

Measles Vaccination Response During Kosi Floods, Bihar, India 2008

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The Kosi floods of Bihar in 2008 led to initial rapid displacement followed by rehabilitation of the affected population. Strategically planned phase-wise activity of supplementary as well as primary measles vaccination combined with a variety of other interventions proved to be successful in preventing outbreaks and deaths due to measles. While 70% supplementary measles vaccination coverage was achieved in relief camps, the coverage of primary measles doses in the latter phases was dependant on accessibility of villages and previous vaccination status of eligible beneficiaries. The integrated diseases surveillance system, which became operational during the floods, also complemented the vaccination efforts by providing daily figures of cases with fever and rash. The overall response was not only successful in terms of preventing measles mortality, but also provided vital lessons that may be useful for planning future vaccination responses in emergency settings.

Key words: Bihar, Disaster, Floods, Measles, vaccination.

On August 18, a 800 meter breach in the eastern embankment of Kosi river in Kusha (Indo-Nepal border) led to sudden release of more than 1.66 lac cusec water, which resulted the Kosi river changing its course and the inundation of 993 villages of 35 blocks in five Bihar districts of *Supaul, Saharsa, Araria, Madhepura* and *Purnia*, affecting more than three million people. The ensuing destruction of 340,742 houses resulted in subsequent displacement of the population to make-shift relief camps(1). This displaced population remained in these relief camps till mid October, and as the flood waters receded, many began returning to their villages. As communications to all villages could not be restored within a few months, some villages remained cut off till as late as early February 2009.

With the changing population profile and communication situation following the floods, there arose a variety of related health issues which called for strategic health planning to prevent any large scale disease outbreak. During the initial phase of

population aggregation in camps, roadsides and embankments, the major threat was the transmission of measles and acute respiratory infections. Later, as waters began receding, the possibility of outbreaks of diarrheal diseases also loomed large. Finally, during the phase of rehabilitation, when displaced persons began returning to their homes, the challenge was to re-establish regular health services in hitherto flooded and cut-off villages.

The Department of Health, Government of Bihar (GoB), tackled the health situation and averted wide spread transmission of any disease. United Nations Children's Fund (UNICEF) and a host of other civil society organizations also contributed to an effective preventive public health intervention through their technical support.

VACCINATION STRATEGY

A series of vaccination activities were undertaken during and following the unprecedented floods of Bihar in 2008. The strategy of each of these activities differed, depending on the prevailing ground

conditions and population movements at that particular time. In the initial relief phase, the strategy aimed at providing a supplementary measles dose to all eligible children of 6 months to 14 years in areas of congregation like camps, embankments and roadsides. The latter rehabilitation and catch-up phases focused on reviving disrupted health services in a variety of field settings and providing missed doses of measles and other vaccines as per routine schedule. The rehabilitation phase was divided into two sub-phases, depending upon the accessibility of villages; initially, all accessible villages were visited through an intensive campaign with bundled interventions, thereafter, 189 cut-off villages were visited by a small number of medical teams repeatedly, for a period of three months.

The duration of each of the phases varied depending on a number of factors such as, stay of displaced populations in camps, restoration of communication to villages, availability of manpower for vaccination, movement of logistics to inaccessible areas, and intermediate time taken for planning and training between phases. The combined duration of all the four phases including intermediate preparatory activities lasted for seven months.

Although combined with a number of outreach health interventions during the Bihar floods, vaccination with measles containing vaccine (MCV) was the key intervention undertaken by the Department of Health, Government of Bihar and supported by a number of international development and civil society organizations. The target beneficiaries for these activities and bundling with other interventions also differed as per the overall strategy planned for each phase. Extra effort was spent to ensure that all beneficiaries in the age range 9 months to 59 months receiving measles vaccine were also given vitamin A supplementation.

All vaccination activities were meticulously planned through micro-planning at sub-district level. These microplans incorporated information about accessibility and reach, mobility arrangement, cold chain maintenance, names of persons in vaccination and supervising teams from available manpower, mobilisers from the affected community and host

villages, quantities of bundled logistics such as vaccines, diluents, injections, vitamin A bottles and spoons, ORS sachets, zinc tablets, vaccine carriers, tally sheets and reporting formats.

Communication materials were prepared for each phase of the activity. As each phase differed in strategy and implementation from the other, the program managers, vaccinators and mobilisers were all given training before each phase. Specifically, training on adverse effects following vaccination and safe disposal of injection wastes was imparted. Teams of supervisors and monitors were deployed to monitor logistics distribution, the proper administration of vaccines and other medicines, as well as effective mobilization of beneficiaries while helping in daily report compilation.

The large-scale destruction of the road network by the floods put a substantial burden on the logistics distribution. While initial stocks of vaccines, diluents and injections had to be transported by helicopter, later, as major roads and train lines were reestablished, material was sent by road and rail to district headquarters. From there, available means of transport, such as boats, tractors and human labor (porters) were used for transfer of logistics. A logistics monitoring cell took day-to-day telephonic (mobile phones proved very helpful during Bihar floods) stock position of vaccines and related material at each ice lined refrigerator (ILR) point. In situations where villages were cut off from their usual headquarters, logistics and commodities were supplied from adjacent districts and ILR points. Cold chain was maintained at all levels despite the absence of regular power supply, diesel generators available at all ILR points proved effective for vaccine storage, while the requirement of large number of ice-packs for the campaigns were met by freezing them in local ice candy factories near the ILR points (as done during regular polio supplementary immunization rounds). The vaccine vial monitors (VVM) now available in all Universal Immunization Program (UIP) vaccines, helped in ascertaining vaccine potency at user level.

During the entire response, a monitoring cell chaired by the health secretary and composed of the Executive Director and program officers of State

Health Society, Bihar and representatives of key development organizations reviewed day-to-day implementation progress and gave strategic oversight and program direction. **Table I** summarizes different phases of vaccination activity during this period.

OTHER INTERVENTIONS

Measles vaccination remained at the center stage of the emergency vaccination while bundling with other interventions enhanced the overall reach and coverage with health interventions during the four phases of the emergency: vitamin A, albendazole tablets, other UIP vaccines were administered to specific groups of beneficiaries who met the eligibility criteria. In Phase 1, maternity huts were constructed in large relief camps where antenatal care and skilled attendance during delivery as well as post natal services were provided. In Phase 2, children with diarrhea were treated with low osmolar ORS sachets and a 10-day course of zinc. Teams of doctors with medical supplies accompanied the vaccination teams in Phases 1 and 3, to treat minor

illnesses, identify and treat children with severe acute malnutrition and refer serious case.

At the same time, interventions to improve drinking water and sanitation such as distribution of chlorine tablets and chlorination of hand pumps was initiated. A surveillance system, using the methodology of the Integrated Diseases Surveillance Project (IDSP)(2) was set up in the flood affected districts on 26th August, 2008 and it remained functional till 4th November, 2008. Medical teams in relief camps and outreach sites were instructed to classify observed conditions and deaths observed as syndromes and report accordingly on a daily basis using a set format. However, laboratory confirmation of specific diseases including measles was not available. Measles was reported as a “fever with rash” syndrome. Cases of “fever with rash” continued to be reported beyond November through information sent by Primary Health Centers and District Hospitals to the Routine Immunization (RI) cell in the State Health Society, where a line list of suspected measles cases was maintained.

TABLE I DESCRIPTION OF DIFFERENT PHASES OF VACCINATION ACTIVITY DURING BIHAR FLOODS 2008-09

Phase No	Phase of activity	Days after the breach* (18 th August 08)	Type of population targeted	Interventions undertaken
1	Relief phase	day 17 to day 38	Displaced population in relief camps, other areas of displaced population aggregation	Supplementary measles vaccine with vitamin A supplementation and supplementary monovalent-1 oral polio vaccine to children. Routine tetanus vaccination to pregnant women.
2	Rehabilitation phase I	day 40 to day 80	Initially accessible villages in flood affected districts	All UIP vaccines as per schedule Vitamin A and albendazole to all eligible children Low osmolar ORS and zinc to children with diarrhea.
3	Rehabilitation phase 2	day 134 to day 194	189 villages with access problems due to access roads being cut-off by flood waters	Treatment and referral of medical ailments, vaccination, chlorination of drinking water, zinc, ORS, antenatal and delivery services, health education.
4	Catch up phase	day 179 to day 186	All villages and urban areas of flood affected districts	All UIP vaccines and vitamin A as per schedule

*Universal Immunization Program (UIP), Oral Rehydration solution (ORS); * leading to floods*

RESULTS

The report of each phase of the activity was computed on a daily basis. Information at sub district level was collected on tally sheets initially, camp-wise and later, village-wise. These were then compiled ILR point-wise at district and state level. The outcome could not always be analyzed in terms of percentage achieved as targets were difficult to determine.

Target groups for measles vaccination differed in each Phase. In the initial phase of the disaster, 6 months to 14 years old children were targeted for vaccination in camps, estimated to be 41% of the population living in these relief camps and other similar settings. As camp population changed from day-to-day and some sections of the displaced population moved from camp-to-camp, determination of the exact target population was difficult. However, based on an officially estimated population size of 362,072 residing in the camps in the relief period, a target group of 148,540 children of the set age group was calculated and of these 111,200 were administered measles vaccine, resulting in a coverage rate of 75% (**Table II**).

During Phase 2, all children under 1 year, who were eligible for measles vaccination in this two month period (the duration of disruption of regular

vaccination services during the floods) were targeted. Of the 60,842 infants targeted, 36,672 were given their primary measles dose while the remaining 19,760 children vaccinated with measles during this phase were of age 12 to 59 months of whom a denominator could not be ascertained. Targets were not determined in Phases 3 and 4 due to problems of ascertaining exact pre-flood / post phase 2 immunization status of eligible beneficiaries. In all, 256,989 doses of MCV were administered (**Table III**).

Further clinical examination of some of these cases, particularly in *Madhepura*, revealed misreporting in some instances where the presentations were more close to impetigo, heat rash and other localized skin infections(3). However, cases clinically resembling measles/rubella were also observed. The later reported cases of “fever with rashes” (**Table III**) to the RI-cell were more suggestive of measles infection. Ten fatal cases of fever with rash in *Madhepura* and two in *Supaul* had a history of fever with generalized rash followed by complications, ranging from severe diarrhea to increased respiratory rate and indrawing of chest wall. From December 2008 to January 2009, measles IgM antibodies were detected in the serum of 5 epi-linked cases (epidemiologically linked to confirmed measles cases) and investigated by a team from GoB,

TABLE II MEASLES VACCINATION UNDERTAKEN DURING PHASE-WISE VACCINATION IN FLOOD AFFECTED DISTRICTS OF BIHAR 2008-09

Phase	Dates	Target age group	Reach vaccination	Type of measles beneficiaries	Target vaccinated	Total beneficiaries	% coverage achieved
1	4 Sept to 18 Oct, 2008	6 months to 14 years	Displaced children in relief camps and places of population aggregation	Supplementary	148,450	111,200	75
2	20 Oct to 30 Nov, 2008	9 months to 59 months	Children in initially accessible villages	Primary*	60,842 (<1yr)	36,672 (9m - <1yr) 56,432 (1yr-5 yr)	36,672 60(< 1yr)
3	1 Jan to 31 Mar, 2009	9 months to 59 months	Children in 189 cut-off villages	Primary*	Not determined	8,248 (9-59m)	–
4	16 to 26 Mar, 2009	9 months to 59 months	All remaining children in flood affected districts	Primary*	Not determined	83,809 (9-59m)	–

*1 dose of 0.5 mL reconstituted Measles containing vaccine administered as per current UIP schedule to children between 9 and 59 months who gave no evidence (card or history) of having been administered this dose of vaccine before.

TABLE III REPORTED CASES OF “FEVER WITH RASH” AND RELATED DEATHS IN FLOOD AFFECTED DISTRICTS OF BIHAR 2008-09

Month	Cases of “fever with rash”		Deaths in cases of “fever with rash”	
	<i>Madhepura</i>	Other flood districts**	<i>Madhepura</i>	Other flood districts**
August 2008	0	7	0	0
September 2008	1331	206	0	0
October 2008	289	6	0	0
November 2008	8	37	0	2
December 2008*	78	0	4	0
January 2009*	105	0	6	0
February 2009*	0	39	0	0
March 2009*	0	0	0	0

*reported independently of IDSP to RI cell, State Health Society Bihar; ** Other flood affected districts are Sapaul, Saharsa, Punia and Araria.

The National Polio Surveillance Project (NPSP) and UNICEF reported in a similar outbreak of 136 “fever with rash” cases in district *Darbhanga*, which was adjacent to the flood affected areas (personal communication).

DISCUSSION

The WHO/UNICEF joint statement, “Reducing Measles Mortality in Emergencies”(3), states that measles is a major killer of children in emergencies. It stresses that “Immunization of children against measles is probably the single most important (and cost-effective) preventive measure in emergency - affected populations especially, those living in camps”(4). In emergency settings, measles is a major cause of mortality, with case fatality rates (CFR) ranging from 2-22% compared with 1-10 % in normal situations and CFR can be as high as 20-30 % (5). Factors like overcrowding found in relief camps, brings susceptibles together to a critical threshold for outbreaks to occur.

Another WHO/UNICEF joint release “Global Plan for Reducing Measles Mortality 2006-2010” (6) also asserts that in conflict or emergency areas, WHO and UNICEF have a commitment to ensure that, at a minimum, measles vaccination and vitamin A supplementation are administered. Complementarily, children in temporary shelters can also be given other vital health interventions such as insecticide-treated mosquito nets to prevent malaria and anti-helminthics for deworming.

Measles emergency campaigns are usually undertaken when there is no current outbreak of measles but an outbreak is anticipated, thus preventing measles outbreaks and thereby reduce the risk of mortality and morbidity due to measles infection. When an outbreak of measles does occur, measles vaccination prevents the spread of measles infection into other adjacent non-affected geographical areas and thus reducing the overall case fatality rates in vulnerable or high risk populations in these areas.

This measles vaccination campaign during a disaster situation in Bihar succeeded in both these aspects; initial vaccination in camps in children from 6mo- 14 year prevented large scale measles outbreaks and death in camps, while vaccination in the later phases contained smaller outbreaks occurring in villages. High mortality due to measles was prevented using a phase-wise, mass measles immunization approach coupled with vitamin A supplementation and several other interventions.

This phase-wise vaccination intervention undertaken in Bihar taught us a valuable lesson: strategies need to be aligned with ground realities and population movements. It may be several months before normal conditions are restored following disasters and therefore an emergency vaccination response need not be limited to initial vaccination of displaced populations in relief camps and areas of congregation. As seen in Bihar, vaccination activity can be extended well beyond this period. Strategic

planning using a combination of health interventions provided through a variety of feasible approaches at different post-flood situations pays rich dividends in preventing health disasters. Vaccination campaigns do contribute to an early restoration of disrupted health services and enhance catch-up activities for missed vaccination doses once communication channels have improved.

While a large scale disaster like the one witnessed in Bihar in 2008 warrants a strong system for disease prevention and surveillance, several constraints to achieving this end were encountered. Timely rather than perfect response was a critical factor. With administrative mechanisms already strained in search, rescue and rehabilitation operations, it was solely up to the existing health infrastructure and personnel to cater to health needs and control widespread outbreaks. Also, building up new systems like IDSP surveillance and new logistic distribution mechanisms in absence of regular supply chains and roadways proved to be challenging. It is therefore pertinent to ensure that regular surveillance systems are well oiled and operational way before any disaster strikes.

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