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# *Conjunctivitis Outbreak Investigation among Residents of Chadiza, Mambwe and Mpulungu Districts of Zambia, April 2024*

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## *Abstract*

*Viral conjunctivitis, a highly contagious ocular inflammation caused by adenoviruses and enteroviruses, accounts for 80% of all conjunctivitis cases, presenting with redness, itching, tearing, and discharge, leading to discomfort and visual disturbances. Accurate diagnosis and management are essential for patient care and preventing transmission. Between February and April 2024, Zambia reported 6,684 suspected viral conjunctivitis cases across Eastern (Chadiza, Mambwe) and Northern (Mpulungu) Provinces. This study aimed to identify factors contributing to the outbreak and recommend control measures. A mixed-methods approach, combining case-control and exploratory designs, was employed. Quantitative data collection involved health facility record reviews. Qualitative data was collected via interviews with healthcare workers, affected individuals (cases), and unaffected household members (controls). Controls were selected from households with reported cases, following a 4:1 ratio. Household environmental and sanitation conditions were assessed using a checklist. Data analysis included descriptive, qualitative, and logistic regression to identify associations. A total of 221 cases and 46 controls were recruited. Females accounted for 151 (68%) of cases, while 67 (30%) were children under 17 (median age: 25, IQR: 17-40). Factors associated with higher odds of conjunctivitis included residing in Northern Province (aOR: 3.66, 95% CI: 1.59-9.96) and household exposure (aOR: 1.49, 95% CI: 1.24-1.84). Elderly individuals (> 65 years) had lower odds of infection (aOR: 0.04, 95% CI: 0.00-0.35). Qualitative findings highlighted use of alternative and harmful remedies in the community, absence of an incident management system at district level, unclear case definitions, and underreporting. Household transmission and regional factors were associated with higher odds of infection. Strengthening surveillance, implementing incident management systems, and increasing community awareness on the disease and its transmissibility are essential for prevention.*

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## Background

Conjunctivitis, commonly known as "pink eye," is a highly contagious eye condition caused by viral, bacterial, or allergic agents. Viral conjunctivitis, often caused by adenoviruses, is the most prevalent form and spreads rapidly transmission in crowded settings [1,2]. The condition presents with symptoms such as eye redness, itching, discharge, and swelling, which can lead to significant discomfort and temporary vision impairment [3].

Key risk factors contributing to the spread of conjunctivitis include poor sanitation, overcrowded living conditions, and lack of public awareness about infection prevention WHO [4]. Previous studies have shown that individuals with coexisting conditions like HIV may experience more severe manifestations and complications from conjunctivitis, posing an additional burden on healthcare systems [5]. Healthcare workers are also at an increased risk of contracting and transmitting infections if proper infection control measures are not adhered to Mukwangole et al. [6].

In early 2024, an outbreak of viral conjunctivitis was reported in Zambia, affecting the Eastern and Northern Provinces. The outbreak was first reported on March 6th at Mfuwe Day Secondary School in Mambwe District, Eastern Province, where students and staff exhibited symptoms such as eye irritation, redness, swelling, discharge, and headaches. By April 30th, the outbreak had escalated to 1,954 cases in Mambwe and Chadiza districts. Concurrently, Mpulungu District in Northern Province reported suspected cases, with the first cluster of three family members identified in a household where symptoms began after children returned from school on February 24th. These index cases presented with typical conjunctivitis symptoms and were seen by a clinician at Mpulungu Urban Health Centre on February 26th. A surge in outpatient visits for eye-related symptoms let to health authorities launching an investigation (Ministerial Statement on Conjunctivitis Outbreak in Zambia) [7].

The primary objective of this investigation was to assess the extent and spread of the outbreak, identify contributing factors, and implement control measures to mitigate further transmission. We describe the epidemiological characteristics of cases and identify high-risk populations, aimed at informing evidence-based public health interventions. Finding from this study, aim to enhance surveillance systems and improve timely response in future outbreaks

## Methods

### Study Setting

Eastern Province is predominantly rural with high poverty levels, a young population, and lower literacy rates. The Northern Province is more sparsely populated and ethnically diverse; it also has a largely rural population and limited access to healthcare and sanitation infrastructure. The main economic activity is agriculture with most households engaged in subsistence farming.

### Study Design

A mixed-methods study design, incorporating a case-control and exploratory approach, was employed. A case-control investigation was conducted to identify potential exposures and sources of infection. Cases were defined based on clinical presentation, including eye redness, discharge, and associated symptoms such as itching and pain. Controls were selected from households with reported cases, following a 4:1 case-to-control ratio. Only participants who provided informed consent were included in the study, resulting in a total of 221 cases and 46 controls. Collection of data from study participants was done by use of a semi-structured questionnaire in Kobocollect to gather information on demographics, symptoms, and potential risk factors [8]. Furthermore, environmental assessments were also carried out to evaluate sanitation practices in the affected areas. Thereafter, data cleaning, processing, descriptive and qualitative analyses were performed using R-Studio. Bivariable and multivariable analyses (logistic regression) were also conducted to inform associations between variables. The reported cases and caregivers with missing information where not included during analysis of the data to ensure complete case analysis.

### Statistical Analysis

We summarized the demographic and clinical characteristics of participants, including caregivers, and compared them between cases and controls. Two-sided

chi-square tests for association were computed to detect relationships between categorical variables. The significance level was set at a p-value level of 0.05. Explanatory variables that were hypothesized to have an association with the primary outcome diagnosis were analyzed using bivariate logistical regression. Variables that were statistically significant in bivariate models with a pre-specified p-value of $< 0.2$ were included in the subsequent multivariate analysis and a resulting $p < 0.05$ taken to be statistically significant in the final model. Epidemiological curves were also drawn using Microsoft Excel 2019 to show the trend of the confirmed cases per week.

## Results

A total of 6,684 suspected cases were reported from March to April 2024 across the three districts (Figure 1). The majority of cases (65%) were reported in Eastern Province. In Chadiza District, 98% of cases involved international truck drivers entering Zambia from Mozambique. For the case-control study, we recruited 221 cases and 46 controls. Females accounted for 181 (68%) of the cases, and 75 (28%) were children under 17 years old, with a median age of 25 (IQR: 17-40). The facility-based cases were documented to have eye pain (76.12%), red or pink eyes (71.27%), and eye discharge (64.93%). Headache, eye itching, and swollen eyes were also frequently reported, while fever occurred in less than a third of cases as documented in the clinical registers.

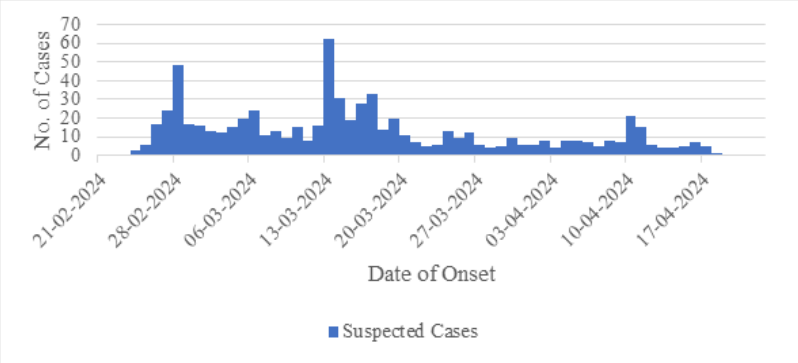


Figure 1: Evolution of conjunctivitis cases by date of onset

The outbreak was characterized by a high attack rate, with 5,933 cases per 100,000 population reported at Chanida Border Health Post in Chadiza District. Mambwe District experienced the highest rates, with 17,337 cases per 100,000 population at Masumba Rural Health Centre and 7,546 cases per 100,000 population at Kakumbi Rural Health Centre. In Mpulungu District, Kaizya Health Post recorded 630 cases per 100,000 population, while Mpulungu District Hospital reported 1,523 cases per 100,000 population. Underreporting was a major issue, with 57% of cases not captured on official line lists.

High household case clustering was evident, with a median of four cases per household in affected areas. Statistical analysis showed that residents of Northern Province were 3.66 times more likely to contract conjunctivitis compared to those in Eastern Province. Additionally, households with prior cases had a 49% increased likelihood of additional members contracting the disease. Elderly individuals aged 65 years and above were less likely to develop the disease.

Environmental assessments found that only 57% of households reported always having handwashing facilities outside toilets, while 23% had no facilities at all. Communities relied on alternative remedies such as human urine, glycerine, lemon juice, and herbal soap for treatment, reflecting widespread misinformation and limited access to proper healthcare.

The investigation also revealed significant gaps in response systems and public health practices, including the lack of a dedicated Incident Management System (IMS) to coordinate the response. Additionally, port health

officers lacked standardized guidelines for identifying and managing cases.

## Discussion

Our investigation documents an extended outbreak of conjunctivitis that occurred in Chadiza, Mambwe, and Mpulungu districts of Zambia. The outbreak was driven by a combination of household transmission factors and potential regional environmental exposures. The case-control study revealed that residing in Northern Province and having a household member with conjunctivitis were significant factors. Previous studies suggest that conjunctivitis spreads rapidly in crowded environments, particularly when hygiene practices are inadequate [1,4].

Qualitative findings highlighted critical gaps in the public health response, including the absence of an incident management system, unclear case definitions, and missed cases. Additionally, the widespread use of alternative remedies such as human urine, breast milk, and herbal soap underscores the need for targeted health education interventions. Similar challenges have been observed in other outbreaks, where misinformation and reliance on home remedies have contributed to delayed healthcare-seeking behavior [2,6].

The investigation revealed significant underreporting, likely due to the lack of a clear case definition and weak community surveillance systems. Underreporting in public health emergencies is a well-documented challenge, often resulting from inadequate surveillance infrastructure and limited healthcare access (Ministerial Statement on Conjunctivitis Outbreak in Zambia, 2024) [7]. Household clustering of cases significantly contributed to the rapid spread of the disease, consistent with findings from other viral conjunctivitis outbreaks (Zambia National Public Health Institute, 2024) [9]. Elderly individuals had lower odds of developing conjunctivitis, possibly due to better hygiene practices—a trend also observed in previous studies on infection control [6].

Despite the significant findings of this study, several limitations should be acknowledged. The retrospective nature of the study, with reliance on self-reported data from interviews, may have introduced recall bias, potentially affecting the accuracy of exposure assessments. The relatively small sample size of controls compared to cases limited the statistical power of the study. The study's focus on three districts may also limit the generalizability of the findings to other areas in Zambia experiencing similar outbreaks. Furthermore, not all potential contributing factors—such as the possibility of conjunctivitis being a symptom of a systemic condition—were explored. The absence of laboratory confirmation for most cases further constrained our ability to definitively identify the causative agent [10].

This study highlights the need for improved public health response systems in Zambia. It is recommended that all districts establish an incident management system to handle future outbreaks. Furthermore, mass awareness campaigns should be implemented to combat misinformation, and surveillance systems should be strengthened to prevent underreporting. Additional research is needed to explore other potential causes and risk factors, seasonal variations, and health-seeking behaviors.

## Conclusions

In conclusion, the 2024 conjunctivitis outbreak in Zambia underscores the urgent need for comprehensive public health interventions and educational initiatives aimed at mitigating future occurrences of this highly contagious condition. Effective strategies must focus not only on immediate treatment and management of affected individuals but also on preventive measures, such as promoting awareness of hygiene practices and the importance of seeking timely medical attention. Furthermore, strengthening healthcare infrastructure, especially in rural and underserved communities, will be crucial in addressing the conditions that facilitate the spread of conjunctivitis and other communicable diseases. Ultimately, an approach that combines both education and infrastructural improvement is essential for safeguarding public health and ensuring that similar outbreaks are effectively prevented in the future, contributing to the overall well-being of the Zambian population.

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## Declaration of Interest Statement

The authors declare that they have no conflict of interests.

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## Annexes

### Annex 1: Quantitative Results

**Table 1:** Demographic Characteristics of Cases and Controls

| Conjunctivitis Status | | | |
|---|---|---|---|
| | **Cases,** | **Controls,** | **Total,** |
| **Variable** | **N = 221 (%)** | **N = 46 (%)** | **N = 267 (%)** |
| Sex | | | |
| Female | 151 (68%) | 30 (65%) | 181(68%) |
| Male | 70 (32%) | 16 (35%) | 86 (32%) |
| Age group (years) | | | |
| 0-17 | 67 (30%) | 8 (17%) | 75 (28%) |
| 18-34 | 87 (40%) | 23 (50%) | 110 (41%) |
| 35-54 | 54 (25%) | 10 (22%) | 64 (24%) |
| 55-64 | 11 (5%) | 2 (4%) | 13 (5%) |
| 65+ | 1 (0%) | 3 (7%) | 4 (2%) |
| Province | | | |
| Eastern | 142 (65%) | 40 (87%) | 182 (68%) |
| Northern | 78 (35%) | 6 (13%) | 84 (32%) |
| District | | | |
| Chadiza | 1 (0%) | 0 (0%) | 1 (0%) |
| Mambwe | 142 (64%) | 40 (87%) | 182 (68%) |
| Mpulungu | 78 (35%) | 6 (13%) | 84 (31%) |

**Table 2:** Health Facility Catchment Areas, Cumulative Suspected Cases, and Attack Rates per 100,000 Population

| Health Facility | Population | Cumulative Suspected Cases | Attack Rate (per 100,000 pop) |
|---|---|---|---|
| Kaizya Health Post | 8736 | 55 | 630 |
| Kasakalawe HP | 7660 | 35 | 457 |
| Mpulungu DH | 40972 | 59 | 1523 |
| Chanida Border Health Post | 2343 | 139 | 5933 |
| Masumba Rural Health Centre | 8958 | 1553 | 17337 |
| Kakumbi Rural Health Centre | 15598 | 1177 | 7546 |

**Table 3:** Symptomatology of Conjunctivitis Cases

| Symptom | Percentage (%) |
|---|---|
| Eye pain | 76.12 |
| Red/pink eyes | 71.27 |
| Eye discharge | 64.93 |
| Headache | 63.06 |
| Eye itching | 62.69 |
| Swollen eyes | 56.72 |
| Light sensitivity | 39.93 |
| Foreign body sensation | 30.22 |
| Fever | 29.85 |
| Impaired vision | 24.63 |

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