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Editorial

'Polar Spectrum' of problems in polio eradication

Those who were optimistic about achieving wild-virus polio eradication by 2004, or latest by 2005, including myself, are struck by certain signals of potential problems in a few foci of persisting virus transmission. Such foci, although very limited in number, have exhibited the tenacious persistence of transmission of wild poliovirus type 1, in spite of intensive and continuous efforts to dislodge it. To most experts this problem might appear to be one of sub-optimal immunization with oral polio vaccine (OPV), both regular and supplementary, but to others it presents an unexpected challenge of poliovirus persistence that might demand careful assessment and additional (better) tactics than applied earlier.

Obviously there is a geographic spectrum of ease and difficulty in interrupting poliovirus transmission in different countries. The purpose of this editorial is to highlight the existence of an extremely difficult problem in a limited number of spots in the world. The intention here is to define the problem so that solutions can be designed to ensure global eradication before the end of 2005. Eradication must be achieved with zero error, and with a built-in margin of safety that overcomes any adverse eventuality. If the persistent foci of transmission are tenacious, they must be identified and eliminated with better strategies. Reduction of transmission by 99.999 per cent is not eradication; it has to be reduction by 100 per cent, no less.

There are 192 member nations of the World Health Organization. By 1988, when World Health Assembly passed resolution to eradicate polio, 67 countries had already achieved the interruption of wild polioviruses in their territories. In many countries the regular childhood immunization using either injectable polio vaccine (IPV) or OPV alone was sufficient to interrupt transmission and to prevent local spread of any imported virus. The very first country to achieve this success was Finland; in 1961, when 51 per cent of the population had received 3 doses of the Salk vaccine, wild virus transmission ceased. The US achieved it in 1972 by the sequential use of IPV in children followed by OPV in mass campaigns in children and adults followed by the exclusive use (3 doses) of OPV in the regular programme of childhood immunization. Japan needed only two doses of OPV per infant to eliminate wild virus transmission. Cuba used a novel tactic of annual two-dose campaigns and interrupted wild virus transmission. These countries represent one end of the polar spectrum, the easier means of interruption of wild virus transmission.

But the eco-epidemiology of polioviruses and the efficacy of the vaccines are not uniform throughout the world and hence we need to have different approaches. Interruption was less easy in some European countries like France and Germany that eventually succeeded by persistent and sustained immunization pressure against the wild viruses. Yet, they managed it by regular immunization alone, using the standard number of doses, without supplementary activities so vital in many developing countries.

Interruption was somewhat more difficult in other countries, such as Taiwan and Oman, where a five-dose OPV regimen succeeded in interruption of wild virus transmission, as the three-dose regimen was found grossly insufficient.

In a number of nations in Latin America, Africa and Asia, large-scale supplementary immunization over many years was found necessary for interrupting wild virus transmission. They included large nations like Brazil and China, smaller nations like Indonesia and Bangladesh, and island nations like Philippines and Sri Lanka.

The difficult end of the spectrum consists of the six countries that have failed to achieve interruption by 2003 and have continued infection even into 2004. They are India, Pakistan, Afghanistan, Egypt, Nigeria and Niger. The problem in Nigeria was the interruption

of immunization for 'local religious politics' and its resumption could interrupt the wild virus spread. When Nigeria succeeds Niger is likely to become polio-free. When the western region of Pakistan succeeds Afghanistan will (most probably) have no further infection. Perhaps three foci may present a formidable barrier to interrupt transmission in 2004 or even by 2005. This is not prediction, but anxiety based on past and current performance and epidemiology. They are a few districts (especially Badaun and Moradabad) in western Uttar Pradesh (UP) in India, the Sind Province in Pakistan and the Nile valley in Egypt.

These foci have remained infected without a break in spite of good quality regular and supplementary immunization (Egypt), or excellent supplementary immunization even if the regular immunization is poor (western UP and Sind). In these foci, types 2 and 3 viruses have been eliminated, attesting to the success of the tactics applied in the past. Yet, in Egypt, type 1 virus has persisted in small numbers until now. Western UP continues to export virus to many previously uninfected districts and states, in spite of the fact that the median number of OPV doses in under-five children is six, mostly through supplementary immunization. Over 95 per cent under-five children have received more than four doses of OPV. Thus, these foci represent the worst end of the spectrum of our difficulty to eliminate wild virus transmission.

If recent experience is any indication, it is unlikely that virus transmission will simply cease in these foci between now and the end of 2005 if we continue the same interventions as had been applied in the past, including in 2004. What might be the factors determining the tenacious persistence of virus transmission? That the three foci are in the ancient civilizations along major rivers, Ganges in India, Indus in Pakistan and Nile in Egypt and the fact that predominantly Muslim communities are involved, suggest some common factors. They may include high density of population, relatively high birth rates and consequent high density of infants and toddlers – the most efficient amplifiers and transmitters of wild poliovirus. Low income levels of families, low literacy, low living standards with poor sanitation and hygiene and sub-optimal health system serving the poor could be others. In short, the 'force of transmission' of wild virus may be extremely high in these foci and interventions that worked in other poor communities may not overcome such exceedingly high force of transmission.

The OPV has geographic variations in efficacy - high in Japan and other rich nations, low in Taiwan and Oman, lower still in many developing countries. In the foci of persistent transmission, the efficacy may be the lowest. In UP there have been several children with polio in spite of consuming many doses, even 8 or more. Low vaccine efficacy spells low effectiveness and low herd effect – factors that make the vaccine a poor match to the task of interrupting the transmission of the most transmissible among wild virus types, namely type 1. In summary, the worst end of the spectrum may be characterized by extremely high force of wild virus transmission and very low efficacy of OPV.

Admittedly, interventions need to be tailored appropriately. Very high proportions of infants of 4 to 8-9 months of age need to be made completely immune to polio by vaccination to overcome the very high force of transmission of type 1 wild virus. Below 4 months infants have maternal antibody. What is the best way to immunize infants of this age? The Expanded Programme on Immunisation (EPI) in India still maintains the old 3-dose regimen, at 6, 10 and 14 wk. A dose at birth is allowed but called 'zero dose' and not counted for immunization coverage evaluation. Therefore zero importance is given to 'zero dose'. What we need is 7-10 doses in these young infants. Therefore, a birth dose, three more doses by 14 wk and a fifth dose along with measles vaccine at 9 months should be the minimum in the regular age-based immunization. We still need three more doses by campaign every six months in order to catch all birth cohorts for covering with 8 doses by 8-9 months of age. Without such high speed and efficacy of immunization, it is unlikely that we will succeed in the three foci. The same or even higher number of

doses at later ages, such as twenty doses by age 5 yr may not achieve very high immunity prevalence among very young infants.

Where this approach is not feasible, yet another intervention might be to add two doses of IPV at 10 and 14 wk, or better with a third dose also at nine months. If this is not feasible, at least one dose any time between 4 and 9 months may be possible. Even a single dose of IPV has been shown to markedly improve immunity in Cote d'Ivoire and in Oman. Polio experts need to grasp the worst-case scenario at the extreme right end of the spectrum of our difficulty in eliminating virus circulation and help these countries to redesign our tactics for the elimination of the scourge.

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