

Review Article

Measles rubella campaign - India's journey from expanded program on immunization to measles elimination

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ABSTRACT

Infectious diseases have always been a major cause of mortality and morbidity in children under 5 years of age and more so in developing countries like India. Steps toward control of these infectious diseases, especially the vaccine-preventable diseases, have been the priority of Indian Government. Smallpox was eliminated followed by polio and next target being measles. Although the journey has been tough, finally, the results are appreciable considering the large population and limited resources of the country. India has traveled a very long distance from the introduction of vaccination and acquiring country's vaccine manufacturing to finally eliminating measles.

Key words: Campaign, Catch up immunization, Expanded program on immunization, Measles, Rubella

Eliminating vaccine-preventable diseases is one of the major steps in the reduction of under five mortality and the importance of vaccines has always been appreciated since ancient times. First vaccine (smallpox) was discovered in 1798 while India received its share of the first smallpox vaccine in May 1802, from England. Import of smallpox vaccine continued until 1880 when India started manufacturing its vaccine and vaccine institutes were set up like Haffkine institute, Central Research Institute and Pasteur's Institute at Shillong. Trials on cholera vaccine, plague vaccine, and typhoid vaccine continued till 1908 [1-4].

During the early 20th century, there were various developments on the political front such as first world war (1914–1918) and cholera outbreak (1896–1907), which led India to shift its an impetus to controlling these events and vaccination took a back seat. Vaccines received priority after Indian Independence.

TUBERCULOSIS (TB)

After independence, it was noticed that a maximum number of smallpox cases in the world was being reported by India. A Bacillus Calmette Guerin (BCG) vaccine laboratory at King Institute, Madras (now Chennai), was established in 1948 and with the support of International TB Campaign till 1957 and later on with the support by United Nations International Children's Emergency Fund (UNICEF), mass vaccination campaign was conducted and BCG vaccination became part of National TB control program in 1962 along with establishment of TB chemotherapy center in 1956 which was later renamed as National Institute for Research in TB. A large BCG trial named

as "Feasibility study for TB prevention trial" was conducted in Chingelput in 1968 with 15 years follow-up till 1987 and this trial was a success which gave India the confidence of conducting large vaccination trials [5].

SMALLPOX

During this period from 1950 onward on the global front, smallpox eradication was the target and this was announced by the World Health Assembly (WHA) in 1958. India started National Smallpox Eradication in 1962 with the aim of 80% vaccination coverage, and the decision was taken to continue with vaccination in children <15 years of age. There was a revision in smallpox eradication strategy with importance being laid on surveillance and investigation of the outbreak. With the help of intensive campaigns in 1973, India became free of smallpox with the last case reported in 1975 and was declared free of smallpox in 1977 by the World Health Organization (WHO) [6].

Eradication of smallpox gave the nation a trained workforce and confidence to control these vaccine-preventable disease. With this positive reinforcement, India adopted expanded program on immunization (EPI) in 1978 to cover six vaccine-preventable disease diphtheria, whooping cough, tetanus, polio, TB, and typhoid but later typhoid vaccine was excluded due to low disease burden and lower efficacy of the vaccine. Measles was included in EPI in 1985, and EPI was renamed as universal immunization program and was launched in 31 districts of India and universalized to cover the whole country in 1990.

In 1988, the WHA took a resolution to eradicate polio in 2000. India's vaccination target was shifted to polio eradication with stress on routine immunization, pulse polio, and surveillance with the last case of wild poliovirus reported in 2011. In 2012, the WHO removed India from the list of polio-endemic countries.

MEASLES AS BURDEN ON GLOBAL FRONT

On the global front, since polio is at the verge of eradication, measles elimination is the next target. Efforts toward achieving this target have been continuing for a long time. The burden of this disease is very large as, in the year 2000, (WHO) estimated that 535,000 children died of measles and United Nation Millennium Development Goals (MDG) were framed with MDG4 targeting reduction of an overall number of deaths among children by 2/3rd between 1990 and 2015. Routine measles vaccination (MCV) coverage is an indicator of progress toward the goal [7-9].

Measles initiative now known as measles-rubella (MR), initiative was launched in 2001 to support technically and financially measles control activities, and this was restricted to control in Eastern Europe. Various partners of the initiative are American Red Cross, United States Centre for Disease Control (CDC) and prevention, UNICEF, United Nation Foundation, and WHO [10]. Measles elimination has already been achieved in America in 2002. After the experience of America now MR initiative wants to extend measles elimination to all other regions of the world and a strategic plan has been made with a target of measles elimination and rubella control by 2020. Recommendations and guidance by the Strategic Advisory Group of Experts on immunization and Global Immunization Vision and Strategic plan have been incorporated into the strategic plan [11].

Various goals and milestones of the plan for 2015 were as follows:

1. To reduce global measles mortality in 2015 by at least 95% compared with the year 2000.
 2. To reduce annual measles incidence to <5 cases per million.
 3. To achieve at least 90% coverage with the first dose of measles-containing vaccine nationally and 80% vaccination coverage in every district.
 4. To achieve at least 95% coverage with the MR vaccine during supplementary immunization activities.
 5. To establish a Rubella/congenital rubella syndrome (CRS) elimination goal in at least three additional the WHO regions.
 6. Establish a target date for global eradication of measles.
- Further, the roadmap by the end of 2020 is as follows:
1. To sustain achievement of 2015 goals.
 2. To achieve at least 95% coverage by both first and second routine doses of measles in each district.
 3. Establish the target date for global eradication of rubella and CRS.

Measles elimination being defined as the absence of endemic measles virus transmission in a region or other defined geographic area for ≥ 12 months in the presence of high-quality surveillance system.

If we go by the achievements in measles control from 2000 to 2016, then there has been substantial progress. Annual measles incidence has decreased by 87% from 145 to 19 cases/million persons, and annual estimated measles death decreased by 84% from 550,100 to 89,780, and around 20.4 million deaths were prevented by MCV [12]. These targets have been achieved due to the increase in MCV coverage because measles first dose (MCV1) coverage has increased from 72% to 88% but has remained at 83–84% till 2013. The incidences of measles have also increased to 33 cases/million population in 2012 which was mainly due to outbreaks reported in Nigeria, China, Pakistan, Angola, Indonesia, Uganda, Georgia, and Turkey. Moreover, it is still a long way to go as 20.8 million infants did not receive MCV1 through routine immunization, and they belonged to 6 countries with suboptimal coverage with India accounting for 2.9 million unvaccinated infants [11-13].

MEASLES BURDEN ON INDIAN FRONT

India was aware of the importance of MCV even in 1978 before MCV became part of EPI in 1985 as a comparison study was conducted in Vellore between vaccinated and unvaccinated children during epidemic of measles where attack rate and case fatality rate were 26% and 14% in vaccinated children while in unvaccinated children attack rate and case fatality rate were 37% and 20%, respectively. The vaccine was received from Rotary International with special Central government's permission [14].

Another extensive two-phase study was carried out by Kaur *et al.* from September 1979 to March 1980 in Varanasi, for establishing the age of MCV in infants based on measles antibody titers. In the first phase of the study, 162 newborns were enrolled and cord samples for measles antibody were measured. It was found that seronegative infants with antibody titer below 1:4 rose from 1 month to 6 months of age as there were 4.17% seronegative infants <1 month of age while 38.89% of infants were seronegative at 6 months of age. This fall in antibody titers was very rapid after 4 months of age making infants more susceptible to infection.

In the 2nd phase of the study, 107 infants were enrolled for MCV and then were followed up for measles antibody titer at 1 month, and data of 62 infants were analyzed. It was concluded that vaccination at 8 months was the optimum time for vaccination as 100% of infants showed four-fold rise in antibodies when vaccinated between 8 and 15 months of age. It was further concluded that high pre-immunization antibody titers interfered with seroconversion later [15,16].

MEASLES OUTBREAKS

Even after the introduction of MCV in EPI, India was not manufacturing MCV till 1990–91. After the introduction of MCV, there has been a decrease in the incidence of measles from 161,216 cases to 36,711 in 2005 and coverage increased from 1% to 59%. In 2006 though coverage increased to 71% as per the WHO data there was an increase in a number of cases to

64,185 which was due to the outbreaks in 2004–2006. One of the outbreak investigations between 2004 and 2006 conducted in Himachal Pradesh, West Bengal, and Uttaranchal concluded that measles outbreaks were noted at younger age and attack rate was higher in an area with lesser immunization coverage compared to areas with higher immunization coverage. After the introduction of national measles surveillance and outbreak investigation in 2005 total suspected measles outbreaks investigated in 2010 were 242 and confirmed outbreaks were 198 while in 2011 there were 109 confirmed measles outbreaks [17,18].

MEASLES CAMPAIGNS

The WHA in 2010 committed to reduce 95% of measles death in 2015 from the levels reported in 2010. It was discovered that though measles mortality had declined by 74% from 535,000 deaths in 2000 to 139,300 in 2010, but Southeast Asian regions were still having high mortality and 47% of measles mortality in 2010 was reported from India. The main reason for this was delayed implementation of measles control activity, and this could be increased by the introduction of a 2nd dose of MCV which was done in 2010. India was the last country to introduce MCV2 into the national immunization program. This introduction of MCV2 was done into routine immunization in 21 states with high immunization coverage and through supplementary immunization coverage/campaign in states with low immunization coverage. These campaigns were carried out in a phased manner. Measles campaign was carried out in 14 States in 3 phases. In phase 1 from November 2010 to March 2011, 45 districts from 13 states (Chhattisgarh, Bihar, Jharkhand, Meghalaya, Rajasthan, Madhya Pradesh, Gujarat, Haryana, Manipur, Assam, Arunachal Pradesh, Nagaland, and Tripura) were covered. Uttar Pradesh was covered in the 2nd phase [17,19].

This campaign lasted three weeks, i.e., 12 working days. 1st week which was school-based campaign (5–10 years old children), 2nd and 3rd weeks being community-based campaign. Coverage was estimated to be 87.2% in this campaign, and >90% coverage was seen in 18 districts. In the 2nd phase between 2011 and 2012, 14 states (Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Jharkhand, Madhya Pradesh, Manipur, Meghalaya, Nagaland, Rajasthan, Tripura, and Uttar Pradesh) were covered and coverage was 90% while in phase three between 2012 and 2013, 5 states were covered and coverage was 82.6% [20].

As per National Family Health Survey (NFHS) -1 (1992–93), MCV coverage was 42% while in NFHS -2 (1998–99), MCV coverage was 51% which increased to 58.8% in NFHS-3 (2005–06) and the coverage increased drastically as per the NFHS-4 (2015–16) to 81.1%. This increase in coverage could be due to the mass campaigns carried out in 2010–11 [21–24].

These campaigns were helpful in controlling the cases of measles and number of cases fell from 10,308 annually in 2010 to 3314 in 2012 but again there was an increase in cases in 2013 and 2014 to 10,059, the reason being the outbreaks. There were around

71 outbreaks in 2013 and 87 in 2014. Even the immunity has waned after 2013 campaigns, and there is a need of campaigning again in these areas which will help in achieving elimination of measles by 2020 [16]. In 2014 National Technical Advisory Group on Immunization also recommended the introduction of MR vaccine in phased manner from 2017 to 2018 to cover all the 36 states and after the campaign replace MCV with MR vaccine at 9 months and 15–18 months because it has been realized that replacing of MCV with MR vaccine would add to only increase in cost by the US \$ 0.3 per dose for MR vaccine and would save the cost of treatment of single CRS case which is around the US \$ 75000 [25]. India's MCV coverage was varied depending on the regions.

If we go by the data of NFHS-4 maximum coverage of MCV is seen in southern states, followed by the northern states and minimum coverage are seen in northeastern states. In southern region, all the states have >75% coverage while in northeastern region only Sikkim has good coverage, i.e., 93.3% while rest of the states have coverage of <75% with least coverage being of Arunachal Pradesh (54.6%) and Nagaland (50.1%) [24].

India introduced a national level MR campaign in 2017 in a phased manner with the first phase completed in 5 states, namely, Goa, Karnataka, Lakshadweep, Pondicherry, and Tamil Nadu. The second phase was launched in August 2017 in 8 states - Kerala, Himachal Pradesh, Uttarakhand, Chandigarh, Andhra Pradesh, Dadra and Nagar Haveli, and Daman and Diu. Third phase was started on January 30, 2018, in Odisha and aim is to cover 12 states till March. The last phase would include Punjab in April–May, 2018 [21]. This campaign would target children from the age group of 9 months to 15 years and would be 1 week for school vaccination followed by outreach teams for 2nd and 3rd weeks and mobile teams for strengthening the outreach areas. Sweeping activity to cover left out/suboptimal coverage area will be done in 4th week [25].

The team includes one vaccinator auxiliary nurse-midwifery, one accredited social health activist, one Anganwadi Worker, and local volunteer. The aim is to vaccinate 100–150 children/vaccinator per day at the outreach center and 150–200 children/vaccinator in school session site. An adverse event following immunization (AEFI) is reported and given special attention [25].

CAMPAIGN - COMMITTEES AND EXECUTION

MR campaign involves a lot of planning at the national, state, and district level. At national level there is steering committee which is chaired by secretary health and family welfare, Government of India which has a role of coordination of activities among Government ministries, departments, institutes such as National Institute of Health and Family Welfare (NIHFW), National Cold Chain and Vaccine Management Resource Centre, National Health Mission (NHM), National CDC, Education, Women and Child Development social welfare, Department of Health Research (DHR), AYUSH, Home Affairs, defence, and Youth Affairs. [25].

Another committee at the national level is central operations group chaired by Joint Secretary (RCH) DC- immunization which comprises officials from Government of India, WHO India, UNICEF, NIHF, and other partners [25]. A control room is established at immunization division Immunization Technical Support Unit (ITSU) under MOHF for planning, monitoring, coordination, and implementation of activities during the MR campaign with members of CDG [25]. At state level there is State Steering Committee under chairmanship of State Chief Secretary and this committee involves mobilizing human and other resources and coordination, planning and implementation of activities along with Government departments such as education, social welfare, NHM, DHR, AYUSH, and Home Affairs and partner coordination with WHO India, UNICEF, Red Cross, ITSU, State Reproductive Maternal, Newborn Child and Adolescent Health, IMA, IAP, National professional bodies of Public Health, Paediatrics, and other departments of medical college and civil societies such as Rotary Lions and GAVI [25].

During the campaign, a state control room is established for day to day monitoring and management of human resources. At district level, there is a district task force for immunization under the chairmanship of District Collector/Magistrate in each District and Chief Medical Officer/District Immunization Officer (DIO) would be members.

There is district task force meetings and establishment of the control room during the campaign at district level [25]. Preparedness at district level along with coordination with other departments, sensitizing school principals, microplanning, training, supervision, communication cold chain, interdepartmental coordination, and AEFI management and release of funds under the leadership of civil medical officer/district health officer is executed.

DIO ensures completion and review of the micro-plans along with training of vaccinators [25]. In Punjab MR campaign was held in May 2018 in phase four along with other states Haryana, Assam, Mizoram, and Andaman and Nicobar Islands where it was estimated that 75 lacs children were vaccinated. Results after supplementary immunization activity and MR Campaigns in India during 2017–2018 have shown that there has been a decline in the number of confirmed cases of Measles from 57,392 in 2017 to 38,505 in 2018 till August. India plans to start to catch up immunization from January 2019 and target is to cover the population of 49,300,000 [26].

CONCLUSION

India has traveled a very long distance from the introduction of vaccination and acquiring country's own vaccine manufacturing to the eradication of one disease after the other. Measles campaigns in 2010–11 in selected states have increased the vaccination coverage of country drastically.

REFERENCES

1. World Health Organization (WHO). Unicef, World Bank. State of the World's Vaccines and Immunization. 3rd ed. Geneva: World Health Organization; 2009.
2. Fenner F, Henderson DA, Arita I, Jezek Z, Ladnyi ID. Smallpox and its Eradication. Geneva: World Health Organization; 1988. p. 369-71.
3. Bazin H. Vaccination: History from Lady Montagu to Genetic Engineering. Paris, France: John Libbey Eurotext; 2011. p. 110-245.
4. Lahariya C. A brief history of vaccines and vaccination in India. *Indian J Med Res* 2014;139:491-511.
5. John TJ, Vashishtha VM, John SM. 50 years of tuberculosis control in India: Progress, pitfalls and the way forward. *Indian Pediatr* 2013;50:93-8.
6. Basu RN. Smallpox eradication: Lessons learnt from a success story. *Natl Med J India* 2006;19:33-6.
7. You D, Hug L, Ejdemyr S, Idele P, Hogan D. Global, regional and national levels and trends in under-5 mortality between 1990 and 2015, with scenario-based projections to 2030: A systematic analysis by the UN inter-agency group for mortality estimation. *Lancet* 2015;386:2275-86.
8. United Nation(UN). Levels and Trends in Child Mortality Report 2011: Estimates Developed by the UN Inter-Agency Group for Child Mortality Estimation. New York: United Nations Children's Fund; 2011. Available from: http://www.childinfo.org/files/Child_Mortality_Report_2011.pdf. [Last cited on 2018 Jun 24].
9. United Nation (UN). The Millenium Development Report 2009. New York, United Nations; 2009. Available from: http://www.mdgs.un.org/unsd/mdg/Resources/Static/Products/Progress2009/MDG_Report_2009_En.pdf. [Last cited on 2018 Jun 24].
10. van den Ent MM, Brown DW, Hoekstra EJ, Christie A, Cochi SL. Measles mortality reduction contributes substantially to reduction of all cause mortality among children less than five years of age, 1990-2008. *J Infect Dis* 2011;204 Suppl 1:S18-23.
11. World Health Organization/United Nations Children's Fund. GIVS: Global Immunization Vision and Strategy 2006-2015. Geneva: World Health Organization (WHO/IVB/05.05); 2005. Available from: http://www.who.int/hq/2005/WHO_IVB_05.05.pdf. [Last cited on 2018 Jun 24].
12. Dabagh A, Patel MK, Dumolard L, Gacic-Dobo M, Mulders MN, Okwo-Bele JM, *et al.* Progress toward regional measles elimination-worldwide, 2000-2016. *MMWR Morb Mortal Wkly Rep* 2017;66:1148-53.
13. World Health Organization (WHO). India: WHO and UNICEF Estimates of Immunization Coverage: 2017 Revision. Geneva: World Health Organization; 2017. p. 1-18.
14. John TJ, Joseph A, George TI, Radhakrishnan J, Singh RP, George K, *et al.* Epidemiology and prevention of measles in rural South India. *Indian J Med Res* 1980;72:153-8.
15. Kaur G, Agarwal DK, Gulati AK, Kalra A, Katiyar GP, Agarwal KN. Maternal and cord blood measles antibody titres. *Indian J Med Res* 1982;76:407-14.
16. Katiyar GP, Kaur G, Agarwal DK, Gulati AK, Kalra A, Agarwal KN. Seroconversion response to mevlin -I measles vaccine at age 6-15 months. *Indian Pediatr* 1985;22:653-9.
17. Measles Elimination and Rubella Control India Marching towards the Goal-Measles and Rubella Initiative. Available from: <https://www.measlesrubellainitiative.org/wp-content/uploads/2014/09/Country-Update-India.pdf>. [Last cited on 2018 Jun 30].
18. Murhekar MV, Hutin YJ, Ramakrishnan R, Ramchandran V, Biswas AK, Das PK, *et al.* The heterogeneity of measles epidemiology in India: Implications for improving control measures. *J Infect Dis* 2011;204 Suppl 1:S421-6.
19. Centers for Disease Control and Prevention (CDC). Progress in implementing measles mortality reduction strategies-india, 2010-2011. *MMWR Morb Mortal Wkly Rep* 2011;60:1315-9.
20. Vashishtha VM, Choudhury P, Bansal CP, Gupta SG. Measles control strategies in India: Position paper of Indian academy of pediatrics. *Indian Pediatr* 2013;50:561-4.
21. National Family Health Survey (NFHS-1) 1992-93. Mumbai: International Institute for Population Sciences (IIPS) and Macro International; 2009. Available from: <http://www.rchiips.org/nfhs/nfhs1.shtml>. [Last cited on 2019 Feb 15].

22. 10 National Family Health Survey (NFHS-2) 1998-99. Mumbai: International Institute for Population Sciences (IIPS) and Macro International; 2009. Available from: <http://www.rchiips.org/nfhs/nfhs2.shtml>. [Last cited on 2019 Feb 15].
23. 11 National Family Health Survey (NFHS-3) 2005-06. Mumbai: International Institute for Population Sciences (IIPS) and Macro International; 2009. Available from: <http://www.rchiips.org/nfhs/nfhs3.shtml>. [Last cited on 2019 Feb 15].
24. 12 National Family Health Survey (NFHS-4) 2015-16. Mumbai: International Institute for Population Sciences (IIPS) and Macro International; 2009. Available from: <http://www.rchiips.org/nfhs/nfhs4.shtml>. [Last cited on 2019 Feb 15].
25. Ministry of Health and Family Welfare. Introduction of Measles-Rubella Vaccine (Campaign and Routine Immunization). National Operational Guidelines; 2017.
26. World Health Organisation(WHO). Global Measles and Rubella Update; 2018. Available from: http://www.who.int/immunization/monitoring_surveillance/burden/vpd/surveillance_type/active/measles_monthlydata/en/. [Last cited on 2018 Oct 16].

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