

## IPV for OPV Primed Children

Number of confirmed polio cases was 741 in year 2009, which declined to 42 and 1 in years 2010 and 2011 respectively. It is indeed a great achievement and needs meticulous planning of strategy for the final eradication of polio. Current recommendation by IAP is to administer two doses of IPV to OPV primed children. I seek following clarifications from the experts so that we may be able to implement the recommendation properly.

How many doses of OPV 'prime up' a child? Does administration of that specific number of doses of OPV primes up every child? These specific information are necessary so that we can know those children who would need two doses of IPV and also the children who would need three or more doses of IPV in spite of taking some doses of OPV.

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### REPLY

The current IAP recommendations state, "IPV may be offered as catch up vaccination for children less than 5 years of age who have completed primary immunization with OPV. IPV can be given two doses at 2 month interval" [1]. The primary immunization with OPV implies here three doses of OPV at 6, 10, and 14 weeks.

Coming to his specific query on 'priming' by OPV, one should know that live vaccines do not work on the "prime-boost" principle. It is the property of killed vaccines, especially the 'T-cell dependent' protein, conjugate vaccines that induce memory B-cell formations in lymphoid tissues. These memory B cells convert to high-affinity antibodies secreting plasma cells on re-exposure to specific antigen (or to the next dose of the same vaccine). Hence, immunologically, priming means formation of memory B cells or in other term, the 'boostability' of an immune response induced by an antigen/vaccine.

When OPV is given by mouth, the vaccine viruses reach the intestines where they must establish infection (vaccine virus "take") before an immune response may occur. Infection may or may not occur each time a dose is given by mouth, therefore multiple attempts are necessary to ensure the 'take' of each type at least once. In this respect OPV differs from other live virus vaccines

which require only one dose for immunizing susceptible subjects [2].

When OPV is given to a child, three possible actions can be anticipated- one, the child may fully seroconvert to all three types of viruses with elicitation of all types of immune responses; second, the dose fails to elicit any serological response and the child may still remain immunologically 'naive', and third, the dose elicits only partial immune responses which may or may not include formation of memory B cells. Hence, a single dose of OPV may seroconvert, prime or fail to have any impact on an individual vaccinee. Administration of an OPV dose at birth (zero dose) serves as a 'priming dose' since it is not protective to the vaccine (*i.e.* it fails to induce protective levels of neutralizing antibodies owing to interfering maternal antibodies and secretory IgA in breast milk) but still manage to produce enough memory B cells that can be boosted to have improved serologic responses to future doses. To document whether a dose has indeed primed an individual or not, one needs to show the presence of memory B cells by eliciting an anamnestic immune response to next vaccine dose.

Immune responses to OPV are quite unpredictable and erratic, especially in tropical countries like India. For reasons that are not yet clear, the vaccine virus take rate is lower in developing countries than in North America or Europe. In industrialized countries, after complete primary vaccination with three doses of OPV, 95% or more of recipients seroconvert and develop long-lasting immunity to all three poliovirus serotypes [3]. In a trial in the United States, 39% of vaccinees seroconverted to poliovirus type 1, 84% to poliovirus type 2 and 71% to poliovirus type 3 after a single dose of OPV. After receipt of two doses of OPV, seroprevalence was 92% to poliovirus type 1, 100% to poliovirus type 2 and 96% to poliovirus type 3; and after three doses of OPV, 97% had antibodies to poliovirus type 1, 100% to poliovirus type 2 and 100% to poliovirus type 3 [3].

However, OPV appears to be considerably less immunogenic in developing countries. A comprehensive review of the immunogenicity of OPV in developing countries reported that a weighted average of only 73%, 90%, and 70% of children participating in these studies have detectable antibody to poliovirus types 1, 2 and 3, respectively, after three OPV doses [3]. Data from India suggest that seroconversion rates after three doses of OPV average 65%, 96% and 63% for Types I, II and III, respectively. Sero-conversion Index (arithmetic mean of seroresponses to all three types of polioviruses) to OPV in children in Vellore was noted as 37 after 1 dose; 54 after 2 doses; 78 after 3 doses, and 87 after 5 doses [2, 4].

Hence, it is very difficult to tell how many doses will 'prime' a vaccinee. This is difficult to predict in developing countries but in industrialized countries it can be predicted with much more certainty. If we go by the above studies, it can be assumed that in industrialized countries, three doses of OPV not only prime but also seroconvert 95% of individuals, however, in India the same proportion would be only 78%. And if the most recent estimates from UP are taken in to account, this would come to a mere 39%!

There are reports to suggest that even one dose of IPV following multiple doses of OPV in a tropical setting helps to narrow the humoral immunity gaps to all three polio virus serotypes [5]. Similarly, mucosal immunity is also boosted following one or two doses of IPV after history of multiple doses of OPV. This is the reason why IAPCOI has recommended only two doses of IPV to OPV primed children.

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