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RESEARCH ARTICLE

Epidemiology of Microbial Keratitis on Uganda: A 7-year update

[version 1; peer review: awaiting peer review]

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Abstract

Purpose

To provide the latest update on the epidemiology of microbial keratitis in Uganda.

Methods

We prospectively recruited patients presenting with microbial keratitis (MK) at three eye units in Uganda between November 2023 and June 2025. Data collected included demographic characteristics, clinical history, presenting features, and laboratory findings. Participants were specifically asked about prior ocular trauma and use of traditional eye medicines (TEM). All centres performed microscopy and culture, while in vivo confocal microscopy (IVCM) and polymerase chain reaction (PCR) were additionally performed at Mbarara University and Referral Hospital Eye Centre.

Results

We recruited 369 patients with MK. The median age of the participants was 45 years (range: 18 — 88); and the majority were male (60.7%). The median presentation time was 17 days from onset (IQR 8–32) with only 4.9% of the patients presenting early (within 3 days). At

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presentation, most (60.8%) of the patients were blind in the affected eye. The overall diagnostic yield was 52.2%, fungal keratitis being the most common. The factors that were associated with a poor presenting visual acuity included distance from the hospital ($p < 0.001$), use of traditional eye medicine ($p < 0.048$) and delayed presentation ($p < 0.001$). These results were comparable to the baseline findings from our previous work (*Epidemiology of microbial keratitis in Uganda – A cohort study*) seven years ago. Clinical and laboratory diagnoses aligned moderately for fungal keratitis but poorly for bacterial disease.

Conclusion

There has not been a significant change in the epidemiology of MK in Uganda. MK is still very common in different regions in the country. Fungal keratitis remains the leading cause of MK in Uganda. The use of advanced diagnostic tests like PCR and IVCM can help improve yields in the identification of the causative microorganisms in patients with MK.

Plain Language summary

Corneal infections are a serious problem and remain a major cause of preventable blindness in Uganda. Our earlier study from 2016–2018 showed that many people reached eye hospitals very late, often after the infection had already caused severe damage and major loss of vision. Many had first used traditional eye medicines, which delayed proper treatment and worsened outcomes. The condition of the eye at the time of arrival was the strongest predictor of whether vision could be saved, highlighting the importance of early care.

Since then, our team at Mbarara University of Science and Technology, together with partners at the London School of Hygiene and Tropical Medicine, has worked to improve awareness, diagnosis, and treatment of microbial keratitis. These efforts include community education, strengthening hospital services, running clinical trials, and helping regional hospitals set up routine eye-infection testing for faster and more accurate diagnosis.

Despite these improvements, it has remained unclear whether the pattern of microbial keratitis in Uganda has changed. Without updated national data, it is difficult to guide treatment, community education, and clinical decision-making.

To update the picture, we studied patients with corneal infections from three hospitals in different regions of Uganda. We enrolled 369 people between November 2023 and June 2025. Most were middle-aged adults, and men were affected more often. Many had symptoms for more than two weeks before reaching care, and more than half were already blind in the affected eye on arrival. Fungal infections were the most common cause. People who lived far from the hospital, used traditional eye medicines, or delayed seeking care were more

likely to have very poor vision.

These findings show that corneal infections continue to cause significant vision loss in Uganda. Improving early care-seeking, discouraging harmful traditional treatments, and expanding access to better diagnostic tools remain essential.

Keywords
Microbial keratitis; bacterial keratitis; fungal keratitis; keratitis; blindness; Uganda

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Introduction

Microbial keratitis (MK) is an infection of the cornea caused by bacteria, fungi, viruses, or protozoa. Although its severity may vary.[1–3] All cases pose a significant risk of vision loss and require prompt intervention. Globally, MK is a leading cause of corneal blindness, with fungal keratitis alone accounting for an estimated 1,051,787 cases annually (range: 736,251–1,367,323).[4] However, the true burden is likely higher due to underreporting, particularly in low-resource settings.[5]

In Uganda, MK remains a major public health concern, contributing significantly to preventable blindness. In 2018, we published results of a cohort study titled *Epidemiology of Microbial Keratitis in Uganda*,[2] which provided foundational insights into disease burden, risk factors, and clinical outcomes in the southwestern region. Key risk factors identified included ocular trauma and the use of traditional eye medicine—both frequently associated with delayed presentation and poor visual prognosis. Our corneal infections group at Mbarara University of Science and Technology and colleagues at the International Centre for Eye Health, London School of Hygiene and Tropical Medicine, UK have undertaken several engagement approaches of community sensitisation, improving diagnosis and treatment of MK in Uganda.[6] Part of this included randomised controlled trials and capacity building of regional hospitals to establish routine ocular microbiology services.

While these initiatives have improved local care, it is plausible that the epidemiological profile of MK in Uganda has shifted due to changes in environmental exposures, healthcare access, and antimicrobial resistance patterns; as has been observed in other countries.[7] However, there is a lack of updated, nationally representative data to determine whether these shifts have occurred or how they may vary across different regions of the country. An up-to-date understanding of MK epidemiology is essential for informing treatment strategies, health education initiatives, and clinical guidelines. Given the high burden of disease and its preventable nature, new data are needed to support evidence-based responses.

The objective of this study was to investigate changes in the epidemiology of MK in Uganda since the 2018 cohort study. Specifically, we aimed to characterize current patterns of disease presentation across three geographically diverse hospitals and to identify any regional trends in the microbial profile.

Methods

Ethical statement

This study followed the tenets of the Declaration of Helsinki. It was approved by the London School of Hygiene & Tropical Medicine Ethics Committee (Ref 29494), Mbarara University Research Ethics Committee (MUST-2022-592) on 26th July 2023 and Uganda National Council for Science and Technology (HS2719ES) on 3rd September 2023. Written informed consent in the local language was obtained before enrolment. If the patient was unable to read, the information was read to them, and they were asked to indicate their consent by application of their thumbprint, which was independently witnessed.

Study design and setting

In this cross-sectional study, we prospectively enrolled patients with signs of MK who presented to Mbarara University and Referral Hospital Eye Centre (MURHEC), Masaka Regional Referral Hospital (MRRH) and Mengo Hospital (MH) from November 2023 to May 2025.

MURHEC is a government-owned tertiary level eye unit located in southwestern Uganda, and it sees about 6,000–10,000 patients/year. MRRH is also a government-owned secondary level eye unit in south-central Uganda; and it sees about 9,000–12,000 patients/years. MH is a church run fee-paying tertiary eye hospital; and it sees about 20,000–25,000 patients/year. MURHEC has an advanced ocular microbiology service including advanced diagnostics like confocal Microscopy. As part of our work, the general laboratories at MH and MRRH were supported to start basic ocular microbiology investigations of microscopy and culture.

Public and patient involvement

There was no direct involvement of patients or the public in the development of the study design, recruitment strategy, data collection methods or dissemination plans for this study. However, formulation of research questions and the selection of outcomes were guided by evidence generated from our prior studies involving patients with microbial keratitis in Uganda including Epidemiology of Microbial keratitis in Uganda Cohort study[2]; Management of microbial keratitis by Pharmacies in Uganda[8] and Traditional eye medicine use in microbial keratitis in Uganda[9] where we had interviews with patients with microbial keratitis, and also with health workers involved in the management of patients with microbial keratitis.

Study participants
The study participants consisted of patients with MK presenting at MH, MRRH and MURHEC. MK was defined as presence of underlying stromal infiltrate (with/without loss of corneal epithelium) associated with any or all signs of inflammation (conjunctival hyperemia, anterior chamber inflammatory cells, ± hypopyon).[10] We excluded those not willing to participate.

Assessment
We documented basic demographic information and their ophthalmic history. This included the duration of eye illness, and predisposing factors. Clinical examination included visual acuity (Snellen 6 M chart), a detailed slit lamp assessment for signs of MK. The clinicians (ophthalmologists, ophthalmic clinical officers) were asked to suggest the most probable clinical diagnosis based on the history and clinical exam.

In all the three hospitals, a corneal scrape specimen was collected from the ulcer at a slit lamp using 21G needles after application of amethocaine anesthetic eye drops. Samples underwent processing for the Gram stain, Potassium Hydroxide [KOH] stain, Calcofluor White [CFW] and KOH stain and direct inoculation on culture media (Sheep's Blood Agar [BA], Chocolate Agar [HBA], Potato Dextrose Agar [PDA] and Brain Heart Infusion broth [BHI]). Additionally, at MURHEC, one sterile corneal scrape sample was taken for Polymerase Chain Reaction (PCR). The number of corneal samples collected per patient in each hospital was dependent on how much material could be safely scraped from the cornea. The order was samples for microscopy, agar, broth, and finally corneal scrape for PCR. In addition, patients seen at MURHEC also underwent *in vivo* confocal microscopy using the Heidelberg Retinal Tomograph 3 (HRT3) for direct visualization of fungal hyphae in the cornea.

Bias
In the study, we anticipated the risk of diagnostic bias arising from the sequence of clinical and laboratory assessments. Specifically, if laboratory investigations were conducted before the optometrist or ophthalmologist made a diagnosis, that there would be potential for the clinical judgment to be influenced by microbiological findings. To mitigate this, all clinical diagnoses were made and recorded prior to the availability of laboratory results. In addition to this, we recognized the possibility of laboratory technicians being influenced by prior clinical impressions. To reduce this risk, technicians were required to capture and archive microscope slide images to support objective confirmation of laboratory findings.

Analysis
Data was analyzed in STATA v17. To describe the presentation of MK, summary frequency tables of demographics, presentation time, and clinical history were generated. Presentation time was classified as prompt (0–3 days), early (4–7 days), intermediate (8–14 days), late (15–30 days) and very late (more than 30 days). Clinical diagnosis was compared with the laboratory diagnosis.

Pearson correlation analysis was used to assess for association between symptom duration and distance from the eye hospital, and Kruskal–Wallis' test examined the relationship between symptom duration and visual acuity in the affected eye. A McNemar's test was used to evaluate the concordance between clinical diagnosis and laboratory diagnosis.

Analysis of selected factors potentially associated with a poor presentation (vision worse than 6/60) was done using both univariable and multivariable logistic regression analyses. Variables that showed statistical significance or borderline significance in the univariable model ($p < 0.2$) were further examined in the multivariable model to adjust for potential confounding.

Results
Participants
The baseline characteristics of the participants is shown in Table 1. The median age of the participants from the three hospitals was 45 years (IQR: 33 — 58 years, total range: 18 — 88). There was no significant difference in the age of the participants from the three hospitals.

Most of the participants were male (60.7%); and there was also no significant difference in gender among the participants presenting at the hospitals. The median distance from the patient's home to the eye hospitals was 50 km (IQR: 20 — 120 total range: 2–500 km). There was a significant difference in the distances the participants lived from each of the hospitals they visited. At the three study hospitals, the median distance from participants' homes to the facility was greatest at MURHEC (100 km, IQR: 50–160; range: 2–400), followed by MRRH (50 km, IQR: 22.5–95; range: 5–200), and MH (30 km, IQR: 10–85.5; range: 2–500).

Table 1. **Demographic characteristics of the study participants (N = 369).**

Variable	All (N = 369,100%)		MURHEC (N = 113, 30.6%)		MH (N = 168, 45.6%)		MRRH (N = 88, 23.8%)		P value
	n/n	(%)	n/n	(%)	n/n	(%)	n/n	(%)	
Age in years (Median, IQR)	45, IQR: 33–58		50, IQR: 35–59		43, 32–56.5		42.5, 32–56		0.25
≤ 30 years	78	(21.1%)	21	(18.6%)	38	(22.6%)	19	(21.6%)	0.890
31–40 years	80	(21.7%)	19	(16.8%)	41	(24.4%)	20	(22.7%)	
41–50 years	67	(18.2%)	21	(18.6%)	29	(17.3%)	17	(19.3%)	
51–60 years	78	(21.1%)	29	(25.7%)	32	(19.0%)	17	(19.3%)	
> 60 years	66	(17.9%)	23	(20.3%)	28	(16.7%)	15	(17.1%)	
Gender									
Female	145	(39.3%)	44	(38.9%)	68	(40.5%)	33	(37.5%)	0.790
Male	224	(60.7%)	69	(61.1%)	100	(59.5%)	55	(62.5%)	
Distance from the eye hospital (Median, IQR)	50, 20–120		100, 50–160		30, 10–85.5		50, 22.5–95		<0.001***
0–50 km	190	(51.5%)	33	(29.2%)	109	(64.9%)	48	(54.5%)	<0.001***
51–100 km	81	(22.0%)	29	(25.7%)	22	(13.1%)	30	(34.1%)	
101–150 km	45	(12.2%)	20	(17.7%)	17	(10.1%)	8	(9.1%)	
> 150 km	53	(14.3%)	31	(27.4%)	20	(11.9%)	2	(2.3%)	

Presentation history

Table 2 shows the clinical history of the study participants. The median time from onset of symptoms to presenting at the hospitals was 14 days (IQR 7–28 days, total range: 2–1095). There was a significant difference in the time it takes for the patients to present at the hospitals. Prompt presentation (within 0–3 days) was observed in only 4.9% of patients overall,

Table 2. **Clinical history.**

Variable	All (N = 369,100%)		MURHEC (N = 113, 30.6%)		MH (N = 168, 45.6%)		MRRH (N = 88, 23.8%)		P-value
	n/n	(%)	n/n	(%)	n/n	(%)	n/n	(%)	
Presenting time (Median, IQR)	14, 7–28		14, 7–28		20, 9.5–28		7.5, 5.5–20		<0.001***
Prompt 0–3 days	18	(4.9%)	6	(5.3%)	4	(2.4%)	8	(9.1%)	<0.001***
Early 4–7 days	93	(25.2%)	24	(21.2%)	33	(19.6%)	36	(40.9%)	
Intermediate 8–14 days	88	(23.8%)	28	(24.8%)	40	(23.8%)	20	(22.7%)	
Late 15–30 days	114	(30.9%)	32	(28.3%)	66	(39.3%)	16	(18.2%)	
Very late >30 days	56	(15.2%)	23	(20.4%)	25	(14.9%)	8	(9.1%)	
History of trauma									
No	237	(64.2%)	78	(69.0%)	111	(66.1%)	48	(54.5%)	0.083
Yes	132	(35.8%)	35	(31.0%)	57	(33.9%)	40	(45.5%)	
Used traditional medicine									
No	142	(38.5%)	45	(39.8%)	72	(42.9%)	25	(28.4%	0.074
Yes	227	(61.5%)	68	(60.2%)	96	(57.1%)	63	(71.6%)	

with notable variation across hospitals: 5.3% at MURHEC, 2.4% at MH, and 9.1% at MRRH. Pearson correlation analysis demonstrated a statistically significant, though weak, positive association between symptom duration and distance from the eye hospital ($r = 0.13$, $p = 0.012$) (see Supplementary Table 1). This indicates that individuals living farther from the facility were more likely to report prolonged symptom duration.

A history of ocular trauma was reported by 35.8% of patients, with the highest rates at MRRH (45.5%) and MURHEC (31.0%). Most of the patients reported using traditional eye medicine (TEM) prior to presentation at the eye hospitals. Prior usage of TEM was particularly high among patients who presented at MRRH (71.6%), followed by MURHEC (60.2%) and MH (57.1%).

Clinical features and microbiology

Table 3 shows the clinical features and microbiology results from the study participants.

Across all hospitals, 60.8% of patients were blind in the affected eye at the time of presentation. The proportion was similar across sites: 56.3% at MURHEC, 65.9% at MH, and 59.1% at MRRH. At MH and MRRH, 5.3% and 1.1% of

Table 3. Clinical features and diagnosis at presentation.

Variable	All (N = 369, 100%)		MURHEC (N = 113, 30.6%)		MH (N = 168, 45.8%)		MRRH (N = 88, 23.8%)		P – value
	n	(%)	n	(%)	n	(%)	n	(%)	
Snellen Visual Acuity in the affected eye (n = 332)									
6/5–6/18	33	(9.9%)	16	(14.3%)	9	(6.8%)	8	(9.1%)	0.140
6/24–6/60	47	(14.2%)	18	(16.1%)	14	(10.6%)	15	(17.0%)	
5/60–3/60	26	(7.9%)	9	(8.0%)	10	(7.6%)	7	(8.0%)	
2/60–1/60	24	(7.2%)	6	(5.4%)	12	(9.1%)	6	(6.8%)	
Counting fingers-light perception	194	(58.4%)	63	(56.2%)	80	(60.6%)	51	(58.0%)	
No light perception	8	(2.4%)	0	(0.0%)	7	(5.3%)	1	(1.1%)	
Snellen visual acuity in non-affected (n = 332)									
6/5–6/18	289	(87.1%)	102	(91.0%)	109	(82.5%)	78	(88.6%)	0.150
6/24–6/60	30	(9.0%)	6	(5.4%)	17	(12.9%)	7	(8.0%)	
5/60–3/60	2	(0.6%)	0	(0.0%)	0	(0.0%)	2	(2.3%)	
2/60–1/60	2	(0.6%)	1	(0.9%)	1	(0.8%)	0	(0.0%)	
HM–PL	9	(2.7%)	3	(2.7%)	5	(3.8%)	1	(1.1%)	
No light perception	0	(0%)	0	(0%)	0	(0%)	0	(0%)	
Clinical diagnosis (n = 318)									
Unknown	113	(35.5%)	38	(33.9%)	39	(27.4%)	36	(56.2%)	<0.001***
Bacterial	26	(8.2%)	10	(8.9%)	13	(9.2%)	3	(4.7%)	
Fungal	124	(39.0%)	62	(55.4%)	37	(26.1%)	25	(39.1%)	
Mixed	55	(17.3%)	2	(1.8%)	53	(37.3%)	0	(0.0%)	
Lab diagnosis (n = 369)									
Unknown	180	(48.8%)	18	(15.9%)	112	(66.7%)	50	(56.8%)	<0.001***
Bacterial	33	(8.9%)	13	(11.5%)	12	(7.1%)	8	(9.1%)	
Fungal	155	(42.0%)	82	(72.6%)	43	(25.6%)	30	(34.1%)	
Mixed (Bacterial/ Fungal)	1	(0.3%)	0	(0.0%)	1	(0.6%)	0	(0.0)	

patients, respectively, had complete loss of vision (No perception of Light) in the affected eye at the time of presentation.

A Kruskal–Walli's test examining the relationship between symptom duration and visual acuity in the affected eye revealed a statistically significant difference in symptom duration across visual acuity groups ($p < 0.001$). Specifically, patients with longer symptom durations presented with more severe visual impairment compared those who presented earlier. Those who presented earlier had better vision ranging from 6/6–6/18 while those who presented earlier, had worse vision (see Supplementary Table 2).

At the time of presentation, in 35% of the cases, the clinicians were not able to make a diagnosis of the possible type of infectious keratitis, the patient might be having. In most of the cases, fungal keratitis was the suspected cause of infection, accounting for 39.0% of cases overall, with particularly high proportions at MURHEC (55.4%) and MRRH (39.1%).

Laboratory diagnosis was unknown in 48.8% of patients overall, with variation across hospitals: 15.9% at MURHEC, 66.7% at MH, and 56.8% at MRRH. Fungal keratitis was the most frequently identified pathogen, found in 42.0% of all cases, with the highest proportion at MURHEC (72.6%), compared to MRRH (34.1%) and MH (25.6%). These differences were statistically significant ($P < 0.001$).

We evaluated the concordance between clinical diagnosis and the composite laboratory standard for fungal infection. The level of agreement was fair ($\kappa = 0.37$), indicating modest diagnostic alignment beyond chance. However, the McNemar test revealed a statistically significant discordance between the two methods ($p < .001$), suggesting that the clinical diagnosis frequently diverged from laboratory confirmation. Clinically diagnosed cases were 2.5 times more likely to be lab-confirmed (OR = 2.48, 95% CI: 1.59–3.96), pointing to potential overdiagnosis or reduced specificity in clinical assessment (see Supplementary Table 3).

The Table 4 above shows the overall model for several variables of interest that we considered in the causal analysis for poor presenting vision. Distance from the hospital emerged as a significant predictor of the outcome. Compared

Table 4. Factors associated with poor vision (N = 369).

Variables		Univariable Analysis		Multivariable Analysis		
	Crude OR	(95% CI)	p-value	Adjusted OR	(95% CI)	p-value
Distance from Hospital (Km)						
0–50	1					<0.001***
51–100	1.92	(0.99–3.73)	0.054	1.94	(0.98–3.81)	
101–150	3.43	(1.27–9.28)	0.015*	3.21	(1.18–8.77)	
>150	7.46	(2.22–25.11)	0.001**	7.53	(2.22–25.60)	
Delay (days)						
0–3	1					<0.001***
4–7	2.43	(0.84–7.09)	0.103	2.64	(0.88–7.91)	
8–14	5.27	(1.73–16.08)	0.003**	5.99	(1.91–18.83)	
15–30	6.74	(2.25–20.20)	0.001**	7.39	(2.39–22.88)	
>30	21.75	(4.75–99.60)	<0.001***	22.45	(4.79–105.13)	
Positive history of trauma	0.90	(0.53–1.52)	0.688			
Used TEM	1.57	(0.94–2.63)	0.088	1.50	(1.00–2.88)	0.048*
Positive Clinical Diagnosis with fungus	1.00	(0.58–1.71)	0.996			
Positive Laboratory diagnosis with fungus	0.77	(0.46–1.27)	0.304			

Table 5. Diagnostic comparison of clinical and laboratory diagnoses for fungus.

Clinical diagnosis	Laboratory diagnosis		Kappa	McNemar p-value	Sensitivity (95%CI)	Specificity (95%CI)
	Negative	Positive				
Negative	94 (57.3%)	45 (28.8%)	0.291	0.0305*	71.2% (66.2–76.1%)	58.0% (52.6–63.5)
Positive	68 (42.0%)	111 (71.2%)				

Table 6. Diagnostic comparison of clinical and laboratory diagnoses for bacteria.

Composite Clinical	Composite Lab		Kappa	McNemars p-value	Sensitivity (95%CI)	Specificity (95%CI)
	Negative	Positive				
Negative	265 (79.1%)	23 (67.6%)	0.071	< 0.001	32.4(27.58–37.13)	79.1(74.96–83.25)
Positive	70 (20.9%)	11 (32.4%)				

to participants residing within 0–50 km of the hospital, those living 101–150 km away were thrice more likely to have poorer vision (aOR 3.43 [95% CI: 1.27–9.28], p = 0.015). While those who resided more than 150 km from the hospital were almost seven times more likely to have poorer vision when compared to those who resided within 50 km from the hospital (aOR 7.46 {95% CI: 2.22–25.11], p = 0.001). While those living 51–100 km away had increased odds (aOR = 1.92, 95% CI: 0.99–3.73), the association was not statistically significant (p = 0.054). These findings suggest that geographical distance has a significant impact on access to timely and effective care, thereby influencing the outcome.

Delay in presentation demonstrated a strong, stepwise association with poor vision. Using the 0–3-day group as the reference, participants who sought care after 8–14 days had 5.27 times greater odds of poor vision (95% CI: 1.73–16.08; p = 0.003). This likelihood increased further among those delaying 15–30 days (aOR = 6.74; 95% CI: 2.25–20.20; p = 0.001) and was greatest in those delaying beyond 30 days (aOR = 21.75; 95% CI: 4.75–99.60; p < 0.001). Although the 4–7-day delay group had an elevated odds ratio of 2.43 (95% CI: 0.84–7.09), this was not statistically significant (p = 0.103).

Table 5 presents the cross-tabulation between clinical diagnosis and the composite laboratory diagnosis (PCR-based) for fungal infection. Among 156 laboratory-confirmed fungal cases, 111 (71.2%) were correctly identified clinically, yielding a sensitivity of 71.2% (95% CI: 66.2%–76.1%). Of the 162 participants without fungal infection, 94 were correctly diagnosed as negative, resulting in a specificity of 58.0% (95% CI: 52.6%–63.5%). The overall agreement between clinical and laboratory diagnoses was modest. The kappa coefficient was 0.291, indicating fair agreement beyond chance. The McNemar test for marginal homogeneity was statistically significant (p = .0305), suggesting that the discordance between clinical and laboratory diagnoses was not symmetrical and that false positives and false negatives were unequally distributed.

Table 6 summarises the level of agreement between the clinical and laboratory-based bacterial diagnoses using standard diagnostic accuracy metrics. The kappa statistic was 0.071, reflecting poor agreement beyond chance. McNemar's test revealed statistically significant discordance between the two diagnostic methods (p < .001). When compared to laboratory diagnosis, the clinical assessment demonstrated a sensitivity of 32.4% (95% CI: 27.6%–37.1%) and a specificity of 79.1% (95% CI: 75.0%–83.3%).

Discussion

In this study, we present the clinical phenotype of patients with MK presenting at three eye hospitals in Uganda located in three regions in the country, each located more than 130 km from each other. We also do a longitudinal comparison with a study we conducted seven years ago at MURHEC.[2]

As noted, there are still many patients with MK presenting at the different eye hospitals in Uganda. Although MK affects people of all ages, our study noted that the most affected were working age adults with a median age of 45 and a high male proportionality (60%). In our previous study 7 years ago, we had noted that most (60%) of the patients with MK were aged

30–60 years. This trend has also been reported in countries like Nepal[3] and India[11] that also have high prevalence of MK. People with MK are usually sick for a long time and not able to work, highlighting the burden of MK on household incomes and quality of life.[12]

Many patients arrived at the hospital already blind in the affected eye. This trend was observed across all three facilities. Our previous work showed that delay, and use of traditional eye medicine were strong predicators of a poor presentation.[9] Within this study, we still noted that majority of the patients presented late and use of traditional eye medicine was common. In addition, we had noted previously that many patients made circular movements across several health facilities before eventually coming to the eye hospital with already advanced disease.[13] There was a missed opportunity within the health system to promptly diagnose, manage or refer and reinforce messages against dangerous practices such as use of traditional eye medicine. Sadly, the situation has not changed much.

Part of the problem with delay and ultimately poor presentation depends on how far patients need to travel to access the right care. In this study, patients traveled considerable distances. Those attending MURHEC tended to come from much farther away compared to MH and MRRH, reflecting geographic disparities in access. Some patients traveled up to 500 km to access eye care, highlighting the extent of physical barriers faced by those in remote regions. Consistently, prompt presentation within the first three days of symptom onset was uncommon, and differed across facilities. This suggests that both physical access and health-seeking behavior may influence how quickly patients seek specialized care for microbial keratitis, and both are associated with poor presenting vision.

Traditional eye medicine (TEM) use was common among patients with microbial keratitis, reflecting the influence of cultural practices on the management of MK. Although usage varied across the hospitals, it remained notably high at all three sites—particularly at MRRH—potentially contributing to delayed care-seeking and more advanced disease at presentation. This pattern mirrors findings from our previous study, where a similar proportion of patients reported prior use of traditional eye remedies. The persistence of this practice may point to a lack of community-level health education on the potential risks associated with TEM use, underscoring the need for targeted public health interventions.

The overall laboratory diagnostic yield was generally modest but variable across facilities depending on their diagnostic portfolio. For example at MURHEC, the proportion of undiagnosed cases was markedly lower, owing to the use of additional diagnostic technologies, including in vivo confocal microscopy and PCR testing. These tools enabled the identification of fungal pathogens in patients who would have otherwise remained undiagnosed using standard methods. These differences not only highlight the clinical value of advanced diagnostics in improving pathogen detection but also underscore the importance of investing in such capabilities to guide appropriate treatment. PCR and confocal microscopy, while highly effective for detecting microbial keratitis,[14,15] remain prohibitively expensive for widespread use in low-resource settings. This underscores the need for affordable, scalable alternatives like loop-mediated isothermal amplification (LAMP),[16] which offer rapid, sensitive pathogen detection without the need for specialized equipment or highly trained personnel. Our group is piloting development and deployment of these technologies in Uganda.

We also found that fungal keratitis was the predominant microbial cause overall, similar to our previous study which also noted a 72.6% fungal keratitis predominance[22]. On the other hand, the proportion of patients with bacterial keratitis or mixed infections was, however, significantly low compared to our previous study. The low proportion of patients presenting with bacterial keratitis or mixed infection keratitis can be attributed to prior use of antibiotics prior to presenting at the eye hospitals, as in Uganda, antibiotics have become more readily available in most drug shops and pharmacies,[17] and it is common practice for patients to first visit these pharmacies and drug shops before going to hospitals for treatment.[18]

The diagnostic concordance between clinical and laboratory findings varied notably by pathogen type. For fungal infections, clinical assessment showed reasonable sensitivity but limited specificity, suggesting that while clinicians could often recognize classic features of fungal keratitis, there remained considerable misclassification among non-fungal cases. In contrast, agreement between clinical and laboratory diagnoses for bacterial infections was substantially lower. These findings underscore the limitations of clinical judgment alone and highlight the importance of integrating laboratory support, particularly molecular diagnostics, to enhance accuracy and guide targeted management.

Strengths/limitations

This is the first prospective study in Uganda to explore the clinical presentations of patients with MK presenting at hospitals in different regions in the country. It adds additional insights of the seriousness of fungal keratitis as a major cause of microbial keratitis and emphasizes the need to address the major drivers of poor presentation. This study also

utilized additional diagnostic technologies to improve diagnostic yield. It was feasible to deploy the more advanced diagnostic (IVCM and PCR) and to systematically present outcomes data of the patients across all the facilities.

Conclusion

This study provided current understanding of the epidemiology of MK in Uganda. Sadly, the study showed that not much has changed compared to seven years ago. It highlighted fungal keratitis as a leading cause of MK. It showed the burden of poor presentation linked to delayed presentation, use of traditional eye medicines, and access challenges of distance. The study also showed the role of additional diagnostic technologies in improving microbial diagnostic yield.

Submission statement

This submission has not been published anywhere previously, and it is not simultaneously being considered for any other publication.

Author consent

All authors have read and approved this manuscript.

Data availability

LSHTM Data Compass: Epidemiology of Microbial Keratitis in Uganda: A 7-year update, https://doi.org/10.17037/DATA.00004852[19]

This project contains the following underlying data:

Underlying data file: dataset (**microbial_keratitis_data**) (restricted access).

Extended data: Supplementary material (unrestricted access).

Extended data: Study questionnaire (Case report) (Unrestricted access).

The microbial keratitis data was collected with an ethical commitment to participants that it would be stored confidentially and securely, which prevents open access. The ethical body that approved this study was the Mbarara University of Science and Technology Research Ethics Committee (MUST-2022-592). The condition for the approval was to have a regulated data sharing plan with collaborators. Therefore, researchers wishing to access the data are invited to complete a request form in the Data Compass repository, outlining the data variables in which they are interested. Once the dataset has been prepared, the applicant will be asked to agree to a short license agreement and provided with a copy of the data without undue restrictions.

Supporting files are available under the terms of the Creative Commons Attribution 4.0 International licence (CC-BY 4.0) which permits unrestricted use, distribution, and reproduction in any medium, provided the original authors are credited.

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