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Epidemiological Outbreak Investigation Of Chickenpox In Aathrai Tribeni Rural Municipality, May – June 2023, Taplejung, Nepal

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Executive Summary
Chickenpox is an acute, highly contagious disease caused by the varicella-zoster virus, transmission via droplets, or direct contact with respiratory secretions, and almost always produces clinical disease in childhood before the age of 10 years, characterized by extensive vesicular eruption.
The health coordinator of Aathrai Tribeni rural municipality of Taplejung district reported to Health Office, Taplejung about chickenpox-like symptoms in students of a nearby school. Health Office team moved towards the reported community to investigate the outbreak of chickenpox.
The objectives of outbreak investigations were to confirm the outbreak, describe the epidemiological linkage of an outbreak, determine the cause of the outbreak and control the outbreak.
The study type was descriptive cross-sectional study. The study was conducted in the affected population of Aathrai Tribeni-5, Chaange village and Maiwakhola-1, Khanitol of Taplejung district. The data were collected through interview and observation and the interview tool was semi-structured-questionnaire. The outbreak investigation duration was fromJune 1 to 7, 2023
Total 157 children were screened and interviewed with their parents and the incidence of chickenpox was 27 percent. The most affected age group was under 5 years with a 34 percent of incidence rate. The mean age of infected children was 8 years.
The epidemic curve of cases concerning time was developed, a total of 43 cases of chickenpox were identified, index case of this outbreak was notified on May 2, 3023.
Janajati especially Limbu are the main inhabitants, and Dalit and Brahmin/Kshetri are also the inhabitants of outbreak areas. All classes from 0 to 10 were infected and this suggested us the transmission was propagated from school and contact history revealed the school and neighborhood were the key places for infection. Most of the rashes were resolved within 5 to 9 days. Among infected children, 63% suffered from fever and 23% suffered from cough and no one has had complications.
Increasing community and school awareness about the mode of transmission and control measures for prevention and training of reportable diseases, case-based management, and treatment for local levels health workers are recommended.

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I. Introduction

Chickenpox (Varicella) is an acute, highly contagious disease caused by the varicella-zoster virus (VZV), only one serotype of VZV is known, and humans are the only reservoir (1). Primary infection of the virus results in varicella (chickenpox) reactivation of latent infection results in herpes zoster (shingles) and short survival in an environment (2). VZV enters through the respiratory tract and conjunctiva and replicates in the nasopharynx and regional lymph nodes, primary viremia has occurred 4 to 6 days after infection, multiple organs are infected during viremia, secondary viremia with viral skin infection is occurred after replication (2).

Transmission occurs via droplets, aerosols, or direct contact with respiratory secretions, and almost always produces clinical disease in susceptible individuals and mild illness in childhood, it tends to be more severe in adults and may be fatal, especially in neonates and in immunocompromised persons, in temperate climates most cases occur before the age of 10 years (1).

The incubation period is 14 to 16 days after exposure, with a range of 10 to 21 days (2). Chicken Pox is characterized by an itchy, rash usually starting on the scalp and face and initially accompanied by fever and malaise, the rash gradually spreads to the trunk and extremities and the vesicles dry out and crusts appear which

then disappear throughout one to two weeks (1). Lesions are usually 1 to 4 mm in diameter and the vesicles are superficial and delicate and contain clear fluid on an erythematous base (2).

The clinical course in healthy children is generally mild, fever (up to 102°F) and other systemic symptoms (e.g., malaise, headache) usually resolve within 2 to 4 days after the onset of the rash, adults may have more severe disease and have a higher incidence of complications and immunocompromised children may develop a severe progressive form of varicella characterized by high fever, extensive vesicular eruption, and high complication rates (2). Recovery from primary varicella infection usually results in lifetime immunity, the second occurrence of varicella is uncommon, it is more common in immunocompromised persons (2). Complications include bacterial infection of skin lesions, Pneumonia, central nervous system manifestations, and Reye syndrome in rare cases (2). Complications are infrequent among healthy children and occur much more frequently in persons older than age 15 years and infants younger than age 1 year (2). Hospitalization rates were approximately 1 to 2 per 1,000 cases among healthy children and 14 per 1,000 cases among adults (2).

The fatality rate for varicella was approximately 1 per 100,000 cases among children aged 1 through 14 years, 6 per 100,000 cases among persons aged 15 through 19 years, and 21 per 100,000 cases among adults. Most deaths occur in immunocompetent children and adults (2).

Epidemiology of Chicken Pox includes the reservoir being human, transmission is person-to-person by direct contact with vesicular fluid or inhalation of aerosols, it has a distinct seasonal fluctuation, with the highest incidence occurring in winter and early spring, communicability is 1 to 2 days before the onset of rash until all lesions have formed crusts (2). The secondary attack rate is 90 percent in household contacts (3).

For preventing chickenpox, Varicella Zoster immunoglobulin is recommended for exposure within 72 hours and the Varicella vaccine is recommended for children between 12-18 months of age who have not had chickenpox (3). Control measures include isolation of cases, notification to the authority, disinfection of fomites used by the patient, and some antiviral drugs like Acyclovir are seen as effective therapy (3). Calamine lotion and a cool bath with added baking soda, uncooked oatmeal, or colloidal oatmeal may help relieve some of the itching (4).

Taplejung is the largest district by area among the 14 districts of Koshi Province. It is located in the northeast of Nepal bordering China and India. The district covers an area of 3,646 km2 and has a total population of 120,359 (5). It is situated at an elevation ranging from 670 to 8,586 meters from sea level. The district's headquarter is Phungling municipality and about 800 km from Kathmandu. Taplejung is divided into 1 urban and 8 rural municipalities. Among 9 local levels, Aathrai Tribeni rural municipality is one of them.

Notification of the event

On May 31, 2023 health coordinator of Aathrai Tribeni rural municipality reported to Health Office about chickenpox-like symptoms in students of a nearby school i.e. Shree Chaange Higher Secondary School (red circle in the Figure 1). Our team confirmed the outbreak situation by connecting the local health post-health worker and school teacher and heading towards the reported community on June 1, 2023, to investigate the outbreak of chickenpox.

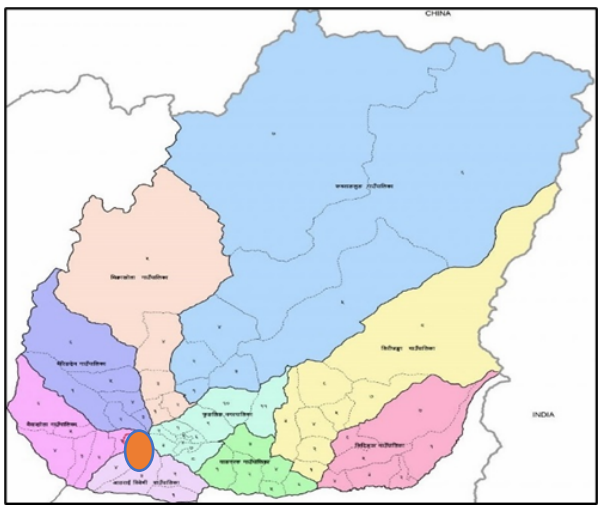

Figure 1: - Taplejung District

Objectives of the outbreak investigation

- To confirm the outbreak
- To describe the epidemiological linkage of an outbreak

- To determine the cause of the outbreak
- To control the outbreak

II. Methodology Of Outbreak Investigation

- **Study type:** Descriptive cross-sectional study
- **Study area**: The study was conducted in the affected population of Aathrai Tribeni-5, Chaange village, and Maiwakhola-1, Khanitol, Taplejung.
  - To confirm the outbreak: we reconfirm from the health post in charge about the cases visited in the health post for service seeking and the health coordinator recontacts the teacher of a school, who reported about the symptomatic illness of students in classes. When we reached and meet with a local health worker then we included Maiwakhola – 1, Khanitol, because the community also received services from Chaange health post and are students of Chaange Higher Secondary school.
- **Case definition** (6)
- **Clinical case definition**: - An illness with acute onset of diffuse (generalized) maculo-papulo-vesicular rash without other apparent cause.
- **Probable:** - A case that meets the clinical case definition, is not laboratory confirmed, and is not epidemiologically linked to another probable or confirmed case.
- **Confirmed:** - A case that is laboratory confirmed or a case that meets the clinical case definition and is epidemiologically linked to a confirmed or a probable case. Note: Two probable cases that are epidemiologically linked are considered confirmed, even in the absence of laboratory confirmation.
- **Data collection technique:** -
  - Interview: - We visited the outbreak area and interviewed every parent of under 15 years children. Line listing of each case was done in terms of time, place, and person. A meeting was held in the school regarding the outbreak, the participants of the meeting were our team, health coordinator and staff of health post, school teacher and headmaster, and president of Wada number 5,
  - Observation: - In school and community household for clinical examination of every child under 15 years was done to evaluate the disease condition by household survey.
  - **Data collection tool:** - Semi-structured questionnaire: - With the help of a semi-structured interview questionnaire which was developed in epi-info7 software and transferred questionnaire in mobile to collect data.
- **Outbreak investigation duration:** - June 1, 2023, to June 7, 2023 (Seven days)
- Data analysis: Data was transferred from mobile to computer in epi-info7 and then analyzed in Microsoft Excel 2007.
- Ethical clearance: Oral consent was taken from the president and chief administrative officer of Aathrai Tribeni rural municipality.

III. Results

Person distribution

Table 1 showed the total number of screened children in the household survey. A total of 157 children were screened and interviewed with their parents about the status of chickenpox. The incidence of chickenpox in different age groups was 34, 21, and 29 percent in 0 to 5 years, 6 to 10 years, and 11 to 15 years respectively, and the overall chickenpox incidence was 27 percent. The most affected age group was under 5 years with 34 percent of incidence rate. The mean age of infected children was 8 years.

Table 1: - Total numbers of children screened in household survey and incidence of Chickenpox

Age group in years	Total number of children screened	Rashes		Percentage of infected children
		Yes	No	
0-5	44	15	29	34
6-10	57	12	45	21
11-15	56	16	40	29
Total	157	43	114	27

Table 2 highlighted the age groups of male and female children, those who suffered from rashes or not. Under 5 years of female children developed rashes in highest than followed by 11 – 15 years of male children. 44% of under 5 years female children were infected and 37% of 11 – 15 years male children were infected. 21% of under 5 male children, 14% and 28% of 6 – 10 years male and female children respectively, and 19% of 11 – 15 years of female children were infected. In total 19 males (25%) and 24 females (30%) were infected. Figure in parentheses are percent.

Table 2: - Total numbers of male and female children who developed rashes by age groups

Age group in years	Rashes in male		Total	Rashes in female		Total
	Yes	No		Yes	No	
0-5	4 (21)	15	19	11 (44)	14	25
6-10	4 (14)	24	28	8 (28)	21	29
11-15	11 (37)	19	30	5 (19)	21	26
Total	19 (25)	58	77	24 (30)	56	80

Time distribution

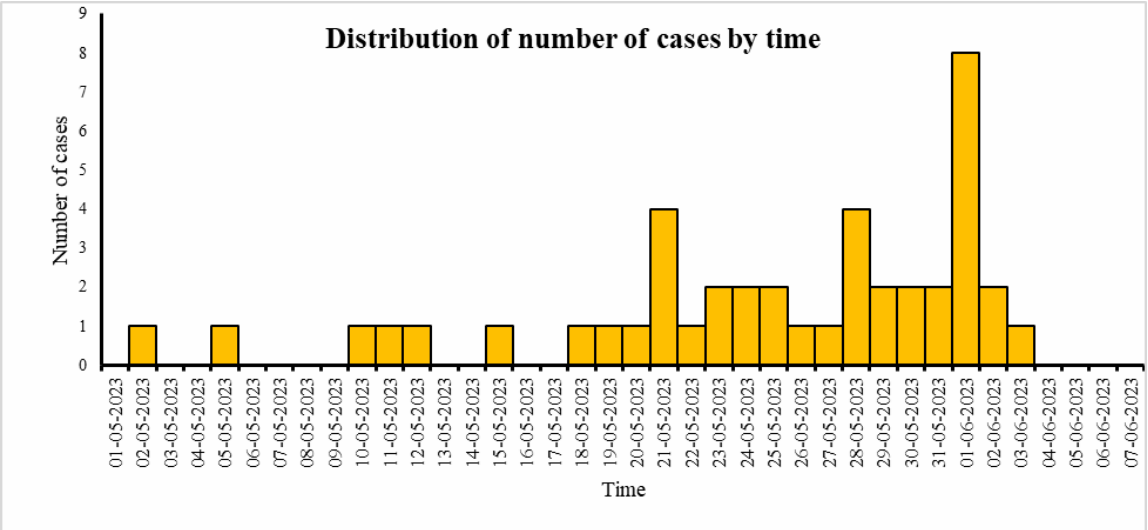

Figure 2: - Epidemic curve of outbreak in respect to cases and time

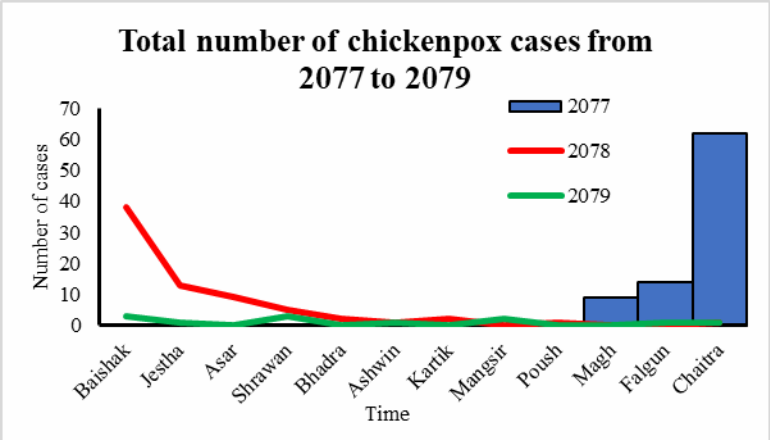

Figure 3: - Distribution of cases from 2077 to 2079

Figure 2 shows the epidemic curve of cases concerning time, a total of 43 cases of chickenpox was identified, which is a higher number of cases in that area than previous year and months, and the first case was reported on May 2, 2023, and was the index case in this outbreak. In the DHIS2 database of the health office Taplejung, in the month of Baisak 2080, 7 cases of chickenpox were reported from a health post of Meringden – 5. From this community, some relatives have visited in Maiwakhola – 1 and the first case of this outbreak was notified. Index case developed secondary cases within the family i.e. house on May 5, 2023, and neighbor, and then neighbor case attained school in incubation period as student and outbreak occurred.

Figure 3 showed the 3 years trends of chickenpox cases in Aathrai Tribeni rural municipality. 2077 Baishak and 2078Chaitra showed highest number of cases and other months showed lowest number of cases and Baishak and Jestha of 2080 showed again highest number of cases indicate outbreak at this place.

We completed the screening of under 15 children through the household survey on 2nd June, so the highest number of cases were seen in 1st June, simultaneously we closed the school on 2nd June by the decision of a meeting that was held in school, and the last reported case of chickenpox was recorded on 3rd of June but we remained in contact with local health worker for newly recorded case till 7th of June for this study and no case was recorded after 3rd of June.

Place distribution

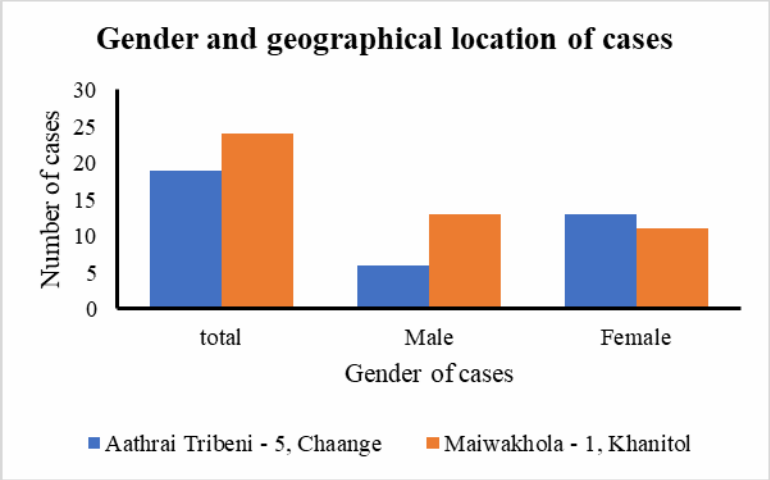

Figure 4: - Distribution of cases according to gender and location

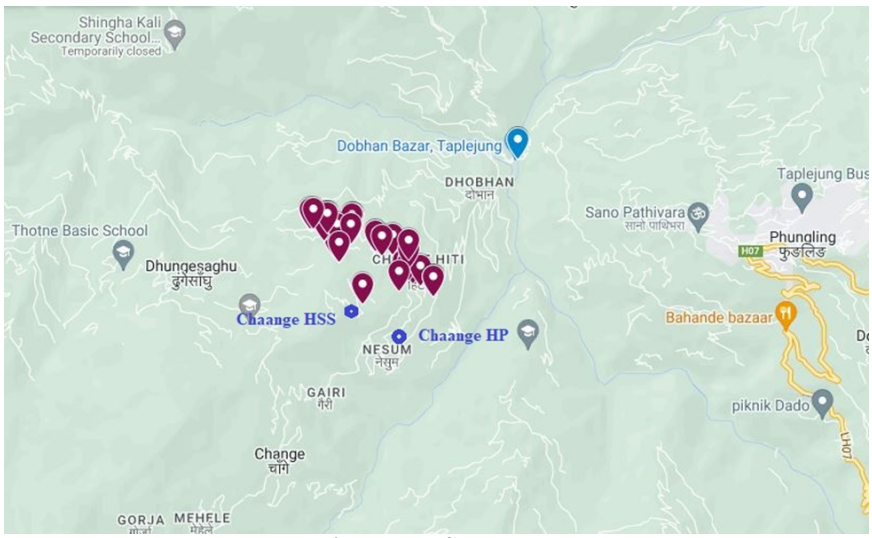

Figure 5: - Spot map

Figure 4 and 5 highlighted the distribution of cases according to their geographical locations. The same border sharing two nearer communities of two rural municipalities was involved in this outbreak. 44% from Khanitol and 56% from Chaange were infected among the total infected children. 14% of male and 30% of female children of Chaange and 30% of male and 26% of female children of Khanitol were infected.

Table 3 highlighted the ethnicity of infected children. Janajati especially Limbu are the main inhabitants, and Dalit and Brahmin/kshetri are also the inhabitants of outbreak areas (7). Among the total infected children, 77% were from the Janajati segment, and the remaining 13% were from the Dalit and Brahmin/Chhetri segments. In this outbreak data, among 157 children 10 were brahmins/chhetri, 23 were dalit and 124 were janajati so the more number of janajati were seems to be infected in this study.

Table 3: - Development of rashes according to their ethnicity

Age group in years	Janajati		Total	Dalit		Total	Brahmin/Chhetri		Total
	Male	Female		Male	Female		Male	Female	
0 – 5	1	9	10	3	2	5	0	0	0
6 – 10	3	7	10		1	1	1	0	1
11 – 15	9	4	13	1	1	2	1	0	1
Total	13	20	33	4	4	8	2	0	2

Figure 6 highlighted the infected children according to their classroom. Among 43 cases only 5 children were not going to school due to their lower age i.e. less than 4 years, zero class was mentioned as less

than one class i.e. nursary, the remaining were school-going children. The highest number of infected were seen in class 4 (8 cases), and least number of case was seen in class 3 (1 case). All classes were infected and this suggested us the transmission was propagated from school.

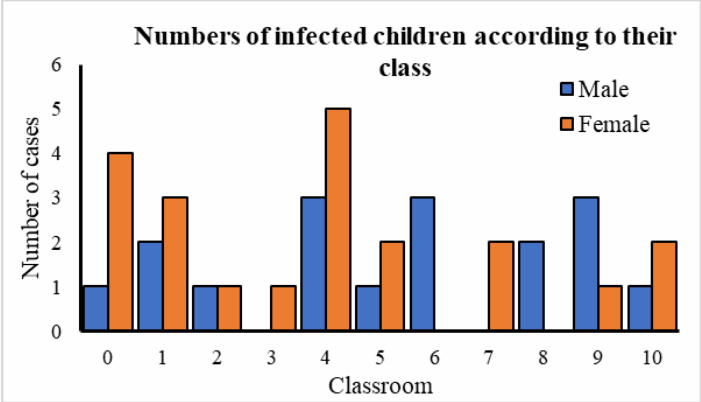

Figure 6: - Distribution of cases according to their class

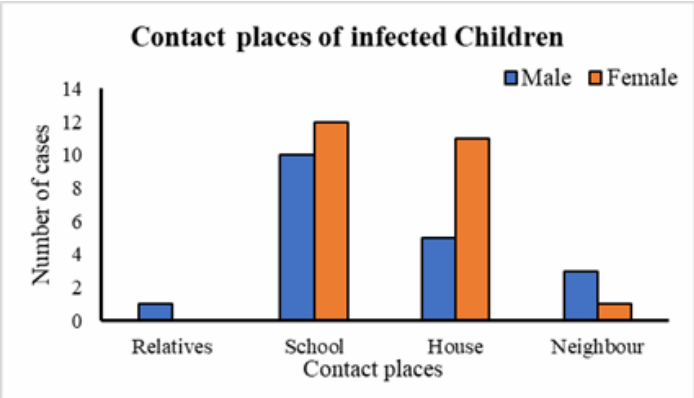

Figure 7: - Contact places of infected children

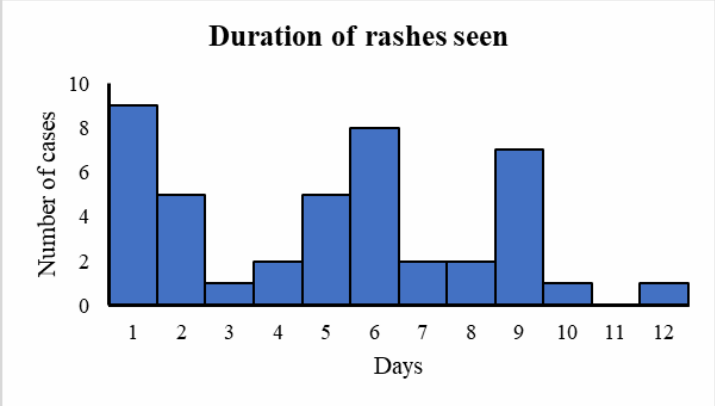

Figure 8: - Duration of rashes seen in infected child

Figure 7 highlighted the contact history of infected children. Among 43 infected, one child didn't have a history of contact because of lower age i.e. did not school going and did not have siblings at the house. The remaining 42 had a contact history. Only one case has had a history of relative contact i.e. index case of this outbreak. Most of the cases had cntact history from school followed by house. More female children have had a history of contact from school (12 cases) and house (11 cases) and more male children have had a history of contact with the neighbor (3 cases).

Figure 8 indicated the duration of rashes in infected children. Those who had equal to or less than 7 days of rashes were in disease condition at the time of household survey and others 8 or more days had resolved the disease and rashes. Most infected resolved their rashes in 9th days (7 cases) and one case resolved in 12 days.

Table 4: - Status of associate symptoms of chickenpox of infected children

Age group	Fever		Cough	
	Yes	No	Yes	No
0 – 5	6	9	5	10
6 – 10	10	2	1	11
11 - 15	11	5	4	12
Total	27	16	10	33

Table 4 highlighted the status of other symptoms associated with chickenpox i.e. fever and cough. Among infected children, 63% suffered from fever, and 23% suffered from cough. More children were suffered from fever in the 6 to 10 years and 11 to 15 year age groups, 10 cases and 11 cases respectively. Fever and cough were resolved from 2 to 6 days of onset.

Table 5: - Health post visited for health servie seeking

Age group	Health visited for health servie seeking	
	Yes	No
0 – 5	5 (33)	10 (67)
6 – 10	10 (83)	2 (17)
11 - 15	15 (94)	1 (6)
Total	30 (70)	13 (30)

Table 5 highlighted the health service seeking behaviour of community at the time of infection. Overall 70% of children visited health post for treatment or management of infection. Only 50% of 0 to 5 years children were visitied health post during infection because of less cases of fever than other age groups.

Intervention

To control the outbreak following interventions were done in affected area: -

- Closed the school for a week
- School health education about chickenpox infection from 6 to 10 grade students
- Parents health education in every house about chickenpox infection and prevention at the time of household survey.

IV. Discussion

Chickenpox shows seasonal trends in temperate settings with peak incidence during spring and driest months (3), such trends follow in this outbreak. The season of this outbreak is the month of May and June, these months are the driest month of the year, and the staring month of spring. Varicella tends to be a childhood disease, with peak incidence among preschool and school-aged children (8). Likewise, in this study all infected persons were under 15 years children i.e. preschool and school-going age, and adults were not found infected at the time of the household survey. In this outbreak, under 5 years female children were infected more than other groups but there was no literature evidence of such gender differences. The incidence of chickenpox is similar for the sexes during childhood and adolescence, however, a higher proportion of cases occur in females than in males during the reproductive years, which may be due to greater exposure of women to potentially infected children in childcare settings (9), but this outbreak study was not cover the more than 15 years of age because of non-infected higher age group.

The epidemic curve showed the first case i.e. index case in the first week of May and other cases i.e. secondary cases were seen in the second week of May, followed by the incubation period of chickenpox. The incubation period of chickenpox was as wide as 10 to 21 days (3). The pattern of outbreak shows the propagated epidemic from relatives to house to school. The propagated epidemic is often of infectious origin and results from person-to-person transmission of an infectious agent, the epidemic usually shows a gradual rise and tails off over a while (3). An overcrowded area i.e. school is favorable for a propagated epidemic, and this outbreak is first notified by the school of the outbreak community. We closed the school for more than a week to control the outbreak, because the community household is not so closed by our observation and situated in scattered patterns deprived of the overcrowded situation, but the school is overcrowded everywhere due to high numbers of students. When we close the school on 2nd June then only one case was reported on 3rd May and then no case was reported in Healthpost. The speed of spread of infection depends upon the opportunity of contacts and propagated epidemics occur where numbers of susceptibles are aggregated (3). Due to this reason, we closed the school and new cases were not reported one day after closing of school. In this outbreak, most of the children revealed a history of infection from the school as like aggregation of susceptibles (3) and followed by house contacts as opportunities for close contact (3).

The rashes of chickenpox often last about 5 to 10 days (10), in this outbreak most of the rashes subsided in 5 to 9 days and those who were in 1 to 5 days of infection were in acute rashes phase at the time of household survey. Most of the infected children were studying in 4 classes indicating that most cases occur before the age of 10 years (1).

Most of the infected children suffered from fever and some of them also suffered from cough, which are the associated symptoms of chickenpox. Other symptoms that may begin to appear one to two days before the rash include fever (1,3,11) and cough is also associated with chickenpox (12). The duration of fever and cough were 2 to 6 days, similar to fever that lasts 3-5 days and is usually less than 102 °F (13). Healthpost visited cases for treatment or service-seeking purposes was seen in this outbreak, not all visited the health post for outpatient services but those who had fever visited Healthpost because the percentage of fever and health post visited for service-seeking purposes was much more similar and fever is perceived as an overt symptom for health care institution visits for care and cure (14).

The higher the strength of community connection, the larger scale of the cross-regional spread of the epidemic (15), likewise in this outbreak, the spread of infection was seen in two rural municipalities, but the communities situated in two rural municipalities shared the same political border and both communities visited in same health post for healthcare services and children of both communities studying in one school so the infection spread in both communities children.

V. Conclusion And Recommendation

The unexpected number of cases of rashes was due to chickenpox, and this outbreak was confirmed as chickenpox, most of the cases were self-limiting and recovered, and it showed the infection in the driest months of year i.e.May and June. These findings highlighted the importance of early reporting of increased numbers of cases by local-level workers and they might play a critical role in providing accurate and timely information to health authorities, allowing for early intervention and outbreak management. Early exclusion of infected persons from school decreased the number of newly infected cases. Health education in the community especially to parents and schools and information about the importance of case notification and management to healthcare providers reduced the new infection and control the outbreaks.

Increasing community and school awareness about the mode of transmission and control measures and training of reportable diseases, and case-based management for local levels health workers are recommended.

Limitation of the outbreak investigation

The limitation of the out break investigation was not incorporated beyond the date of June 7, 2023 and not took the cases from other rural municipalities.

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