Inactivated Polio Vaccine (IPV) Introduction

In May 2012 the World Health Assembly declared the completion of poliovirus eradication to be a programmatic emergency for global public health and called for a comprehensive polio endgame strategy. In response, the *Polio Eradication and Endgame Strategic Plan 2013-2018* was developed.

The plan outlines a comprehensive approach for completing eradication including the elimination of all polio disease (both wild and vaccine-related).

As one of its four major objectives, the plan calls on countries to **introduce at least 1 dose of Inactivated Polio Vaccine (IPV)** into routine immunization schedules**, strengthen routine immunization** and **withdraw Oral Polio Vaccine (OPV)** in a phased manner, starting with type 2-containing OPV. This sheet provides information on the rationale behind this objective.

Frequently Asked Questions

- **Why should countries introduce IPV?**
- **Why will countries need to switch from tOPV to bOPV?**
- **When do countries need to introduce IPV and switch to bOPV?**
- **Why should countries introduce IPV prior to the tOPV-bOPV switch?**
- **What schedule should countries be using for IPV, and how many doses are recommended?**
- **What is the difference between IPV and OPV?**
- **What is the risk for countries if they do not introduce IPV?**
- **Why can't OPV withdrawal occur immediately and all countries switch entirely to IPV use instead of 1 dose in routine immunization?**
- **What type of protection do polio vaccines offer?**

◆ Why should countries introduce IPV?

Introducing IPV is a key element of the endgame plan and global readiness to manage risks associated with OPV type 2 withdrawal. The endgame plan calls for the introduction of IPV in all OPV-only using countries by the end of 2015. The primary role of IPV will be to maintain immunity against type 2 poliovirus while removing OPV type 2 globally. More specifically, IPV needs to be introduced for the following reasons:

- ***To reduce risks.*** Once OPV type 2 is withdrawn globally, if no IPV is used, there will be an unprecedented accumulation of children susceptible to type 2 poliovirus. IPV use will help maintain immunity to type 2. This will help prevent emergence of type 2 viruses should they be introduced after the type 2 component is removed from OPV. Thus, a region immunized with IPV would have a lower risk of re-emergence or reintroduction of wild or vaccine-derived type 2 poliovirus.

- ***To interrupt transmission in the case of outbreaks***. Should monovalent OPV type 2 (mOPV type 2) be needed to control an outbreak, the immunity levels needed to stop transmission will be easier to reach with use of mOPV type 2 in an IPV-vaccinated population compared to use of mOPV type 2 in a completely unvaccinated population. Thus, introducing IPV now could facilitate future outbreak control.

A WHO Position Paper on polio vaccines published in February 2014 is available online at: http://www.who.int/wer/2014/wer8909.pdf ⇧

◆ Why will countries need to switch from tOPV to bOPV?

There are three types of wild poliovirus (WPV) - type 1, 2 and 3 - each of which is targeted by a different component of the trivalent oral polio vaccine (tOPV).

Live attenuated vaccines are very effective against the wild virus, but in very rare cases can lead to paralysis. There are two ways this can occur:

- Vaccine Associated Paralytic Poliomyelitis (VAPP): At a global level for every birth cohort of 1 million children in OPV-only using countries, there are 2-4 cases of VAPP. This translates to an estimated 250 – 500 VAPP cases globally per year. Of these, about 40% are caused by OPV's type 2 component. In the Region of the Americas, the VAPP risk is 1 case per 7.68 million doses administered.

- Circulating Vaccine Derived Poliovirus (cVDPV) outbreaks: these rare outbreaks occur when a vaccine-related virus is passed from person-to-person, mutating over time and acquiring wild virus transmissibility and neurovirulence characteristics. Almost all cVDPV outbreaks in recent years have been caused by a type 2 vaccine-derived virus.

Although wild poliovirus type 2 appears to have been eradicated globally in 1999, vaccine-related type 2 viruses continue to cause the majority of cVDPV outbreaks and many VAPP cases. Therefore, OPV type 2 now carries more risk than benefit and undermines global polio eradication efforts. Thus, tOPV will be replaced with bivalent OPV (bOPV), which will continue to target the remaining polio types 1 and 3. Once these types are eradicated, bOPV will also be withdrawn. ⇧

◆ When do countries need to introduce IPV and switch to bOPV?

OPV type 2 withdrawal would be achieved by switching from trivalent OPV (tOPV) to bivalent OPV (bOPV) (containing only types 1 and 3 poliovirus) in routine immunization programs. The World Health Organization's (WHO) Strategic Advisory Group of Experts on immunization (SAGE) has called for a global withdrawal of type 2-containing OPV during 2016. This sets the stage for ending bOPV use entirely in 2019-2020. As a risk mitigation measure, SAGE recommends that prior to the 'tOPV-bOPV switch' all countries that currently use only OPV in their routine immunization programs introduce at least 1 dose of IPV into their routine schedules (i.e., by the end of 2015). ⇧

◆ Why should countries introduce IPV prior to the tOPV-bOPV switch?

The withdrawal of OPV type 2 would leave a gap in population immunity against type 2 poliovirus. Thus, immediately following global withdrawal of OPV type 2, countries that have not introduced IPV would be at an increased risk of outbreaks in the case of reintroduction of a type 2 virus. A reintroduction or emergence of circulating vaccine-derived poliovirus type 2 (cVDPV2) could potentially result in a substantial polio outbreak or even re-establishment of global transmission. Such an outbreak could be rapidly interrupted through mOPV type 2. Vaccinating the population with IPV through routine immunization would lessen the risk that reintroduction would lead to sustained transmission. If reintroduction of type 2 polioviruses does occur post-eradication, having a population that has received IPV would also facilitate rapid control through targeted use of mOPV type 2. ⇧

◆ What schedule should countries be using for IPV, and how many doses are recommended?

In April of 2014, the Pan American Health Organization's (PAHO) Technical Advisory Group on Vaccine-preventable Diseases (TAG) issued the following recommendations for the Region of the Americas:

- When introducing IPV, countries should consider sequential schedules. Ideally, countries should consider two IPV doses followed by two OPV doses. However, if a country is considering only one IPV dose, this should be with the first DTP dose and followed by three OPV doses.

- Countries should not consider moving directly to an IPV only schedule at this time, unless they meet the criteria previously recommended by TAG and WHO (low risk of transmission and importation, high homogeneous coverage, and good sanitation).

Vaccination Schedule recommended for the introduction of inactivated poliovirus vaccine (IPV) in combination with the oral poliovirus vaccine (OPV).

Schedule	Basic			Booster	
	1st	2nd	3rd	1st	2nd
First option	IPV	IPV	OPV	OPV	OPV
Alternate option	IPV	OPV	OPV	OPV	OPV

This schedule, in addition to preparing the countries for the switch from tOPV to bOPV, has the additional advantage of lowering the incidence of VAPP cases, considering that in our Region, around 50% of VAPP cases are associated with the first dose of OPV. ⇧

◆ What is the difference between IPV and OPV?

IPV and OPV evoke different immune responses and therefore have distinct advantages and disadvantages. To complete eradication and get the benefits of both, they should be used together.

Figure 1: A comparison of advantages and disadvantages for OPV and IPV

	Advantages	Disadvantages
Oral Polio Vaccine (OPV)	• Humoral (antibodies in the blood) immunity. • Gut/intestinal immunity. • Easy to administer via drops. • Inexpensive.	• Vaccine-associated paralytic poliomyelitis (VAPP) globally occurs in rare cases (2-4 cases per 1 million children). • Rarely, through circulation in poorly immunized populations, the vaccine viruses mutate to circulating vaccine-derived polioviruses (cVDPVs) and can cause outbreaks of paralytic polio.
Inactivated Polio Vaccine (IPV)	• Very good humoral immunity. • Equivalent to OPV in inducing immunity in the oral cavity thus is as effective as OPV in stopping oral – oral transmission of virus.	• Insufficient to prevent wild polio virus (WPV) replication in guts of infected person and consequently poliovirus can still be transmitted by excretion in stool. • Requires injection. • More expensive than OPV.

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◆ What is the risk for countries if they do not introduce IPV?

Two main risks are associated with OPV type 2 withdrawal:

- immediate time-limited risk of cVDPV2 emergence; and
- medium and long-term risks of poliovirus re-introduction from a vaccine manufacturing site, research facility or diagnostic laboratory.

All countries face a time-limited (1-2 years) risk of cVDPV2 outbreak during OPV type 2 withdrawal if they do not introduce a dose of IPV. ⇧

◆ Why can't OPV withdrawal occur immediately and all countries switch entirely to IPV use instead of 1 dose in routine immunization?

Until polio transmission is interrupted globally, OPV will be a critical component of the eradication strategy. OPV is the appropriate polio vaccine for achieving the eradication of wild polioviruses worldwide because it is inexpensive, easy to administer and offers good oral and intestinal immunity, which is needed to interrupt person-to-person spread of the virus, particularly in settings of high population density and poor sanitation. ⇧

◆ What type of protection do polio vaccines offer?

When a child receives OPV, the vaccine virus enters the child's mouth and gut and replicates. The child then mounts immune responses in three places: (1) **antibody response in the blood** that protects against the virus invading the nervous system and causing paralysis, (2) **immune response in the mouth** which prevents shedding of virus in oral secretions and spread from those secretions and (3) **intestinal immunity** (also called gut or mucosal immunity), which prevents shedding of the virus in the stool. Thus, children vaccinated with OPV who come into contact with wild poliovirus are less likely to excrete poliovirus in their oral fluids or stool than unvaccinated persons. The predominant mode of transmission in the developing world is thought to be fecal-oral. Virus is shed in the feces and, in poor sanitary conditions and with suboptimal hygiene measures, can infect other persons if transmitted by dirty hands or contaminated food and water. Therefore, strong intestinal immunity prevents transmission.

IPV is an inactivated vaccine (killed virus) that stimulates a very good humoral response (antibodies in the blood) in children after only 1 or 2 doses. IPV also prevents children from excreting virus in their mouths as effectively as OPV and hence to the extent that polioviruses are transmitted through oral secretions, IPV is very effective at blocking that type of transmission. However, IPV alone does not induce the same level of intestinal immunity as OPV. Thus, while individuals vaccinated with IPV alone are protected against paralysis, they may excrete the virus and allow it to spread.

The combination of IPV with bOPV provides the advantages of both vaccines: strong intestinal immunity and antibody protection against the two serotypes in bOPV, types 1 and 3. This combination gives both the child and the child's community the best protection. ⇧