

POLIOMYELITIS IN DELHI: A PROJECTION ON POOL OF AT-RISK UNDERFIVE DURING 1995

**J. Bhattacharjee
Devadethan
R.S. Sharma**

ABSTRACT

Due to lacunae in coverage and limitation in efficacy, immunization with oral polio vaccine has left a group of susceptible children at risk of developing poliomyelitis. The present study, with the help of statistics, projects the size of that susceptible pool of underfive children in Delhi during 1995. With the help of available data and some assumption, a formula has been developed for the purpose. The size of the pool thus estimated is about 3.7 lakh. There is a need to develop methodology for finding such susceptibles at community level, particularly at the terminal phase of eradication. An additional approach of immunization has also been suggested to facilitate the prospect of polio eradication.

Key words: Pool, At-risk underfive, Poliomyelitis, OPV potency, Mopping-up, Primary doses.

From the National Institute of Communicable Diseases, 22 Shamnath Marg, Delhi 110 054.

Reprint requests: Dr. J. Bhattacharjee, National Institute of Communicable Diseases, 22 Shamnath Marg, Delhi 110 054.

*Received for publication: December 21, 1993;
Accepted: March 22, 1994*

Lacunae in immunization coverage against poliomyelitis under the Universal Immunisation Programme has created a group of "at-risk under-five children" due to two reasons. The first group is that of unvaccinated children due to inadequacy of vaccine coverage and the second is due to limitation of oral polio vaccine (OPV) efficacy among the vaccinated children. The total number of this at-risk, over any period, is dependent on the total population and birth rate, subject to the varying influences of OPV coverage, its efficacy, potency and, age specific mortality rates prevalent at different points of time during the period.

The metropolitan cities of India are very populous, with increasing population every year. This has been creating more burden on public health and other civic amenities. Such, situation can pose problem for the polio eradication goal of the country by 2000 AD. With this background, an attempt has been made to work out a simple formula for estimating the pool of underfive children at-risk of developing poliomyelitis in Delhi during 1995. This would help the health authorities to look more pragmatically towards the prospect of polio eradication and enable them to take up additional or modified immunization activities for achieving the goal.

Material and Methods

Since the year of projection is 1995 and children below five years are under consideration, the starting point of the exercise has to be 1991. If "P" was the population of Delhi during 1991 with a birth rate of "p", there were "Pp" infants during that year. Assuming OPV potency Co be 100 per cent, "c" and "e" as the OPV coverage and the efficacy factors respectively, out of the Pp infants, Pp(1-c) constituted the

"unvaccinated" component and $Pp.c(1-e)$ the "vaccinated but not effectively protected" ones. The sum of these two formed the infants at-risk during 1991. As this group transited through the first and entered the second year, i.e., 1992, its size underwent reduction in accordance with the Infant Mortality Rate (IMR). Also, in 1992 a new group of infants at-risk had emerged in identical fashion. The one-year old at-risk children in turn was depleted in strength during their passage into 2-year old in 1993 as per existing death rate in the 1-4 years age group. This process of creation and transformation will continue till 1995, when there will be five at-risk sub-pools of infants, one-year old, two-year old, three-year old and four-year old and their total will constitute the pool of at-risk underfive.

The aim of statistics is to arrive at the order of magnitude of large scale phenomena rather than their exact dimensions. Therefore, certain convenient assumptions, without any loss of generality, have been adopted to facilitate a simple and comprehensive approach to the exercise. The major assumptions include constant annual value of population 'P', birth rate 'p', IMR 'r', death rate in 1-4 years groups 'd', vaccine coverage 'c' and its efficacy 'e' which in actual approximate their annual averages for 1991 to 1995. Population 'F' has been estimated by extrapolating the exponential growth between 1981 and 1991(1). For birth rate 'p', IMR 'r' and OPV efficacy 'e', latest available data(2,3) were used. Death rate in 1-4 years 'd' was estimated(4). The vaccine coverage 'c' was prefixed and its potency has been assumed to be 100 per cent through out the period.

Results

The year-wise accrual to the pool of

underfive at-risk during 1995 is symbolically presented in *Table I*, which shows that, at-risk underfive 'R' at the end of 1995 can be represented by the formula:

$$\begin{aligned} R &= Pp(1-e.c) \\ &[1 + (1-r) + (1-r)(1-d) + (1-r)(1-d)^2 + \\ &(1-r)(1-d)^3] \\ &= Pp(1-e.c) [1 + (1-r) \{1 - (1-d)^4\} / d], \end{aligned}$$

Using information mentioned earlier, where:

$$P = 10187000, p = 0.025, r = 0.048,$$

$$d = 0.003, e = 0.93 \text{ and } c = 0.75 \text{ (prefixed),}$$

R (1995) in Delhi =

$$\begin{aligned} &10187000 \times 0.025 (1 - 0.93 \times 0.75) [1 + (1 - \\ &0.048) \{1 - (1 - 0.003)^4\} / 0.003] \\ &= 254675 (f - 0.93 \times 0.75) (4.791) \\ &= 254675 (0.302) (4.791) \\ &= 368485. \end{aligned}$$

Discussion

Leaving aside the absolute number of 3.7 lakh underfive children, who will remain at risk of developing poliomyelitis during 1995 in Delhi, the other important factors to determine the occurrence of disease will be the place distribution of these at-risk children and proportion of unvaccinated children being protected by vaccine virus excreted from the successfully vaccinated children. Though, it is impossible to quantify the second factor, the first can be taken care of by uniformly high OPV coverage.

Increase in OPV coverage is the best way to cut down the transmission of wild virus in India. However, there seems to be two distinct opinions about the approach to

TABLE I—Age Wise Accrual to the Pool of Underfive At Risk of Developing Polio in Delhi During 1995

Year	Population	Expected infants	Expected unimmunized infants	Expected immunized but at risk	Total at risk infants	Total at risk 1 year children (-r)	Total at risk 2 year children (-d)	Total at risk 3 year children (-d)	Total at risk 4 year children (-d)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1991	P	Pp	Pp(1-c)	Pp.c.(1-e)	[Pp(1-e.c)]				
1992	do	do	do	do	do	(6)(1-r)			
1993	do	do	do	do	do	do	(6)(1-r) (1-d)		
1994	do	do	do	do	do	do	do	(6)(1-r) (1-d) ²	
1995	do	do	do	do	do	do	do	do	(6)(1-r) (1-d) ³

do so. An ICMR study(5) has shown that, even 85 to 90% of OPV coverage with 3 to 4 primary doses can not prevent the disease occurrence in certain parts of India. They thought that, increasing the number of primary doses to seven can achieve the desired objective. On the other hand, Ward of WHO in a recent interview(6) has expressed that, while routine immunization has decreased the disease, enough children are not immunized so that it never goes away. He has therefore, advocated mass campaign to shrink the pool of susceptible children and house to house mopping-up operation in high risk and under-served areas. Whatever may be the approach, the health authorities have to increasingly address to the need of protecting children from the disease through immunization. In such situation, they may require to know about the size of susceptible children population also.

In the absence of correct data-base, this technique can make an approximate projec-

tion. However, it helps to look at the prospect of polio eradication from another angle and can give a fair idea of the task ahead. The technique can be used for other metropolitan* cities, as well as their municipal wards independently, where large population are living in small and well defined areas. There is also a need to develop methods for conducting community based at-risk survey. This will be particularly useful at the terminal phase of polio eradication.

Pragmatically looking and considering the huge size of the pool of at-risk underfives, it may be very difficult to stop the transmission of wild polio virus in Delhi through routine immunization during immediate future. Similar may be the case in other areas of India having a high "polio transmission potential". This potential is a product of "vulnerability" and "susceptibility". Vulnerability can be reduced only by the improvement in environmental sanitation, which is a long-drawn process in India.

However, susceptibility of a particular place can be reduced substantially and quickly by 'Mopping-up' polio immunization on campaign basis. Under the campaign, 2 doses of OPV are to be given at 4-6 weeks interval to all underfives irrespective of their previous vaccination status. The authors feel that such campaign be undertaken in the underserved areas identified with the help of the technique suggested in the paper.

The actual operation should be performed during pre-transmission season (March and April) of the disease and continued for three consecutive years. This will set a true eradication phase in the country by replacing the wild virus with vaccine virus and reducing the pool of at-risk underfives.

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