Investigation of an outbreak of type 3 wild poliovirus in Cote d'Ivoire in 2011

Nguessan C.K, Traoré Y, Agbo S.K, Coulibay A, N'diaye S, Dagnan S.N

National Institute of Public Health, University Félix Houphouët-Boigny

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ABSTRACT

Background: Côte d'Ivoire had no type 3 wild poliovirus (WPV3) outbreak since 1999. In 2011, the country was re-infected by WPV3. The objective of this study is to explore the reasons behind the occurrence of WPV3 outbreak in Côte d'Ivoire in 2011.

Method: Data on WPV3 cases were obtained from specific investigation records during the outbreak investigation. Data on AFP cases was obtained from AFP routine investigation forms. Information on polio immunization was extracted from National EPI databases and documents. Univariate analyses were done to summarize characteristics of AFP and WPV3 cases. Bivariate and multivariable analyses were done to compare polio cases to non-polio AFP cases. Finally, the proportion of non-vaccinated children in routine immunization from 2006 to 2010 was calculated.

Results: In the Côte d'Ivoire outbreak, from January to July 2011, 36 WPV3 cases were notified. The median age was two years old (interquartile range two to four years old). Among these cases, 29 had received less than three polio vaccine doses. The majority of WPV3 cases were living in precarious socio-economic conditions. Regarding vaccination status of AFP cases, the polio cases had a statistically significant higher risk to have less than three doses of polio vaccine compared to non-polio cases, OR: 16.9 [95% CI: 2.3 – 125.0]. More than 27% of the children of less than one year old who were expected to be vaccinated in the country were not vaccinated from 2006 to 2010.

Conclusion: Despite the limitations, this study shows that a country that has interrupted polio transmission for one type of poliovirus can still be at high risk for polio outbreaks of this same type following an importation. This can occur when routine immunization coverage is low, polio supplementary immunization activities are done with only the poliovirus vaccine against the circulating poliovirus, people live in precarious socio-economic conditions and AFP surveillance is poorly performed. Côte d'Ivoire experienced this outbreak as many of these conditions occurred together.

Correspondence to:

Youssouf Traoré
National Institute of Public Health,
University Félix Houphouët-Boigny
Personal address: 01 BP 951 Abidjan 01
Cellulaire : (+225) 07 67 69 74
Email : traore_youl@yahoo.fr

INTRODUCTION

In 1988, the World Health Assembly by a special resolution asked the member states of the World Health Organization (WHO) to fight for the eradication of polio. The majority of states in the world have joined this initiative. The Global Polio eradication Initiative (GPEI) uses vaccination as key intervention. Since the start of the polio eradication initiatives in 1988, polio cases have decreased by more than 99%, from an estimated 350,000 cases in 1988 to 407 reported cases in 2013. The reduction is the result of the global effort to eradicate the disease. In 2013, polio remained endemic in only three countries (Afghanistan, Nigeria and Pakistan), down from more than 125 countries in 1988.[1] However, as long as a single child remains infected, children in all countries are at risk of contracting polio. According to World Health Organization (WHO), failure to eradicate polio from these last remaining strongholds could result within 10 years in as many as 200,000 new cases every year, all over the world.[1]

In 2012, the World Health Assembly of the World Health Organization (WHO) declared the completion of polio eradication a programmatic emergency for global health.[1]

Côte d'Ivoire faces problems to maintain interruption of polio transmission. In this country,

after several years without wild poliovirus transmission, wild poliovirus type 1 (WPV1) was reintroduced in December 2008. The circulation continued until 2009 and 26 cases of WPV1 infection were notified. In response to this epidemic, 10 national immunization days (NIDs) using the monovalent type 1 vaccine were conducted in 2009 and 2010. The circulation of WPV1 stopped in August 2009. Wild poliovirus type 3 (WPV3) which transmission had been interrupted since 1999, but an outbreak of wild poliovirus type 3 occurred in 2011.

The aim of this study is to investigate and understand the reasons behind the 2011 WPV3 outbreak in Côte d'Ivoire and the response to this outbreak.

METHODS

Study type, sources of information and data collection

We conducted a retrospective study to explore the reasons behind the WPV3 outbreak in Côte d'Ivoire in 2011.

The description of the WPV3 cases was based on data collected during the process of epidemic investigation. For each confirmed case of WPV, a field epidemiological investigation was conducted to identify factors that may explain the occurrence of the infection. Epidemiological surveillance officers registered these data using an investigation form.

The description of the AFP cases and analysis to compare polio cases to non-polio AFP cases was based on data collected in 2011 by epidemiological surveillance officers using the routine AFP surveillance forms. Information on polio immunization was extracted from national EPI databases and documents.

Operational definitions and variables

An acute flaccid paralysis (AFP) is defined as:

- Any case of AFP in a child <15 years of age; OR

- Any case of paralytic illness (regardless of age) in which a clinician suspects polio

- A case of wild poliovirus (WPV) is defined as a person with AFP for whom a stool specimen tested positive for WPV by virology in an accredited WHO laboratory.

- Vaccination status, during the wild poliovirus type 3 cases investigation, only those who could give evidence with a vaccination card were considered to be vaccinated in routine immunization.

Laboratory tests and AFP cases classification

Laboratory tests were performed by the Pasteur Institute of Côte d'Ivoire, a WHO accredited laboratory.

Study populations

The study population for WPV characteristics analysis comprises all WPV3 cases in Côte d'Ivoire in 2011. Characteristics analysis for AFP cases is about all cases of AFP in 2010 and 2011. Immunization coverage and response to epidemic refer to the whole population of Côte d'Ivoire.

Data analysis and presentation

The information collected on the investigation records was entered, cleaned and analyzed using the EPI Info software 3.5.4.

- Univariate analysis was performed to summarize the characteristics of WPV3 cases.

- Univariate analysis was performed to summarize the characteristics of AFP cases.

- A bivariate analysis was conducted to access differences between polio cases and non-polio AFP cases. We reported crude odds ratios (OR) and 95% confidence intervals.

- A multivariate analysis (logistic regression) was performed to build an explanatory model to look for confounding, interaction and linear trends. We reported adjusted odds

ratios (OR) and 95% confidence intervals.

- A calculation was performed to get the number of children not vaccinated during 5 years from routine immunization coverage and the target population of children under one year old from 2006 to 2010.

Ethics

The data were collected in routine activities and during an outbreak investigation. We did not get approval of an ethic committee. Before data collection, we obtained children parents' oral consent.

RESULTS

1.1 Description of cases with wild poliovirus type 3 infection

During the 2011 outbreak in Cote d'Ivoire, 511 cases of AFP were notified and among them, 36 cases were confirmed as wild poliovirus cases. The median age of the WPV cases was two years old (interquartile range: two to four years old); 35 out of 36 children were less than five years old (table 1). The ratio of boys to girls was 1.6:1. More than half of the cases (20 out of 36) came from foreign families and the majority of these polio cases (27 out of 36) lived in villages or camps. The housing conditions of 35 out of 36 cases were classified as precarious. Most of these families (30 out of 36) did not have access to tap water, while more than half of the cases (19 out of 36) had no latrines (table 5). Finally all these polio cases come from different household.

Regarding vaccination status, only three of 36 polio cases (8%) were vaccinated at polio zero; polio zero is a polio vaccine dose administered at birth. Among the children with poliomyelitis 11 out of 36 received the first dose of oral polio vaccine (OPV1). Also nine of poliomyelitis cases were vaccinated on the second polio vaccine dose (OPV2).

Finally, seven polio cases among 36 cases (19%) were vaccinated with the third dose of oral polio vaccine (OPV3). Among the 36 polio cases, 24 cases had not received any dose of polio vaccine in routing immunization.

Table I: Socio demographic characteristic of WPV3 in Côte d'Ivoire in 2011 (N= 36)

Factors	Categories	Number	Frequency %
Age		2*	[2;4]*
Sex	Male	22	61
	Female	14	39
Nationality	Ivorian	16	44
	Foreigner	20	56
Place of residence	Town	9	25
	Village or camp	27	75
Type of housing	Precarious housing	35	97
	Modern housing	1	3
Source of water	Running water	6	17
	Non running	30	83
Latrine	Latrine available	17	47
	No Latrine available	19	53
Elimination of waste water (N=25)	Appropriate	1	4
	Non appropriate	24	96

* Median age in years; the interquartile range is given between brackets.

Table II: Vaccination status of WPV3 cases in Côte d'Ivoire in 2011 N=36

Factors	Number	Frequency (%)
Immunized Polio 0	3	8
Immunized Polio 1	11	32
Immunized Polio 2	9	25
Immunized Polio 3	7	19

The first notified case of polio occurred in week 4 of the year 2011 and was notified in week 5. The second, third and fourth cases occurred four to five weeks later. Then, from week 11 to week 17, no cases were notified. The peaks of the epidemic were in May and June 2011. The last case occurred in week 30.
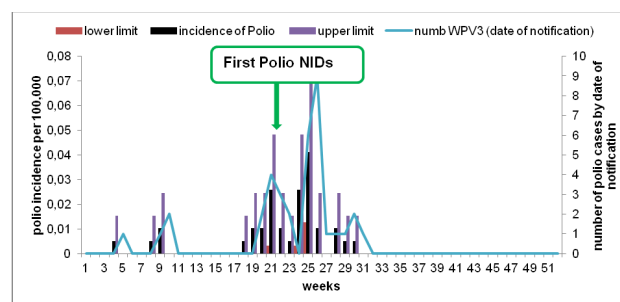

Figure 1: Evolution of Wild Poliovirus type 3 cases in Côte d'Ivoire in 2011

The most affected districts were the districts Duekoué and Soubré. Among the 101 districts 23 (22.7%) notified at least one polio case. Seven regions out of 19 regions in the country did not notified polio cases. The eastern part of the country was the less affected area during this epidemic. Characteristics of AFP cases in Côte d'Ivoire in 2010 and 2011,

Characteristic of AFP surveillance in 2010 and 2011

Concerning socio demographic characteristic of AFP cases, the median age of AFP cases in 2011 was 2.6 years (interquartile range: 1.6 to 5 years).

The sex ratio boy to girls was 1.4:1. The majority of AFP cases were boys (58.1%). A small proportion of AFP cases were hospitalized for their paralysis (17.2%).

Table III: Socio demographic characteristics of AFP cases in Côte d'Ivoire in 2011

Factors	Categories	Total population (N)	Number	Frequency %
	Age in years	511	2.6	[1.6; 5]*
Sex	Female	511	214	41.9
	Male		297	58.1
Hospitalization	Hospitalized	511	88	17. 2
	Not Hospitalized		423	82.8

*Median age in years; the interquartile range is given between brackets.

Table IV: Number of polio doses of AFP cases in 2011 in Côte d'Ivoire

Parameters	Total population (N)	Number	Frequency %
Total polio doses	511	2	[0;4]*
Total polio doses < 3 doses	511	364	71.2

*Median polio doses; the interquartile range is given between brackets.

Concerning the number of polio vaccine doses received by the AFP cases, the median number of vaccine doses received was two (interquartile range: zero to four doses). A high proportion of AFP cases (71.2%) had less than three doses of polio vaccine.

Comparison of characteristics of Polio cases to non-polio cases

Table 5 offers summary information of this comparison. On bivariate analysis, polio was significantly associated with age, hospitalization, and vaccination status. 94.4% of polio cases were under 5 years old compared to 75.2% of the non-polio AFP cases (OR 5.6; 95% CI 1.3 - 23.7). 30.6% of polio cases had been hospitalized compared to 16.2% of the non-polio AFP cases (OR 2.3; 95% CI 1.1 - 4.8). 30 of 36 polio cases (83.3%) had received less than three doses of polio vaccine compared to 47.6% among the rest of the AFP population. This association between polio and vaccination status was strong and significant: OR 15.5; 95% CI 2.1; 114.5.

No significant differences were found between polio and non-polio cases in the following characteristics: male sex (OR 0.9; 95% CI 0.4 – 1.8), presence of fever (OR 0.9 [95% CI: 0.4 – 1.8]), sudden progression of paralysis (OR 0.5; 95% CI 0.2 – 1.2]), and symmetry of limb paralysis (OR 1.2; 95% CI 0.5 – 2.6).

The three major signs of polio (sudden onset of asymmetrical paralysis and fever) were present together in 19.4% of the polio cases and in 15.6% of the non-polio cases. This difference was not statistically significant (OR 1.3; 95% CI: 0.5 – 3.1)

In multivariate analysis

The association between polio vaccine doses and wild poliovirus type 3 cases remained highly significant when controlling for age. Age was found to be an associated factor which improves the association between polio vaccine doses and WPV3.

Interaction term and linear trends were tested by using chi square for Likelihood ratio test, interaction terms such as (age group and sex) and linear trends (age) were found to not fit the data significantly better than those without the interaction terms and linear trends (Model with age and vaccine polio dose/WPV3).

Thus, after adjustment for age, polio cases were

more likely to have less than three polio vaccine doses compared to non-polio cases (adjusted OR 16.9; 95% CI: 2.3 - 125.0).Finally, polio cases were also more likely to be under 5 years old than non-polio cases, after adjustment for vaccination status (adjusted OR 6.3; 95% CI: 1.5-26.9).

Table V: Bivariate and Multivariate analysis of AFP cases (N=511)

Variables	Categories	Bivariate analysis		Multivariate analysis	
		Odds Ratio	95% CI	Odds Ratio	95% CI
Age	Age < 5 years old	5.6	1.3 - 23.7	6.3	1.5 - 26.9
Sex	Female	0.9	0.4 - 1.8		
Polio Vaccine Doses	Vaccine doses < 3	15.5	2.1 - 114.5	16.9	2.3-125.0
Hospitalization	Hospitalized	2.3	1.1 - 4.8		
Fever	Presence of fever	0.9	0.4 - 1.8		
Paralysis progression	Progression <= 3 days	0.5	0.2 - 1.2		
Asymmetrical	Paralysis asymmetric	1.2	0.5 - 2.6		
3 keys Polio signs together	Yes	1.3	0.5	3.1	

1.2 Polio immunization coverage and number of children at risk of WPV3 before the onset of the epidemic in 2011

OPV3 vaccination coverage was below 80%, except in 2010. In the year 2006, this coverage in the country started to decrease from 76% to reach 58% in 2008. This coverage increased afterwards to reach 81% in 2010 and then decreased in 2011 to reach 58%.

We determined the number of unvaccinated children against polio from 2006 to 2010. In total there was an accumulation of 807,930 unvaccinated children (27%) during the five years.

Table VI: Evolution of the number of children not vaccinated per year in CI from 2006 to 2010

Years	2006	2007	2008	2009	2010	Total	Proportion
Total population	16996000	17949000	18260000	18601000	18977000		
Children under 1 year old	567000	598000	611000	625000	642000	3043000	
Children vaccinated	430920	448500	354380	481250	520020	2235070	73%
OPV3 Coverage	76%	75%	58%	77%	81%		
Children not vaccinated	136080	149500	256620	143750	121980	807930	27%
Total children Not vaccinated accumulated during 5 years						807930	27%

Before the epidemic in 2011, there were several polio NIDs in response to WPV1 outbreaks but these campaigns were implemented with monovalent OPV type 1.

Response to the epidemic

From the notification of the first case of WPV3 in Côte d'Ivoire in 2011, the Ministry of Health and its partners (WHO, UNICEF…) tried to implement activities to control the polio epidemic but the ongoing political and military crisis hampered the implementation of the activities.

All the WPV3 cases of 2011 were investigated, but many of these investigations were conducted late due to the crisis situation.

During the year 2011, seven polio NIDs were organized in the country. The first campaign was implemented from May 27th to May 30th, five months after the index case.

The polio outbreak was interrupted in July as the date of onset of the last case was on 24 July 2011. This outbreak was interrupted after the two first campaigns.

During the polio outbreak in 2011, the national EPI implemented activities to reinforce AFP surveillance in the country.

511 AFP cases were reported in 2011, 36 of them were WPV3 cases according to laboratory results.

In response to the polio epidemic, the country carried out activities to strengthen routine EPI but the results were poor. At the end of 2011, the routine EPI coverage of OPV3 was 58%.

DISCUSSION

After more than 10 years without polio epidemic of type 3 wild poliovirus, in 2011, Côte d'Ivoire faced an outbreak of the wild poliovirus type 3. The median age of WPV3 cases was two years old (interquartile range two to four years old). Thirty-five out of 36 polio cases were less than five

years old. The results from our study are similar to a WHO statement indicating that polio mainly affects children under 5 years old.[1] However, our observation differs from a study conducted in the Democratic Republic of Congo (DRC) reporting that 58% of 34 cases of WPV were over 15 years old. The ratio of boys to girls was 1.6:1.0 which is almost similar to the epidemic in DRC where the sex ratio was 1.7.[5]

Among the polio cases in the 2011 Côte d'Ivoire outbreak, most of the subjects (75%) were living in rural areas and the majority of them were living in precarious socio-economic conditions. A study in the Republic of Congo also reported poor living conditions as risk factor of polio epidemic.[6]

Regarding the number of polio vaccine doses received by WPV3 cases in routine immunization, 29 polio cases had less than 3 doses of polio vaccines. According to CDC, more than 95% of recipients seroconvert with 3 doses of polio vaccine.[1] In Pointe-Noire (Republic of Congo), a study found low vaccination coverage (55.5%) for polio cases. In Tajikistan, the main factor driving the development of an outbreak was inadequate population immunity against poliovirus.[8]

Before the epidemic, WPV3 was circulating in the West African region particularly in Nigeria, Niger, Benin and Mali from 2008 to 2010. The circulation of WPV3 in the region may have driven the outbreak as neighboring countries were in epidemic of WPV3. Genetic sequencing has enabled WHO to identify the WPV3 epidemic in Côte d'Ivoire as an importation of WPV3 from Nigeria (11;12).

Regarding acute flaccid paralysis surveillance, its objectives are to identify areas with WPV transmission and areas with low AFP reporting where polio cases might go undetected.[13] The AFP surveillance system in Côte d'Ivoire had poor indicators before the epidemic as reported in 2010. In that year, only 47% of the districts reached the two major indicators of AFP surveillance (rate of non-polio AFP and proportion of stools collected in

14 days).

Thus, the country could have failed to detect the polio outbreak before 2011 as the surveillance indicators were weak. Even in 2011, from January to April, there were gaps in the AFP surveillance as the country was not able to strengthen its AFP surveillance during the conflict period. An analysis of virus sequences done by the CDC provided evidence that AFP surveillance of varying qualities had missed chains of WPV transmission during 2011 in Côte d'Ivoire.[13]

The study on immunization status of AFP cases in 2011 showed that the median number of doses was two (interquartile range zero to four doses). Among AFP cases, 71.2% received less than three doses of polio vaccine. In a study in China, out of the 578 AFP cases reported in 2011 in the region of Xinjiang, only 127 (22%) had received 3 doses or more OPV.[15] The number of vaccine doses received by AFP cases could be an important indicator of children immunization in countries.

Comparing polio cases to non-polio AFP cases, 94.4% of polio cases were under 5 years old while 75.2% of the non-polio AFP cases were less than 5 years old. After adjustment for vaccination status (adjusted OR 6.3; 95% CI: 1.5-26.9) polio cases were more likely to be under 5 years old than non-polio cases. These results are in line with WHO statements on age of polio cases.[1]

Regarding vaccination status, after adjustment for age, polio cases were more likely to have less than three polio vaccine doses compared to non-polio cases (adjusted OR 16.9; 95% CI: 2.3 - 125.0). In China, the non-polio cases received 3 doses or more OPV than polio cases.[15] Also in Angola, case-patients were more likely than control-subjects to be under-vaccinated with less than four routine doses of oral poliovirus vaccine with an odds ratio of 4.1 (95% confidence interval 1.2–13.6).[16] A study in Nigeria on AFP cases, wild poliovirus was only detected in children not vaccinated or uncompleted vaccinated.[17]

Although these children with non-polio AFP are not representative of other children in the country, their vaccination status could reflect that polio cases were less vaccinated than other children. In addition, among the AFP cases who received 3 doses of polio vaccine, many of them were not protected against poliovirus type 2 and type 3 because they just received monovalent type 1 during Supplementary Immunization Activities (SIA).

Concerning polio immunization in Côte d'Ivoire from 2006 to 2010, there was an accumulated number of 807,930 children not vaccinated for OPV3; meaning that 27% of the children, who were expected to be vaccinated in that period, were not vaccinated. A study in Angola showed weak routine vaccination coverage (from 46% in 2005 to 75% in 2008) before the onset of epidemics in 2007 and 2008.[16] In another study on a massive polio outbreak caused by type 3 wild poliovirus in Angola in 1999, low routine OPV coverage (45% in 1998) was found to be a major factor that contributed to this outbreak.[18]

Over several years, the routine immunization coverage in Côte d'Ivoire was less than the minimum coverage admitted by WHO in routine immunization which is 80%. The data on OPV coverage in Côte d'Ivoire in this study are based on administrative coverage of the country. The number of non-vaccinated children could be even higher if this analysis was based on the coverage obtained during the evaluation of the national EPI in 2010 where OPV3 coverage was found to be 57%.

In the period before the outbreak in Côte d'Ivoire in 2011, there were several immunization campaigns against WPV1 epidemics. The vaccine used during these SIAs was the monovalent polio vaccine type 1 (mOPV1) as monovalent OPV is more effective than trivalent OPV to produce immunity[19] and there were several WPV1 outbreaks before 2011. Children non-immunized by trivalent routine vaccine could be protected by the campaigns. Unfortunately, the NIDs were implemented with monovalent type 1 only.

These children were therefore susceptible to wild poliovirus type 2 and type 3. In India, SIA rounds were conducted each year from 2007 to 2009 with tOPV, mOPV1 or mOPV3 in different areas depending on serotype specific assessment.[20] The introduction of bivalent OPV 1& 3 reduced by 95% the number of polio cases in 2010 compared to 2009.[21] These studies show that the type of polio vaccine used in polio SIAs is an important element in the eradication of polio.

We think that factors that could have led to this outbreak after importation of WPV3 include the low coverage of OPV of routine immunization, vaccination during polio SIAs with monovalent type 1 and precarious socio-economic conditions of the population.

According to Patriarca PA, the most common cause for the persistence of poliomyelitis in developing countries has been the failure of routine immunization programs to provide three or more doses of poliovirus vaccine to a high proportion of children.[22]

Following this outbreak of wild poliovirus type 3 in Côte d'Ivoire, the Ministry of Health and its partners (WHO, UNICEF ...), implemented activities to interrupt polio transmission in the country. However, the investigation of WPV3 cases was delayed. The first SIAs against the polio outbreak was held five months after the date of onset of the outbreak index case. Epidemiological surveillance was strengthened only five months after the index case was found.

The delay in the response to the outbreak could be linked to the 2010 Côte d'Ivoire post-election crisis. Polio epidemic control can be very challenging in conflict environment. For instance in Afghanistan and Pakistan, WPV circulation in high-risk districts continued because of difficulties of reaching children in conflict-affected areas and operational limitations in parts of Pakistan.[23] There were several

similar situations where conflicts affected polio eradication process like in Syria, Sudan and Colombia.[24]

The 2011 Côte d'Ivoire WVP3 epidemic was stopped after two response campaigns with bivalent OPV type 1 and type 3. Four polio NIDs were held after the last case in 2011 although the GPEI recommends only 2 NIDs after the last WPV case. In DRC, in the epidemic of Kinshasa, several polio NIDs were held after the last polio case.[5]

Although the epidemic was stopped in July 2011, we think that the delay in implementation of response activities has been a factor in the spread of the epidemic across the country and in the neighboring countries such as Mali and Guinea Conakry.

According to GPEI, the time taken to detect and respond to an outbreak has been shown to be one of the most critical factors in limiting the size of an outbreak.[25] In a study, using mathematic modeling to evaluate the response scenarios to potential polio outbreaks, Thomson found that delay in response represents a crucial risk factor for occurrence of large outbreaks.[26]

This study has several limitations as the study design was retrospective, using AFP surveillance routine data, WPV3 investigation data and routine immunization data. The data on WPV3 were collected for the purpose of epidemic investigation and the available data are only on polio cases (case series).

It was difficult in this study to make some comparisons as it was not set up to include a control group. The data of AFP cases, there was a comparison group (non-polio AFP cases) but this group is not representative of the general population.

CONCLUSION

Overall, this study shows that AFP surveillance was poorly performed before the 2011 Côte d'Ivoire

WPV3 epidemic, and that 81% of the polio cases had not been vaccinated. A large majority of polio cases were living in precarious socio-economic conditions. There were an accumulated number of 807,930 non-vaccinated children against polio. This means that more than 27% of children were not vaccinated for trivalent OPV in routine immunization. Children were vaccinated with monovalent type 1 during polio SIAs. Finally WPV3 was circulating in neighboring countries of Côte d'Ivoire since 2008 (Genetic sequencing showed that the first cases were imported from Nigeria). All these factors could have contributed to the epidemic of WPV3. These factors are some of the risk factors GPEI found to be contributing to polio outbreak.[25]

Despite the limitations, this study shows that a country which interrupted polio transmission for one type of poliovirus can still be at high risk for polio outbreaks of this same type following an importation when routine immunization coverage is low, polio supplementary immunization activities is done with only the poliovirus vaccine against the circulating poliovirus, people live in precarious socio-economic conditions and AFP surveillance is poorly performed. Côte d'Ivoire experienced this outbreak as many of these conditions occurred together.

The delay in the response to this outbreak may have contributed to the spread of the disease in the whole country and in neighboring countries. The response activities to the epidemic were not carried out in time. In Côte d'Ivoire, this delay was partly due to a conflict environment.

This outbreak emphasizes the necessity to reach and maintain high immunization coverage to prevent polio outbreaks, to select the appropriate polio vaccine combination during polio SIAs, to design an emergency plan particularly in countries at risk of conflict and to maintain high quality AFP surveillance to quickly identify and respond to any potential cases of polio before an outbreak intensifies.

ANNEXES:

Tables VII: Population characteristics in CI (Source: NIS)

Indicators	Values	Years and source*
Birth rate	35,7 per 1000	2011 (NIS)
Crude mortality rate	12,9 per 1000	2011 (NIS)
Life expectancy at birth	53,1 years	2011 (NIS)
Average annual population growth	2,6%	2011 (NIS)
Fertility rate	4,8 children per woman	2011 (NIS)
Proportion of people living in poverty	48.9	2011
Human development index	0.43	2011

Table IX : Number of polio cases in western Africa from 2008 to 2011 (source WHO website)

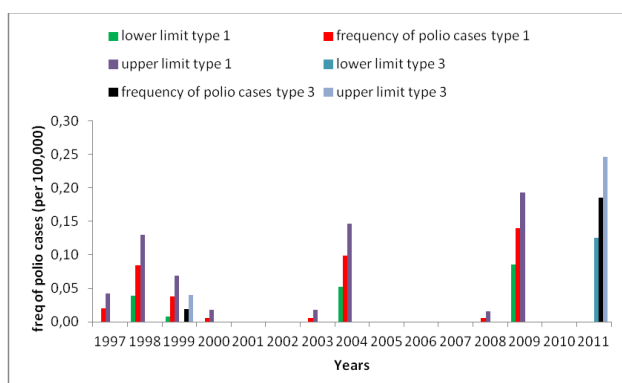| Country or territory	WPV in 2008	WPV in 2009	WPV in 2010	WPV in 2011
Benin*	6	20	0	0
Burkina Faso	6	15	0	0
Cape Verde	0	0	0	0
Côte d'Ivoire*	1	26	0	36
Gambia	0	0	0	0
Ghana	8	0	0	0
Guinea*	0	42	0	3
Guinea-Bissau	0	0	0	0
Liberia	0	11	2	0
Mali*	1	2	4	7
Mauritania	0	13	5	0
Niger*	12	15	2	5
Nigeria*	798	388	21	62
Sao Tome and Principe	0	0	0	0
Senegal	0	0	18	0
Sierra Leone	0	11	1	0
Togo	3	6	0	0

*Countries with WPV3 circulation

Figure 2:Evolution of WPV cases in Côte d'Ivoire from 1997 to 2010

Table VIII: polio NIDs in Côte d'Ivoire in 2009 and 2010 (source National EPI database)

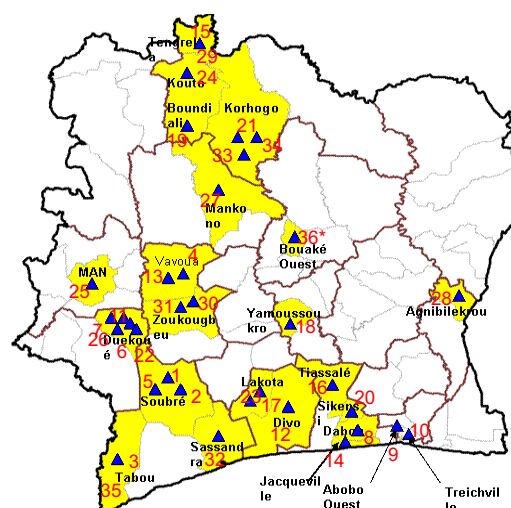| Years	2009	2010
Total Number of Polio NIDs	7	3
Number of Polio NIDs with Monovalent type 1	7	3
Number of Polio NIDs with Monovalent type 3	0	0
Number of Polio NIDs with Trivalent	0	0
Number of Polio NIDs with Bivalent type 1 and 3	0	0

Figure 3
Geographic distribution wild poliovirus cases in Côte d'Ivoire in 2011 (*number represent the sequences of cases occurrence).

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