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## Achieving polio eradication in Nigeria: prospects and challenges

DOI:<http://dx.doi.org/10.4314/njp.v40i1.3>

Accepted: 24th July 2012

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**Abstract** The Global polio eradication initiative was launched in 1988 by the international community. Since then, tremendous progress has been made (99%). However, the last 1% of the journey has experienced several setbacks and rate of progress has slowed down in the last few years. Nigeria is one of the remaining 3 endemic countries in the world

that has never interrupted the transmission of the poliovirus compared to more than 125 countries in 1988. What are the prospects and challenges to polio eradication in Nigeria? This paper discusses these and other relevant issues regarding polio eradication in Nigeria.

### Introduction

#### *Polio virus*

Polio or poliomyelitis is an acute viral disease characterized by inflammation of the nerve cells of the brain stem and the spinal cord. The disease is caused by a virus called Poliovirus. It belongs to the genus, Enterovirus and the family, Picornaviridae. Viruses in this family are small in size with single stranded RNA. There are 3 serotypes: types 1, 2 and 3. Type 1 is the commonest and most virulent. Type 2 has not been detected globally since 1999<sup>1</sup>.

### *Trends*

Polio cases drastically reduced by more than 99%<sup>2</sup> from an estimated 350,000 in 1988 to 1,352 reported cases in 2010<sup>1</sup>. The number of endemic countries has reduced from 125 in 1988 to 3 in 2012. However, in 2009–2010, 23 previously polio-free countries were re-infected from importations<sup>3</sup>. Tables 1a and 1b show the trend of reported wild poliovirus cases from 2010 to 2012.

**Table 1a:** Reported wild poliovirus (WPV) cases,\* by type (WPV1 or WPV3) and category of polio-affected country — worldwide, January–March 2010, 2011 and 2012<sup>3,4</sup>.

Category/Country†	January–March 2010			January–March 2011			January–March 2012		
	WPV1	WPV3	All WPV	WPV1	WPV3	All WPV	WPV1	WPV3	All WPV
Polio-endemic countries	7	33	40	35	2	37	40	9	49
Afghanistan	1	6	7	1	—	1	6	—	6
India	3	16	19	1	—	1	—	—	—
Nigeria	---	2	2	6	2	8	21	7	28
Pakistan	3	9	12	27	—	27	13	2§	15
Countries with reestablished transmission	1	7	8	77	3	80	3	0	3
Angola	1	---	1	2	—	2	—	—	—
Chad	---	7	7	33	3	36	3	—	3
Democratic Republic of the Congo	---	---	---	42	—	42	—	—	—
Total**	16	80	96	224	10	234	86	16	104

\* Case data reported to the World Health Organization as of May 15, 2012, by date of onset.

† Country category based on Global Polio Eradication Initiative 2010–2012 Strategic Plan

§ Includes one mixed WPV1/WPV3.

\*\*Countries affected by outbreaks are excluded in this table

**Table 1b:** Reported wild poliovirus (WPV) cases,\* by type (WPV1 or WPV3) and category of polio-affected country — worldwide, 2010–2011<sup>3,4</sup>

Category/Country†	Total 2010			Total 2011		
	WPV1	WPV3	All WPV	WPV1	WPV3	All WPV
Polio-endemic countries	163	69	232	324	17	341
Afghanistan	17	8	25	80	—	80
India	18	24	42	1	—	1
Nigeria	8	13	21	47	15	62
Pakistan	120	24	144	196	2	198
Countries with reestablished transmission	144	15	159	227	3	230
Angola	33	—	33	5	—	5
Chad	11	15	26	129	3	132
Democratic Republic of the Congo	100	—	100	93	—	93
Total**	614	168	782	1102	40	1142

\*\*Countries affected by outbreaks are excluded in this table

Table 2 shows the trend of vaccine derived polioviruses worldwide from July 2009 to March 2011<sup>5</sup>.

**Table 2:** Vaccine-derived polioviruses (VDPVs) detected --- worldwide, July 2009--March 2011

Category	Country	Year(s) detected*	Source (total cases or specimens)†	Serotype	No. of isolates‡ July 2009--March 2011			VP1 divergence from Sabin OPV strain (%)¶	Routine coverage with 3 doses of polio vaccine (%)¶¶	Estimated duration of VDPV replication**	Current status (date of last outbreak case, last patient isolate, or last environmental sample)
					Cases	Contacts	Non-AFP source				
cVDPV††	Afghanistan	2010--2011	Outbreak (6 cases)§§	2	6	—	—	1.0--2.7	83¶¶	2.5 yrs	January 20, 2011
	Chad	2010	Importation (1 case)***	2	1	—	—	5.3	36	—	November 10, 2010
	DRC†††	2008--2010	Outbreak (37 cases)	2	17	—	—	0.7--3.5	68	3.2 yrs	October 26, 2010
	Ethiopia	2009--2010	Outbreak (7 cases)	3	7	—	—	1.3--3.1	60	2.8 yrs	November 4, 2010
	India	2009--2010	Outbreak (16 cases)	2	16	—	—	1.0--1.6	50§§§	1.5 yrs	January 31, 2010
	Niger	2006--2010	Importations (5 cases)***	2	1	—	—	2.5	71	—	June 1, 2010
	Nigeria¶¶¶	2005--2011	Outbreak (355 cases)****	2	48	—	—	0.7--6.2	61	6 yrs	March 7, 2011
	Somalia	2008--2011	Outbreak (13 cases)	2	5	6	—	0.7--2.8	26	2.6 yrs	March 22, 2011

Abbreviations: cVDPV = circulating VDPV; DRC = Democratic Republic of Congo; iVDPV = immunodeficiency-associated VDPV; aVDPV = ambiguous VDPV; OPV = oral poliovirus vaccine; IPV = inactivated poliovirus vaccine; AFP = acute flaccid paralysis.

\* Total years detected and cumulative totals for previously reported cVDPV outbreaks (DRC, Ethiopia, and Nigeria).

† Outbreaks list total cVDPV cases. Some VDPV case isolates from outbreak periods might be listed as aVDPVs.

‡ Total cases for VDPV-positive specimens from AFP cases and total VDPV-positive samples for environmental (sewage) samples.

¶ Based on 2009 data from the World Health Organization (WHO) Vaccine Preventable Diseases Monitoring System (2010 global summary) and

WHO-UNICEF coverage estimates, available at [http://www.who.int/immunization\\_monitoring/en/globalsummary/countryprofileselect.cfm](http://www.who.int/immunization_monitoring/en/globalsummary/countryprofileselect.cfm). National data might not reflect weaknesses at subnational levels.

\*\* Duration of cVDPV circulation was estimated from extent of VP1 nucleotide divergence from the corresponding Sabin OPV strain; duration of iVDPV replication was estimated from clinical record by assuming that exposure was from initial receipt of OPV; duration of aVDPV replication was estimated from sequence data.

†† Most cVDPV isolates from Afghanistan, Chad, DRC, Ethiopia, Niger, Nigeria, and Somalia were vaccine/nonvaccine recombinants.

§§ Three cases from 2009 are not included in the count because they had <10 nucleotide substitutions in VP1 and the new definition was not yet implemented.

¶¶ Routine trivalent OPV coverage was 14% among case-patients.

\*\*\* Importations from Nigerian cVDPV outbreak. One imported VDPV from Niger had been previously incorrectly assigned to be from Guinea.

††† Previously reported outbreak. Additional information available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5836a3.htm>.

§§§ cVDPVs clustered in Uttar Pradesh and Bihar, where routine coverage with trivalent OPV was ~50%.

¶¶¶ Previously reported outbreak. Additional information available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5836a3.htm>.

\*\*\*\* Count does not include 29 cases with <10 nucleotide substitutions in VP1 detected before 2010.

The global estimation of routine trivalent OPV (tOPV) vaccination coverage (3 doses of tOPV by 12 months) by the end of 2010 was 86%. The WHO Regional coverages were 79%, 93%, 96% and 77% for African, the

Americas, European and West Pacific, and South-East Asian Regions respectively<sup>6</sup>. Some indicators of success of the global polio eradication efforts are shown in table 3<sup>1</sup>.

**Table 3:** Selected indicators of the success of the Global Polio Eradication Initiative

Parameter	1988	2000	2006	2009
No. of new cases per year	300 000	719	1997	1606
No. of endemic countries	>125	20	4	4
No. of endemic WHO Regions	6	3	3	3
No. of circulating wild WPV serotypes	3	2	2	2
No. of remaining WPV genotypes#	WPV1: 20 WPV2: 5 WPV3: 17	WPV1: 9 WPV2: 0 WPV3: 7	WPV1: 2 WPV2: 0 WPV3: 2	WPV1: 2 WPV2: 0 WPV3: 2

WPV, Wild-type poliovirus.

# A genotype is a group of genetically closely related poliovirus strains (difference in capsid protein VP1 coding sequence  $\geq 15\%$ ) that are considered to have epidemiological linkage with each other<sup>1</sup>.

### Transmission

Polioviruses are mainly transmitted through the faeco-oral route (via stool contaminated food and water) and also by person to person contact. They are acid resistant and therefore able to travel safely through the stomach to settle in the gut where they replicate. Therefore transmission occurs most in areas with poor personal and environmental hygiene. Polioviruses can survive for weeks in water and sewage. Poliomyelitis is highly infectious and transmission is expected to occur in almost 100% of susceptible children and more than 90% of susceptible adult household contacts. In general, transmission is higher in developing countries. Additionally, other factors that determine the ease and speed of spread include population density and rate of contact<sup>7</sup>.

From the gut the viruses reach the central nervous system through the blood stream to cause disease. The incubation period is 7-14 days (4-35 days). Polio can be symptomatic (4-8%) or asymptomatic (~95%); paralytic or non-paralytic (99%)<sup>1</sup>. On the average, only 1 in 200 infections will result in acute flaccid paralysis (AFP). Paralytic polio could be spinal, bulbar or bulbo spinal<sup>8</sup>.

### Clinical features

The symptoms include fever, headache, vomiting, fatigue, neck and back stiffness and muscle pains. Other clinical features are paralysis of the limbs and respiratory muscles, respiratory failure, swallowing difficulty, urinary retention, constipation, diarrhoea and abnormal sensations (but not loss of sensation). Severity increases with increasing age of infection. Only about 0.1-2% of infected people have paralytic polio out of which 5-10% die of respiratory failure. Recovery from an infection confers serospecific immunity<sup>8</sup>.

### Vaccination

Polio has no cure: clinical cases can only be managed with supportive care. Therefore, prevention is the mainstay of management of polio. Apart from improvement in hygiene and sanitation standards, vaccination is the primary mode of prevention. Primary and booster doses of polio vaccine protects most vaccinees for life.

Two vaccines are currently available namely the live attenuated Oral Polio Vaccine (OPV), developed by Albert Sabin; and the Inactivated (killed) Polio Vaccine (IPV) developed by Jonas Salk. Both vaccines are trivalent, though recently, bivalent (bOPV) and monovalent (mOPV) vaccines have been produced for data-driven supplementary immunization activities (SIAs) in some endemic countries.

Although OPV is safe, rare adverse event could occur and Vaccine associated paralytic polio (VAPP) is one of the most important of these rare adverse events. While OPV virus has the potential to revert to a live virus that is capable of causing paralysis, IPV cannot cause polio. The vaccine associated paralysis is caused by mutation or reversion of the Sabin virus to neurovirulence. Such circulating vaccine derived polio viruses (cVDPVs) therefore can result in polio cases and paralysis similar to that caused by wild polio viruses (WPVs). Vaccine associated paralytic polio occurs in both vaccinees and their unimmunized contacts<sup>7</sup>. Although wild type 2 polio virus has been eliminated since 1999<sup>1,2,7</sup>, type 2 cVDPVs are still being reported in some endemic countries.

In a few individuals with primary B-cell immunodeficiency, there is chronic shedding of the Sabin virus with increased neurovirulence. Such viruses are called immunodeficiency-associated vaccine derived polioviruses (iVDPV). These are not known to occur in HIV infec-

## Definitions

The following definitions were given by the Dahlem Workshop on Disease Eradication in 1997 and published by the Centers for disease control and prevention (CDC) in 1999<sup>9</sup>:

- **Control:** The reduction of disease incidence, prevalence, morbidity or mortality to a locally acceptable level as a result of deliberate efforts; continued intervention measures are required to maintain the reduction. Example: diarrhoeal diseases.
- **Elimination of disease:** Reduction to zero of the incidence of a specified disease in a defined geographical area as a result of deliberate efforts; continued intervention measures are required. Example: neonatal tetanus.
- **Elimination of infections:** Reduction to zero of the incidence of infection caused by a specific agent in a defined geographical area as a result of deliberate efforts; continued measures to prevent re-establishment of transmission are required. Example: measles, poliomyelitis.
- **Eradication:** Permanent reduction to zero of the worldwide incidence of infection caused by a specific agent as a result of deliberate efforts; intervention measures are no longer needed. Example: smallpox.
- **Extinction:** The specific infectious agent no longer exists in nature or in the laboratory. Example: none.

However, there are several other definitions of elimination and eradication ranging from geographically limited definitions to global definitions<sup>10</sup>.

The ultimate aims of public health are disease control, elimination and eradication. The basic question is when these aims will be achieved.

### Why is polio eradicable?

Polio is considered eradicable because:

- Man is the only reservoir/host.
- A long term carrier state is not known to occur<sup>11</sup>.
- Effective and cheap vaccine is universally available (OPV).
- The vaccine (OPV) is easy to administer on mass basis.
- The polio vaccine is relatively stable.

### Direct and Indirect effect of OPV (Herd effects)

When adequate number of doses of OPV are administered to a population at risk, the immunity so conferred interrupts transmission in that population. This is known as the indirect effect of the vaccine, such that any susceptible individual in that community will no longer be exposed to the virus and so is protected, though non-immune (herd protection). Secondly, vaccinated individuals transmit the vaccine virus to unvaccinated

individuals thereby conferring immunity on them.

This is the direct effect of the vaccine (herd immunity)<sup>12</sup>. These herd effects result in a population immunity that is higher than the sum of the individual immunity of the vaccinated individuals in the community.

### How synchronized OPV mass campaigns work

Simultaneous administration of OPV within a short period interrupts the transmission of wild polio virus by displacing it from the gut. The effect is enhanced by a 100% vaccine coverage of the population at risk (children less than 5 years). The result is abrupt interruption of WPV transmission in the community<sup>11</sup>.

### Global Polio Eradication Initiative (GPEI)

The Global polio eradication initiative was launched in 1988. It was made up delegates from 166 member states who adopted a resolution to eradicate polio world-wide. It was primarily led by the World Health Organization (WHO), the Rotary International, the United States Centers for Disease Control and Prevention (CDC), and the United Nations Children's Fund (UNICEF).

The objectives of the GPEI include<sup>7, 13</sup>:

- Interruption of wild polio virus
- Certification of global polio eradication
- Contribution to health system development and strengthening of routine immunization surveillance for communicable diseases in a systematic way.

The GPEI has four major strategies<sup>1</sup> for countries affected or at risk of re-infection namely:

- High routine infant immunization coverage with 4 doses of OPV in the first year of life
- Supplementary immunization activities for all under five children
- Optimum surveillance for WPV through reporting and laboratory testing of all AFP cases in children less than 15 years.
- Targeted (data-driven) "mop-up" campaigns once WPV is limited to specific focal areas.

### GPEI Strategic plan 2010-2012

In May 2008, the 61<sup>st</sup> World Health Assembly called for a new one-year programme of work to replace the earlier multi-year strategic plan and subsequently, the 2009 Programme of work was developed. Following the implementation of the 2009 GPEI programme of work, a strategic plan was developed based on lessons learned from 20 years of experience in polio eradication and implementation of the 2009 programme of work. This new plan is to be implemented from 2010-2012 with definite milestones set (Table 4). The progress is to be internationally analyzed and graded by experts<sup>2</sup>.

**Table 4 : GPEI global milestones 2010-2013**

By mid-2010	By end-2010	By end-2011	By end-2012	By end-2013
Cessation of all polio outbreaks with onset in 2009*	Cessation of all 're-established' Poliovirus transmission**	Cessation of all polio transmission in at least two of the four endemic countries***	Cessation of all wild poliovirus transmission†	Initial validation of 2012 milestones††

\* validated when six months without a case genetically linked to a 2009 importation (i.e. by end-2010). The target for stopping any new outbreaks (i.e. with onset in 2010, 2011 or 2012) will be within six months of the confirmation of the index case.

\*\* validated when 12 months without a case genetically linked to the re-established virus (by end-2011).

\*\*\* validated when 12 months without a case genetically linked to an indigenous virus (by end-2012); the year-to-year change in the number of polio cases will be monitored quarterly for each endemic country to guide the assessment of progress towards this global milestone.

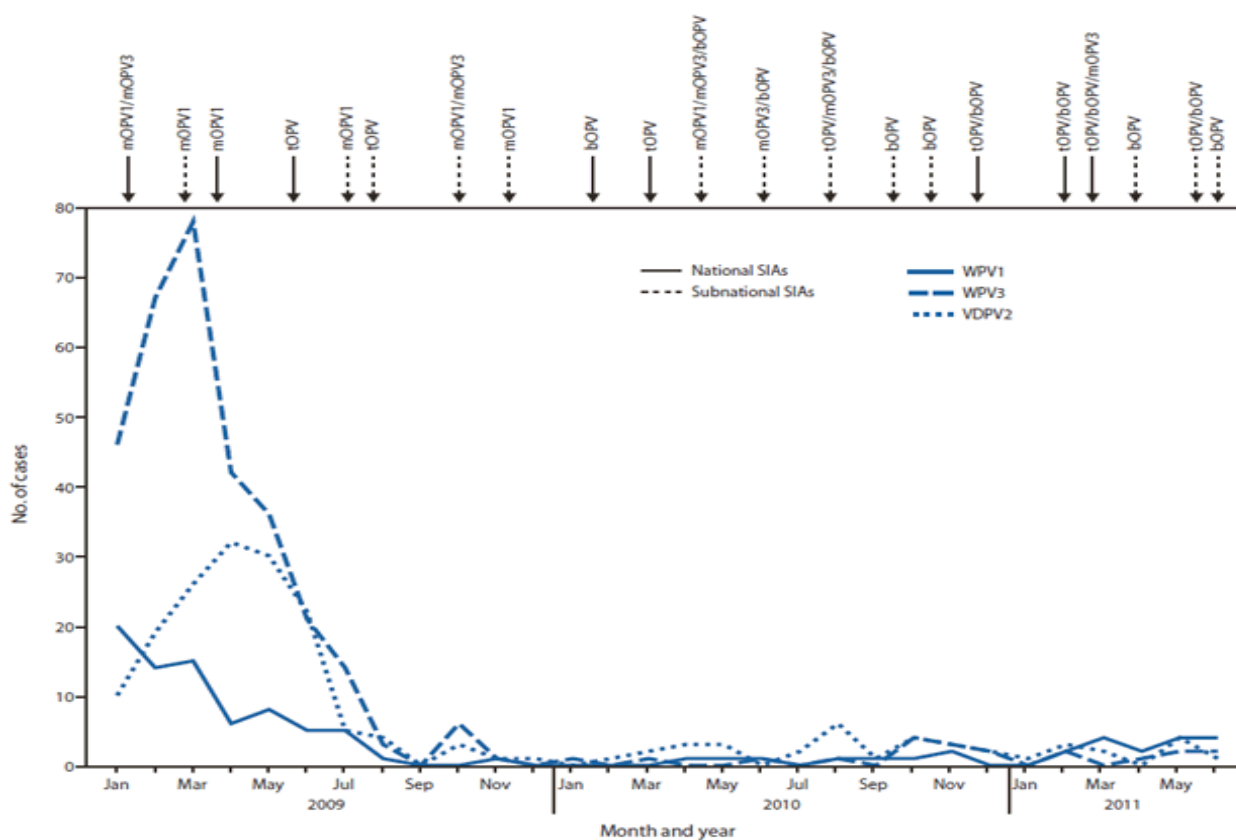
† validated when 12 months without a case genetically linked to an indigenous virus (by end-2013).

†† 'certification' will require at least three years of zero polio cases in the presence of appropriate surveillance across an entire epidemiologic region<sup>2</sup>.

**Table 5: WHO Regions certified polio free<sup>14</sup>**

WHO Region	Year certified
The Americas (36 countries)	1994
Western Pacific (37 countries)	2000*
European Region (countries)	2002*

\*Some countries in these regions have suffered importations after certification

**Fig 1: Number of laboratory-confirmed cases by wild poliovirus (WPV) type or vaccine-derived poliovirus type 2 (VDPV2) and month of onset, type of supplementary immunization activity (SIA),\* and type of vaccine administered in Nigeria, January 2009--**

**Abbreviations:** mOPV1 = monovalent oral polio vaccine (OPV) type 1; mOPV3 = monovalent OPV type 3; tOPV = trivalent OPV; bOPV = bivalent OPV.

\* Mass campaign conducted in a short period (days to weeks) during which a dose of OPV is administered to all children aged <5 years, regardless of previous vaccination history. Campaigns can be conducted nationally or in portions of the country.

However, the current objectives are<sup>1</sup>

- Interrupting wild poliovirus transmission in Asia
- Interrupting wild poliovirus transmission in Africa
- Enhancing global surveillance and outbreak response
- Strengthening immunization systems

For a WHO region to be certified polio-free, three conditions must be met<sup>8</sup>:

- At least 3 years of no polio case due to WPV
- Disease surveillance efforts in countries must meet international standards
- Each country must show capacity to detect, report and respond to “imported” polio cases.

Since 1988, more than 2 billion children around the world have been immunized against polio, through the unprecedented cooperation of more than 200 countries and 20 million volunteers, backed by an international investment of more than US\$ 5 billion<sup>1</sup>.

So far, the following regions have been certified polio-free: (Table 5)

However, to achieve a global polio-free certification, laboratory stocks must be contained and safe management of WPV in IPV manufacturing sites must be assured.

## Polio Eradication Trends in Nigeria

In Nigeria, routine surveillance report of AFP cases associated with faecal excretion of type 2 cVDPV, type 1 and type 3 WPVs from January 2005 to June 2009 were studied by Jenkins et al<sup>15</sup>. It revealed that within the study period there were a total of 2,323 cases of type 1 WPVs, 278 cases of type 2cVDPVs and 1,059 cases of type 3 WPVs. There were no significant differences in the clinical severity of paralysis caused by these types of polioviruses.

The progress of polio eradication had been initially slow, then checkered and retarded by political and socio-cultural factors in 2003. Following the resurgence of polio in Nigeria in 2003, and subsequent export of the virus to 20 other countries, the feasibility of polio eradication was brought under serious question<sup>16</sup>. Subsequently there was a sudden success leap towards the end of 2009 followed by uneven progress till date. Fig 1 from CDC summarizes the progress between January 2009 and June 2011<sup>17</sup>.

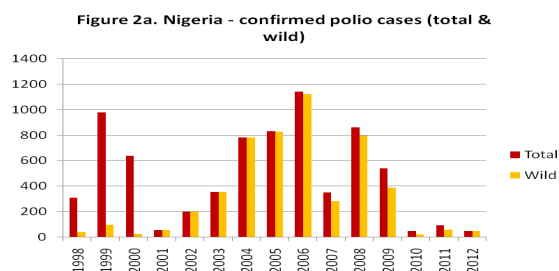
Table 6 shows the WPV situation worldwide and country break down as at first week of July 2012. The data which was published by the GPEI<sup>18</sup> shows that Nigeria tops the list and endemic countries contribute more than 95% of global burden. The total year-to-date WPV in Nigeria increased by more than 300% from 2011 to 2012.

**Table 6:** Wild poliovirus situation worldwide as at 4<sup>th</sup> July 2012

Countries	Year-to-date 2012			Year-to-date 2011			Total in 2011*	Date of most recent case
	WPV1	WPV3	Total	WPV1	WPV3	Total		
Nigeria	40	12	52	12	5	17	62	06-Jun-12
Afghanistan	10		10	8		8	80	29-May-12
Pakistan	19	2+1W1W3	22	57	1	58	198	22-May-12
India				1		1	1	13-Jan-11
Chad	4		4	82	3	85	132	11-May-12
DR Congo				60		60	93	20-Dec-11
Angola				4		4	5	07-Jul-11
Niger					1	1	5	22-Dec-11
CAR							4	08-Dec-11
China							21	09-Oct-11
Guinea					1	1	3	03-Aug-11
Kenya							1	30-Jul-11
Côte d'Ivoire					11	11	36	24-Jul-11
Mali					4	4	7	23-Jun-11
Congo				1		1	1	22-Jan-11
Gabon				1		1	1	15-Jan-11
Total	73	14	88	226	26	252	650	
Total in endemic countries	69	14	84	78	6	84	341	
Total outbreak	4	0	4	148	20	168	309	

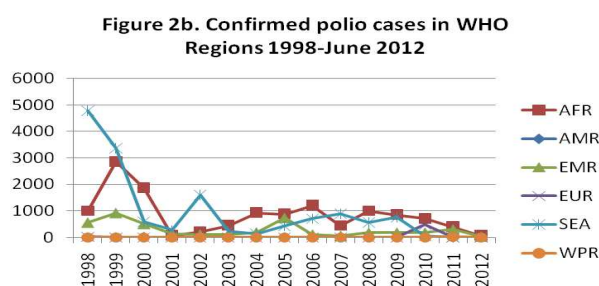
Data in WHO as of 05 Jul 2011 for 2011 data and 03 Jul 2012 for 2012 data<sup>1</sup>

**Fig 2a**<sup>19</sup> highlights the persisting presence of cVDPVs in Nigeria. They still constitute a significant proportion of the total polio cases.



Note: The difference between total confirmed polio cases and wild virus confirmed polio cases is due to circulating vaccine-derived polio virus.

**Fig 2b**<sup>19</sup> shows the global picture and Africa has the highest burden.



### Rational arguments

The eradicability of polio has been a subject of debate especially in recent years. Some have called to question the rationality or otherwise of the huge sums of fund spent globally on the Polio Eradication Initiative (PEI) while proponents have advanced their own reasons for continuing effort towards the global project. While some believe polio is not eradicable, others think that even if it is eradicable, it is of little individual benefit<sup>20</sup>. Yet others strongly believe it is not only eradicable, but that eradication is in sight. This group also believes it is of great public good.

### Arguments against eradication

That small pox was successfully eradicated does not necessarily imply that other diseases will be eradicated also. Epidemiologists have argued that some diseases, for which global eradication programs have been launched in the past, are not eradicable. This is because diseases that have non-human reservoirs could be re-introduced following a presumed eradication. This applies to malaria and yellow fever whose past global eradication programmes have failed<sup>20</sup>.

Polio vaccine is not as effective as small pox vaccine<sup>20</sup> and after 3 doses of OPV, full protection is not guaranteed as vaccines are not equally effective against all 3 strains of the virus<sup>7</sup>. The live vaccine virus on rare occasions can revert to neuro-virulence and cause disease similar to that caused by the wild polio virus. Some have described this as using fire to fight fire. These cVDPV

have been responsible for polio outbreaks in several countries<sup>7</sup> including Nigeria, Democratic Republic of Congo (DRC), Egypt, Haiti and Madagascar<sup>5</sup>.

Experts argue that since OPV from which these reverted strains are derived currently remains the main stay of the Polio Eradication Programme (PEP), and realizing that IPV is too expensive to serve as a substitute in many developing countries; "it is clear that poliovirus eradication using the current affordable strategies is unrealistic"<sup>20</sup>. It has been argued that the huge sum of money spent on PEP cannot be justified on the basis of disease burden. They rather advocate that such funds should be invested in developing a cheaper non-live polio vaccine<sup>20</sup>.

The other argument is that polio is largely an asymptomatic disease and it is estimated that for every single case of paralytic polio there are about 200 undetected infections. By the time a response with an SIA is organized, the disease would have likely spread. Although man is the only host, chronic polio virus carriage has been demonstrated in small number of patients with B-cell deficiency in which polio virus has persisted for many years<sup>7</sup>.

Additionally and very importantly too, neuro virulent polio virus has been synthesized de novo in the laboratory<sup>21</sup> and this strongly raises a question as to the view or concept that the planet can ever be reliably sterilized from polio virus. With the advent of bioterrorism countries cannot ignore the possibility of such an agent being used against them by terrorists. According to Grepkin<sup>20</sup>, although the PEP has achieved remarkable success in the control of the disease, the continued policy towards the present end-point of polio virus eradication, is unattainable.

### Arguments for eradication

On the other hand, some experts see polio eradication as very feasible from biological point of view. In their opinion, since there are effective vaccines, just like in the case of small pox, polio can be eradicated. Indeed, one of the 3 types of the virus (types) has been eradicated. Additionally 99% reduction in circulation of WPV worldwide has already been achieved and many countries and some regions have already eliminated the virus. The last 1% should be achievable. Only 3 countries have never interrupted WPV transmission-Nigeria, Afghanistan and Pakistan. Even in Nigeria, transmission is only limited to Northeast and Northwestern regions of the country. All these point to the feasibility of polio eradication, not only in Nigeria but globally. Before India achieved certification for elimination, it similarly had WPV transmission limited to the Uttar Pradesh and Bihar states and the Indian Government almost gave up on eradication efforts. However further concentration of eradication efforts in these areas eventually led to a successful interruption of polio transmission. This is in spite of lower immune response to tOPV in South East Asia than in Africa<sup>2</sup>.

Although polio eradication has been said to divert limited financial and human resources away from primary health care<sup>22</sup>, a world free of the need for polio vaccine would save USD81.5 billion per year in immunization costs alone<sup>16,23</sup>. Additionally, apart from financial savings and prevention of crippling effects of polio, polio eradication also has intangible and co-incidental benefits. These include stronger immunization and surveillance systems, well established global laboratory network, millions of trained health workers and strong advocacy movements<sup>24,25</sup>. The option of controlling rather than eradicating polio (by means of routine immunization only) has been shown in a modeling study to potentially result in great cumulative cost and far larger number of cases<sup>16,26</sup>.

### Prospects

The prospects for polio eradication in Nigeria and by extension globally are high. These are based on:

- The antecedent of not just small pox eradication but also progress so far made in polio eradication in Nigeria, India and the currently polio-free countries and regions.
- The huge financial and human resources the country is able to mobilize from the Federal, State and Local Governments; as well as from International and local partners.
- Already existing health care structure, especially for immunization, established by the National Programme on Immunization (NPI) and improved upon by the National Healthcare Development Agency (NPHCDA).
- High level of community and political awareness already achieved.
- A level of political and community commitment
- Skilled and experienced personnel-both full time and adhoc health workers.
- Massive global technical, political and financial support especially based on the fact that polio eradication is a global initiative and not just a Nigerian programme.

### Challenges

Although the prospects are high, the challenges are enormous and require total commitment and focused strategies to overcome. These challenges include;

- Low and differential routine and supplemental immunization coverages below the threshold required for interruption of transmission. These immunity gaps allow viruses to persist in smaller areas and population sub-groups<sup>2</sup>.
- Relatively lower effectiveness of tOPV resulting in low immunity especially against type 1 virus in vaccinated population<sup>15</sup>. Type 1 is the commonest in Nigeria.
- The emergence of type 2 cVDPVs outbreaks in Nigeria whose transmissibility, pathogenicity and disease severity are similar to those of type 2 WPV. Type 2 WPV has been eliminated globally since 1999.

- The continuing cases of VAPP resulting from the reverted VDPV.
- Mal-orientation of communities, politicians and health workers.
- Politicization of health issues.
- Very large population and high population growth rate with cultural, religious and geographical barriers.
- Funding short-falls and poor accountability framework.

With elimination of poliovirus in India, Nigeria stands out as the single most important country now in the global polio eradication agenda.

### The Way Forward

- The current use of mOPV 1, mOPV 3, bOPV and tOPV must continue but must be guided by sound scientific advice from experts. However, the use of mOPV and bOPV must be balanced with the findings of waning population immunity against type 2 which predisposes to susceptibility to type 2 cVDPV. Yet, it must be born in mind that tOPV which is the only OPV against type 2 has much lower effectiveness against the commonest type 1 in the country. This calls for a delicate balance in the use of these vaccines and for further research.
- It also draws the country's attention towards planning to explore the place of IPV in the future which will totally eliminate the threat of cVDPVs and VAPP.
- There is a very urgent need to raise routine immunization coverage to at least 95%. This coverage should not only be achieved nationally but also sub-nationally in all Local Government Areas (LGAs) and wards.
- Additionally SIAs should be more effective with realistic coverage approaching 100%.
- Focused and effective mop up activities in special areas.
- Continuing immunogenicity, epidemiological and communication studies are required to monitor trends and develop area-specific strategies.
- Targeted mop ups and penetration of conflict areas are required to eliminate reservoirs of the virus.
- Re-orientation of health workers, adhoc personnel, policy makers and the community.
- Effective advocacy to politicians and massive social and community mobilization.
- Targeted communication strategies aimed at overcoming cultural, religious and political barriers. Also improvement in community participation
- Intensive and special arrangement for adequate coverage of hard to reach areas and migrant populations.
- Urgent strengthening of AFP surveillance in all communities in all LGAs.
- Country / government ownership of PEP as well as routine immunization programme with full implementation of the accountability framework.



## Conclusion

Small pox was eradicated and polio is biologically eradicable. The global eradication effort has already achieved over 99% success with elimination certification in many countries and WHO regions. Even re-infections have been successfully and promptly eliminated in previously certified countries. India whose polio eradication history is similar to Nigeria's in several ways has eventually achieved elimination certification. Nigeria has also achieved giant strides (90% success) since the PEP in the country. Therefore the prospects for polio eradication in Nigeria are high but the current challenges require urgent, sustained and focused attention so as to shorten the journey from now to eradication time.

## The future

Even after WPV transmission is interrupted and eliminated globally. The problem of reverted neurovirulent vaccine virus would remain to be addressed. As long as live OPV remains in use, Nigeria and indeed, the world cannot relax. Nigeria and the global community must plan for a switch from OPV to IPV and then complete stoppage of OPV production. Many countries have already stopped the use of OPV while others are at the OPV-IPV transition phase. While the call for a cheaper IPV continues, Nigeria must not wait but should begin to plan for financing of the switch. Local vaccine production is a potentially cheaper option.

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