgery; eye health systems; Turkana County; RAAB-HS; refractive error; diabetic retinopathy
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Introduction

Worldwide, 2.2 billion people are affected by vision impairment and blindness, with at least 1 billion cases being preventable or left untreated [(1).] The leading causes are uncorrected refractive errors and cataracts.

The Rapid Assessment of Avoidable Blindness (RAAB) is a population-based survey that supports eye care planning and evaluation (2). The RAAB survey was conducted in Turkana in October 2023 (2). Show an overall extrapolated prevalence of 6.2%, with the age-gender weighted prevalence of blindness was 6.6% among people aged 50 and above (95% confidence interval 4.9-7.5%). Cataract was the leading cause of blindness (57.3%) 48.0% of moderate vision impairment, and 24.2% of mild vision impairment.

Two core indicators in the Eye Care Indicator Manual (ECIM) are effective cataract surgical coverage (eCSC) and effective refractive coverage (eREC) (McCormick et al., 2020). Cataract surgical coverage (CSC) is the number of patients operated on for cataracts in a given population, expressed as a proportion of all people who have undergone surgery or are still requiring surgery. Adequate cataract surgical coverage (eCSC) is the proportion of patients in a population who have undergone cataract surgery and achieved a good outcome (at least 6/12 post-operative presenting VA) among all patients operated on or still requiring surgery. eREC, which is the proportion of people needing refractive error services who have received services and have had good-

quality outcomes, describes the quality, availability, and accessibility of refractive services in defined areas. WHO global targets for eREC and eCSC are 40% and 30% increases by 2030, respectively, covering both coverage and quality of care. (3)

In Turkana County, eCSC was 6.2% at the 6/12 cataract surgical threshold, while CSC was 40.2%. The quality gap was 34%, which is calculated as a difference between CSC and eCSC, and the relative quality gap shows the proportion of operated cases with poor outcomes, which standardizes the quality problem across settings, calculated as the percentage difference between the CSC and eCSC; the relative quality gap was 84.5%, indicating a higher rate of poor outcomes.

Refractive errors

Addressing uncorrected refractive errors in low- and middle-income countries involves providing comprehensive refraction services and integrating them into public eye care delivery. This approach ~~includes~~ offering refraction services and dispensing spectacles at primary and secondary levels, where communities have the most access (World Health Organization, 2022**).** Achieving this requires trained personnel to perform patient refractions, provide counselling, and dispense spectacles using functional equipment. It is also essential to ensure that spectacles are affordable to these communities.

In 2020, uncorrected refractive error emerged as the primary cause of moderate-to-severe vision impairment worldwide. (5). It affected an estimated 157 million out of 295 million individuals with impaired vision, displaying a visual acuity of <6/18 to 3/60 in their better eye. (4). Effective refractive error coverage (eREC) refers to the percentage of individuals requiring refractive error services who have successfully received services, lenses, or refractive surgery with VA of 6/12 or better In the global monitoring of eREC spectacle coverage for near and distance vision impairment, the 74th World Health Assembly advises that countries with an initial eREC rate of 60% should aim for universal coverage. (6).

In Kenya, approximately 6.39% of the population is estimated to suffer from uncorrected refractive errors (7) 90% of eye care facilities offering refractive error services are in urban areas, leaving rural areas underserved imbalance limits the accessibility of refractive error services across different economic sectors.

The current state of refractive error services in Kenya needs strengthening, as the government relies heavily on conventionally trained personnel rather than specialists. (8) This situation calls for a shift towards skill development and task shifting to strengthen the public Health system.

Diabetic Retinopathy

Diabetic retinopathy (DR) is a microvascular complication of both type 1 and type 2 diabetes that can result in vision loss. (9). The prevalence of diabetic retinopathy among individuals with diabetes varies globally, with rates ranging from 13% in South and Central America (4.5 million cases) to 36% in Africa (10). It is essential to ensure effective, high-quality service delivery for diabetic retinopathy globally. Despite the cost-effectiveness of screening and preventing blindness from diabetic retinopathy, there are significant gaps in screening, diagnosis, referral, treatment, and follow-up. (11) Measures to prevent vision loss from DR comprise successful primary and secondary prevention, including early identification through screening for diabetes and efficient management when it is diagnosed, through strict sugar control. Patients who consistently receive diabetes care according to guidelines have a lower risk of vision impairment and blindness. (12)

Overview of the eye health system in Turkana County

In Kenya, eye health services are unevenly distributed, with most concentrated in urban areas, leaving rural and marginalized regions underserved. Turkana County, located in the arid northwest region of Kenya, faces additional challenges, including poverty, limited healthcare infrastructure, and rugged terrain.

Structure of the Eye Health System in Turkana County

1. County Level – Ophthalmic Services Department

At the county level, the **Ophthalmic Services Department** provides overall leadership and strategic direction for eye health services. It is responsible for planning, coordinating, and managing eye care programmes across the county. The department oversees the development and implementation of eye health activities, facilitates training and capacity building of eye health personnel, coordinates the distribution of equipment and other eye health resources, collects and manages eye health data, and monitors the quality of services provided. The **County Eye Health Coordinator** provides technical leadership and supervises the implementation of eye health activities across all sub-counties.

2. Sub-County Level – Sub-County Eye Care Coordination

At the sub-county level, **Sub-County hospitals and designated eye clinics** serve as important points for the delivery of eye care services. Each sub-county has a **Sub-County Eye Care Coordinator** who coordinates and

supervises eye health activities within the sub-county. The coordinator links the county-level ophthalmic services department with health facilities, supports implementation of eye health programmes, monitors service delivery, facilitates reporting and data flow, and identifies gaps in human resources, equipment, supplies, and other service requirements.

3. Health Facility Level – Service Delivery

At the health facility level, eye health services are delivered through **sub-county hospitals, eye clinics, and other designated health facilities** by trained eye health personnel. These facilities provide services such as eye screening, diagnosis and management of common eye conditions, refraction and spectacle services, treatment, referral, and follow-up. Health facilities also collect and submit eye health data to the sub-county and county coordination structures and participate in outreach and community-based eye health activities.

4. Community Level – Outreach, Screening and Referral

At the community level, eye health services are supported through **community health structures, outreach programmes, and linkages with health facilities**. Community-level activities focus on health education, identification and screening of people with eye problems, referral of patients requiring further assessment or treatment, and follow-up. This level is particularly important in Turkana because of the county's large geographical area and dispersed population.

RAAB-HS Assessment of Eye Health Service Delivery in Turkana County

The Rapid Assessment of Avoidable Blindness Health Systems (RAAB-HS) module is an extension of the standard RAAB survey designed to assess the capacity of health systems to deliver eye care services. The module evaluates important components of eye health service delivery, including human resources, infrastructure, equipment availability, service organization, financing mechanisms, referral pathways, and access to essential medicines and surgical supplies. This study applied the pilot RAAB Health Systems HS module to assess the strengths and gaps in eye health service delivery in Turkana County, and compared cataract surgery outcomes with RAAB survey 2024 findings. It explored patient-reported access to cataract surgery at Lodwar County Referral Hospital, focusing on travel time, transport options, and costs. The findings aim to provide evidence to guide eye health planning and improve access to essential services in rural and underserved regions of Turkana and Kenya.

Problem statement/Rationale

The burden of avoidable blindness in Turkana County is primarily driven by inadequate access to essential eye care services, particularly cataract surgery, refractive error correction, and screening and treatment for diabetic retinopathy. Although the 2023 Rapid Assessment of Avoidable Blindness (RAAB) survey documented a high prevalence of blindness and visual impairment in the county, the findings did not sufficiently explain how weaknesses within the local health system contribute to poor service coverage and outcomes. To be specific, there is limited information on surgical capacity, equipment, referral systems, financing, and patient-level barriers that affect access to eye care services. This gap in evidence limits the ability of county health planners and partners to design targeted interventions and allocate resources well. By applying the RAAB health systems module alongside patient perspectives, this study seeks to identify critical service delivery gaps and barriers to access, thereby generating evidence to inform strategies to strengthen eye health services in underserved settings.

Aim

To assess Turkana County eye health system and services provision for cataract, refractive error, and diabetic retinopathy and describe patient self-reported access to cataract surgery in terms of travel time, modalities, and cost at Lodwar County Referral Hospital.

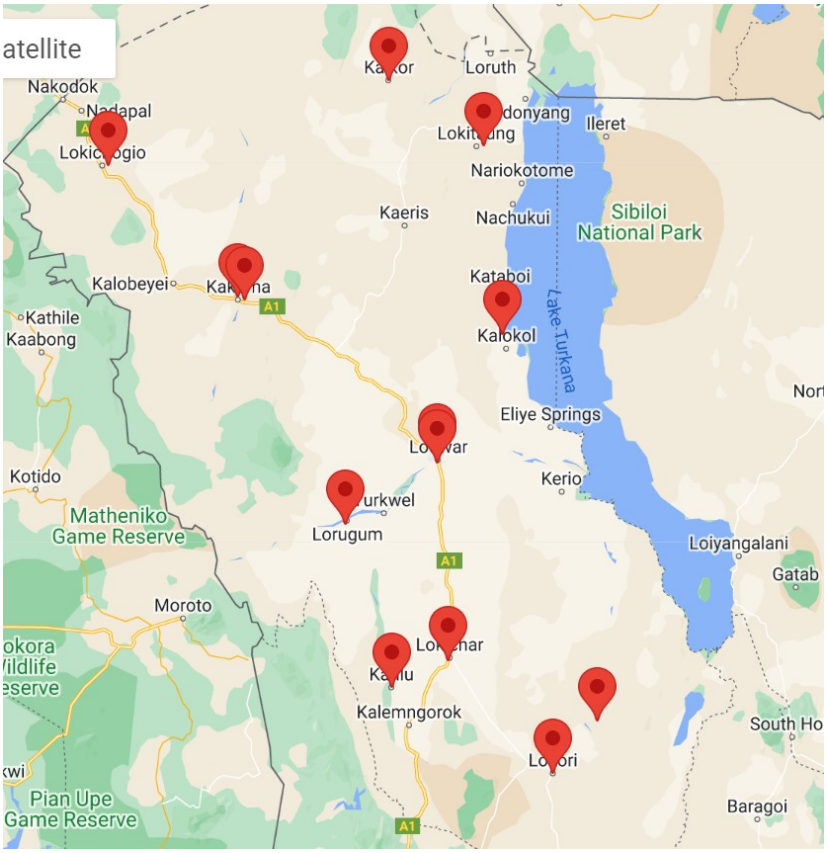
Objectives

1. To conduct a rapid situational assessment of the eye health system and service delivery in Turkana County, using the pilot Eye Health Systems and Services Assessment template developed under the RAAB project.
2. To compare facility and RAAB estimates from the Turkana RAAB survey 2023 on cataract post-operative visual acuity outcomes.
3. To describe patient self-reported travel time and modalities to access cataract surgical services among patients attending Lodwar County Referral Hospital.
4. To describe the cost of cataract surgical services (travel and surgery cost) among patients attending Lodwar County Referral Hospital.

Materials and Methods

Study design and setting

A cross-sectional situational analysis was conducted in Turkana County, Kenya, between July and August 2024. The study focused on cataract, refractive error, and diabetic retinopathy services across public, faith-based, and private facilities (data from January to December 2023), complemented by patient interviews at Lodwar County Referral Hospital (LCRH).



a. **Figure 1: Map of Turkana County with the location of health Facilities**

Health Systems Assessment.

The pilot RAAB health systems HS module was used in 13 eye health facilities to collect data on service availability, infrastructure, human resources, and service provision. Facility managers and eye health coordinators were trained to use the tool to collect data, and the data was verified during site visits. Facility managers received soft copies of the templates in advance of the investigator's site visits to help them familiarise themselves with the document.

Before the assessment, the Eye Health Coordinator and managers of the eye units/clinics participated in a training session to familiarise themselves with the pilot RAAB Health Systems (RAAB-HS) module. The training aimed to ensure a common understanding of the assessment tool, its indicators, and the procedures for collecting and documenting information on eye health service delivery. The RAAB-HS module provides a standardised framework for assessing key components of the eye health system, including service delivery, infrastructure, equipment, human resources, service organisation, and availability of essential supplies.

Following the training, the RAAB-HS module was applied systematically across **13 eye health facilities in Turkana County** to assess the capacity and readiness of the facilities to provide eye health services. The use of a standardised assessment tool across all 13 facilities facilitated consistent data collection and enabled

comparison of eye health system capacity, service availability, infrastructure, staffing, equipment, and other essential components of service delivery across the county.

Patient survey

At Lodwar County Referral Hospital (LCRH), a patient-level survey was conducted among patients who were awaiting cataract surgery or had recently undergone cataract surgery. The survey was administered by the researcher using an electronic questionnaire developed on the Open Data Kit (ODK) platform. A total of 50 patients were interviewed. The survey was conducted during the period of the eye health systems assessment, with eligible patients approached at the hospital and interviewed individually after providing informed consent.

The questionnaire collected information on patients' access to cataract surgery, including the distance and time travelled to reach LCRH, modes of transport used, direct and indirect costs incurred in accessing care, and insurance coverage. The information was collected directly from patients to document their reported experience of accessing cataract surgical services and to identify potential financial and geographical barriers to care.

Data management and analysis

Data management and analysis

Raw field data were collected electronically via the KoBoToolbox (version 2.025) platform, enabling real-time capture of patient and service information from health facilities and outreach activities. The collected datasets were then cleaned, validated, and analyzed using IBM SPSS(version 29.0) Statistics to generate descriptive statistics and compare surgical performance indicators with the RAAB survey benchmarks.

Facility data and patient survey responses were entered into electronic templates and analyzed descriptively. Cataract surgical outcomes were compared against Turkana's 2023 RAAB survey estimates. Indicators included the cataract surgical rate CSR, cataract surgical coverage (CS), effective Cataract Surgical coverage (eCSR), and effective refractive coverage (eREC).

Ethical Considerations and Consent

Ethical approval for the study was obtained from the London School of Hygiene and Tropical Medicine Ethics Committee and the Moi University Institutional Review Board. Permission to conduct the study was obtained from the Turkana County Ministry of Health and the administration of Lodwar County Referral Hospital (LCRH).

Before participation, each eligible patient was provided with information about the study, including its purpose, procedures, the type of information to be collected, the expected duration of the interview, potential benefits and risks, and their rights as participants. The information was explained in a language that the participant understood, and where necessary, translation and interpretation into the appropriate local language was provided to ensure adequate understanding. Participants were given an opportunity to ask questions and seek clarification before deciding whether to participate.

Participants were informed that participation was entirely voluntary and that they could decline to participate or withdraw from the study at any time without providing a reason. They were also explicitly informed that their decision to participate or not participate would **not affect the eye care or other health services they would receive at the facility**, including access to cataract surgery or other services for which they were eligible. Written informed consent was obtained from all participants before data collection commenced.

Results

Health facility Service Availability.

The assessment identified 13 eye health facilities in Turkana County, comprising 2 hospitals, 11 eye clinics, and 2 private institutions, in addition to two optical shops. The hospitals provided a range of eye health services, including cataract surgery, refraction, spectacle services, and diabetic retinopathy screening. Cataract services were provided regularly in some facilities and intermittently through surgical camps in others. Refraction services were available regularly in most facilities, while spectacle services were regularly available across the assessed facilities.

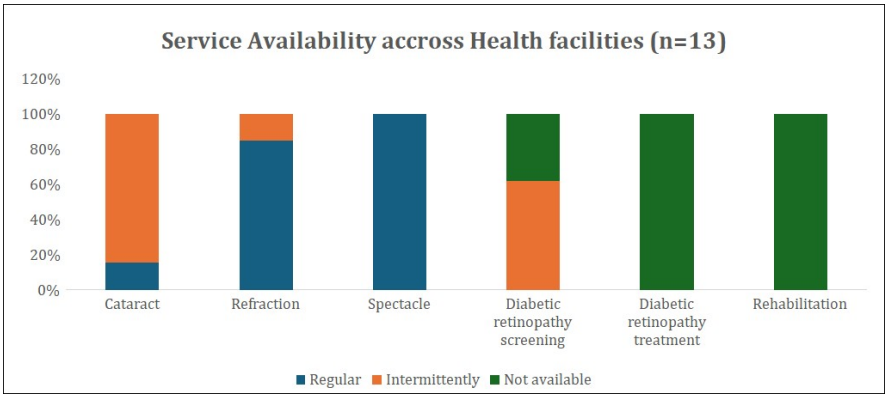


Figure 2: Service availability across Health facilities

Figure 2 presents the availability of key eye health services across the health facilities in Turkana County. Cataract services were available regularly in only 15.4% (2/13) of the facilities, while 84.6% (11/13) provided cataract services intermittently, largely through periodic surgical camps. This indicates limited access to routine, facility-based cataract surgery across the county, with Lodwar County Referral Hospital (LCRH) serving as the only permanent centre for cataract surgery.

Refraction services were regularly available in 84.6% (11/13) of facilities, while 15.4% (2/13) offered the service intermittently. Spectacle services showed the highest level of regular availability, with all 13 (100%) facilities reporting that the service was regularly available.

For diabetic eye care, diabetic retinopathy screening was regularly available in none of the facilities. It was provided intermittently in 61.5% (8/13) of facilities, while 38.5% (5/13) had no diabetic retinopathy screening service. Diabetic retinopathy treatment was unavailable in all 13 (100%) facilities. Similarly, low-vision rehabilitation services were unavailable in all 13 (100%) facilities.

Human Resource for eye health

The assessment found that Turkana County had two ophthalmologists, two optometrists, four clinical officers, and 11 ophthalmic nurses. This corresponded to an ophthalmologist-to-population ratio of 1.77 per million population.

Table 1: Number of eye care workers in Turkana County

Cadre	Public	Private	Total Existing HREH*	Expected WHO+ HREH*	HReH Ratio per million
Ophthalmologist	2	0	2	5	1.77
Optometrist	2	0	2	5	1.77
Clinical officers/CS/OCO	3	1	4	10	3.54
Ophthalmic nurse	10	1	11	20	9.73
Ophthalmic Assistant	4	0	4	20	3.54
Mean	**4.2**	**0.4**	**4.6**	**12.0**	**4.07**

Notes:
*HREH = Human Resources for Eye Health.
†WHO = World Health Organization.
CS = Clinical Specialist; OCO = Ophthalmic Clinical Officer.

Cataract services

Table 2: Number and type of cataract surgery in Turkana County, 2023

Health facilities	Phaco*		SICS+		Other non-cataract surgeries#		Total
	Male	Female	Male	Female	Male	Female	
Lodwar Eye Unit	0	0	117	132	81	55	385
Katilu Eye Clinic	0	0	78	61	14	3	156
Lokitang Eye Unit	0	0	54	75	19	7	155
Kakuma Eye Clinic	0	0	53	59	14	14	140
Lokori Eye Clinic	0	0	44	46	4	10	104
Lorugum Eye Clinic	0	0	36	33	0	0	69
Lopiding Eye Clinic	0	0	25	19	3	5	52
Amusait Hospital	0	0	34	16	0	0	50
Kaikor Eye Clinic	0	0	0	0	0	0	0
Lokichar Eye Clinic	0	0	0	0	0	0	0
AIC Kalokol Eye Clinic	0	0	0	0	0	0	0
Kanamkemer Eye Clinic	0	0	0	0	0	0	0
Elelea Eye Clinic	0	0	0	0	0	0	0
Total	**0**	**0**	**441**	**441**	**135**	**94**	**1111**

Notes

*Phaco= Phacoemulsification

+SCIS= Small incision cataract surgery

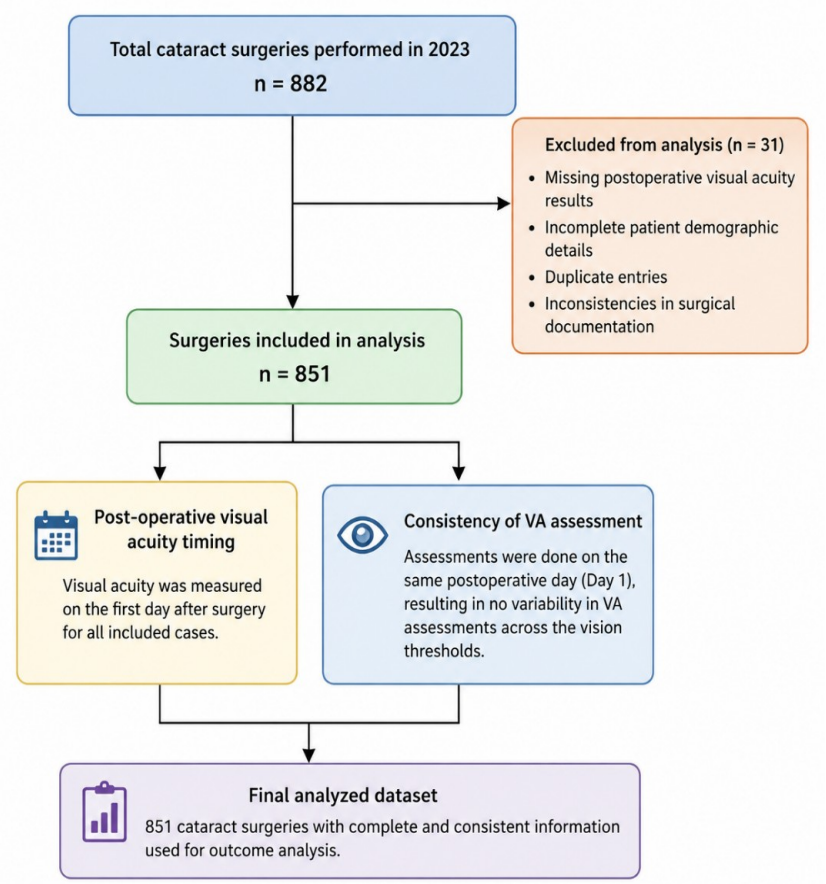
#Other surgeries included conjunctival growth excision, corneal repair, trachoma, and keratectomy.

A total of 882 cataract surgeries were performed in 2023, corresponding to a cataract surgical rate (CSR) of 781 per million population. The median waiting time for cataract surgery was 90 days, with waiting times ranging from 30 to 180 days.

Cataract surgical outcomes

851 of the 882 completed surgeries were analyzed because some records contained incomplete or missing information required for outcome assessment. Cases with missing postoperative visual acuity results, incomplete patient demographic details, duplicate entries, or inconsistencies in surgical documentation were excluded to ensure accuracy, reliability, and consistency of the analysis. The post-operative visual acuity was measured on the first day after the operation, resulting in no variability in VA assessments across the vision thresholds.

This can be summarized below;



The analysis of postoperative outcomes for 851 eyes revealed that 16.5% (n=140) had a visual acuity (VA) of 6/12 or better, with 18.9% (n=161) experiencing mild VI at 6/18, 40.3% (n=343) experiencing moderate VI at 6/60, and 18.3% (n=156) experiencing severe VI at 3/60. Additionally, 6% (n=51) were classified as blind (worse than 3/60). The results indicate that cataract cases mainly operate in severe and blind categories, with the post-operative VA majority having borderline vision.

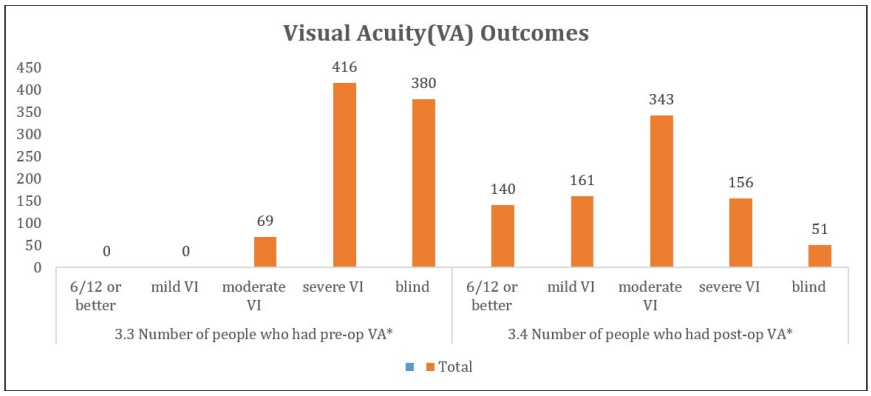


Figure 3: Pre and Postoperative PVA, Day 1 Post-operative

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Table 3 Comparison between the RAAB7 survey and the RAAB Module facility data 2023

Post-operative VA outcome (PVA)	RAAB7 survey (October 2023)		RAAB Health Systems Module (Jan-Dec 2023)	
	%	N*	%	N*
Good (≥6/12)	23.8	65	16.5	140
Borderline (<6/12 to 6/60)	44.0	120	59.2	504
Poor (<6/60)	32.2	88	24.3	207
Total	**100**	**273**	**100**	**851**

*N= Number of patients

Post-operative Results for 851 eyes showed that only 16.5% achieved good vision ≥6/12, while 59.2% remained in the borderline category (<6/12 to 6/60), and 24.3% had poor outcomes (<6/60). The 2023 RAAB survey reported slightly better outcomes (23.8%≥6/12).

Refractive error services

Table 4: Number of refractions and spectacles dispensed per facility

Health facilities	Refractions		Distance spectacles dispensed		Near spectacles dispensed		Fully subsidized spectacles	
	N*	%	N*	%	N*	%	N*	%
Kaikor Eye Clinic	222	20	0	0	122	100	122	100
Lorugum Eye Clinic	215	20	0	0	167	100	162	97
Amusait Hospital	208	19	0	0	0	0	0	0
Lodwar Eye Unit*	157	14	0	0	79	100	9	11.4
Kakuma Eye Clinic	112	10	0	0	48	100	0	0
Katilu Eye Clinic*	57	5	6	1.2	16	72.7	6	27.3
Lopiding Eye Clinic	47	4	0	0	31	100	0	0
Kanamkemer Eye Clinic	22	2	0	0	9	100	0	0
Lokori Eye Clinic	20	2	0	0	13	100	0	0
Lokichar Eye Clinic	20	2	0	0	10	100	0	0
Aic KaloKol Eye Clinic	12	1	0	0	9	100	0	0
Lokitang Eye Unit	7	1	0	0	4	100	0	0
Elelea Eye Clinic	0	0	0	0	0	0	0	0
Total	1,099	100	6	1.2	508	98.8	299	59%

*N = Number of refractions and spectacles

1,099 refractions were performed, but only 514 spectacles were dispensed; 98.8% were for near vision and just 1.2% for distance vision. Effective refractive error coverage (eREC) was 0% according to the RAAB survey (2023), highlighting the near absence of refractive services. Distance spectacles were rarely available within the facilities, with procurement delays of up to 14 days. Two private optical workshops were present, but their data were unavailable, likely underestimating coverage.

Diabetic retinopathy services

Only two hospitals provided diabetic retinopathy screening, with no treatment or rehabilitation services available. Screening was restricted to opportunistic walk-in patients without formal referral or coordination between diabetes and eye clinics. Those screened and found to have DR are referred to Moi Teaching and Referral Hospital for treatment.

Patient access to cataract services

Table 5: Travel time from LCRH, distance from village to facility.

Distance (km)	Travel time to health facility			Total n (%)
	One hour or less n (%)	More than two hours and ≤ three hours n (%)	More than 3 hours n (%)	
Patients who have undergone cataract surgery (n = 30)				
0–9	27 (90.0)	1 (10.0)	0 (0.0)	**28 (93.3)**
10–19	3 (10.0)	4 (13.3)	0 (0.0)	**7 (23.3)**
20–29	0 (0.0)	1 (3.3)	0 (0.0)	**1 (3.3)**
30–39	0 (0.0)	2 (6.7)	0 (0.0)	**2 (6.7)**
40+	0 (0.0)	2 (6.7)	10 (33.3)	**12 (40.0)**
Total	**30 (100.0)**	**10 (100.0)**	**10 (100.0)**	**50 (100.0)**
Patients awaiting cataract surgery (n = 20)				
0–9	9 (45.0)	1 (5.0)	0 (0.0)	**10 (50.0)**
10–19	1 (5.0)	2 (10.0)	0 (0.0)	**3 (15.0)**
20–29	0 (0.0)	0 (0.0)	0 (0.0)	**0 (0.0)**
30–39	0 (0.0)	1 (5.0)	0 (0.0)	**1 (5.0)**
40+	0 (0.0)	1 (5.0)	5 (25.0)	**6 (30.0)**
Total	**10 (50.0)**	**5 (25.0)**	**5 (25.0)**	**20 (100.0)**

Kms = Kilometres; n = number of patients; % = percentage (row percentages within each patient group)

Key findings: Among patients who have undergone cataract surgery, 93.3% (28/30) lived within 19 km of the facility, with 90% (27/30) travelling one hour or less.

Among patients awaiting cataract surgery, 50% (10/20) lived within 9 km, while 30% (6/20) travelled more than 40 km, and half (25%, 5/20) took more than 3 hours to reach the facility.

Fifty patients were interviewed at LCRH (40% male, 60% female). Participants were selected using purposive sampling, targeting adult patients who had undergone cataract surgery or were awaiting surgery during the study period. Patients were recruited consecutively from the eye clinic and surgical wards based on their availability and willingness to participate in the interviews. The questionnaires were used to collect information on travel time to the facility, means of transport, waiting time for surgery, and perceived barriers to accessing services. The sampling approach ensured inclusion of both male and female patients from different geographic areas within Turkana County to capture varied experiences related to access to cataract care.

60% reported spending ≤ 1 hour to reach the facility, mainly on foot or by public transport, while 40% traveled for 2-3 hours or more, often by private transport. Although physical access was relatively good for those near Lodwar, delays in receiving surgery were commonly reported, with patients dissatisfied with long waiting times for theatre availability.

Table 6: Travel time from LCRH, distance from village to facility.

Distance	One hour or less	More than two hours and less than or equal to three hours	More than 3 hours
0-9 Kms	27	1	0
10-19 Kms	3	4	0
20-29 Kms	0	1	0
30-39 Kms	0	2	0
40+ km	0	2	10
Total	**30**	**10**	**10**

Costs of cataract surgery.

At LCRH, they are required to pay partial surgical fees despite receiving subsidies. Of the 24 post-operative patients, 62.5% (n=) paid between 3000 and 5000 Kenyan shillings (approximately 23 -39 USD), while only 8.3%(n=) could afford the 5000 KES and more.

Health insurance coverage among patients was low at 37.5% (n=19/50), and some reported that their insurance policies had expired. Indirect costs, including transportation, accommodation, meals, and lost income during the treatment period, further increased the financial burden associated with accessing cataract surgical services.

The assessment also examined the type of insurance coverage held by patients. Most insured patients were enrolled under SHA or the former NHIF transition arrangements, while only a small proportion reported having private medical insurance coverage.

Table 7: Health insurance coverage and out-of-pocket

Out-of-pocket payment for cataract surgery (Ks)	N*	%
With health insurance - Fully covered		
(0 Ks)	9	37.5
With health insurance - Cover expired	5	20.8
0 (Fee waived)	**0**	
1000-2999	**0**	
3000-4999	**4**	
5000+	**1**	
Without health insurance – Never covered		
0 (Fee waived)	1	4.2
1000-2999	3	12.5
3000-4999	5	20.8
5000+	1	4.16
	24	100%

*N= Number of patients who paid out of pocket

Discussion

Most surgeries are carried out at Lodwar County Referral Hospital, with other facilities relying on visiting teams and surgical camps, which further limits access.

The RAAB-HS assessment found that **16.5%** of operated eyes achieved good postoperative visual acuity (≥6/12), compared with **23.8%** reported by the 2023 RAAB survey. The RAAB-HS assessment also recorded **59.2% borderline outcomes** and **24.3% poor outcomes**. The lower proportion of good outcomes may partly reflect differences in **study population, case selection, and outcome assessment methods**. Importantly, postoperative VA in the RAAB-HS assessment was measured **on the first day after surgery**, which may capture temporary postoperative effects and therefore may not be directly comparable with the timing of VA assessment in the RAAB survey.

The high proportion of borderline outcomes suggests that many patients experienced visual improvement but did not achieve good vision. Differences in surgical technique, postoperative care, surgeon experience, equipment, and underlying ocular conditions may also have contributed. Therefore, the **16.5% versus 23.8% difference should be interpreted cautiously**, while highlighting the need for continued monitoring and improvement of cataract surgical outcomes in Turkana County.

Access and Equity

The findings show that geographical distance remains an important barrier to cataract surgery in Turkana, particularly for patients from remote areas who depend on costly private transport. This is consistent with studies in Kenya and other African countries identifying distance, transport costs and weak referral systems as major barriers to cataract services. The **90-day median waiting time** further demonstrates that physical access does not necessarily translate into timely access to surgery. Strengthening outreach, decentralising surgical services, improving referrals and reducing waiting times could therefore improve access and utilisation.

Cost and Financial Protection

Despite subsidies, patients continued to incur substantial direct and indirect costs, including transport, accommodation and lost income. Similar findings have been reported in Kenya and other African settings, where out-of-pocket and indirect costs remain important barriers to cataract surgery. The presence of expired insurance coverage and inconsistent financial assistance further suggests gaps in financial protection. Strengthening insurance coverage and establishing a **clear, standardised waiver and transport-support mechanism** could improve equitable access.

Refractive Error Services

Although more than 1,000 refractions were conducted, the **0% effective refractive error coverage (eREC)** indicates that providing refraction alone did not translate into effective correction. This is consistent with evidence from Kenya and sub-Saharan Africa showing gaps in spectacle availability, affordability and dispensing. The very low provision of distance spectacles compared with near spectacles suggests weaknesses in the spectacle supply chain. Improving procurement, availability and affordability of spectacles is therefore essential.

Diabetic Retinopathy Services

The limited availability of diabetic retinopathy screening and absence of treatment services reflect wider challenges in sub-Saharan Africa, where shortages of personnel, equipment, referral systems and integration between diabetes and eye-care services have been reported. Given the substantial burden of diabetic retinopathy in East Africa, integrating eye screening into routine diabetes care and strengthening referral and treatment pathways are important priorities.

Strengths and limitations

A key strength of this study is the use of the RAAB health systems module, offering a more comprehensive picture than prevalence surveys alone.

The findings emphasize how systemic gaps create real barriers for patients. However, limitations include reliance on day-one postoperative visual acuity rather than long-term outcomes, and potential underestimation of refractive services due to missing data from private optical shops. Cultural and awareness barriers were also not evaluated, and a qualitative investigation was required.

Conclusion

The study highlights significant gaps in eye health service delivery in Turkana County, Kenya, for cataract, refractive error, and diabetic retinopathy services. The findings indicate that surgical output remains very low

despite a network of 13 facilities, refractive error services are nearly non-existent, and diabetic retinopathy care is limited to screening. These gaps, exacerbated by financial and structural barriers, reflect challenges faced across many low-resource and arid settings in sub-Saharan Africa.

Turkana County faces a triple challenge of limited cataract surgical services, minimal refractive coverage, and a lack of diabetic retinopathy care. Without targeted investment in human resources, infrastructure, and funding, avoidable blindness disproportionately impacts this underserved region. The RAAB Health Systems Module has been valuable in connecting prevalence data with systemic barriers, providing a framework for evidence-based planning in Kenya and other contexts. Add to the conclusion from the comments above.

Recommendations

The findings highlight the urgent necessity for a multifaceted approach.

1. Boosting cataract surgical output by increasing theatre days and expanding outreach.
2. Expanding refractive services through dependable spectacle supply chains and trained mid-level personnel.
3. Task shifting strategies, local spectacle production, and integration of school screening could significantly improve coverage.
4. Urgent integration of DR screening into diabetes clinics, training of staff, and acquisition of laser equipment are essential to prevent a future epidemic of diabetes-related blindness.

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