Original research article

Outbreak of measles at Bardhwaja, Howrah district, West Bengal in November 2014[☆] Nilanjan Mondal^{a,*}, Manoj V. Murhekar^b^a Department of Health and FW, West Bengal, India^b Department of Health and FW, Govt. of India, ICMR, India

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ABSTRACT

Background: On 10th November 2014 health workers from Bardhwaja village informed district surveillance unit, Howrah, about suspected measles outbreak. We investigated it to confirm etiology, estimated coverage and effectiveness of MCV.

Method: We conducted a retrospective cohort study among 0–15 years' children ($n = 613$). We did house-to-house survey to identify measles cases, defined as occurrence of fever with rash with one of the three: cough, coryza, conjunctivitis. We tested blood samples from 8 case-patients. We described the distribution of case-patients by time, place and person. We estimated the coverage (and 95% CI) of MCV and compared the attack rate (AR) among vaccinated and unvaccinated children to estimate effectiveness of MCV.

Result: We identified 68 measles case-patients (AR: 11.1%, no death). All sera were positive for IgM measles antibodies. Cases started occurring from 2nd week of September, peaked during October and declined during November. Median age of case-patients was 84 months (IQR: 54–114 months); Vaccine coverage of MCV1 among 9 months to 15 years' children was 64.8% (379/584) and that of MCV2 among 16 months to 5 years' children was (62/98) 63.2%. Compared to unvaccinated children, those who received one (RR: 0.16, 95% CI 0.09–0.2) and two doses (RR: 0.09, 95% CI 0.02–0.4) of measles vaccine were at lower risk. The risk of measles was higher among children of religious minority (RR: 28.3, 95% CI 7–114.5). Vaccine Effectiveness of one and two doses of measles vaccine was 83.4% (95% CI 71.2–90.4) and 90.32% (95% CI 59.2–97.7) respectively.

Conclusion: MCV coverage in Bardhwaja was low. We recommended strengthening of outreach immunization targeting religious minority.

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1. Introduction

Measles is caused by a virus in the paramyxovirus family and it is normally passed through direct contact and through the air. The virus infects the mucous membranes, then spreads throughout the body. Globally, more than 60% of the 21.5 million children who did not receive one dose of measles vaccine in 2013 were belong to six countries. Being one of the six countries, India was bearing highest proportion (48%) of children who did not receive one dose of measles vaccine.¹ Study findings have indicated that more than 50% of the global measles associated deaths were reported in India alone. Another systematic review of studies in 12 Indian states

published over four decades revealed that the median case fatality ratio was 1.63%.²

In order to reduce the incidence of measles and associated deaths, the Government of India has adopted various strategies. These strategies include achieving 90% coverage with the first dose of the measles vaccine at the national level and 80% for each district; intensive surveillance activities supported by adequate laboratory support (outbreak and case-based surveillance assisted by laboratories to ensure serological/virological categorization) and appropriate case management including administration of vitamin A. (NTAGI recommendation).^{1,3}

Coverage of measles vaccination in West Bengal was 65%, 82.8% and 88.6% as per District Level House Hold Survey (DLHS-2) in 2002–2004, DLHS 3 in 2007–2008 and DLHS 4 in 2012–2013 respectively. 4–5 74.7% National Family Health Survey (NFHS-3) in 2005–2006 reported 74.2% Coverage of measles vaccination in West Bengal.⁶

According to previous three DLHS reports there was increasing trend in coverage of Measles Containing Vaccine (MCV) in Howrah

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Fig. 1. Trend of occurrence of fever with rash in Shyampur I block, Howrah from 2012–'14.

district. Coverages were 60%, 76.3% and 90.3% as per DLHS 2–4 respectively.

But outbreak of measles continued to be occurred in Howrah district (IDSP) and we had little information about investigation of outbreak of measles at sub-district level because of weak surveillance and delayed reporting practice. Study finding revealed, the overall sensitivity of measles surveillance in Howrah district was 3.2% in 2006.⁷

District Surveillance Unit (DSU) received weekly report of fever with rash from sub-center through block health authority according to Integrated Disease Surveillance Program (IDSP) reporting format. About 250 cases of fever with rash reported annually from Shyampur-I block. Nearest cold chain point of Bardhwaja village is at Dhawaja Primary Health Centre (PHC) which is about two kilometers away from village. Block Medical Officer of Health (BMOH) stored MCVs in Ice-lined Refrigerator (ILR) at PHC and supplied them time to time according to vaccination session plan.

On 9th November 2014, Block Medical Officer of Health, Shyampur-1 block reported 47 case patients (all were under 15 years of age) of fever with rash at Bardhwaja village to the District Surveillance Unit Howrah. On 11th November, District Rapid Response Team (RRT) started investigation with the help of National Polio Surveillance Project (NPSP).

Hence, we investigated of probable measles outbreak at Bardhwaja village, (1) to describe the outbreak in Time, Place and Person distribution (2) to estimate the efficacy and coverage of MCV-1 and MCV-2 and (3) to determine the factor(s) associated with the outbreak.

2. Method

2.1. Descriptive epidemiology

Bardhwaja village is situated in Shyampur-1 block, at the bank of river Ganges in southern part of Howrah district of West Bengal, India. For confirmation of outbreak, we used surveillance data of fever with rash reported from Shyampur -1 block from 2012 to 2014 under Integrated Disease Surveillance Project (IDSP) to calculate outbreak threshold. We compared 42nd weeks' IDSP data of 2014 with average weekly number of cases during 2012–2013 to determine whether outbreak threshold (more than two standard deviation of mean number of fever with rash) had been crossed. (Fig. 1)

We used WHO case definition of measles case as, occurrence of fever with rash with one of the three: cough, coryza, conjunctivitis appeared among the persons residing at Bardhwaja village from September to November 2014.⁸

We conducted house to house survey using semi-structured questionnaire to find out measles case in Bardhwaja village. We

collected information about sociodemographic status, vaccination status of first and second dose of MCV, time of onset of fever and rash with cough or coryza or conjunctivitis, probable reasons of their children not getting vaccinated and complications associated with measles. We cross-checked history of vaccination from immunization card where ever available. In case of non-availability of immunization card, we collected information from other senior member of the family.

We collected blood samples from those who had history of fever with rash for ten days. With these selection criteria, we randomly select eight case patients and sent the sera to Institute of Serology, Kolkata (WHO collaborated laboratory in Eastern region of India) for presence of IgM antibody against measles. IgM ELISA method used for detection of IgM antibody against measles.

We plotted number of measles case patients over time in days to draw epidemic curve. We drew map according to attack rates in different areas of Bardhwaja village. We estimated coverage of MCV-1 as number of children aged between 9 months to 15 years received MCV-1 among total number of children of that age group residing at Bardhwaja village. Similarly, we estimated coverage of MCV-2 as number of children aged between 16 months to 5 years received MCV-2 among total number of children of that age group residing at Bardhwaja village. District Health Authority started vaccination with MCV-2 on November, 2011 among children aged between 16–24 months' age group. So, while calculating coverage of MCV-2 on November, 2014 we considered children aged between 16 months to 5 years. We calculated case fatality rate (CFR) and attack rate (AR) among different age groups, sexes and religions. We entered data into MS excel and analyzed it using Epi info software (version 7.1), open epi (version 3.02) and prepared map using Epi-map (version 3.5.4).

Table 1

Attack rate of Measles according to different age group, gender and religion in Bardhwaja village, Howrah district, West Bengal in 2014.

	No. of measles cases	Population	Attack rate
Age group			
0–9 months	4	29	13.79%
10–12 months	4	19	21.05%
13–60 months	17	149	11.41%
61–180 months	43	416	10.34%
Total	68	613	11.1%
Gender			
Male	29	314	9.24%
Female	39	299	13.04%
Religion			
Hindu	2	283	0.71%
Muslim	66	330	20%

Bold values are either highest or overall.

Fig. 2. Occurrence of Measles case patients at Bardhwaja from September to November 2014.

2.2. Analytical epidemiology

Low coverage of MCV-1 and MCV-2 could have contributed to occurrence of outbreak. To test this hypothesis, we conducted retrospective cohort study to compare the incidence of measles among those who vaccinated with MCV-1 and MCV-2 with those children who were not vaccinated and to compare the incidence of measles among children who belong to religious minority with those children who belong to Hindus. We calculated relative risk (RR) for above comparison. We calculated the effectiveness of MCV-1 and MCV-2 with 95% confidence interval (95% CI) using 1-RR formula.

3. Result

3.1. Descriptive epidemiology

Of 1866 people of Bardhwaja village we surveyed those children who were under 15 years of age. Of the 613 under 15 years' children, we found 68 measles case patients with Attack Rate (AR) of 11.1% and no death due to measles (0% Case Fatality Rate). Institute of Serology, Kolkata found all the eight sera positive for IgM antibodies against measles. Median age of case patients: 84 months (IQR: 54–114 months). AR was highest (21.05%, 4/19) among children of 10–12 months' age group, more among females (13.04%, 39/299) and among children of religious minority (20%, 66/330), (Table 1). Measles case patients started occurring during mid of September, peaked in last week of October and decreased on mid of November 2014. Clustering of cases occurred 13th of October and index case reported to district RRT on 10th November. There was a delay of outbreak reporting of 28 days from Shyampur-1 block (Fig. 2).

Primary case appeared at Barkolia area then propagated to Sheik para west and Sheik para north on October 2014 and finally stopped at Sheik para south area of Bardhwaja village on November 2014. AR was highest (32%) at Sheik para south.

3.2. Analytical epidemiology

Risk of having measles was more among children of religious minority than among Hindu children [RR: 28.3; 95% CI: 6.9–114.5]. Compared to unvaccinated children who received one [RR: 0.16, 95% CI 0.09–0.28] and two doses [RR: 0.09, 95% CI 0.02–0.4] of measles vaccine were at lower risk of getting measles (Table 2). Vaccine coverage of MCV1 among 9 months to 15 years' children

was 64.8% (379/584) and that of MCV2 among 16 months to 5 years' children was 63.2% (62/98). Vaccine Effectiveness of one and two doses of measles vaccine was 83.4% (95% CI 71.2–90.4) and 90.32% (95% CI 59.2–97.7) respectively.

4. Discussion

Despite 90.3% of MCV1 coverage in Howrah district according to DLHS-4, district surveillance unit of Howrah used to report 5–6 measles outbreak each year. Vaccine cold chain point was two kilometers away from Bardhwaja village. So, there was scope for more frequent vaccination session to increase the coverage of MCV-1 and MCV-2.

We found Vaccine coverage of MCV1 and MCV2 among 9 months to 15 years' children were low compared to district target formulated after NTAGI recommendations. Challenges faced by health system to achieve target of vaccination coverage may include inadequate infrastructure, manpower, and communication; faults in vaccine storage, transport, and cold chains.^{3,9,10} These barriers may cause low coverage of MCV-1 and MCV-2 which may lead to multiple outbreaks in the district time to time.

In weak program settings, organized catch-up vaccination campaigns that benefit from specific planning and intense communication and coordination efforts have been proven to effectively achieve high coverage levels in all socio-economic strata. Furthermore, numerous studies from a range of development settings have found two doses of measles vaccine to be highly cost effective. In settings of low immunization coverage, the campaign approach has also been found to be more effective.

Table 2

Risk factors for Measles outbreak at Bardhwaja, Howrah, West Bengal, 2014.

	Measles cases		Non cases		RR	95%CI	P-value
	n	%	n	%			
Religion							
Muslim	66	20	264	80	28.3	6.9–114.5	<0.001
Hindu	2	0.71	281	99.29			
Vaccination status							
MCV1 received	15	3.96	364	96.04	0.16	0.09–0.28	<0.001
Unvaccinated	49	23.9	156	76.1			
MCV2 received	2	3.23	60	96.77	0.09	0.02–0.4	<0.001
Unvaccinated	12	33.33	24	66.67			

Bold values are statistically significant.

There was considerable delay in reporting of measles outbreak. We found clustering of cases on 13th October, 2014. Reporting of outbreak could have been done immediately. But surveillance system was weak and block health authority delayed reporting index case by 28 days after clustering of cases.

We found incidence of measles among children belong to religious minority was higher than Hindus. Because coverage of both MCV-1 and MCV-2 were significantly lower among children belong to religious minority. National level study showed poor coverage of measles can be attributed to various existing shortcomings or barriers. These barriers include higher birth order, low family income, lower parental education, Muslim religion, poor knowledge of measles and the measles vaccine, defective surveillance activities.

Vaccine effectiveness of both MCV-1 and MCV-2 were around expected level of 85%.

5. Limitation

There could be a chance of recall bias while collecting vaccination history. We cross checked it with immunization card where ever available. In case of non-availability of immunization card, we cross checked vaccination history with other senior family members.

6. Conclusion

With the finding of our study we could conclude that risk of getting measles was lower among those children who were vaccinated with one dose as well as two dose of MCV. Coverage of MCV-1 and MCV-2 were low at Bardhwaja village particularly in Muslim dominated area. This could be one of the reasons of measles outbreak at Bardhwaja village. Late detection of outbreak reveals weak surveillance system.

7. Recommendation

Based on our conclusion, to decrease the occurrence of measles outbreak at Shyampur-1 block we propose number of recommendations. We recommend more frequent outreach vaccination session particularly at Muslim dominated area. Measles surveillance system to be strengthened by training of block level as well as peripheral level health workers.

Conflict of interest

The authors have none to declare.

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Contribution details

	Nilanjan Mondal	Manoj V. Murhekar
Concepts	✓	✓
Design	✓	✓
Definition of intellectual content	✓	✓
Literature search	✓	✓
Clinical studies	✓	

(Continued)

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Experimental studies		
Data acquisition	✓	
Data analysis	✓	✓
Statistical analysis	✓	✓
Manuscript preparation	✓	✓
Manuscript editing	✓	✓
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