Against the clock: Effect of late detection of a mumps outbreak in the Western North Region of Ghana, 2022

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ABSTRACT

Introduction: Mumps is an acute viral illness caused by the Mumps Virus (MuV) that spreads through direct contact with infected individuals**.** While children typically experience a mild form of the disease, adults may suffer from more severe complications. Mumps vaccination is not included in Ghana's Extended Program on Immunization (EPI). In March 2022, the Western North Region of Ghana experienced an outbreak of mumps. We investigated this outbreak to determine its magnitude and distribution in the region. **Methods:** A cross-sectional survey was conducted from 9 to 12 August 2022 to assess the magnitude and distribution of the mumps outbreak in the Western North Region in Ghana. Active and retrospective case searches were performed using IDSR reports and data collected via Kobo Collect and Excel application software, focusing on individuals with confirmed, probable, or suspected mumps cases. Median age and interquartile range were calculated, with frequencies, proportions, and spatial distribution analysed using Excel, Epi Info, and QGIS. **Results:** Out of the 267 mumps cases that were identified, 88.4% (234/267) were school-going children with a median age of five years interquartile range of six (Q3 (9)-Q1 (3)). Seven out of nine districts recorded cases with the highest number, 102 (38.2%) being recorded in the Juaboso district. The mumps outbreak in the Western North Region started in epi-week 12 and progressed through to epi-week 32, lasting for 20 weeks. **Conclusion:** The mumps outbreak in the Western North Region primarily affected school-going children, particularly in the Juaboso district. It was detected late, implementation of response activities was delayed and the outbreak lasted 20 weeks, emphasizing the need for targeted interventions, improved vaccination, and continued surveillance. **Recommendation:** The outbreak highlights the need for improved healthcare capacity, enhanced surveillance, source investigations, and inclusion of mumps vaccines in Ghana's EPI.

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Introduction

Mumps is an acute viral illness caused by the Mumps Virus (MuV) that spreads through direct contact with infected individuals. It has an incubation period of 16 to 18 days [1]. The mumps virus spreads through direct person-to-person transmission via respiratory droplets or infectious nasopharyngeal secretions that come into contact with the mucous membranes of a susceptible individual. It can also spread indirectly through contaminated surfaces or fomites. The primary manifestation is swelling of the salivary glands, particularly the parotitis below the ear, lasting 3-7 days with most cases resolving within 10 days. Clinically, there are three distinct phases of the MuV; prodromal, early acute and established acute. The prodromal phase is marked by non-specific and often mild symptoms, including low-grade fever, headache, and malaise. This is followed by an early acute phase, likely indicating the virus's spread from the respiratory tract and the onset of systemic symptoms, commonly parotitis, which typically lasts a few days to one week. During the established acute phase, complications such as orchitis, meningitis, or encephalitis may develop [2]. Other symptoms include fever, chills, myalgia, headache, malaise, anorexia, nausea, vomiting, fatigue, and stiff neck [3]**.** Children typically experience a mild form of the disease, while adults may suffer from more severe complications [1], [3], [4], [5]. It has been observed that 70-80% mumps vaccine coverage among children can lead to about 97% reduction in mumps cases in a population [6], [7], [8]. However, only 123 member states had access to the vaccine as at the end of 2021 after its introduction by the World Health Organization (WHO) in 1967. Most countries in sub-Saharan Africa have not included mumps vaccination in their national immunization programs. Although there is limited data on mumps epidemiology in Africa, a notable outbreak occurred in Marashda, Egypt, in 2012, in which more than 3,500 school children were infected. The WHO 2016 global summary on vaccine-preventable diseases reported 3,780 cases in Ghana in 2011 [9]. In 2021, a total of 13,801 mumps cases were recorded in Ghana. These cases increased to 33,162 (140%) in 2022 [10]. The current childhood immunization program does not include mumps vaccination, which could lead to an estimated incidence of 100 to 1,000 cases per million and the likelihood of epidemics occurring every four to five years [3]. On July 9, 2022, the Bibiani-Ahwiaso-Bekwai (BAB) Municipal Disease Control Officer reported suspected cases of mumps in some facilities within the municipality. In response, the Regional Surveillance Officer (RSO) alerted all districts to enhance surveillance of mumps within the region. Since the creation of the Western North region in 2018, the Region had not documented any mumps cases until 2022. This prompted a review of health records and an investigation to assess the situation. The study aimed to understand the epidemiological characteristics of mumps in the region, identify potential contributing factors, and recommend preventive measures to mitigate future outbreaks. According to the 7-1-7 matrix, rapid improvement for early disease detection and response, a suspected infectious disease outbreak should be detected within seven days. Public health authorities should be notified to start an investigation within 24 hours of detection and to complete an initial response within seven days [11], [12]. We therefore investigated this outbreak to determine its magnitude, and distribution in the region.

Methods

Study design

We conducted a cross-sectional survey to determine the magnitude and distribution of the mumps outbreak in the Western North Region of Ghana from 9 to 12 August 2022.

Outbreak setting

The outbreak occurred in the Western North Region of Ghana, one of the six (6) new regions created in 2019 (Figure 1). The region shares borders with Cote D'Ivoire on the southeast with the influx of people from the country through many unapproved routes. It also has common boundaries with the Ashanti, Ahafo and the Bono regions in the North and Western Region to the southwest with different groups of people moving in periodically to work on cocoa farms. The Western North Region has a population of 898,540 [13]**.** The region is administratively divided into nine health districts: Bibiani-Anhwiaso-Bekwai, Sefwi Wiawso, Aowin, Sefwi Akontombra, Suaman, Bodi, Juaboso, Bia West, and Bia East.

Epidemiological surveillance in the Western North Region is organised through a robust system involving active and retrospective case searches in communities and health facilities. The region has 16

hospitals, 26 health centres, 31 clinics, 238 CHPS compounds, and 24 maternity homes, all contributing to surveillance and reporting. Health workers and community volunteers track and report diseases, including mumps. Disease reporting is managed through the Infectious Disease Surveillance and Response (IDSR) framework, complemented by registers for efficient data collection, enabling timely responses and effective outbreak control.

The Western North Region of Ghana features a tropical climate with substantial annual rainfall averaging 1,637 mm and warm temperatures ranging between 24.5°C and 29.2°C. Its two rainy seasons, from April to July and September to November, play a crucial role in shaping agricultural activities and water resource management [14],[15]

Coordination activities

Public Health Response: We established mumps response teams in all the nine districts in the region and conducted training for them. These response teams, led by the district disease control officers, were composed of a clinician, an environmental health technologist, and a nurse. Their main responsibilities included actively identifying cases, reporting them, and creating community awareness about the outbreak. We equipped clinicians at each facility with a standardized line list and questionnaire and provided mobile phone airtime for effective communication.

Logistics and resource mobilization: The investigation team identified the most affected districts and the route of transmission of the disease within the region. Based on this, resources such as personnel, personal protective equipment (PPE), and contact tracing tools were distributed equitably among the districts. Communication channels such as social media, radio and community information centres were well utilized for education on the preventive measures for the further spread of the disease. There were also collaborations between the health facilities for active case searches within the communities in the region.

Communication and collaborations: The districts, through their district directors of health service, reported on cases to the Regional Health Directorate (RHD) daily. Daily debriefings were done at the regional level, and the next steps were communicated to the districts and health facilities as needed. Health promotion officers conducted public education activities in the facilities and communities. Teachers and school authorities of some of the affected schools were also engaged during the investigations.

Study population

The study population of this mumps outbreak investigation in the Western North Region includes individuals with confirmed, probable, or suspected mumps cases based on clinical and laboratory criteria. It also comprises close contacts of these cases, such as family members, classmates, or coworkers, as well as residents of communities, schools, or institutions identified as the outbreak hotspots. Additionally, the study targeted unvaccinated or partially vaccinated individuals, particularly children and adolescents who are typically most affected by mumps outbreaks, while also considering adults in cases of extended transmission. This diverse population provides a comprehensive basis for assessing the extent and spread of the outbreak.

Case definitions

The following case definitions were used for the investigations:

Suspected case: Any person living in the Western North Region and presenting with parotitis (acute salivary gland swelling) with or without encephalitis, hearing loss, orchitis, oophoritis, mastitis, pancreatitis from 23rd March to 11th August 2022.

Clinically confirmed case: Any suspected case clinically diagnosed as mumps by a clinician in the Western North Region from 23rd March to 11th August 2022.

Confirmed case: A suspected case with a positive laboratory confirmation for mumps virus with Reverse Transcription Polymerase Chain Reaction (RT-PCR) or positive mumps viral culture.

Case search and data collection technique

In our mumps outbreak investigation, we defined a contact as anyone exposed to a confirmed or probable case within two days before to five days

after symptom onset. Exposure included direct face-to-face interaction, sharing utensils, or living in the same household.

We followed up contacts by monitoring them for 25 days for symptoms like fever and gland swelling. Preventive measures included hand hygiene, and respiratory etiquette.

For symptomatic contacts, we recommended isolation for five days after symptom onset, laboratory confirmation, and supportive care with hydration and analgesics. We emphasized reporting cases to health authorities to track secondary transmission.

Our approach ensured early detection, reduced transmission, and improved outbreak management through coordinated surveillance, vaccination assessment, and timely interventions.

The team conducted an active case search in communities across selected districts through house-to-house visits and school engagements. Community searches were carried out in Juaboso, Kantankrobo, and Antobia in the Juaboso District; Datano, Dwinase, and Wiawso in Wiawso Municipality; and Old Town, Old Compound, Estate, Ahodwo, Gee Akurase, Gyidie, California, and Kyekyewere in Bibiani Municipality. Additionally, medical records were reviewed at Juaboso Government Hospital, Bibiani Government Hospital, and Divine Love Hospital in Bibiani using two electronic data repositories: the Lightwave Health Information Management System (LHIMS) and the District Health Information Management Systems (DHIMS2).

The investigation team also reviewed facility-based Integrated Disease Surveillance and Response (IDSR) reports from January to August 2022. Interviews were conducted with case patients, caregivers, and teachers to collect demographic and clinical data, including age, gender, place of residence, date of disease onset, and disease outcomes. Data collection was conducted systematically to ensure comprehensive coverage and accurate reporting using Kobo Collect and Excel software applications.

Data processing and analysis

The median age and interquartile range (Q3-Q1) were calculated. Categorical variables were summarized as frequencies and proportions using Microsoft Excel Spreadsheet Software (Microsoft 365) and Epi Info statistical software (Epi Info version 7.2.2.16, www.cdc.gov>epiinfo). Quantum Geographical Information System (QGIS) was used to describe the spatial distribution of cases and the attack rate.

Data availability

The dataset for this investigation is available upon request from the corresponding author (josebilly35@gmail.com).

Ethical consideration

This investigation was conducted as part of the responsibilities under the IDSR protocols being implemented by the Ghana Health Service per the mandate of Ghana's Public Health Act, (Act 851, 2012) (The Parliament of Ghana, 2012). Permissions were obtained from the National Disease Surveillance Department (DSD) of the Ghana Health Service and the Regional Health Directorate of Western North Region before going to the field. Informed consent was obtained from case patients before interviewing them. Parents assented for their wards who were affected before any interaction occurred. Participants were given the opportunity to withdraw at anytime during the investigation. Data obtained from the investigation was anonymized and password-protected.

Consent was obtained from the participants for publication of this investigation. The authors have also consented to the publication of this work.

Results

Epidemiological profile of the outbreak

A total of 409 suspected cases of mumps were reported from 23 March to 11 August 2022, out of which 65.3% (267/409) of these cases were clinically confirmed through thorough examination resulting in an incidence rate of 30/100,000 population. None

of the suspected or clinically diagnosed cases were tested using laboratory methods such as Reverse Transcription Polymerase Chain Reaction (RT-PCR) or mumps viral culture. The median age was five years (interquartile range 3-9) and the majority, 55% (147/267) were males. About 88.4% (234/267) were school pupils with Juaboso district recording the highest proportion of cases i.e.38.2% (102/267) whilst Suman district recorded the least – 0.4% (1/267) as shown in Table 1. The Juaboso district also recorded the highest attack rate of 113/100,000 population while the Aowin district recorded the least (2/100,000 population). None of the recorded mumps cases had received any vaccination against the mumps virus (Figure 2).

Evolution of the outbreak

The mumps outbreak in the Western North Region started in epi-week 12 (March 23, 2022) and progressed through to epi-week 32, (August 11, 2022) lasting for 20 weeks. The outbreak was first detected in epi-week 27 (July 9, 2022), almost 15 weeks after the first case occurred. The epi-curve had six distinct peaks depicting a propagated outbreak as shown in Figure 3. The team from the national level joined the regional team to investigate the outbreak on August 9, 2022 (epi-week 31), almost one month after notification of the outbreak. The first case could not be followed up for in-depth information on their exposures because of the unavailability of a traceable address.

During the outbreak investigation, no deaths were recorded among the suspected or clinically diagnosed cases giving a zero percent case fatality rate. Despite the spread of disease within the affected population, all reported cases were managed without any fatal outcomes. Additionally, no mortality was linked to secondary infections or complications arising from mumps.

Preventive measures

During the mumps outbreak, several preventive measures were implemented to control the spread of the virus. Suspected cases were isolated, with infected individuals kept away from school and restricted from attending crowded events. Public health education campaigns were conducted to promote early detection, proper hygiene, and isolation practices. These measures, combined with ensuring adequate hydration and rest for affected individuals, played a significant role in reducing transmission and supporting recovery.

Case management

The case management approach focused on symptomatic treatment, including pain relief for fever and swelling, and ensuring proper hydration for affected individuals. Supportive care was provided to monitor complications, though none were observed. With no specific antiviral treatment for mumps, the case management strategy emphasized alleviating symptoms and supporting recovery, while isolation measures successfully prevented further spread of the virus.

Discussion

This investigation sought to determine the magnitude and distribution of the mumps outbreak in the Western North Region. We found that between March and August 2022, the Western North Region experienced a mumps outbreak, with a high incidence but no fatalities. The outbreak was widespread in the region and prolonged, beginning in Epi-week 12 and continuing until Epi-week 32. The outbreak was detected late with response activities also coming in late. Children of school-going age were the most affected.

The mumps cases did not undergo laboratory testing through methods like Reverse Transcription Polymerase Chain Reaction (RT-PCR) or mumps viral culture. This was primarily due to paraclinical examination and limited availability of laboratory resources, logistical constraints, and the reliance on clinical diagnosis based on characteristic symptoms. Additionally, the outbreak setting may have prioritized symptomatic case management over extensive laboratory testing, particularly in areas with restricted diagnostic capacity.

The high incidence of cases during the outbreak could be due to a lack of herd immunity for the mumps virus since most of the population have no evidence of vaccination against the virus. Ghana's Expanded Programme on Immunization (EPI), similar to other African countries, does not include mumps [6][7][8]. Studies have established that routine vaccination against mumps remarkably

reduces the incidence of mumps and its implications within a population [7],[16]

The outbreak occurred in seven out of the nine districts in the region. However, the attack rates varied across the different districts in the region. Juaboso district had the highest attack rate, which could be attributed to high population density and under-recognition of the mumps symptoms. High population density, especially in urban areas has been found to facilitate the transmission of infectious disease [17]. Also, areas with high social interactions significantly experience a high rate of the disease. The most affected population of the disease were the school-aged children. There is a higher susceptibility of school-aged children to mumps due to their higher levels of contact within school and community settings and this distribution is consistent with previous research on mumps [9],[18]. The outbreak was detected late, almost 15 weeks after its occurrence. This provided the opportunity for more susceptible people to acquire the infection, thereby increasing the magnitude of the outbreak and its related burden. The global goal for preventing epidemics is to have systems that can detect early, report, and adequately respond to infectious diseases and other threats. This goal is situated in the 7-1-7 matrix, which aims at detecting all infectious disease outbreaks within seven days after their emergence and notifying public health authorities within 24 hours [11],[12]. This outbreak violated this principle, and this could account for the prolonged outbreak and high magnitude. Not only was the outbreak detected late, but response activities were delayed, almost four weeks after notification. The late detection and response are characterized by the gaps in the surveillance systems which need to be improved to prevent future occurrences in the region.

The delay in recognizing the outbreak could be associated with inadequate training which highlights the importance of enhancing the capacity of health systems to detect and respond to emerging infectious diseases promptly. Strengthening surveillance mechanisms and making certain diseases notifiable or reportable can improve the early detection of outbreaks. Previous research has emphasized the need for robust disease surveillance systems to promptly detect and respond to outbreaks [19]. It's crucial to investigate the source of the outbreak further to prevent future occurrences.

No death was recorded in the outbreak as commonly seen in mumps infection. This situation makes people give little attention to preventive measures as well as seeking care when infected, leading to prolonged infection and community spread. Clinical interventions and supportive care provided to affected individuals were effective in preventing severe complications.

The implementation of preventive measures, including isolation of suspected cases and public health education campaigns, was crucial in containing the outbreak and preventing widespread transmission of mumps. These measures align with recommendations from previous studies, which emphasize the importance of early detection, isolation, and hygiene practices to limit outbreaks. The successful control of the outbreak, despite the spread within the affected population, highlights the critical role of timely public health interventions in reducing morbidity [20],[21].

Case management, primarily based on supportive care and symptom management, proved effective in preventing severe complications, consistent with existing guidelines for managing viral infections like mumps [20]. The were no fatalities and secondary infections in the outbreak as commonly seen in mumps infection. This situation makes people give little attention to preventive measures as well as seeking care when infected, leading to prolonged infection and community spread. The clinical interventions provided including by the healthcare workers, including hydration, rest, and pain relief, were successful in mitigating severe outcomes. While no specific antiviral treatments were available, the approach of providing symptom relief and monitoring for complications is in line with standard mumps care. However, the lack of long-term data on post-recovery outcomes limits the ability to assess the full impact of the interventions. Future research should explore the effectiveness of these strategies in different population settings.

Conclusion

The mumps outbreak in the Western North Region of Ghana in 2022 started from March to August with a high incidence but no fatalities were recorded. The outbreak was widespread in the region and

prolonged. Children of school-going age were the most affected. The outbreak was detected late, and response activities were also implemented late.

Recommendations

Strengthening surveillance systems by enhancing early detection and reporting mechanisms is crucial to improving outbreak preparedness and response. There is need for regular capacity building of healthcare workers on reporting and management of mumps cases in the region. Integrating mumps into routine disease surveillance and ensuring timely notification of public health authorities can help detect outbreaks early, allowing for prompt interventions to reduce the spread of infections.

Expanding laboratory capacity is essential to confirm mumps cases accurately. The limited availability of diagnostic testing, such as RT-PCR and viral culture, contributed to reliance on clinical diagnosis. Strengthening laboratory infrastructure and ensuring access to necessary reagents and equipment will improve case confirmation and epidemiological assessments.

Considering the high incidence of cases and the lack of herd immunity, introducing the mumps vaccine into Ghana's Expanded Programme on Immunization (EPI) should be explored. Routine vaccination has been proven to significantly reduce the burden of mumps and prevent future outbreaks, especially among school-aged children who are at higher risk.

Public awareness and health education must be improved to ensure communities understand the symptoms, transmission, and prevention strategies for mumps. Encouraging timely healthcare-seeking behaviour and reinforcing hygiene practices will help reduce disease transmission and mitigate outbreak severity.

To effectively manage future outbreaks, it is essential to prioritize prompt responses and case management. This includes quickly identifying and isolating cases, providing supportive treatment, and implementing targeted interventions to minimize community spread. Ensuring that healthcare workers are well-equipped to handle symptomatic cases can help prevent severe complications.

Finally, further research is needed to assess post-recovery outcomes and explore the feasibility of introducing the mumps vaccine into national immunization programs. Investigating long-term immunity and evaluating the effectiveness of current public health strategies will provide valuable insights for future outbreak prevention and control efforts.

What is already known about the topic

- The Mumps vaccination is not included in Ghana's Extended Program on immunization (EPI) activities.

What this study adds

- Late detection, reporting and responding to emerging infectious diseases can result in outbreaks. There is therefore the need to strengthen surveillance mechanisms, making diseases notifiable to detect possible outbreaks.
- The Mumps outbreak in the Western North Region was widespread and prolonged.
- Children of school-going age were mostly affected by the virus.
- The outbreak had a high incidence with no fatalities.
- The outbreak lasted for 15 epidemiological weeks.

Competing Interest

The Authors declare no competing interest.

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Authors´ contributions

Marion Okoh-Owusu, Billy Joshua, Saibu Adama Sawadigo, Samuel Dapaa, Samuel Twum-Andoh, Patrick Avevor, Osei Sakyi, Ephraim Foanor Kwadodeh, Martha Arkaa Kotey and Kingsley Osei-Kwakye conceptualized the investigation,

participated in its design and coordination, drafted the manuscript, initiated the investigation, interpreted the results, and drafted the final manuscript. Dennis Laryea, Franklin Asiedu Bekoe, and Seidu Salifu were involved in data collection, revised the methods, and guided the discussion and write-up of the manuscript. All the authors have read and approved the final manuscript.

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Table 1: Distribution of mumps cases, Western North Region, 2022

Variables (N=267)	**Frequency (n)**	**Percentage (%)**
Age (Years)		
1-5	163	61.1
6-10	70	26.2
11-15	8	3.0
Above 15	26	9.7
Sex		
Female	120	44.9
Male	147	55.1
Occupation		
Other	31	11.7
Pupil	234	88.3
District		
Juaboso	102	38.2
Bibiani-Anhwiaso-Bekwai	97	36.3
Bodi	37	13.9
Wiawso	25	9.4
Bia West	3	1.1
Aowin	2	0.8
Suaman	1	0.4
Case Fatality		
Total Deaths	0	0
N=Total number of cases		

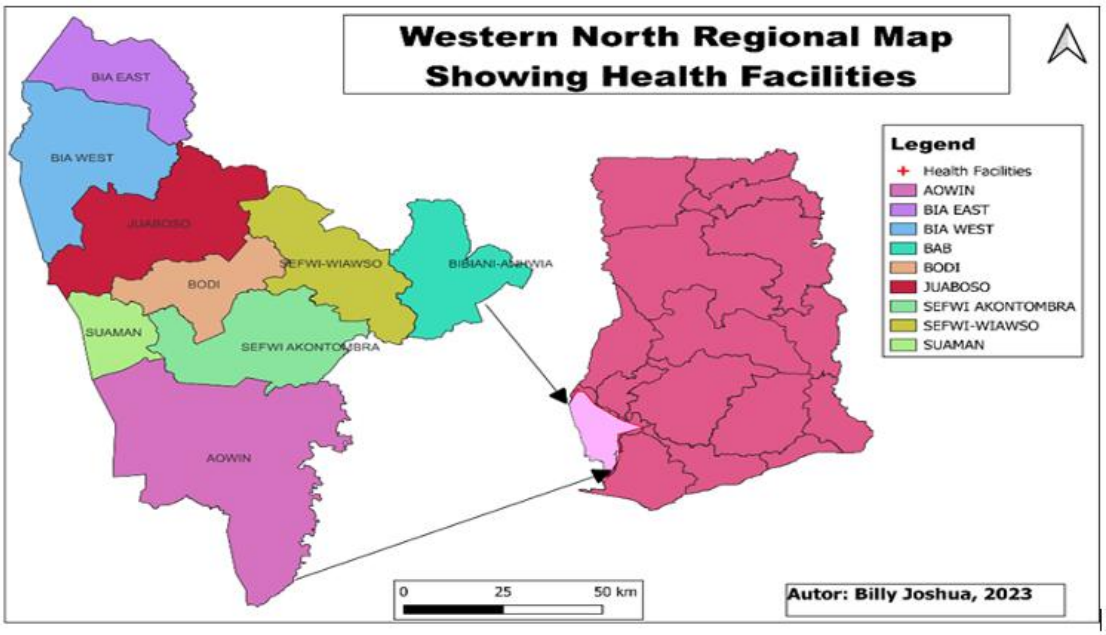

Figure 1: Map of Ghana showing Western North Region and districts

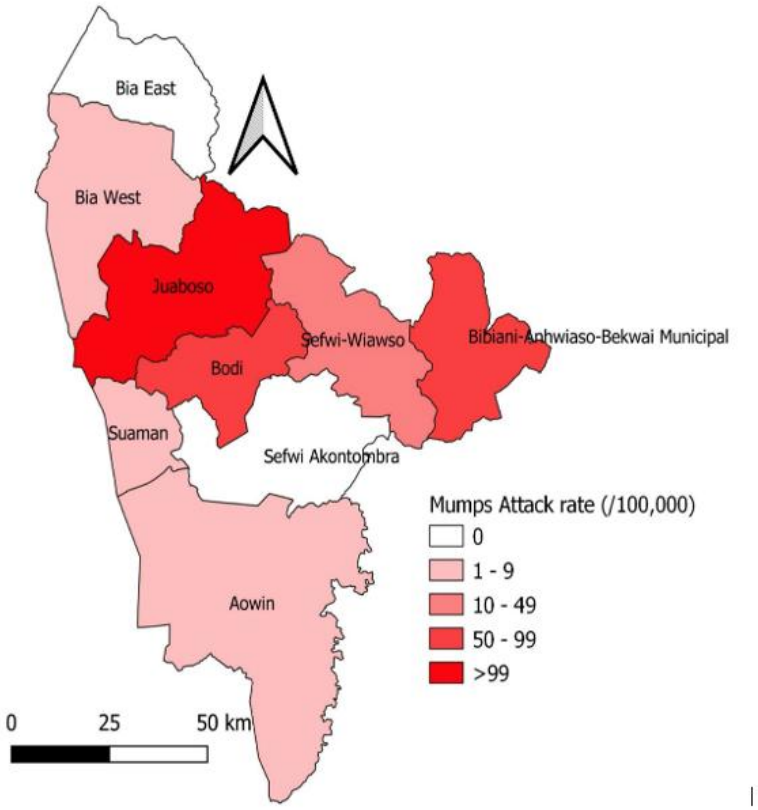

Figure 2: Distribution of mumps attack rates by district, Western North Region, August 2022

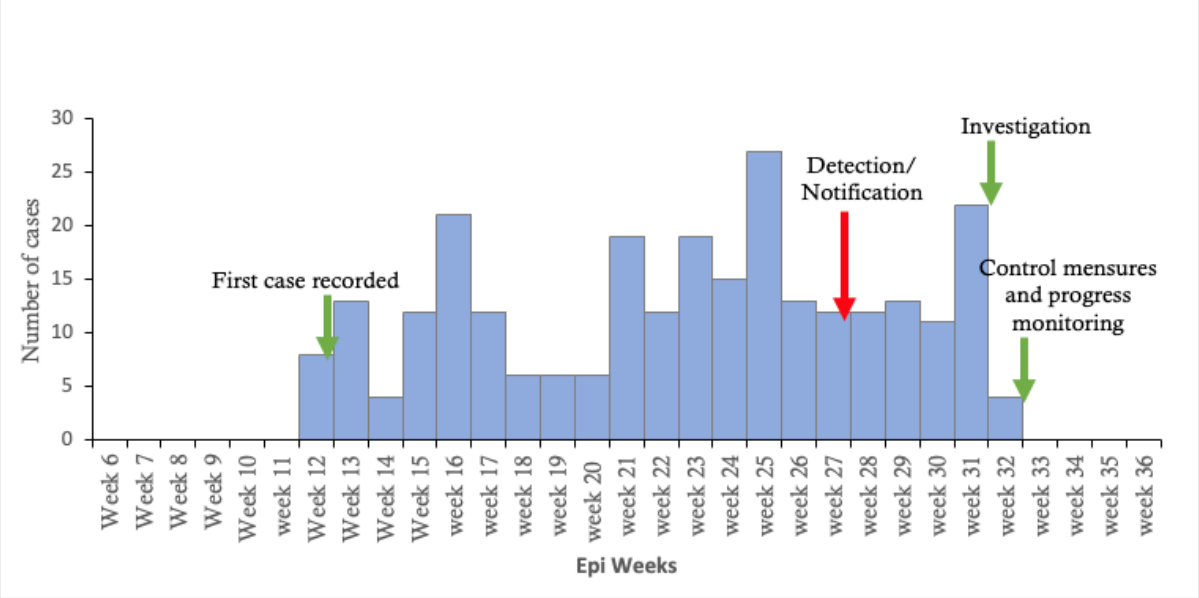

Figure 3: Epidemic curve of Mumps cases, Western North Region, August 2022