

Concurrent Multiple Outbreaks of Varicella, Rubeola, German Measles in Unvaccinated Children of Co-Educational Mount Carmel Senior Secondary School, Thakurdwara Palampur of Northern Himachal, India

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ABSTRACT

Background: In April, 2009, in a co-education school, we investigated suspected triple outbreak; varicella first and then with chance detection of rubeola and rubella. The aim was to confirm diagnosis and recommend remedial measures to prevent further outbreaks. **Materials and Methods:** We defined a case of varicella with maculopapulovesicular rash without other apparent cause in students or staff of the school and residents of neighboring villages of Khalet and Roady since 23rd March to 14th October, 2009. We line listed case patients and collected information on age, sex, residence, date of onset, symptoms, signs, traveling, treatment history, and vaccination status. The outbreak was described by time, place, and person characteristics. Diagnosis was confirmed epidemiologically and serologically; first to chickenpox, measles, and german measles viruses. **Results:** We identified 505 case patients from mixed outbreaks of varicella, measles, and german measles (30/505 clinically, 467/505 epidemiologically linked and 8/505 laboratory confirmed case patients from a study population of 3280. We investigated the suspected outbreak with case definition of varicella but measles 20/3280 (0.60%) and rubella 34/3280 (1.03%) cases were also observed. The overall attack rate (AR) was 15% while in school; it was 22% but highest (56%) in Nursery up to 4th standard with index case in first standard. Sex-specific AR was (23%) more in boys. Triple concurrent infection caused 05% complications but no death was reported. Severity of the symptoms was more in 5th standard onwards with 49–249 lesions and severer in poor villages Roady and Khalet ($P < 0.05$). Only 4% were immunized against varicella/german measles privately. Seventeen percent of the cases went for traditional treatment vs modern medicine ($P < 0.001$). 5/10 samples for IgM antibodies for chickenpox and 2/10 samples were positive for rubella. **Conclusions:** Triple infection of varicella, measles, and rubella was confirmed epidemiologically and serologically. We recommended local authorities for MMRV in the school and near villages with aggressive IEC activities in affected areas.

Keywords: MMRV vaccination, multiple outbreaks, Northern Himachal, Palampur, Triple infection

Introduction

Chickenpox or varicella is a common childhood disease. It is usually mild, but it can be serious, especially in young infants and adults. Before licensure of the varicella vaccine, varicella was a common childhood disease, causing about 4 million cases, including an average of 10,500 hospitalizations and 105 deaths, each year.^[1] In October 2003, large numbers of varicella cases were reported in a school with high vaccination coverage.^[2]

As overall disease incidence declines, the risk for exposure to varicella-zoster virus (VZV) decreases, leading to susceptible (unvaccinated and vaccinated) children aging into adolescence and adulthood. Although the total number of varicella cases is declining, a shift of the remaining varicella disease burden to middle school years is being observed. Likewise, nowadays there is a distinct change in the measles and mumps disease pattern due to measles and MMR vaccination. More and more case patients of measles and rubella are being examined in higher age group adolescent children.^[3] Similarly, in 1995, the median age of varicella infection ranged from 3–5 years in vaccinated persons and from 5–6 years in unvaccinated persons. By 2005,

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the median age increased to 6–8 years in vaccinated persons and 13–19 years in unvaccinated persons.^[4] The outbreaks are quite common in school children and simultaneous outbreak of varicella and measles has also been recorded. In such cases of double infection, the notable finding is that first infection diminishes the severity of rash of the second infection.^[5]

We investigated the three in one multiple outbreak of varicella, rubeola, and rubella with the principle objectives of confirming existence of the outbreak; estimate measles immunization coverage among cases; initiate appropriate measures to reduce morbidity and mortality and formulate recommendations on the basis of the results of present outbreak investigation.

Materials and Methods

The members of the community from Khalet reported that there were increased number of occurrence of cases of febrile rash with blisters under subcentre Khalet in the villages; Khalet had population of 669 males and 825 females with total of 1494 and Roady 426 males and 489 females with a total of 915, of Gopalpur medical block of Kangra followed by its profuse spread in a propagated fashion to its adjacent Co-educational Mount Carmel Senior Secondary School, (MCSSS) Thakurdwara, Palampur. This school had a total strength of 1,825 students and 45 members of the staff and is located on the Kangra, Palampur national highway – 37 km toward Mandi. Most of the students are from districts other than Kangra such as Sujanpur, Hamirpur Mandi, Sandhol areas of Himachal Pradesh. Hence, the sample size of the affected subcentre Khalet; villages Khalet, Roady and students of Co-educational Mount Carmel Senior Secondary School, (MCSSS) Thakurdwara was 1495 (56 case patients) +915 (39 case patients) from 0 to 50 years + 1870 (410 case patients) from 4 years to 45 years, respectively. The outbreak started from 23rd March and culminated to 14th October, 2009.

Having lodged firsthand information report (FIR) to the district health authorities telephonically, the outbreak was investigated on 5th April, 2009 with the rapid response team. The team comprised of an epidemiologist with a medical officer and the workers of the affected Gopalpur block from the local health system. Written informed consent from the mothers of children in local language for interview schedule, physical examination, and also for laboratory samples was obtained. The following case definitions approved by Council of State and Territorial Epidemiologists (CSTE) for varicella disease in 1999 and for varicella-related deaths in 1998^[6] were used.

Varicella clinical case definition

An illness with acute onset of diffuse (generalized) maculopapulovesicular rash without other apparent cause in students/staff of Mount Carmel Senior Secondary School, Palampur and residents of the neighboring villages of Khalet, Roady, and Thakurdwara of Gopalpur block of Kangra since 23rd March to 14th October, 2009. In vaccinated

persons who develop varicella more than 42 days after vaccination (i.e. breakthrough disease), the rash may be atypical in appearance (maculopapular with few or no vesicles).

Varicella case classification

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

Case that is laboratory confirmed or 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.

Varicella deaths classification

Probable

A probable case of varicella that contributes directly or indirectly to acute medical complications that result in death.

Confirmed

A confirmed case of varicella that contributes directly or indirectly to acute medical complications that result in death.

Laboratory criteria for diagnosis

Direct detection-the demonstration of VZV antigen by polymerase chain reaction (PCR) tests, by direct fluorescent antibody (DFA), or by isolation of VZV through viral culture from a clinical specimen.

Four-fold or greater rise in serum varicella immunoglobulin G (IgG) antibody level between acute and convalescent serum by a quantitative serologic assay. A four-fold rise in IgG antibodies might not occur in vaccinated persons.^[7]

Serologic test results that are positive for varicella-zoster immunoglobulin M (IgM) antibody by IgM capture assay.

Descriptive epidemiology

Active case search was initiated by visiting class to class of the school and adjoining villages to identify case patients that meet the case definition in affected villages. To accomplish this exercise, two teams of health workers were formed. Each team has two health workers: One male and second female supervised by one male health supervisor. We interviewed for 20 min mother of each case patient or the next elder available member in the family with the semistructured questionnaire in the Hindi language. As the team was not oriented in carrying out outbreak investigation previously, two senior medical officers trained and supervised the whole team.

In the fourth week of the ongoing outbreak, we collected (i) ten randomly collected 5 ml of blood for each specimen observing universal safety precautions and (ii) four samples of nasopharyngeal swabs in virus transport media (VTM) for virus isolation and genotyping of the strain. We crystallized, separated the sera, and refrigerated under + 4°C to + 8°C for testing specimens for IgM/IgG antibodies using ELISA. We assigned international identification numbers and labeled other epidemiological details on all the samples. We transported the specimen to National Institute of Virology (NIV), Pune, in reverse cold chain. The laboratory tested specimens for IgM antibodies using ELISA. Inclusions and exclusions were that only the random samples were taken from those who were willing while the reluctant and refusing populations were dropped. We line listed the case patients and described them in terms of person, place, and time characteristics. We also collected information about age, sex, symptomatology and date of onset of illness, treatment taken, travel history; any outsiders or foreigner visiting the place; pregnancy status; immunization status of case patients and susceptible population by mothers' interviews, assessment of reverse cold chain system. The severity of the disease was checked by the number of lesions the case patient had: (a) less than 50 lesions (all could be counted in 30 s or less); and (b) 50 lesions to 249 (some skin was affected, but there was a clear area at least as big as the child's hand) and (c) 250 lesions to 500 (some skin was affected, but clear areas were not large enough to fit the child's hand without touching other lesions).

We mapped the villages by location of households to show the distribution of the cases by residence. The attack rate of cases by age group, sex groups using population data obtained from the block/primary health centre/subcentre health authorities were calculated. The dynamic of the outbreak was examined through

the construction of an epidemic curve. We made the action plan with local authorities to suitably manage the cases. During analysis, coding for the participants to maintain confidentiality was employed and the data were analyzed by MS-excel sheet using Epi info version 3.3.2. For all *P* values less than 0.05 or 0.001 was considered significant. Ethical committee review was not indicated, since this investigation was conducted in the context of a public health response to an outbreak.

Results

In our study results, we identified a total of 505 case patients from mixed outbreaks of varicella, measles, and german measles (30/505 clinically, 467/505 epidemiologically linked and 8/505 laboratory confirmed case patients from a study population of 3,280 which covered the affected age group of 0–45 years under the villages of subcenter Khalet and mainly from Mount Carmel School, Thakurdwara from Gopalpur block [Tables 1 and 2]. We started the suspected outbreak with the case definition of varicella but the measles and german measles case patients were also observed. The overall attack rate (AR) was 15% (505/3280) while in MCSSS, it was 22%. In the school, the AR was the highest in Nursery up to 4th standard, both in boys and girls (First category; 6.4% to 56%) followed by the reduction of AR from 5th to 8th standard (second category; 8–27%) and lowest in 9th to 12th standard (third category with school staff; 2–11%). Sex-specific AR was more in boys (23%). The two adjoining villages Rody and Khalet have AR highest in 0–10 years of age group (11%) followed by declining trend of AR; 9–10% (11–20 years) and lowest in the higher age group of 21 years plus. The sex specific rate was only 5% in Rody village in females due to distantly populated villages. The total number of epidemiologically linked rubeola cases

Table 1: Age and sex specific attack rates of concurrent multiple outbreaks of varicella/rubeola/german measles outbreak in unvaccinated children of Mount Carmel Senior Secondary School, Thakurdwara-Palampur

Class	Boys affected	Total number of boys in class	Attack rate (%)	Girls affected	Total number of girls in class	Attack rate (%)	Total case patients (C**+M***+GM***)	Total strength of the class	Attack rate (%)
Nursery	5	78	6.4	11	70	16	16	148	11
Lower KG	22	86	26	9	70	13	31	156	20
Upper KG	30	98	31	12	66	18	42	164	26
1 st standard	48	92	52	31	68	46	79	160	49
2 nd standard	45	81	56	25	68	37	70	149	47
3 rd standard	16	84	19	16	55	29	32 (27+2+3)	139	23
4 th standard	23	67	34	22	73	30	45 (38+3+4)	140	32
5 th standard	17	77	22	14	52	27	31 (27+2+2)	129	24
6 th standard	9	70	13	6	45	13	15	115	13
7 th standard	7	64	11	4	52	8	11	116	9
8 th standard	9	68	13	5	47	11	14	115	12
9 th standard	5	59	8	6	48	13	11	107	10
10 th standard	3	52	6	4	54	7	7	106	7
11 th standard	2	26	8	0	12	0	2	38	5
12 th standard	0	24	0	2	19	11	2	43	5
Total	241	1026	23	167	799	21	408	1825	22
Female staff=8 and total 45	2	37	5	0	8	0	2	45	4
Grand total	243	1063	23	167	807	21	410	1870	22

C*: Chicken pox; M**: Measles; GM***: German measles

Table 2: Age and sex specific attack rates of concurrent multiple outbreaks of varicella/rubeola/german measles outbreak in unvaccinated children under sub centre Khalet of Rody and Khalet villages

Name of village	Age group	Number of cases			Total population	Attack rate (%)
		Chickenpox	Measles	German measles		
Rody	0-10 years	12	3	2	156	11
	11-20 years	11	2	4	174	10
	20 years upwards	2	0	3	586	0.85
	Total (39 case patients)	25	05	09	916	04
Khalet	0-10 years	15	5	8	254	11
	11-20 years	16	3	6	284	09
	20 years upwards	1	0	2	956	0.31
	Total (56 case patients)	32	08	16	1494	04
Mount Carmel School, Thakurdwara	4 years to 45 years (410 case patients)	394	07	09	1870	22
Sex						
		Attack rate (%)				
Male						
Rody	16/426	04				
Khalet	23/669	04				
Female						
Rody	22/490	05				
Khalet	34/825	04				

with febrile macular popular rashes with conjunctivitis in three places were (20/3280) 0.60% and those of german measles was (34/3280) 1.03% [Table 2]. Median age of the case patients is 13 years and the range is 4 to 45 years.

The history of the fever was 501/505 (99%) in all case patients while 495/505 (98%) cases have rash [Table 3]. Five percent case patients have complications the in form of diarrhea and pneumonia but no death reported on account of triple concurrent infection. An uninvestigated and undocumented varicella outbreak was reported in the area 6 to 7 years ago. The severity of the symptoms of the outbreak was less among the younger cases up to first category; more cases belonged to less than 50 lesions and less were falling between 50–249 lesions while in second and third categories; the lesion were numbered in between 49–249 and severer in nature particularly in the lower socioeconomic strata in the villages of Rody and Khalet ($P < 0.05$) while in MCSSS; case patients kept on swelling up over the period of time on account of overcrowding of the children in the school and others ($P < 0.04$). Occasional cases of herpes zoster were also noticed in higher age group in the villages.

As per the school records and mothers' interviews, of 505 case patients, 20/505 (4%) were immunized against varicella/german measles privately while proportions of children vaccinated for measles were 89% from governmental institutions. The reverse cold chain was observed to be satisfactory in the field for measles vaccination. Profuse distribution of the cases with maximum concentration of the cases existed in the first category of the school in the first and second standard with AR as high as 56% followed by second and then, by third one [Table 1]. Since many of the school students were hailing from district other than Kangra and even from Chandigarh. The index male

Table 3: Symptomatology of concurrent multiple outbreaks of varicella/rubeola/german measles outbreak in unvaccinated children of Mount Carmel Senior Secondary School, Thakurdwara-Palampur

Signs and symptoms	Number of cases	Percentage
Fever	501/505	99
Rash	495/505	98
Conjunctivitis	20/505	04
Cough	32/505	06
Lymphadenopathy	29/505	06
Arthralgia	21/505	04
Encephalitis	03/505	0.6
Loose motions	27/505	05
Pneumonia	23/505	05
Hemorrhagic conditions	10/505	02

student case from first standard contracted infection from Chandigarh while traveling in the bus with infected children. It was identified and reported on 2nd April, 2009. The outbreak started in the class and then gradually spread to other class mates and school mates. Local students from MCSSS infected the villagers of Rody and Khalet. The epidemic curve of triple infection suggested that there were number of generations of cases with a propagated outbreak peaking around (i) 20th August, 2009 at MCSSS [Figure 1] followed by (ii) 14th August at village Rody [Figure 2] and (iii) 20th August at village Khalet [Figure 3]. The number of cases declined during fourth week of September, 2009, and there was no case in the month of October with two incubation period free of fresh case patient.

The case patients were treated from the local practitioners and also at Civil Hospital, Palampur, while serious cases got referred

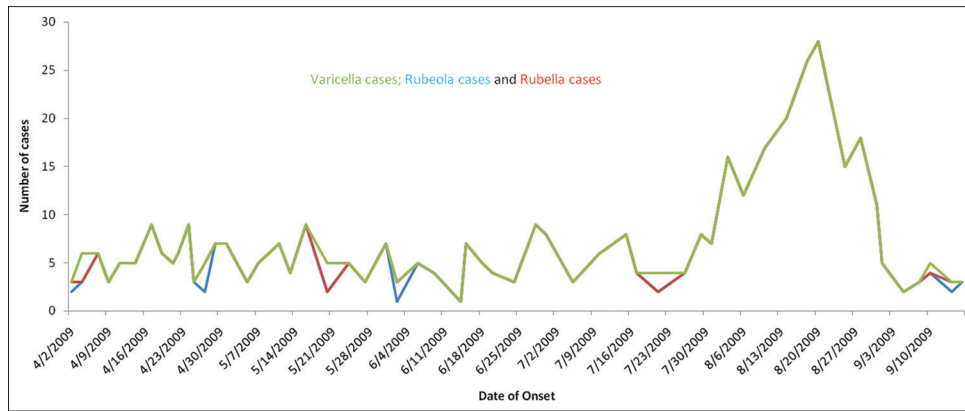


Figure 1: Epidemic curve of concurrent multiple outbreaks of varicella/rubeola/german measles outbreak in unvaccinated children of Mount Carmel Senior Secondary School, Thakurdwara-Palampur (Line diagram)

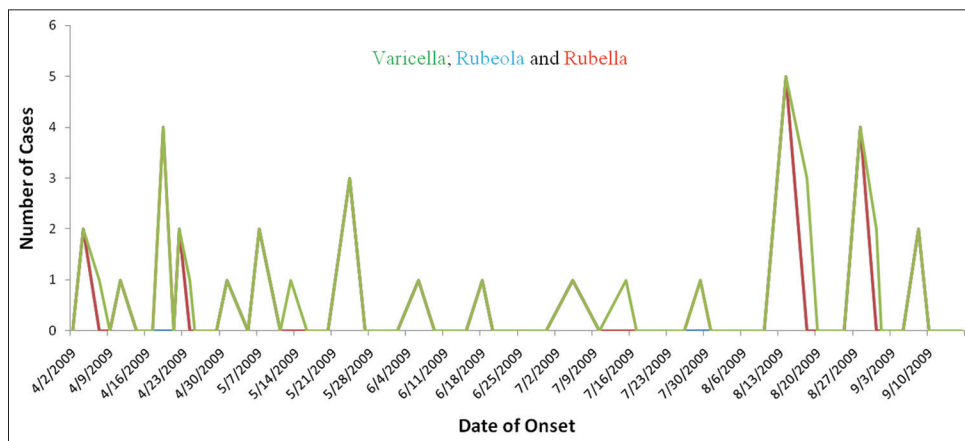


Figure 2: Epidemic curve of concurrent multiple outbreaks of varicella/rubeola/german measles outbreak in unvaccinated children of Roady village under sub centre Khalet of Gopalpur Block of Palampur (Line diagram)

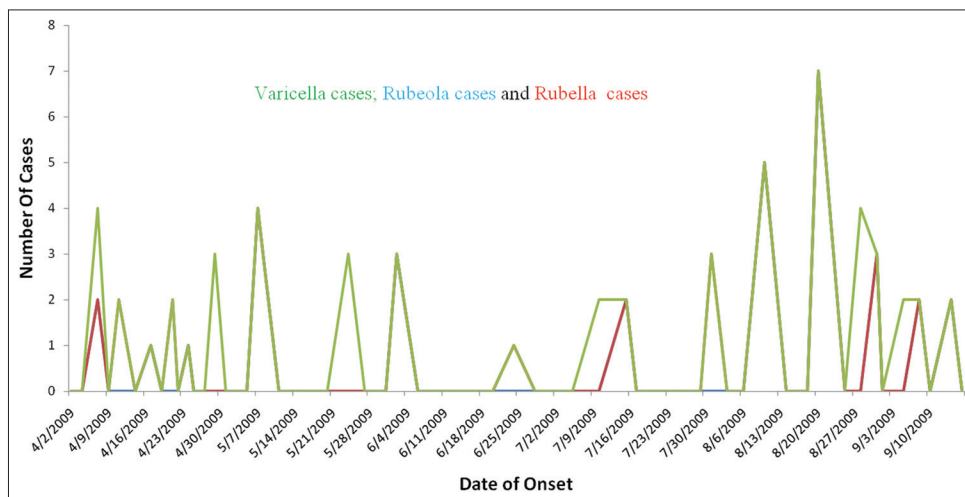


Figure 3: Epidemic curve of concurrent multiple outbreaks of varicella/rubeola/german measles outbreak in unvaccinated children of Khalet village under sub centre Khalet of Gopalpur Block of Palampur (Line diagram)

to Dr. Rajinder Prasad Government medical college hospital, Kangra at Tanda. On account of prevailing community belief, still the sufferers and their attendants believe in traditional healers. Seventeen percent (85/505) of the cases went for the traditional treatment of *Vannan bushes* (medicinal herbal plant)

which included repeated movements of the bushes upon the chest and face of the patients from nearby local *chelas/faith healers* (Traditional healers vs modern medicine, $P < 0.001$) and diet rich in *seul* while 63% (318/505) had their treatment of choice to the modern system of medicine. Still many of the

case patients, that is, 20% (101/505) believed the treatment in both ways; traditional conservative one first and then later on switched onto the modern one, or some times, both the system operating together.

The (5/10) samples for IgM antibodies for chickenpox and 2/10 samples were positive for german measles while 1/10 for measles. Samples of nasopharyngeal swabs for virus isolation were destroyed while in transportation and hence, no result was available for them.

Discussion

Three in one simultaneous multiple outbreaks of varicella/rubeola/german measles outbreak in unvaccinated children derived its origin from the index male student case from first standard who contracted infection from Chandigarh while travelling in the bus with infected children. It was identified and reported on 2nd April, 2009. The outbreak started in the class and then gradually spread to other class mates and school mates and nearby villages of Khalet and Rody under sub centre Khalet in more or less unvaccinated population; be it school children or the adjoining villagers. This outbreak covered mostly the school children with the highest AR in the first category; (56%) in Nursery upto 4th standard with index case in first standard. Sex specific AR was (23%) more in boys. The outbreak tapered during fourth week of September, 2009 and there was no case in the month of October with two incubation period free of fresh case patient. A high proportion of unvaccinated case-patients is suggestive of low vaccination coverage as a cause of the outbreak; a high proportion of vaccinated case-patients is suggestive of vaccine failure as a cause of the outbreak. Triple concurrent infection caused 05% complications but no death reported. Some of the case patients have serious complications like pneumonia^[8] Severity of the symptoms was more in 5th standard onwards with 49-249 lesions and severer in poor villages Rody and Khalet ($P < 0.05$). Only 4% were immunized against varicella/german measles privately. The varicella vaccine does not provide 100% protection; it is expected that cases will occur among vaccinated persons, although disease is generally milder than that in unvaccinated persons as has been observed in immunized case patients.^[9] Varicella in vaccinated persons (i.e. breakthrough disease) is a varicella-like rash that occurs more than 42 days after vaccination. The disease is usually mild with a shorter duration of illness, less constitutional symptoms, and fewer than 50 skin lesions (sometimes even <10 ; compared with approximately 250-00 lesions in unvaccinated healthy persons). Rash is atypical, often maculopapular, with few or no vesicles. However, breakthrough varicella disease in vaccinated persons has been shown to be contagious.^[10] Varicella outbreaks have been documented in highly vaccinated populations. Although breakthrough varicella is generally mild, approximately 25% of case-patients may have >50 lesions and clinical features similar to those among unvaccinated persons.^[2] Occasional cases of herpes zoster were also noticed in higher age group in the villages. After primary infection as varicella, varicella zoster virus (VZV) resides

in the cell bodies associated with spinal nerves. Reactivation of latent VZV results in herpes zoster (HZ). Clinical features of HZ include a localized pruritic, often painful, vesicular rash that generally appears unilaterally in one or more dermatomes. Persons with HZ are infectious during the vesicular stages of rash; the rash typically crusts over within 7-10 days but may take from 2 to 6 weeks to heal completely. Localized HZ is approximately one-fifth as infectious as varicella or disseminated HZ^[11] but transmission of VZV has been reported. Reports indicated the rare occurrence of airborne transmission of VZV from HZ case-patients in healthcare settings.^[12]

It is critical to note that no supplementary immunization activities like MMRV during the outbreak were done and the case patients themselves took the treatment from different specialized centers. It is an important point to add here that in the light of recent development of outbreaks in the plus five age category, the case patients of measles and rubella have also been observed in the higher age groups and so is varicella troubling to all unvaccinated ages, especially, our adolescents. Hence, introduction of MMRV is very useful for the clinical practitioners of primary care physicians.

Important finding to pin point here is that 17% of the cases went for traditional treatment Vs modern medicine ($P < 0.001$). Traditional beliefs and barriers about varicella/german measles/measles do not foster healthy behaviors^[13,14] in the population more so in cases of Khalet and Rody villages reducing the diet intake to the minimum with *Seul rich diet* and VANNAN bushes movement as part of help seeking behavior before or with modern medicines later on forms the mainstay of the treatment. The diet rich in *seul* (A herbal plant with small granules, thought to be hot in nature by the local community members and they are supposed to facilitate the eruption of measles; These granules are also roasted for eating as well as smoked fumes are placed underneath the cot of the ailing patients. That is why, the least number of the cases have reported to sub centre Khalet. Hence, the sensitivity of the health care facilities is more or less nil and so is weakness of the existing surveillance system. At present, there was lack of trained persons in specimen collection and transportation. Logistics for specimen collection is poorly available.

Limitations

(1) Sero-surveillance in the study area could not be carried out due to funds and time constraints.

Conclusions

Triple infection of varicella, measles and rubella was confirmed clinically, epidemiologically and serologically. No supplementary immunization/MMR to the susceptible were provided in the affected cases of the school and other areas, especially slum areas. Weak surveillance system was in place; medical human resource available was untrained with inadequate logistics support and supply. Traditional beliefs and barriers form the mainstay of the treatment part.

Recommendations

On the basis of investigation we proposed a number of recommendations:

1. Vaccinate MMRV to the susceptible.
2. Ensure IEC activities aggressively at all the fronts, especially for adolescents, school children and the susceptible.
3. Identify outreach strategies to cover slum and remote villages.
4. Strengthen surveillance system and other logistics for specimen collection and transportation.

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