Capacity for glaucoma screening and treatment at primary and secondary level health centers in Uganda: Situational analysis

Onyango J[1], Kwaga T[1,2], Namwase S[1], Tusingwire P[2,3], Arunga VN[1], Atwine D[4], Arunga S[1,5]

[1]Mbarara University of Science and Technology, Mbarara, Uganda
[2]Ruharo Mission Hospital, Mbarara, Uganda
[3]Kabale University, Uganda
[4]Soar Research Foundation, Mbarara, Uganda
[5]London School of Hygiene & Tropical Medicine, London, UK

Corresponding author: Dr. Teddy Kwaga, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda. Email: tkwaga@must.ac.ug

ABSTRACT

Objective: To measure the capacity for glaucoma screening and treatment at primary and secondary level health centers in southwestern Uganda.
Methods: In a cross-sectional study, we used quantitative methods to conduct a situation analysis at primary (health center IVs, district hospitals) and secondary level health facilities (referral hospitals) within southwestern Uganda. Survey questionnaires were administered to eye health workers at the health facilities to ascertain glaucoma awareness. An inventory checklist was used to establish equipment and consumables available to screen, diagnose and treat glaucoma in the primary and secondary level setting.
Results: There were 86 primary and secondary level health facilities enrolled in this study. Out of the 86 facilities, 45 (52.3%) did not have any eye care worker. Majority lacked functioning basic eye equipment and consumables for the diagnosis of glaucoma. Only 28 (32.6%) facilities had a direct Ophthalmoscope. Timolol was the most common eye drop and was available in 12 (14%) of the health facilities. The lowest level of knowledge about glaucoma was observed at health center IVs (34.6%), while the highest level of knowledge was observed at regional referral hospitals (82.7%).
Conclusion: There is need to improve the availability of equipment, diagnostic consumables and essential medicines for glaucoma at health facilities in southwestern Uganda. Additionally, training and deployment of more eye care workers at the primary and secondary health facilities is necessary for quality access to eye care services.

Key words: Glaucoma, Screening, Developing, Uganda, Sub-Saharan Africa

INTRODUCTION

Glaucoma is a major cause of visual impairment and blindness affecting 76 million people globally[1]. Glaucoma causes irreversible blindness by causing progressive damage to the optic nerve, a vital structure responsible for transmitting electrical signals from the retina to the brain for interpretation[2]. The burden of glaucoma is highest in sub-Saharan Africa where the prevalence is estimated to be 4.8%, twice the global average[1,3]. Recent global estimates have predicted a substantial increase in absolute numbers of individuals affected in African populations over the next decade if no interventions are made[1].

In sub-Saharan Africa and other Low- and Middle-Income regions, 90% of glaucoma is undetected until too late[4]. Glaucoma causes severe visual impairment and irreversible blindness which impacts the ability to work, economic empowerment, autonomy and dignity of the affected. An ideal situation for reducing avoidable blindness due to glaucoma is having a system where the population is knowledgeable about the condition, a strong mechanism to screen and find early cases, strong referral linkages to where the care is, an armamentarium of good treatment options, follow up and rehabilitative services. Unfortunately, such a system does not exist in Uganda and many other resource limited setting areas.

In Uganda, glaucoma was reported to cause 38.5% of all blindness, second only to Nigeria which had 42%[5]. This is due to several sequential factors which ultimately lead to blindness among patients with glaucoma. There is very low level of awareness among the population and a resource-limited primary health system to enable identification of patients at risk, no capacity to support active case finding, a weak disjointed referral system and a highly centralised and less accessible glaucoma care. Ultimately, majority of patients present late to the tertiary hospitals with sight loss in one or both eyes[4].

As part of a 3-year glaucoma screening and treatment project in southwestern Uganda, in collaboration with Mbarara University of Science and Technology (MUST), Ruharo Mission Hospital, and Christian Blind Mission, this study was conducted with an aim of measuring the

baseline capacity for glaucoma screening and treatment at primary and secondary level health centers in southwestern Uganda.

MATERIALS AND METHODS

Ethics statement: This study protocol adhered to the tenets of the Declaration of Helsinki and was granted ethical approval in Uganda by the Mbarara University of Science and Technology research ethics committee (Approval reference number 2021-257 and Uganda National Council of Science and Technology (Approval reference number HS2016ES. In addition, permission was sought from Uganda Ministry of Health and the District Health Offices to approach the facilities. Informed consent was sought from the health facility in-charges prior to the data collection.

Study design and setting: In a cross-sectional study design, primary and secondary level health facilities within the project area (southwestern and south-central Uganda) were enrolled. Primary health facilities consisted of health center IVs and district hospitals. Secondary level facilities were the four regional referral hospitals across four districts (Masaka, Kabale, Fort Portal and Mbarara).

The health system in Uganda is organized based on a tier system comprised of seven levels with the lowest unit being at the village level. Patients are referred along this tier system depending on the complexity of care required for the condition they present with.

Sampling: All the health facilities within the project area were enrolled into this baseline survey. This included 72 Health Centre IVs, 10 district hospitals and 4 regional referral hospitals. Consideration of these levels was guided by the Uganda Ministry of Health scheme of service where ophthalmology services are provided for starting at a health center IV level.

Data collection: Data collection was done in 2022 by trained research assistants. These travelled to the health facilities and administered in person interviewer guided questionnaires and checklists. The tools included a staffing profile checklist to ascertain the number of eye health cadres available at the selected facilities, survey questionnaires with glaucoma picture quizzes to ascertain the level of knowledge on glaucoma, an inventory checklist to establish equipment and consumables available and functioning to screen, diagnose and treat glaucoma. Other general parameters like outpatient attendance and registered diagnoses (eye conditions) in the past 12 months were recorded.

Data analysis: Data was entered and cleaned using Microsoft excel workbook, analysis was done using excel and STATA v15. We used descriptive statistics to report health facility, patient characteristics, and human resource capacity at the health facilities. Inventory of the available glaucoma diagnostic equipment and medicines was presented by proportions in a bar graph. Knowledge was reported as percentage scores of a test that had 26 questions on: i) Seven questions on parameters for diagnosis of glaucoma; ii) Six questions on presentation of glaucoma; iii) Four questions about investigations for glaucoma; iv) Five questions on management of glaucoma, and v) Four picture quizzes about diagnosis of glaucoma (Appendix 2). The total scores of the participants were calculated out of 26 and multiplied by 100 to get the percentage score. The median score for the primary and secondary level health facility was calculated, and presented along with the interquartile and full ranges. The list of questions and picture quiz have been attached as supplementary material.

RESULTS

A total of 86 facilities were enrolled in this study, 72 (83.7%) were health center IVs (primary level health center), 10 (11.6%) were district hospitals (primary level health facilities) and 4 (4.7%) were regional referral hospitals (secondary level health facilities). Table 1 shows health facility and patient characteristics. The total outpatient attendance at these facilities for the past 12 months was 956,725 of which majority (63.8%) were female. Of these, 22,090 (2.3%) had an eye condition and only 67 (0.007%) had a diagnosis of glaucoma.

Table 1: Health facility and patient characteristics

Variable	No.	(%)
Level of Health Centre		
Health Centre IV	72	(83.7)
District Hospital	10	(11.6)
Regional Referral Hospital	4	(4.7)
Outpatient attendance in the last 12 months		
Male	346,328	(36.2)
Female	610,397	(63.8)
Patients with an eye condition*		
Male	4,476	(1.3)
Female	17,614	(2.9)
Proportion of patients with diagnosis of glaucoma†		
overall	67	(0.007)
Male	24	(0.007)
Female	43	(0.007)

*The proportion for eye condition were percentages of the total number of males (346,328) and females (610,397) †Proportion for the diagnosis of glaucoma were percentages of total number of patients (956,725), total number of males (346,328) and females (610,397)

In terms of human resource staffing coverage (Table 2), 45 out of 86 (52.3%) facilities did not have any eye care worker. Eye care workers were considered as ophthalmic assistant, ophthalmic nurse, ophthalmic clinical officer, and ophthalmologists. This study did not consider optometrists because they are currently not yet included in the Uganda Ministry of Health scheme of service. All the facilities without any eye care worker were health center IVs.

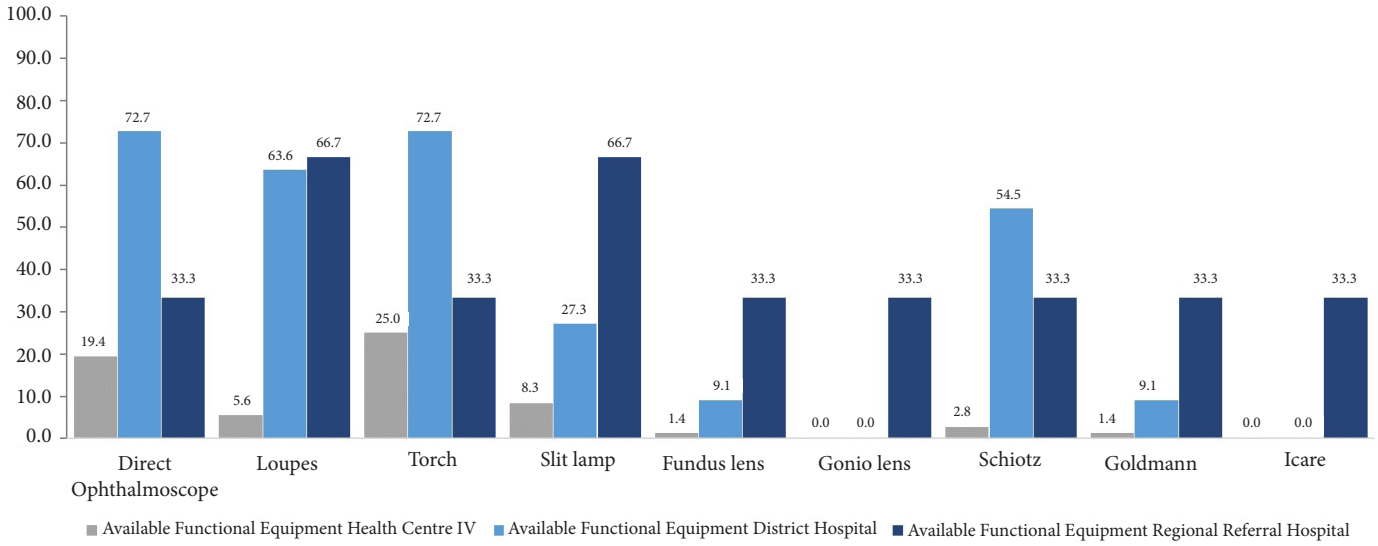
Table 2: Human resource capacity at the health facilities

Cadre type	Staffed facilities, No.	Total number of facilities, No.	(%)
Ophthalmic assistant coverage			
Health Centre IV	3	72	(4.2)
District Hospital	4	10	(40)
Regional Referral Hospital	1	4	(25)
Ophthalmic nurse coverage			
Health Centre IV	2	72	(2.8)
District Hospital	4	10	(40)
Regional Referral Hospital	2	4	(50)
Ophthalmic Clinical Officer coverage			
Health Centre IV	25	72	(34.7)
District Hospital	9	10	(90)
Regional Referral Hospital	4	4	(100)
Ophthalmologist coverage*			
Health Centre IV	0	72	(0.0)
District Hospital	0	10	(0.0)
Regional Referral Hospital	4	4	(100)

*According to the Uganda Ministry of Health scheme of service, Ophthalmologists are expected to be at a regional referral hospital level. The other eye care workers are expected to be deployed at health center IVs, district hospitals and regional referral hospitals

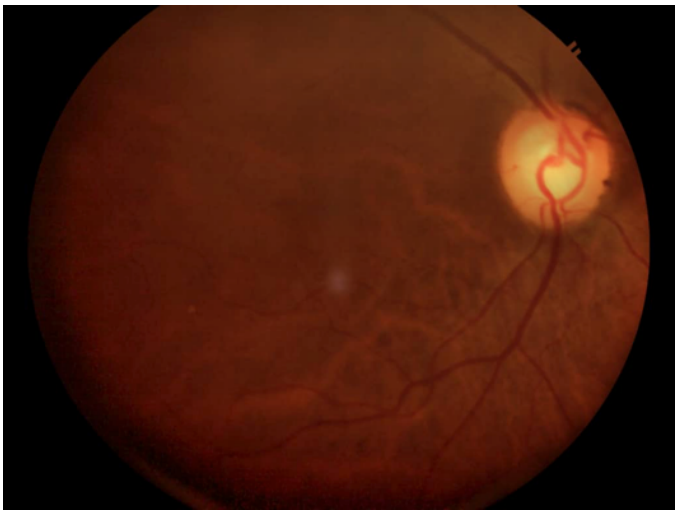
In regard to equipment, this study considered a direct Ophthalmoscope (used for viewing the optic nerve head) and any intraocular pressure measurement device (Shiotz tonometer, Perkin's tonometer and icare tonometer) as basic tools for diagnosis of glaucoma. A summary of these findings is presented in Figure 1. Only 28 (32.6%) facilities had a direct Ophthalmoscope of which 22 were functional at the time of the study. Availability of this equipment was more at the district and regional referral hospitals. Only 10% of the facilities had a Schiotz tonometer, while the icare and perkins tonometer were rare at 1.2%.

Figure 1: Available functional equipment inventory at the different health facility levels (n=86)

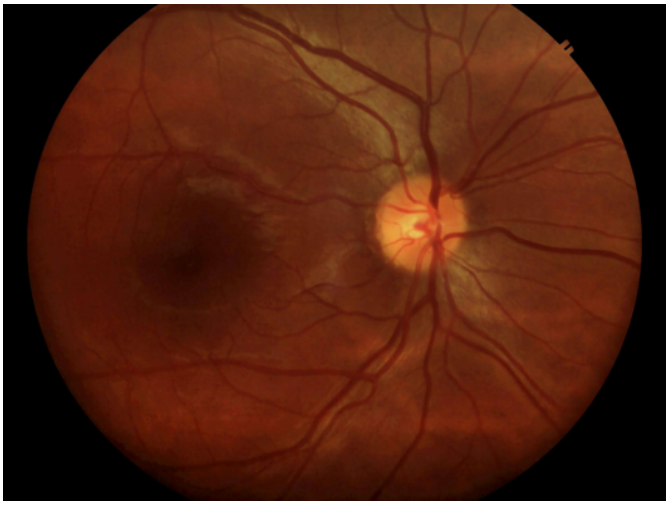


Concerning glaucoma consumables at the 86 facilities, this study noted a low supply of glaucoma medications at the health facilities as indicated in the Figure 2. We found that only 16 (18.7%) had dilating drops, 12 (14.0%) had amethocaine and 7 (8.1%) had fluoresceine strips. Timolol eyedrops a basic glaucoma treatment drug was available in stock at only 12 out of 86 health facilities (14.0%).

Figure 2: Availability of glaucoma medicines and consumables at the health facilities



Fundus image of a patient with a cupped disc that was used in the picture test



Fundus image of a normal disc that was used in the picture test

Knowledge of ophthalmic clinical officers and other eye care providers: Knowledge among all cadres of eye care was lowest at health center IVs with a median test score of 34.6% (IQR 25 – 53.8, full range 0.0 - 92.3), moderate at district hospitals with a median test score of 67.3% (IQR 51.9 – 81.7, full range 42.3 - 96.2), and highest at regional referral hospitals with a median test score of 82.7 (IQR 79.8 – 86.5, full range 76.9 -92.3).

DISCUSSION

In Uganda, the prevalence of glaucoma is estimated to be that of Africa which is around 4.8%[1]. However, our study revealed a gross under diagnosis of the condition with a prevalence of glaucoma in the study population standing at only 0.007%. Therefore, for every glaucoma case diagnosed, about 685 other cases are missed. This shocking finding suggests that there is a gross under diagnosis of glaucoma in the country, highlighting the gross under capacity to diagnose and manage glaucoma and eye health in general within the health system. Underpinning these were the grossly low staffing levels, low levels of knowledge among the heath workers, lack of equipment and drugs.

The study also assessed the knowledge about glaucoma among healthcare workers at various levels of care. The lowest level of knowledge was observed at health center IVs, while the highest level of knowledge was observed at regional referral hospitals. The results showed that the knowledge about the condition was commensurate with the available cadre at the eye facilities.

As per the staffing norms set by the Uganda Ministry of Health, it is expected that every healthcare facility at the HC IV level and above should have an Ophthalmic Clinical Officer (OCO) among the staff. However, our findings indicate that 52.3% of the health facilities lack an eye health worker, resulting in patients being attended to by non-ophthalmic staff members who possess limited knowledge of eye care[6,7]. The insufficient staffing levels at these facilities may contribute to the low utilization of eye care services, as evidenced by only 2.3% of individuals presenting for treatment of eye conditions in this study. This raises concern as early diagnosis and treatment are crucial in preventing the progression of glaucoma and avoiding blindness[8]. Insufficient Human Resources for Eye Health (HREH) is a prevalent issue in many sub-Saharan African countries, impeding the achievement of the Vision 2020 staffing target[9,10].

The findings of this study highlight a concerning lack of essential eye equipment and diagnostic and treatment resources for glaucoma in the majority of health facilities. This situation mirrors the challenges faced by several developing countries, underscoring the urgent need for enhanced infrastructure and increased availability of resources to support the diagnosis and management of glaucoma in Uganda[11]. Notably, the study revealed that only 14.0% of the surveyed health facilities stocked Timolol eye drops, a fundamental medication for glaucoma treatment. It is worth noting that Timolol is not only the most affordable antiglaucoma medication but also listed as a basic requirement for glaucoma management by the International Agency for the Prevention of Blindness[12]. Consequently, it is imperative that Timolol be made readily available in all facilities offering eye services, especially considering that a 5ml bottle of locally made eye drops costs approximately US$4 in the market.

Limitations

This study evaluated the capacity of the facilities to screen and treat for glaucoma at a specific point in time, potentially coinciding with a period when the facilities may have experienced stockouts.

Strengths

This study provides insightful information for advocacy towards strengthening eye care services in the country.

CONCLUSION

The study highlights the need for improved eye care services in Uganda, particularly in the diagnosis and management of glaucoma. There is a need for increased awareness and education about the condition, as well as improved infrastructure and resources. Addressing these issues will go a long way in reducing the burden of glaucoma and preventing blindness in the country.

Financial disclosure: Funded by Christian Blind Mission (CBM).

Conflict of interest: None of the authors have any proprietary interests or conflicts of interest related to this submission.

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request

REFERENCES

1. Organization WH. World report on vision. 2019.
2. Weinreb RN, Khaw PT. Primary open-angle glaucoma. *The Lancet.* 2004; **363**(9422):1711-20.
3. Allison K, Patel D, Alabi O. Epidemiology of glaucoma: the past, present, and predictions for the future. *Cureus*. 2020; **12**(11): e11686.
4. Gyasi M, Amoako W, Adjuik M. Presentation patterns of primary open angle glaucomas in north eastern ghana. *Ghana Med J*. 2010; **44**(1): 25–30.
5. Kyari F, Abdull MM, Bastawrous A, Gilbert CE, Faal H. Epidemiology of glaucoma in sub-Saharan Africa: prevalence, incidence and risk factors. *Middle East Afr J Ophthalmol.* 2013; **20**(2):111.
6. Kalua K, Gichangi M, Barassa E, Eliah E, Lewallen S, Courtright P. Skills of general health workers in primary eye care in Kenya, Malawi and Tanzania. *Human Res Health.* 2014; **12**:1-6.
7. Byamukama E, Courtright P. Knowledge, skills, and productivity in primary eye care among health workers in Tanzania: need for reassessment of expectations? *Intern Health*. 2010; **2**(4):247-252.
8. Weinreb RN, Aung T, Medeiros FA. The pathophysiology and treatment of glaucoma: a review. *JAMA*. 2014; **311**(18):1901-11.
9. Palmer JJ, Chinanayi F, Gilbert A, Pillay D, Fox S, Jaggernath J, *et al*. Mapping human resources for eye health in 21 countries of sub-Saharan Africa: current progress towards VISION 2020. *Human Res Health*. 2014; **12**(1):1-16.
10. Palmer JJ, Chinanayi F, Gilbert A, Pillay D, Fox S, Jaggernath J, *et al*. Trends and implications for achieving VISION 2020 human resources for eye health targets in 16 countries of sub-Saharan Africa by the year 2020. *Human Res Health*. 2014; **12**(1):1-15.
11. Kizor-Akaraiwe NN, Olawoye O. Allocating resources for glaucoma care - A review. *Touch Reviews Ophthalmol J.* 2019.
12. Blindness IAftPo. IAPB ESSENTIAL LIST for Glaucoma. London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, England, UK: International Agency for the Prevention of Blindness; 2017.

Questionnaire 1: Health centre data tool

Health Centre data collection tool. This tool will be used for collecting information from the health centre on knowledge, capacity, and practise in management of glaucoma. It has four parts; general information, knowledge on glaucoma, capacity of the health centre and information on treatment practise for glaucoma.		
Name of the HC		write
1. Study Number	(write)	
2. Location (district)	(write)	
3. Level of the HC	1=HCIV, 2=District Hospital, 3=RRH	
4. Geo location of HC	Write Latitude	
	Write Longitude	
5. How would you describe the road access to your HC?	1=Mostly murram (not graded), 2=Mostly graded murram 3=Mostly tarmacked	
6. What is the population coverage of your HC?	Write number	
7. Is there a functional latrine/toilet?	0= No, 1 = Yes	
8. Is there a water source at the HC?	0= No, 1 = Yes	
9. What is the main water source do you have at the HC?	0= none, 1=Well, 2, 3 = Piped, 4= Roof collected tank, 5=Borehole, 6=protected spring	
10. How far is the nearest water source?	0= water at HC, distance in metres	
11. What is your main type of electricity supply?	0= None, 1 = solar, 2=Hydro, 4=Generator	
12. Is there mobile phone network?	0 = No, 1 = Yes	
13. What is the distance in KM of the next referral centre		
14. Name of the next referral centre		
15. Geo location of the next referral centre	Write Latitude	
	Write Longitude	
16. What is the Level of the next referral HC	1=HCIV, 2=District Hospital, 3=RRH	

HC Capacity					
17.	What is the total number of staff at your HC?	Write number			
18.	What is the total number of the following types of staff cadre available at your HC? If none write 0	1=Ophthalmic assistant			
		2=Ophthalmic nurse			
		3=Ophthalmic Clinical Officer			
		4=Ophthalmologist			
19.	Equipment for screening/treating glaucoma				
20.	What eye equipment is available to you: (If available, ask about condition and number)	Item	Available 0=No, 1=Yes	Number of functional equipment	Number of non-functional equipment
		Direct Ophthalmoscope			
		Magnifying loupes			
		Torch			
		Slit lamp			
		Fundus diagnostic lenses (D90/D78/D60)			
		Gonio lens			
		Schiotz tonometer			
		Goldman tonometer			
		Icare tonometer			
		Perkin's tonometer			
21.	Which of the following glaucoma diagnostic consumables do you have currently?	Fluorescein strips	0=No, 1=Yes		
		Amethocaine eye drops	0=No, 1=Yes		
		Dilating eye drops	0=No, 1=Yes		
22.	Drugs				
23.	Which of the following glaucoma treatment stocks do you have currently?	Timolol eye drops	0=No, 1=Yes		
		Betoxolol eye drops	0=No, 1=Yes		
		Pilocarpine eye drop	0=No, 1=Yes		
		Acetazolamide tablets	0=No, 1=Yes		
		Latanoprost eye drops	0=No, 1=Yes		
		Bimatoprost eye drops	0=No, 1=Yes		
		Brimonidine eye drops	0=No, 1=Yes		
		Dorzolamide eye drop	0=No, 1=Yes		
		IV Mannitol	0=No, 1=Yes		
24.	Knowledge-information to be obtained from the OCO or person who usually sees eye patients or the in charge				
25.	What is your training in eye care?	0=None, 1=partial (as part of my course), 2= Certificate in eye care, 3=Diploma in eye care, 4=Specialist			

26. How much in percentage time of your training was spent on eye care?	Out of 100%		
27. According to you, what is the definition of glaucoma? 0=Not mentioned, 1=Mentioned		Optic nerve disease	
	Progressive		
	Visual field loss		
	Blindness		
	Irreversible		
	Raised IOP		
	Cupped disc		
28. According to you, how is a patient of glaucoma most likely to present? 0=Not mentioned, 1=Mentioned		Blind/reduced vision	
	RAPD		
	Visual field loss		
	Pain (occasionally)		
	Cupped disc/disc changes		
29. Here is one picture of the back of the eye, can you mention which structures you are able to identify? 0=Not mentioned, 1=Mentioned		Normal Retina	
	Normal Optic disc		
	Normal blood vessels		
30. What would you say is the diagnosis in the picture shown? 0=Not Mentioned, 1=Mentioned		Normal Eye	
	Other (write)		
31. Here is another picture of the back of the eye, can you mention which structures you are able to identify? 0=Not mentioned, 1=Mentioned		Cupped optic disc	
	Pale disc		
	Peri papillary atrophy		
	Nasal shifting of the vessels		
32. What is the most likely diagnosis in this picture? (write) 0=Not mentioned, 1=Mentioned		Normal Eye	
	Glaucoma		
	Other (write)		
33. Assuming you had all the resources available to you, how would you confirm this condition? 0=Not mentioned, 1=Mentioned		IOP check	

	Visual fields		
	History of glaucoma/blindness		
	OCT		
	CCT		
	Anterior segment OCT		
	Gonioscopy		
34. Assuming you had all the resources available to you, how would you treat this condition? 0=Not mentioned, 1=Mentioned		Refer	
	Counselling		
	Eye drops		
	Surgery		
	Laser		
35. According to you, do you think this condition can be reversible?		0=No, 1=Yes	

Questionnaire 2: HMIS data tool

Health Centre data collection tool. This tool will be used for collecting information from HMIS summary from the health facilities by district to determine the proportion of people presenting with glaucoma in Southwestern Uganda.		
Variable		write
1. Name of facility	(write)	
2. Location (district)	(write)	
3. Total number of patients seen in the past 12 months	(write)	
4. Total number of males seen in the past 12 months	(write)	
5. Total number of adults seen in the past 12 months	(write)	
6. Total number of male adults seen in the past 12 months	(write)	
7. Total number of Children seen in the past 12 months	(write)	
8. Total number of male children seen in the past 12 months	(write)	
9. Total number of patients with eye conditions seen in the past 12 months	(write)	
10. Total number of males with eye conditions seen in the past 12 months	(write)	
11. Total number of adults with eye conditions seen in the past 12 months	(write)	
12. Total number of male adults with eye conditions seen in the past 12 months	(write)	
13. Total number of Children with eye conditions seen in the past 12 months	(write)	
14. Total number of male children with eye conditions seen in the past 12 months	(write)	
15. Total number of patients with glaucoma seen in the past 12 months	(write)	
16. Total number of males with glaucoma seen in the past 12 months	(write)	
17. Total number of adults glaucoma seen in the past 12 months	(write)	
18. Total number of male adults with glaucoma seen in the past 12 months	(write)	
19. Total number of Children with glaucoma seen in the past 12 months	(write)	
20. Total number of male children with glaucoma seen in the past 12 months	(write)	