
Viewpoint

Measles Control in India: Additional Immunization Strategies

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There is a greater burden on the health of children in developing countries due to measles than to any other vaccine-preventable disease (1). Although an estimated 90 million cases and 1.54 million measles associated deaths are prevented each year, WHO estimates that 45 million cases of measles and 1.19 million measles associated deaths still occur each year (1). The World Health Assembly and the World Summit for Children set the goal of a 95% reduction in deaths and a 90% reduction in cases by 1995 compared with pre-immunization levels, as a major step to the global elimination of measles in the longer run (2,3); the goal of a 90% reduction in measles morbidity requires more than 95% coverage with currently available vaccines, especially in more densely populated areas (3). India is committed to the goals for measles control.

Measles vaccine was introduced in the National Immunization Programme in 1985-86 (4) and the reported coverage levels

increased rapidly to about 88% in 1993-94 (5). Commensurate with the increase in immunization coverage, the reported annual incidence declined from 160,216 cases of measles in 1985 to 65,077 cases in 1993 (5); this corresponds to a reduction of about 59%. The coverage levels however, are not showing any further rise since 1990, and in many areas these levels remain below the national average (5). With an 85-90% effective vaccine when administered at 9-11 months of age, more than 20% of children remain susceptible to measles (Table I) which allows continued transmission of infection in the community.

Further improvements in vaccine efficacy in young infants are unlikely to be seen in the near future and many important operational, managerial and financial constraints continue to limit measles immunization coverage (6). Consequently, the existing measles control strategies could not achieve the target of 90% reduction in measles case by 1995. Therefore, supplementary immunization efforts are necessary to further raise the coverage to achieve the midterm goals as a step towards eventual eradication (6).

The Additional Strategies for Raising Immunization Coverage

The additional strategies for raising and maintaining immunization coverage include elimination of missed opportunities for immunization (7-11), identification and immunization of all eligible children in high risk areas and groups (2,3,11), adoption of a two dose policy (12-14), and use of mass campaigns which target all children in a particular age group (1,6,15) regardless of prior immunization or disease history (6).

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Elimination of Missed Opportunities for Immunization

A direct approach to increase immunization is to provide immunization to all eligible persons at every opportunity. An opportunity for immunization is missed when a contact with a health service does not result in an eligible child or woman receiving all needed vaccines(7-9). Since 1983 the EPI Global Advisory Group is recommending that programme managers seeks ways to reduce missed opportunities for immunization(9). The most important reasons for missed opportunities are: (i) false contraindications to immunization; (ii) practice of not opening a multidose vial for a small number of children to avoid vaccine wastage; (iii) failure to administer simultaneously all vaccines for which a child is eligible; (iv) immunization not offered at every health care contact; and (v) logistic problems, poor clinical organization and inefficient clinic scheduling; refusal by families are infrequent(7-9). Missed opportunities for immunization are relevant in our country also(10). In a study of missed opportunities at a Tamil Nadu hospital, 57% of the children were found who needed but did not receive the vaccine(10). All children should therefore, be screened for immunization at every health care contact (7-9).

Unfortunately, an opportunity to immunize with measles vaccine is missed more often than an opportunity to immunize with other vaccines(9). A recent review of surveys from 13 developing and industrialized countries estimated the prevalence of missed opportunities for measles vaccine as 52% (range 19-84%)(9). Such studies in India are not many. Nevertheless, missed opportunities can be reduced to a minimum by appropriate immunization policies; elimination of missed

opportunities for immunization could result in increased measles vaccine coverage(7-9).

Identification and Immunization of Children in High Risk Areas and Groups

In a situation with scarce financial and human resources, this approach offers an effective way to further increase coverage levels to control measles(2,3,11), especially to reduce the measles associated complications and mortality. The high risk approach however, requires an effective disease surveillance system to identify pockets of susceptible individuals and then direct programme resources to these areas of greatest need(3). For measles, the urban poor are considered a special high risk group because there is a high rate of transmission of measles virus in crowded environment(3,16,17).

The other high risk groups may include: (i) refugees living in camps; (ii) migrants; (iii) children admitted to hospitals; (iv) mal nourished children; (v) members of certain ethnic and religious subgroups who may have cultural beliefs which restrict their access to health services or to accepting immunization; (vi) those in zones of armed conflict or border areas; and (vii) those living in high risk areas(2,3,11). High risk areas include: (i) those with a high population density; (ii) those with significantly lower immunization coverage than national average; (iii) those reporting high measles incidence or death rate; and (iv) areas of known vitamin A deficiency(2,3,11). Once identified, high risk areas or groups should be addressed by special immunization activities depending on how extensive these areas/groups are and the capacity of the health services to undertake additional activities; managers should balance needs against resources(3). It should be emphasized that conducting specific or intensified

activities in high risk areas should not jeopardize the continuation of the routine immunization activities(3).

The high risk areas and groups will differ from country to country and will change as the programme matures. An effective surveillance system is a prerequisite for the identification of high risk areas/groups in a community(3). Unfortunately, we have a very poor surveillance system which reports less than 5% of the cases in the country. Consequently, we have not been able to utilize this strategy to its maximum for raising immunization coverage levels. Nevertheless, urban poor and those living in high risk areas may be important groups in the Indian context.

Two-dose Policy

The WHO has already recommended two doses of measles vaccine for certain groups which are at high risk of measles deaths, for example, infants staying in refugee camps or admitted to hospitals before the scheduled age of immunization (between 6-9 months)(11).

In other situations, WHO does not currently recommend a two dose schedule for developing countries because it is felt priority must be given to reaching every infant with one dose at an appropriate age(11). Nevertheless, two-dose strategy is being used routinely in many countries; some developed countries which have measles elimination goals and which have achieved high coverage with one dose of vaccine have also adopted two dose schedule(12). The second dose is given to reduce those susceptibles who either remained unimmunized or did not respond to the first dose of vaccine. As shown in *Table I*, if 90% of children get the second dose of vaccine at 15-23 months of age and 95% of those who get this dose seroconvert (vac-

cine efficacy is 95% at this age), less than 4% of the children will remain susceptible after second dose.

Unfortunately, these presumption may not hold true because: (i) those children who missed the first dose are more likely to miss the second dose too(18); and (ii) some of the vaccine failures may not seroconvert after revaccination(19). Nevertheless, after ignoring the second factor and assuming a lower coverage of 75% with second dose at 15-23 month of age, we may achieve a 93% immunity level (*Table I*) which may not be sufficient to interrupt the transmission but is sufficient to achieve the mid-term goal of a 90% case reduction. Additional costs, logistic, problems of administration, low rate of return for a second dose, and the altered immune response following revaccination were some of the reasons why a two dose policy was not preferred earlier. However, we found that an additional amount of Rs. 22 crores will be required every year to cover the additional doses of vaccines and disposable syringes in the whole country (*Table II*). This affordable money and some efforts from those who are involved in the programme may increase the immunity level by around 16 points (to 93 from 77) (*Table I*), which may be crucial to achieve the mid-term goal of measles control. The strategy is therefore, worth trying at least as a pilot project.

Mass Campaigns

Mass campaigns raise measles vaccine coverage rapidly to high levels and consequently have the maximum impact on interrupting the transmission of virus (1,6,15). However, the strategy requires meticulous planning and organization in the areas of logistics, staffing and publicity(20). Mass campaigns also require enormous resources which may not be easily available in developing countries(20)

(Table II). Moreover, even if mass campaigns are not needed every year, a campaign strategy is not a one-time event; adoption of a campaign strategy requires a long-term approach to resource mobilization(6). High immunization levels achieved only briefly, temporarily suppress the transmission of virus; newborns may subsequently accumulate as susceptible children until disease transmission again be-

comes easy(20). A universal measles mass campaign strategy therefore, can not be advocated in a vast country like India. Since measles can not persist in any community with fewer than 5,000-10,000 births per year(16) (or 170,000-350,000 population in India), densely populated urban cities are the important reservoir for seeding measles virus to rural population(16-17). The control of measles in these cities may therefore,

TABLE I —Level of Measles Immunity Following a Two Dose Schedule

Dose	Vaccination age (mo)	Immunization coverage (%)	Vaccine efficacy (%)	% of immune children	% remaining susceptible
First	9-11	90	85	76.5	23.5
Second	15-23	90	95	96.6	3.4
Second	15-23	75	95	93.2	6.8

TABLE II -Additional Costs for Supplementary Immunization Strategies

Strategy	2-dose policy	Mass campaign without pulse-polio	Mass campaign along with pulse-polio	Mass campaign without pulse-polio
Setting	Whole country	Cities with population >1.5 lac	Cities with population >1.5 lac	Whole country
Total population in 1991 (million)	846	126	126	846
Target Age (months)	15-23	9-49	9-49	9-49*
Estimated target children in 1995 (million)	27	15**	15**	96**
Additional Cost per child (Rs)	8@	16-24#	10#	16-24#
Schedule	Routine and with OPV/DPT booster	Annual [§]	Annual [§]	Annual [§]
Total costs in crores (Rs.)	22 ^{##}	24-36	15	154-230

* Age limits should preferably be between 9 month and 10 years in rural areas.

** 10.4% of total population

@ Cost for additional vaccine and syringe; 50% vaccine as wastage.

Cost suggested by EPI (Reference 6).

The cost will be 18 crores if cities with population of more than 150,000 are excluded.

§ Mass campaigns not necessary every year.

act as a key to the control of measles in the country. Therefore, annual mass campaign in cities with more than 150,000 population may prove the right and cost-effective strategy.

Analysis of available data on the age distribution of measles cases guide us in the choice of age groups to be immunized during mass campaign(6). Majority of cases in the metropolitan areas occur by 3 years of age and virtually all cases are reported by 5 years of age. Conversely, only one-half of the cases usually occur in rural areas by 5 years of age; cases continue to occur upto 10 years of age. The situation is in between in the rest of the population(21). The suggested age limits in mass campaign are shown in *Table III* (21). Since vaccine failure is quite high when children are immunized below 9 months of age and a high vaccine failure rate might jeopardize the credibility in the community of a measles immunization programme(22), the lower age limit may be 9 months of age in all areas.

Timing mass campaign activity to the pre-epidemic season, which is the last quarter of the year in India, maximizes effectiveness(23). Fortunately, pulse-polio campaigns are also being organized during the same months; the most cost-effective means of conducting a measles mass campaign will therefore, be in conjunction with a poliomyelitis immunization campaign(6). Data from campaigns conducted in the Americas and the Philippines suggest that the cost of a measles mass campaign ranges

from US \$ 0.50 to \$ 0.75 per child, and if administered during a poliomyelitis mass campaign, is approximately US \$ 0.30 additionally per child(6).

Proposed Measles Control Policy

In conclusion, we suggest that measles mass campaign may be taken in cities with more than 150,000 population along with pulse-polio campaigns; in the rest of the country a two-dose policy should be adopted. Incidentally, it is relatively easier to deliver a second dose in rural areas which have a strong primary health care infrastructure, whereas it is easy to organize a campaign in compact population of urban areas. Besides, surveillance should be strengthened to identify remaining pockets of susceptible individuals and then direct programme resources to these areas of greatest need. Additionally, children should be screened and immunized at every health care contact and all efforts should be made to eliminate the missed opportunities for immunization. Finally, monitoring and evaluation of the programme to assess its effectiveness and to provide information for further evolution of immunization policies should also receive due emphasis. These efforts will not only achieve the mid-term goals of disease reduction but will also make it possible to eliminate measles from India.

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TABLE III - Age Limits for Mass Campaigns

Type of area	Lower age limit (mo)	Upper age limit (yr)	
		May be	Preferably
Metropolitan City	9	3	5
Cities with population more than 150,000	9	5	5
Other urban or rural areas	9	5	10

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