

# The role of routine polio immunization in the post-certification era

Roland W. Sutter,<sup>1</sup> Victor M. Cáceres,<sup>2</sup> & Pedro Mas Lago<sup>3</sup>

**Abstract** The role of routine vaccination against poliomyelitis for the post-certification era remains an important area for policy decision-making. Two critical decisions need to be taken: first, to continue or discontinue vaccination with the live attenuated oral poliovirus vaccine (OPV); and second, if OPV is to be discontinued, whether vaccination with inactivated poliovirus vaccine (IPV) is needed. Four potential vaccination scenarios can be constructed: stop all polio vaccination; continue with current vaccination policies (OPV, IPV, or sequential schedule); discontinue OPV, but continue IPV universally; or discontinue OPV, but continue IPV in selected countries. All possible scenarios require continued investments in a surveillance and response strategy, including a stockpile of polio vaccine. Continuing vaccination would limit the savings that could be applied to the control of other health priorities. This report reviews the key issues associated with each scenario, highlights the advantages and disadvantages of each scenario, and outlines the major challenges for policy decision-making.

**Keywords** Poliovirus vaccine, Oral/administration and dosage; Poliovirus vaccine, Inactivated/administration and dosage; Poliovirus/pathogenicity; Certification; Immunization programs/organization and administration; Forecasting; Policy making (*source: MeSH, NLM*).

**Mots clés** Vaccin antipoliomyélique Sabin/administration et posologie; Vaccin antipoliomyélique inactivé/administration et posologie; Poliovirus humain/pathogénicité; Certification; Programmes de vaccination/organisation et administration; Prévision; Choix d'une politique (*source: MeSH, INSERM*).

**Palabras clave** Vacuna antipolio oral/administración y dosificación; Vacuna antipolio de virus inactivados/administración y dosificación; Poliovirus/patogenicidad; Certificación; Programas de inmunización/organización y administración; Predicción; Formulación de políticas (*fuente: DeCS, BIREME*).

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## Introduction

In 1988, the World Health Assembly resolved to eradicate poliomyelitis globally. Since then, the polio eradication initiative has reported dramatic progress in decreasing the incidence of poliomyelitis and in limiting the geographical extent of transmission. The number of polio-endemic countries decreased from over 125 in 1988 to 7 in 2002 (1). Three WHO regions, comprising 134 countries and territories and over three billion people, have been certified polio-free by international commissions (2–4). This progress towards eradication is the result of implementing the eradication strategies worldwide (5, 6).

The implicit promise of any eradication programme is to end the intervention once the causative agent for the disease has been eradicated (7, 8), and apply the financial savings to other priority interventions. The case for stopping vaccination against polio is complex because the OPV contains an attenuated form of live polioviruses that can acquire the characteristics of wild poliovirus, cause cases of vaccine-associated paralytic poliomyelitis (VAPP), or cause outbreaks of circulating vaccine-derived poliovirus (cVDPV). In addition, rare long-term carriers of VDPVs may pose a threat towards re-seeding the population

with poliovirus. To rapidly control the potential emergence or spread of these viruses in the post-eradication era requires the establishment and maintenance of a vaccine stockpile and a response capacity.

The objectives of the post-certification policy are to maintain polio eradication, discontinue polio vaccination, if it is safe to do so, and apply the financial saving to other priority health interventions (9, 10). This paper examines the key issues for decision-making, outlines the plausible vaccination scenarios, and highlights the advantages and disadvantages of each scenario.

## Background

The definitions of eradication will continue to evolve. However, the most recent one reads as follows: “The absence of a disease agent in nature in a defined geographical area as the result of deliberate efforts. Control measures can be discontinued when the risk of disease importation is no longer present.” (7, 8).

Poliovirus isolates originating from OPV are, by definition, vaccine-derived polioviruses (VDPVs). Isolates that have >1% sequence diversity from the parental Sabin strains indicate prolonged replication with or without circulation. These isolates can

<sup>1</sup> Medical Officer, Department of Immunization, Vaccines and Biologicals, World Health Organization, Geneva, Switzerland (email: sutterr@who.int). Correspondence should be sent to this author.

<sup>2</sup> Global Immunization Division, Centers for Disease Control and Prevention, Atlanta, GA, USA.

<sup>3</sup> Pedro Kouri Institute, Ministry of Health, Havana, Cuba.

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be subdivided into: first, immunodeficient excretors of VDPVs isolated from patients with congenital immunodeficiency syndrome who become chronically infected after exposure to OPV (such cases are rare); second, cVDPVs that arise and circulate in communities with low population immunity; and third, other VDPVs detected from healthy children or from environmental samples.

A study in the United Kingdom in 1962 described two individuals with B-cell deficiency disorder who excreted VDPVs for 32 and 21 months, respectively (11). WHO has since established a registry of such patients, which currently contains a total of 19 patients with evidence of poliovirus replication of at least 6 months (and in some instances up to 10 years or more) (12–14) (WHO, unpublished data, 2003).

It has been shown only recently that these Sabin-derived viruses can acquire the transmission characteristics of wild polioviruses, and cause both endemic and epidemic disease. During 2000–02, three outbreaks of cVDPVs were reported — from Hispaniola (15), Madagascar (16), and the Philippines (17). Retrospective investigation of viruses from Egypt showed that during 1988–93, type 2 cVDPVs had re-established endemic circulation in that country (18). The risk factors for the emergence of these viruses are poorly understood. However, low type-specific immunity appears to facilitate the transmission of cVDPVs.

Two interrelated events (the World Trade Center terrorist and the anthrax bioterrorist attacks) have changed the perceived risk associated with creating or leaving a large non-immune population susceptible to potential agents for bioterrorism. At the moment, poliovirus might not be considered to represent a major bioterrorism threat because population immunity against polio is currently very high (19, 20). This would change, however, if immunization is discontinued and susceptible cohorts accumulate.

In 1988, only a few countries used inactivated poliovirus vaccine (IPV) either exclusively (Finland, France, Iceland, the Netherlands, and Sweden) or in a sequential schedule with OPV (Denmark). As at 2003, 22 countries and territories have adopted IPV (primarily as part of combination vaccines), and a further nine countries and territories use a sequential IPV/OPV schedule to ensure that immunity against polio can be maintained, while minimizing the burden of VAPP (Fig. 1 (web version only, available at: <http://www.who.int/bulletin>) (6)).

The preparations for the post-certification era began in 1998, when a group of experts discussed the scientific basis for stopping vaccination (21). Since then, several meetings and reports have addressed different issues related to the post-certification era (22, 23). The following criteria for stopping polio vaccination were defined by global advisory committees: first, termination of wild poliovirus transmission globally; second, containment of laboratory stocks of polioviruses; third, demonstration that VDPVs will not circulate for a prolonged period after cessation of OPV vaccination; and fourth, establishment of a global stockpile of, and a production capacity for, OPV, should it be required in the post-vaccination era.

In April 2002, a workshop was held in Annecy, France, bringing together senior stakeholders, especially from developing countries, to discuss the development of the post-certification polio immunization policy. They concluded: "... that the accomplishments of the polio eradication initiative must be protected as part of post-certification policy. The primary stakeholders are the current and future generations of children. They must be shielded

from the potential harms due to policy decisions, whether from the disease, the intervention, or the opportunity cost." "... any decision to stop polio immunization would require one global policy, endorsed by the World Health Assembly" (24).

### Vaccination policy for the post-certification era

The formulation of a routine vaccination policy for the post-certification era requires that two critical decisions are made: to continue or discontinue vaccination with live attenuated oral poliovirus vaccine (OPV); and, if OPV is discontinued, whether vaccination with inactivated poliovirus vaccine (IPV) is needed. From these decisions, four possible scenarios can be constructed for potential routine vaccination policies (Fig. 2): first, stop all polio vaccination; second, continue with current vaccination policies (OPV, IPV, or sequential schedule); third, discontinue OPV, but continue IPV universally; and fourth, discontinue OPV, with some countries electing to continue the use IPV.

For each of the scenarios, we will examine whether they are consistent with eradication (see Background) of all polioviruses and then highlight the main advantages and disadvantages.

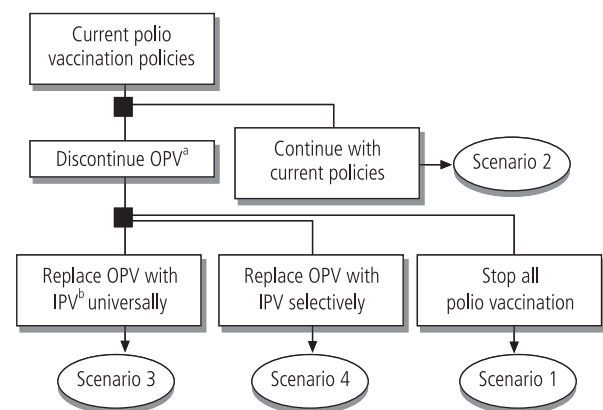
#### Scenario 1: discontinue all polio vaccination

This scenario is consistent with eradication, but it is also associated with major uncertainties, including whether vaccine-virus will continue to circulate, during a 3–5 year transition period from vaccination to no vaccination.

The two major advantages of scenario I are: it is consistent with the traditional interpretation of eradication (with discontinuation of the intervention once the causative agent has been eliminated) (7, 8), and the maximum cost-savings — that is, the maximum savings possible and higher than the other scenarios — that could be applied to other health priorities would be realized, thus the implicit promises of eradication would be delivered.

The major disadvantages of scenario I are: first, it would probably result in dual policies — that is, some industrialized countries would continue with IPV (regardless of global policy) because of the perceived threat of bioterrorism, while the rest of the world would discontinue polio immunization; second, with time it would create an increasing population of persons susceptible to polioviruses that may support major outbreaks of poliomyelitis,

Fig. 2. Decision tree for developing a post-certification vaccination policy



■ Decision node

<sup>a</sup> Inactivated poliovirus vaccine.

<sup>b</sup> Oral poliovirus vaccine.

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should poliovirus be released intentionally or unintentionally; third, the use of live-attenuated poliovirus vaccines for outbreak control may lead to the re-establishment of endemic or epidemic circulation and the need to re-institute routine vaccination against polio; and fourth, discontinuation would require unprecedented coordination and collaboration among regions and countries.

### **Scenario II: continue with current immunization policies, including OPV**

Because OPV (live-attenuated poliovirus) would be used, it is likely that at any time, anywhere, the conditions may be suitable for VDPVs to acquire the neurovirulence and transmission characteristics of wild poliovirus and cause outbreaks. Thus, any scenario that permits OPV to be used indefinitely after interruption of wild poliovirus transmission appears inconsistent with eradication.

The major advantages of scenario II are: first, there is a defined end-point for the special eradication efforts after certification of global eradication of wild poliovirus; second, population immunity against polioviruses would remain high (albeit declining, particularly in the developing world); third, secondary transmission from OPV vaccinees to close contacts would continue to contribute to population immunity (25); fourth, because OPV manufacturing capacity would need to be maintained, the costs of continuing vaccination with OPV for the developing world, the establishment of a related stockpile of OPV for outbreak response and the response capacity would be relatively modest; and fifth, no globally coordinated approach to policy development and implementation would be needed, except for a surveillance and response strategy.

The main disadvantages of scenario II are: first, it is not consistent with eradication because the continued use of OPV may permit some of these viruses to acquire the phenotypic characteristics of wild polioviruses and thereby establish endemic or epidemic transmission; second, a continuing VAPP burden (two to four cases per million birth cohort (26)) would occur in the absence of naturally occurring disease; third, the frequency of cVDPV outbreaks would almost certainly increase after eradication, with the likely decline of routine vaccination coverage in some countries, and the discontinuation of the mass vaccination campaigns; fourth, immune-compromized patients would still be exposed to OPV, and constitute a potential reservoir for the future reintroduction of virus into the population; and fifth, there could be difficulties in communicating the rationale regarding why the world needs to continue vaccination against a disease that has been eradicated.

### **Scenario III: discontinue OPV, with universal IPV use**

Scenario III would be consistent with the definition of eradication (see Background) because it would remove all potential sources of live polioviruses from the population (although laboratories and manufacturers would retain virus).

The major advantages of scenario III are: first, it is not associated with VAPP, or the threat of cVDPV or immunodeficient excretors of VDPVs emergence (except during a transition period); second, it is consistent with potentially maintaining a high population immunity; third, it requires a relatively modest stockpile of vaccine to be established (since population immunity remains high); fourth, it requires large quantities of IPV to be manufactured, which should lead to decreased vaccine costs; fifth, depending on transition strategy, it could maximize the population immunity (if IPV is introduced 1–2 years before OPV cessation).

The main disadvantages of scenario III are: first, the costs would be much higher than the “no vaccination” or “continue with current immunization” scenarios; second, it requires OPV manufacturing capacity to be maintained (to respond to outbreaks with cVDPVs probably occurring during the switch from OPV to IPV, or a break in containment); third, because the immunogenicity of IPV administered in a 6, 10, 14-week schedule in tropical developing countries is suboptimal, these countries may have to change the routine schedule to benefit optimally from IPV (Fig. 3, web version only, available at: <http://www.who.int/bulletin>, shows routine vaccination schedules by country); and fourth, there could be difficulties in communicating the rationale regarding why the world needs to continue vaccination against a disease that has been eradicated with a potentially more expensive vaccine.

### **Scenario IV: discontinue OPV, with some countries electing to use IPV**

Scenario IV remains consistent with eradication (see scenario III). It is treated here as a separate scenario because it has unique features that do not apply to scenario III.

The major advantages of scenario IV are: first, cost-savings from discontinuation of all polio vaccination in developing countries enable a shift of these funds to other health priorities; second, countries considering themselves at risk for bioterrorism could continue to vaccinate against polio; and third, countries producing IPV would probably continue routine vaccination against polio, and thus limit the consequences of any containment failure from a production site.

The major disadvantages of scenario III are: first, it could lead to a dual vaccination policy (industrialized and perhaps large, vaccine self-producing countries would continue vaccinating with IPV, while most developing countries would discontinue all polio vaccination); second, the use of live-attenuated poliovirus vaccines for outbreak control may lead to the re-establishment of endemic or epidemic circulation (because many countries would have accumulated susceptible cohorts to polio), and hence to the need to reinstitute routine vaccination against polio; and third, the surveillance and response strategy for responding to outbreaks of cVDPV would need to be adjusted for the growing population susceptibility gap over time.

### **Impediments to polio vaccination policy development**

Several important gaps in knowledge impede the formulation of a policy for the use of routine polio vaccines for childhood immunization in tropical developing countries. Some of these gaps are related to scientific uncertainties, whereas others relate more to operational and programmatic issues. As the risks associated with continuing OPV use are detailed in Table 1, this section of the report will focus on other scenarios.

Among the scientific uncertainties, it is currently not known whether IPV-induced mucosal immunity can reduce or eliminate the circulation of VDPVs after OPV discontinuation. Just as for outbreak control under scenario I, live-attenuated polioviruses would face a “border” either in time (pre- and post-OPV cessation) or in geography (between populations that use or do not use OPV). It is currently not known whether routine vaccination with IPV, under any schedule or vaccination coverage, can prevent the breakthrough transmission across these borders or

Table 1. Potential risks associated with continued use of OPV<sup>a</sup> or IPV<sup>b</sup> in the post-certification era

Vaccine	Event	Current situation	Future risk/comment
OPV	VAPP <sup>c</sup>	250–500 cases per year <sup>d</sup>	<ul style="list-style-type: none"> <li>• Dependent on population size using OPV</li> <li>• Total VAPP risk estimated at 2–4 cases per million birth cohort<sup>d</sup></li> </ul>
	cVDPV <sup>e</sup> causing outbreaks	1 outbreak per year (average 10 cases per outbreak)	<ul style="list-style-type: none"> <li>• Risk is dependent on immunity profile and contact rates in population</li> <li>• Risk is highest in areas of low coverage, low hygiene and sanitation, and high population density</li> </ul>
	cVDPV establishing long-term endemic transmission	One event reported (endemic transmission of cVDPV type 2 in Egypt from 1988 to 1993) <sup>f</sup>	<ul style="list-style-type: none"> <li>• Risk is probably dependent on time (continuum Sabin → VDPV → cVDPV)</li> <li>• Unrecognized endemic or epidemic transmission of cVDPV or an inadequate controlled cVDPV could re-seed large areas of the world</li> <li>• Risk of cVDPV may be associated with a transition from OPV to IPV, and especially to the discontinuation of all polio immunization (but is likely to decline over time)</li> </ul>
	Transmission from chronic carriers to contacts resulting in paralytic disease/outbreak	None observed thus far	<ul style="list-style-type: none"> <li>• WHO registry contains 19 cases of immunodeficient excretors of VDPVs (all of these, except Argentina and Iran, are from industrialized countries)<sup>g</sup></li> <li>• Few cases with prolonged excretion of wild poliovirus documented (Finland, Egypt)<sup>h</sup></li> <li>• Risk of transmission is dependent on prevalence of carriers, immunity among contacts, and the environmental conditions (i.e. hygiene)</li> </ul>
	OPV containment failure leading to exposure of contacts/re-seeding of population with Sabin-derived poliovirus	None observed, but difficult to detect and differentiate from secondary spread of OPV before discontinuation of OPV	<ul style="list-style-type: none"> <li>• Unlike IPV manufacturing sites, all of which are currently in developed countries, OPV is produced or finished from bulk in Brazil, China, Egypt, India, Indonesia, Mexico</li> <li>• Current containment plans do not address Sabin viruses</li> </ul>
IPV	IPV containment failure leading to exposure of contacts/re-seeding of population with wild polioviruses used in the production process	Few events reported of virus outside contained areas; no related outbreaks detected	<ul style="list-style-type: none"> <li>• All current IPV manufacturers are upgrading facilities to meet enhanced biosafety requirements</li> <li>• Containment plans call for maintenance of immunity among workers</li> <li>• Risk is minimized by the fact that industrialized countries with IPV production sites are expected to continue vaccination</li> </ul>

<sup>a</sup> OPV = oral poliovirus vaccine.

<sup>b</sup> IPV = inactivated poliovirus vaccine.

<sup>c</sup> VAPP = vaccine-associated paralytic poliomyelitis.

<sup>d</sup> Ref. 26.

<sup>e</sup> cVDPV = circulating vaccine-derived poliovirus.

<sup>f</sup> Ref. 18.

<sup>g</sup> Ref. 14.

<sup>h</sup> D. Wood, unpublished data, 2003.

stop the transmission of VDPVs in tropical developing countries, with vast heterogeneity in coverage and contact rates (6, 14).

There is currently insufficient information to formulate an optimal IPV immunization schedule (age at first dose, number of doses, and interval between doses) for the tropical developing country setting. IPV data have been reviewed (27–29). Table 2 provides a summary of immunogenicity data available for a primary vaccination series in developing countries or countries in transition (30–38). Table 3 provides additional data on IPV combination vaccines from developed countries (39–43). Primary immunization contacts usually occur at a younger age in developing countries than in developed countries, at a time when the higher

levels of maternal antibodies to poliovirus potentially interfere with IPV immunogenicity. Table 4 provides data on IPV doses following previous IPV doses in developed countries or following previous OPV doses in developing countries (44–46).

Vaccination coverage rates with three doses of diphtheria and tetanus toxoids and pertussis (DTP) vaccine are low in many developing countries, especially Africa and Asia. Therefore, exclusive use of IPV in these countries could substantially decrease population immunity against polio. IPV, given in an appropriate schedule, would be expected to induce humoral immunity against polioviruses in those vaccinated, but it would probably not be expected to have a major effect in terms of mucosal immunity.

Table 2. Immunogenicity of IPV<sup>a</sup> in single or combination vaccines in developing countries or countries in transition (from developing to developed)

Reference	Country	Vaccine	Schedule	Cut-off ( $\geq$ ) <sup>b</sup>	No. of doses	Seroconversion or seroprevalence $\geq$ 1 month after last dose (%)		
						Type 1	Type 2	Type 3
Schatzmayr et al. (1986)	Brazil	IPV	2 m, 4 m <sup>c</sup>	1:5	2	99	100	100
			2 m, 4 m, 6 m	1:5	3	100	100	100
Simoes et al. (1985)	India	DTP <sup>d</sup> -IPV	6–7 w <sup>e</sup> , 4 w int <sup>f</sup>	1:8	2	95	75	97
			6–7 w, 8 w int	1:8	2	95	83	96
			8–12 w, 4 w int	1:8	2	94	88	100
			8–12 w, 8 w int	1:8	2	100	95	100
			13–45 w, 4 w int	1:8	2	100	90	90
			13–45 w, 8 w int	1:8	2	100	100	100
Schwartz et al. (1989)	Israel	IPV	0, 6 m	1:8	2	80	98	71
Kok et al. (1992)	Kenya	DTP-IPV	2–3 m, 4–5 m	1:8	2	94	98	87
			2–3 m, 4–5 m, 6–7 m	1:8	3	100	100	98
Nirmal et al. (1998)	India	IPV intradermal	6–8 w, 8 w int	1:4	2	90	70	97
			6–8 w, 4 w int	1:4	2	90	80	98
WHO et al. (1996)	Oman <sup>g</sup>	DTP-IPV	6 w, 10 w	1:8	2	71	83	81
			6 w, 10 w, 14 w	1:8	3	90	96	95
	Thailand <sup>g</sup>	DTP-IPV	6 w, 10 w	1:8	2	40	48	79
			6 w, 10 w, 14 w	1:8	3	67	65	94
	Gambia <sup>h</sup>	DTP-IPV	6 w, 10 w, 14 w	1:8	3	81	82	98
Gylca et al. (2001)	Moldova	DtaP <sup>i</sup> -HBV <sup>j</sup> -IPV/sep <sup>k</sup> Hib <sup>l</sup>	6 w, 10 w, 14 w	1:8	3	99	98	99
Borcic et al. (1998)	Croatia	IPV	3 m, 4.5 m, 6 m	NA <sup>m</sup>	3	97	100	97
Lagos et al. (1998)	Chile	DTaP/sep IPV	2 m, 4 m, 6 m	1:5	3	100	100	100
		DTaP-IPV	2 m, 4 m, 6 m	1:5	3	100	100	100
		DTaP-IPV/sep Hib	2 m, 4 m, 6 m	1:5	3	100	100	100
		DTaP-IPV/reconstituted with Hib	2 m, 4 m, 6 m	1:5	3	100	100	100

<sup>a</sup> IPV = inactivated poliovirus vaccine.  
<sup>b</sup> The cut-off value is the lowest titre used to define the presence or absence of poliovirus antibodies.  
<sup>c</sup> m = months.  
<sup>d</sup> DTP = diphtheria and tetanus toxoids and whole-cell pertussis vaccine.  
<sup>e</sup> w = weeks.  
<sup>f</sup> int = intervals.  
<sup>g</sup> Seroconversion.  
<sup>h</sup> Seroprevalence.  
<sup>i</sup> DTaP = diphtheria and tetanus toxoids and acellular pertussis vaccine.  
<sup>j</sup> HBV = hepatitis B vaccine.  
<sup>k</sup> sep = separate.  
<sup>l</sup> Hib = *Haemophilus influenzae* type b vaccine.  
<sup>m</sup> NA = not available.

## Discussion

This report outlines the scenarios for possible routine immunization policy options for the post-certification era, describes the major advantages and disadvantages of each scenario, and highlights some of the major gaps in knowledge that impede policy development. The task of choosing one option (other than continuing with the current vaccination policies), seeking global political endorsement for it, and aggressively implementing it is a considerable challenge, given the substantial gaps in scientific knowledge and the potential consequences (in terms of paralytic disease) of lowering immunity to polioviruses.

A recent informal WHO meeting concluded that VDPVs represent a threat to polio eradication and urged WHO to develop a strategy to safely discontinue OPV after certification of global eradication (47).

Scenario I (discontinuation of all polio vaccination) is the least costly option, but one that will require the most risk-taking for current and future generations of children. Under this scenario, the population immunity could decrease rapidly, and cVDPVs may emerge during a transition period. The period of risk associated with such a transition is not known. Although this scenario is the least costly option overall, it requires the relatively

Table 3. Immunogenicity of IPV<sup>a</sup> used in combination vaccines in developed countries

Reference	Country	Vaccine	Schedule (months)	Cut-off <sup>b</sup> (≥)	No. of doses	Seroconversion or sero-prevalence ≥ 1 month after last dose (%)		
						Type 1	Type 2	Type 3
Knutsson et al. (2000)	Sweden	DTaP <sup>c</sup> -IPV/(reconstituted with Hib) <sup>d</sup>	3, 5, 12	1:4	3	100	100	100
		DTaP-IPV/Hib sep	3, 5, 12	1:4	3	100	100	100
Gyhre et al. (1999)	Denmark	DTaP-IPV	3, 5, 12	1:4	3	100	100	100
		DT <sup>e</sup> -IPV	5, 6, 15	1:4	3	100	100	100
Modlin et al. (1997)	United States	DTP <sup>f</sup> /IPV dual chamber syringe	2, 4, 15	1:4	3	99	100	100
Mallet et al. (2000)	France	DTaP-IPV-HB-Hib	2, 4, 6	1:5	3	100	100	100
		DTaP-IPV/Hib/HBV <sup>g</sup>	2, 4, 6	1:5	3	100	100	100
Carlsson et al. (1998)	Sweden	DTaP-IPV/Hib	3, 5, 12	1:5	3	100	100	100
		DTaP-IPV/Hib	2, 4, 6, 13	1:5	4	100	100	100
		DTaP-IPV/Hib	2, 4, 6	1:5	3	100	100	100
		DTaP-IPV/Hib	3, 5	1:5	2	99	99	100

<sup>a</sup> IPV = inactivated poliovirus vaccine.

<sup>b</sup> The cut-off value is the lowest titre used to define the presence or absence of poliovirus antibodies.

<sup>c</sup> DTaP = diphtheria and tetanus toxoids and acellular pertussis vaccine.

<sup>d</sup> Hib = *Haemophilus influenzae* type b vaccine.

<sup>e</sup> DT = diphtheria and tetanus toxoids.

<sup>f</sup> DTP = diphtheria and tetanus toxoids and whole-cell pertussis vaccine.

<sup>g</sup> HBV = hepatitis B vaccine.

Table 4. Immunogenicity of IPV<sup>a</sup> administered as a booster dose after IPV or OPV<sup>b</sup>

Reference	Country	Vaccine	Schedule	Cut-off <sup>c</sup> (≥)	No. of doses	Seroconversion or seroprevalence ≥ 1 month after last dose (%)		
						Type 1	Type 2	Type 3
<b>Children with primary IPV immunization &gt;10 years of age enrolled</b>								
Begue et al. (1998)	France	DTaP <sup>d</sup> -IPV	>10 y <sup>e</sup>	1:8	1	100	100	100
		DT <sup>f</sup> -IPV	>10 y	1:8	1	100	100	100
<b>Infants 6 and 9 months of age with primary 3-dose OPV immunization enrolled<sup>g</sup></b>								
Moriniere et al. (1993)	Ivory Coast	IPV	6 m <sup>h</sup>	1:8	1	80	100	76
		IPV	9 m	1:8	1	81	100	67
<b>Infants 9 months of age with primary 5-dose OPV immunization enrolled</b>								
Sutter et al. (2000)	Oman	DTP-IPV	9 m	1:8	1	100	100	97

<sup>a</sup> IPV = inactivated poliovirus vaccine.

<sup>b</sup> OPV = oral poliovirus vaccine.

<sup>c</sup> The cut-off value is the lowest titre used to define the presence or absence of poliovirus antibodies.

<sup>d</sup> DTaP = diphtheria and tetanus toxoids and acellular pertussis vaccine.

<sup>e</sup> y = years.

<sup>f</sup> DT = diphtheria and tetanus toxoids.

<sup>g</sup> In children who were seronegative at enrollment (i.e. <1:8 reciprocal titre to the respective poliovirus serotype).

<sup>h</sup> m = months.

<sup>i</sup> DTP = diphtheria and tetanus toxoids and whole-cell pertussis vaccine.

highest maintenance costs (surveillance and response strategy, stockpile, and OPV manufacturing capacity).

As additional information becomes available, one of the scenarios will emerge as superior. Scenario II (continuing with current vaccination policies) is not attractive, but remains the “fall-back” option, if no other scenario can be developed that is

safer, more effective (in terms of preventing viruses from circulating), and feasible. Scenario III (switching to IPV globally) is costly and not entirely understood because IPV performance in terms of stopping the circulation of VDPVs in tropical developing country settings with low hygiene, high population density, and high contact rates is currently not known. This scenario

could lead to a widening susceptibility gap in tropical countries. Scenario IV (switching to IPV selectively) is not attractive because it implies a dual-vaccination policy (developed versus developing countries).

In conclusion, it is not yet possible to recommend or choose one of the scenarios for the post-certification vaccination policy. The ultimate aim for the post-certification era is to stop OPV safely and effectively, and eventually discontinue IPV. Further research is urgently needed to answer key scientific and programmatic questions. The most important of these questions are related to IPV immunogenicity, and whether an IPV-vaccinated population in a tropical area could prevent the emergence and sub-

sequent transmission of VDPVs. Furthermore, the economic studies in progress will better define the costs and benefits of each policy scenario. One of the economic studies is included in this special theme issue of the *Bulletin* (48). In the meantime, we must ensure that high levels of immunity against polioviruses will be maintained. Although not all risks in the post-certification era can be eliminated, we believe that they can be effectively managed, so that we will not have to continue immunization to “vaccinate” against the unwanted effects of OPV vaccination. ■

**Conflicts of interest:** none declared.

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## Résumé

### Rôle de la vaccination systématique contre la poliomyélite après la certification

Il reste deux décisions importantes à prendre à propos de la vaccination antipoliomyélitique après la certification de l'éradication : premièrement, arrêter ou poursuivre la vaccination systématique par le vaccin antipoliomyélitique buccal (VPO), fabriqué à partir de souches vivantes atténuées ; deuxièmement, si l'on arrête l'administration du VPO, aura-t-on besoin du VPI (vaccin antipoliomyélitique inactivé). Quatre scénarios sont possibles : arrêt total de la vaccination ; poursuite de la politique actuelle (VPO, VPI ou calendrier séquentiel) ; arrêt du VPO mais poursuite du VPI dans le monde entier ; arrêt du VPO mais poursuite du VPI

dans certains pays. Quel que soit le scénario retenu, il faudra continuer à investir dans la surveillance et dans une stratégie de riposte, en constituant notamment des réserves de vaccins antipoliomyélitiques. La poursuite de la vaccination empêchera de consacrer les fonds qui auraient pu être ainsi économisés à d'autres priorités. Dans le présent rapport, les auteurs passent en revue, pour chacun des scénarios, les questions essentielles, les avantages et les inconvénients, et décrivent les principales difficultés liées aux décisions politiques.

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## Resumen

### Papel de la inmunización sistemática contra la poliomiélitis en la era poscertificación

La función de la vacunación sistemática contra la poliomiélitis en la era poscertificación sigue siendo un tema relevante para la toma de decisiones de política. Hay dos decisiones críticas que es preciso adoptar: primero, la de continuar o interrumpir la inmunización con la vacuna oral atenuada contra el poliovirus (OPV); y, segundo, en caso de suspensión de la OPV, determinar si es necesario emplear la vacuna antipoliomiélitica inactivada (IPV). Cabe imaginar cuatro escenarios de vacunación posibles: suspensión de todo tipo de vacunación antipoliomiélitica; mantenimiento de las políticas actuales de vacunación (OPV, IPV o pauta secuencial); interrupción de la OPV y mantenimiento

universal de la IPV; o interrupción de la OPV y mantenimiento de la IPV en determinados países. Todos esos escenarios requieren inversiones continuas en una estrategia de vigilancia y respuesta, incluida una reserva de vacuna antipoliomiélitica. La prosecución de la vacunación limitaría los ahorros eventualmente deducibles al control de otras prioridades de salud. En este informe se analizan los aspectos más importantes de cada escenario, se ponen de relieve las ventajas e inconvenientes de cada uno de ellos y se exponen sucintamente los retos principales para la toma de decisiones de política.

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Fig. 1. Vaccines used in the routine polio vaccination schedules, by country, 2003

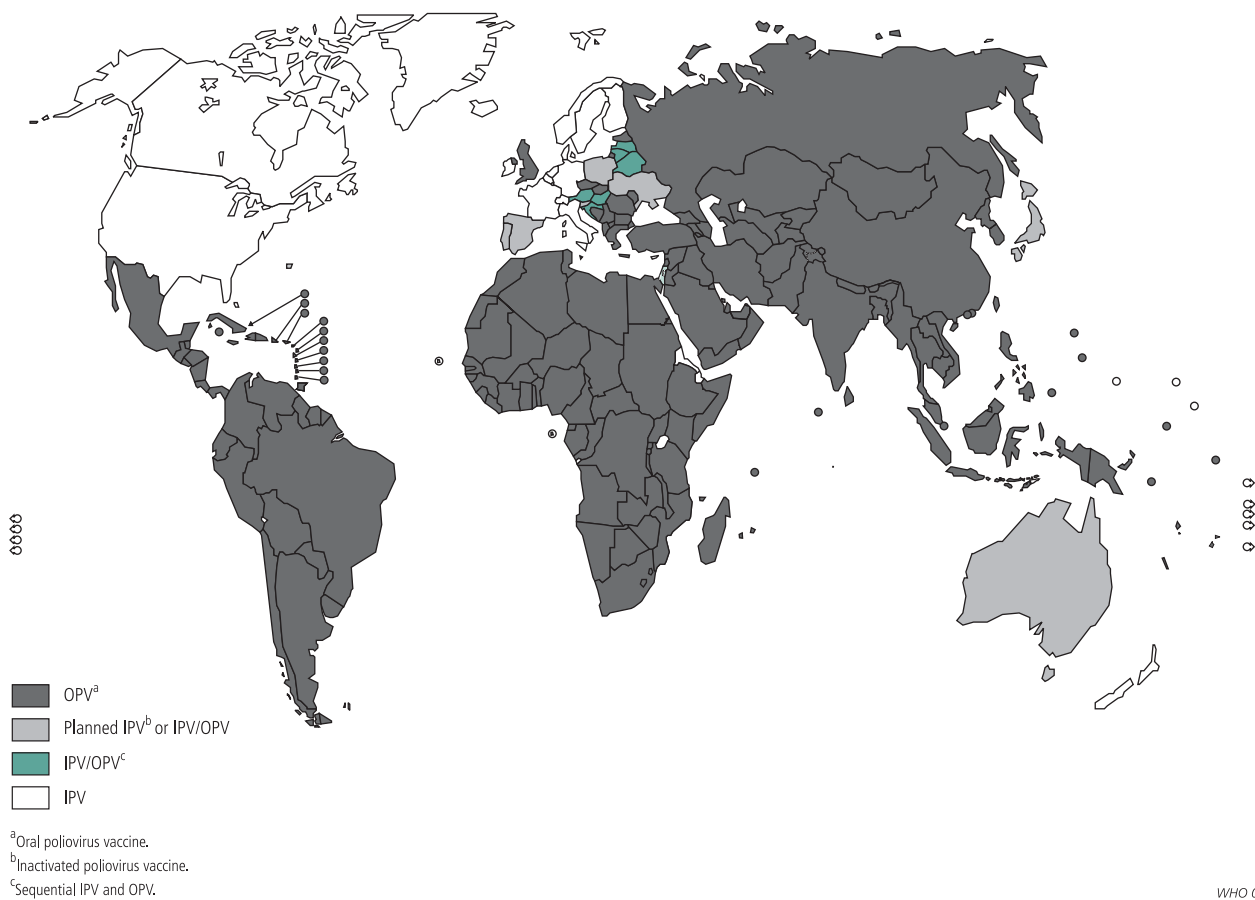


Fig. 3. Countries, by timing of routine polio immunization schedule, 2003



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