The Challenges in Eradication of Measles and Its Re-emergence in North-Eastern State of Meghalaya

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Abstract

Measles is a highly transmissible viral disease, resulting in complications in over 30% of cases, which may be even fatal at times. After eradication of other viral diseases like smallpox and polio, measles is considered to be the next target for eradication. Though the tools to fight measles are potent and morbillivirus vaccines have proven to be very effective with eradication of rinderpest; the challenges that lay ahead for measles eradication are varied and many. Health of the population and changing demographics of the disease, awareness and religious beliefs, terrorism and social unrest, natural disasters, resources and logistics are few issues among the lot. It is pertinent that these issues are appropriately addressed and the vaccine coverage is steadily increased and maintained for achieving measles eradication. Any stagnancy or lag in the program may result in outbreaks.

Keywords: Measles, Communicable disease, Infection, Eradication, Elimination, Outbreak

Background

Measles (khasra or chotimata in Hindi, niang pyriat in Khasi) is a highly communicable disease. MeV (measles virus) is an RNA virus of the Paramyxoviridae family of the genus morbillivirus; it is serologically a monotypic virus, but genetically distinguished into 24 genotypes compiled in eight clades (A–H). Measles or rubeola is an airborne infection transmitted by nasopharyngeal droplets and its occurrence peaks during winter and spring. It is often missed in the initial phase when it mostly presents with fever, cough, coryza and conjunctivitis lasting for 2–4 days. This phase is followed by a specific pattern of maculopapular rash. It is mostly self-limiting; however, associated complications have been reported to cause mortality in the affected patients. Common complications of measles are diarrhea, otitis media, pneumonia, malnutrition, vitamin A deficiency and xerophthalmia. Rarer and graver complications are subacute sclerosing panencephalitis (SSPE), encephalitis and corneal scarring leading to blindness. Also, more serious outcomes occur in pregnancy including maternal death, abortion, preterm birth and low birth weight (LBW). Persons afflicted with measles are more susceptible to opportunistic infections for years after recovery owing to generalized immunosuppression. There is no specific anti-measles treatment; so the main weapon against this potential disease is primary prevention with immunization. The malnourished and the immunocompromised are affected by severe measles infection and so vaccinating them with measles containing vaccine (MCV) is essential. Also, measles may be prevented by administration of human immunoglobulin early in the incubation period. Prior to the advent of vaccination, measles was a dreaded infection affecting over 90% of the children before they reached 15 years of age and causing serious complications and mortality in young children. If they survived, they were granted lifelong immunity. Though measles is the next

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disease targeted for eradication following the success of poliomyelitis, and its incidence has decreased to a great extent in the developed nations, the occurrence of cases is still noted in many countries including Europe, New Zealand, Spain, France, Germany, the UK, Romania and a large number of other European countries. The developing and the underdeveloped nations have always continued to suffer from the rage of measles where it still causes a substantial case fatality.

**Importance of Measles Eradication**

The use of MCV attributed to a cumulative estimated 17.1 million lives saved between 2000 and 2015. However, around 114,900 people, mostly children, died due to measles in 2014 due to lag in the program. These deaths could have been prevented with a timely measles vaccination. Measles is a highly infectious disease and the basic reproduction rate ($R_0$) for measles is one of the highest for any human pathogen and is calculated to be 12–18. Since the secondary attack rates (SAR) among susceptible persons is 90% or greater, each new birth cohort requires effective vaccine delivery to ensure that at least 95% of individuals are immune or the immunity gaps give way to epidemics. However, sustaining herd immunity in regions where elimination has already been achieved might pose a challenge with migration and globalization. Measles eradication program will prove to be very cost-effective as treatment costs for measles infections (>US$ 2 billion per year) can be avoided and disability-adjusted life year (DALY) losses prevented (>15 million DALYs per year valued at >US$ 63 billion). By using combination vaccines like MR (measles rubella), MMR (measles mumps rubella) and MMRV (measles mumps rubella varicella) during the process, it can be made more cost-effective while other diseases and the disabling CRS (congenital rubella syndrome) can be averted too. Owing to these factors, WHO South East Asia Region (SEAR) countries have resolved to eliminate measles by 2020. WHO defines elimination of measles as the absence of endemic measles for a period of >12 months in the presence of adequate surveillance while measles eradication is defined as the worldwide interruption of its transmission and the simultaneous elimination of measles in all WHO regions.

**Achievability of Measles Eradication**

Measles satisfies all the criteria to be considered as eradicable, which were established at the Dahlem Conference on Disease Eradication in the year 1997: (1) humans must be critical to maintaining transmission, (2) accurate diagnostic tests must be available, (3) an effective intervention (in this case vaccine) must be available and (4) it must be possible to interrupt transmission for a prolonged period in a large geographic area. Measles eradication is biologically feasible because of certain properties of the virus and the disease: humans are the only hosts for measles and no vectors are involved, lifelong immunity occurs after natural infection, MeV has only one serotype and is a genetically stable virus, only source of infection is a case of measles which are mostly overt and the disease has no long-term carrier state. However, subclinical infection may be there in previously vaccinated individuals though they are unlikely to be contagious. MeV is rapidly inactivated by heat, light, acidic pH, ether and trypsin and has a short survival time (<2 hours) in air or fomites. Isolation of the patient for a week from the onset of rash covers the period of communicability and limits the chances of secondary infection among potential contacts.

Measles eradication is technically feasible because of availability of a safe and effective measles vaccine providing long-term protection (at least 20 years) against all known genotypes, and the availability of accurate diagnostic tests. Measles vaccine efficacy is 89% when given at 9 months and 99% when given at >12 months of age. However, actual vaccine effectiveness under field conditions is usually lower. It is 85% when given at 9 months and 95% when given at >12 months of age. In addition, MCV can be used during an outbreak, and vaccination within 2 days of exposure may modify the clinical course of measles or even prevent clinical symptoms.

Although the success could not be recreated in the remaining five regions, the feasibility of measles eradication, both biological and programmatic or operational, has already been proven in the region of Americas since elimination of measles since 2002. Effectiveness of MCV was also proven during 2000 and 2011 when measles first dose coverage increased from 72% to 84%, and the number of countries providing a second dose of measles through routine immunization increased from 97 (50%) in 2000 to 141 (73%) in 2011. During the same time, the incidence of measles decreased 65%, from 146 to 52 cases per 1 million population, and estimated mortality from measles decreased 71%, from 542,000 to 158,000.

**India and Measles Eradication**

The World Health Organization (WHO) South East Asia Region (SEAR) has setup a target for the elimination of measles and control of rubella before 2020; however, measles remain to be the leading cause of death amongst all vaccine-preventable diseases (VPDs) in India and there were around 297 measles outbreaks in 2016. Though the surveillance system often under-report the deaths due to measles, various studies in India have shown median case-fatality ratio (CFR) of 3.8% (range: 0% to 30%). However, the National Family Health Survey 4 (NFHS 4) reported that 81% of infants aged 12–23 months received the measles vaccine as compared to 59% in NFHS 3.
Various strategies have been adopted by the Government of India (GoI), initially towards measles control and currently towards measles eradication. In 1985, one dose of measles containing vaccine (MCV1) at the age of 9–12 months was introduced in the Indian routine immunization. This was followed by: (a) achieving high coverage with the first dose of the measles vaccine, 90% at the national level and 80% for each district; (b) intensive surveillance activities and adequate laboratory support ensuring serological categorization; (c) appropriate case management; (d) implementation of catch-up measles vaccination campaigns (MCUP) for children aged 9 months to 10 years in 14 states with the weakest coverage; 24 (e) introduction of second dose of measles containing vaccine (MCV2) to be given at the age of 16–24 months in the national immunization schedule (NIS) during 2010, 25 (f) intensification of both first and second doses of measles vaccination coverage was undertaken under mission Indradhanush from 2015 as the keep-up strategy of vaccination, (g) introduction of MR vaccine in February 2017 in a phased manner starting from five states and UTs (Karnataka, Tamil Nadu, Puducherry, Goa and Lakshadweep) to vaccinate children aged 9 months to less than 15 years and (h) follow-up, defined as subsequent nationwide vaccination campaign conducted every 2–4 years targeting usually children born after the catch-up campaign, is planned to be done.

**Obstacles to Eradication**

Obstacles to measles eradication are multifold. Measles vaccine is injectable and not easy to administer unlike oral polio vaccine (OPV). It requires trained personnel for administration. Studies are evaluating needle-less delivery modes such as aerosol as a solution to this and also to avoid needle contamination. 26 Again, it is a live attenuated vaccine which needs to be reconstituted; so proper maintenance of cold chain during the entire process of transportation, storage and delivery is crucial to the success of the campaign. It is not immunogenic in young infants, necessitating vaccine administration at 9 months of age or older making younger infants vulnerable to risk of infection. Adverse events following immunization (AEFI) post measles vaccine like fever, pain at injection site and, in rare cases, red or purple discolorations on the skin known as thrombocytopenic purpura, or febrile seizures may have a negative impact on the use of the vaccine. Anti-vaccination lobbies and rumours surrounding vaccination in general affect the acceptance of vaccines among the masses. Measles vaccination rates had dropped drastically following the publication of Wakefield AJ et al., which claimed MMR (measles mumps rubella) vaccine was linked with autism and intestinal abnormalities, ranging from lymphoid nodular hyperplasia to aphthoid ulceration. 29 However, succeeding researches refuted the claim but the damage was done. 30, 31

Also, though incidences of such occurrences have become minimal now, unsafe needle practices can be devastating to the mass vaccination campaigns. Another important challenge is competing priorities like polio eradication, introduction of newer vaccines (Hemophilus influenzae type B, rotavirus, Japanese encephalitis, pneumococcal and inactivated polio vaccines in the NIS), and also health initiatives against other public health concerns. 32

These are compounded by challenges from population displacement, migration and civil unrest, terrorism and war. Poor coverage of measles or high case fatality rate can be attributed to socio-demographic parameters like higher birth order, low family income, lower parental education, Muslim religion, overcrowding, unhygienic conditions, poor knowledge of measles and the measles vaccine, limited public demand for and trust in vaccines. Other challenges faced are accumulation of the susceptible population, difficult-to-reach areas; inadequate infrastructure, manpower, and communication; maintenance of cold chain; inadequate surveillance and reporting of adverse events following immunization, improper outbreak response and biomedical waste disposal. 33-37

In addition to these, owing to high transmissibility of measles virus, high coverage of ≥95% is needed for fully protective herd immunity which is very difficult to achieve. The situation is rendered worse by primary vaccination failure occurring at rates of 4–8%, and secondary failure at about 4%. 38 Also, appropriately vaccinated persons have been afflicted with measles during epidemics, particularly in heterogeneous group settings such as schools, universities, etc. 39, 40 Another challenge is demographic shift that has been observed in many countries making measles no more an exclusively childhood disease. 38 It has been observed that 40% of confirmed cases in the European region and 29% in the Western Pacific region were 15 years of age or older, and 19% in the European region and 13% in the Western Pacific region were 15 years of age or older. 41 Also, in a country like India where shortage of trained human resources is present, just after extensive polio eradication campaign may give rise to ‘campaign fatigue’ for measles.

**Current Situation in Meghalaya**

Meghalaya is a remote border Indian state, beset of hilly and difficult terrain and inhabited mostly by tribal population making it more vulnerable than most other states of India. This is supported by observed higher case fatality ratio among under-five children and children from the backward class. 42 Meghalaya was one of the 14 states with measles coverage less than 80% in which MCV2 was introduced through catch-up vaccination campaign. And, according to NFHS 4 data, 72% of infants aged 12–23 months received the measles vaccine, though this is higher than 44% in NFHS 3, 43 still is lagging far behind the intended objective.
For achieving measles eradication, case-based measles and rubella surveillance has been initiated in a phased manner in SEA countries in which all suspected measles cases presenting with fever and non-vesicular maculopapular rash with cough, coryza or conjunctivitis are notified, investigated and subsequently confirmed either in laboratory or epidemiologically or clinically. But, case-based surveillance is still lagging in Meghalaya. Again, highly sensitive virological and molecular biological test methods (i.e. viral sequencing, genotyping and phylogenetic analyses) are essential tools for the assessment of epidemiological situation. However, laboratory support is not very robust in the state.

In addition to the above facts, other existing obstacles to achieve measles eradication are: ignorance of primary caregivers regarding the disease and the vaccine, superstitions and religious beliefs and fears of adverse events and apparent harm to the child. Parents were apprehensive in vaccinating a sick child and this remained uncompensated later. Sometimes, they found the health centers were distant and did not have time to take their children for vaccination.

These obstacles have to be overcome as there has been a re-emergence of measles in Meghalaya. In the years 2014 to date, a number of outbreaks observed were 1, 2, 12 and 1 respectively and the number of confirmed measles cases were 8, 148 and 552 respectively in the last 3 years. The recent outbreak in Meghalaya started from August 31, 2016 to January 18, 2017 in East and West Jaintia Hills and 325 cases (51% female) were identified, including three deaths from various parts of East (191) and West (134) Jaintia Hills districts. The median age of the cases was 4 years, ranging from 3 months to 50 years. In Byrwai village, 192 cases were identified and a population attack of 8% was observed and only 16% of which had received vitamin A. The relative risk (RR) of unvaccinated children to vaccinated children for MCV1 was 5.3 [95% confidence interval (CI), 3.2–8.9].

Conclusion

Keeping in mind all the discussed facts, it can be concluded that though measles elimination and subsequent eradication are feasible, the path will be strewn with multifaceted challenges that need to be overcome. This will require untiring efforts from all the regions of the world and all the stakeholders. Political will, human resource development, adequate supply of vaccine and other logistics, awareness amongst public and motivation among health workers has to be maintained throughout. Since conflict, war and terrorism adversely affect health and such programs, the governments of all countries should work collaboratively towards solution of such issues. Overall health condition and nutritional status of a country should be maintained to achieve success in measles eradication.

Conflict of Interest: None

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Figure 1. Trend of Measles Cases during the Last 3 Years