

Epidemiological Surveillance of Poliomyelitis During the Military and Political Conflict in the Central African Republic, 2013 and 2014

Alain Farra,^{1,a} Ella C. Gonofio,¹ Alexandre Manirakiza,² Arthur Mazitchi,¹ Raphaël Mbailao,³ Casimir Manengu,⁴ and Ionela Gouandjika-Vasilache¹

¹Enteric Viruses and Measles Laboratory, Institut Pasteur de Bangui; ²Epidemiology Unit, Institut Pasteur de Bangui; ³Expanded Programme on Immunization, Ministry of Health, Bangui; ⁴Focal Point for Immunization, Vaccines and Emergencies, World Health Organization, Bangui

Background. Since December 2012, the Central African Republic (CAR) has been undergoing a severe military and political conflict. This situation has resulted in general insecurity and total disorganization of surveillance activities, including those for acute flaccid paralysis (AFP). In this study, we used laboratory data to evaluate surveillance of AFP in 2013 and 2014, the most critical period of the conflict.

Methods. The laboratory data on AFP were analyzed retrospectively for the age, sex, vaccination status (oral poliovirus vaccines), and geographical origin of the samples. The χ^2 test was used, with $P < .05$ as the threshold for significance.

Results. Decreased activity of AFP surveillance of 57% was registered in 2013 and 36% in 2014 compared with previous years. Only 37.3% and 49.7% of children with AFP were vaccinated in 2013 and 2014, respectively, but no wild poliovirus or vaccine-derived poliovirus (VDPV) was isolated. Laboratory performance concerning the timeliness of cell culture and intratypic differentiation/VDPV results was only 65.5% and 66.7% of the target in 2013 but reached 95.5% and 100% in 2014.

Conclusions. All personnel involved in the monitoring of AFP must be mobilized to improve vaccination coverage and surveillance activities in the CAR.

Keywords. AFP; military; monitoring; political crisis.

In 1988, the World Health Organization (WHO) launched the polio eradication initiative, which has been effective in 3 of the WHO regions: the Region of the Americas, the European Region, and the Western Pacific Region. Poliomyelitis remains endemic only in Afghanistan and Pakistan [1–7].

In the Central African Republic (CAR), the last case of wild poliovirus infection was isolated in November 2011; therefore, active surveillance of cases of acute flaccid paralysis (AFP) should place the country on track for certification as poliomyelitis-free [8]. Since December 2012, however, the country has been undergoing a severe military and political crisis. This situation has caused not only general insecurity throughout the country but also severe, chronic disruption of the health system, including surveillance for AFP. We used laboratory data

to evaluate the level of surveillance for AFP in 2013 and 2014, when the crisis was particularly severe.

METHODS

Study Type, Population, and Geographical Origin

The active surveillance database for AFP of the WHO reference laboratory for poliomyelitis in the CAR, housed at the Institut Pasteur de Bangui, was analyzed retrospectively for data from 2013 and 2014. Samples were obtained during surveillance in the 7 health districts of the country. Although the target population is children aged 0–5 years, some samples were taken from relevant cases among people aged over 15 years.

Sampling and Transport

Fecal samples were taken and transported to the laboratory according to WHO recommendations: 2 samples taken at an interval of 24–48 h within 14 days of paralysis were sent to the laboratory within 3 days of the second sampling, and the cold chain was maintained throughout. On arrival at the laboratory, the adequacy of the samples was determined; those deemed adequate consisted of 2 aliquots of at least 10 grams, which were properly labeled and maintained at 4–8°C [9–11].

Treatment of Samples and Isolation of Virus by Cell Culture

The samples were first treated with chloroform and penicillin plus streptomycin in a 20% solution of phosphate-buffered saline. The supernatants were inoculated with RD and L20B cell

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^aPresent affiliation: Laboratory of Mycobacteria, Institut Pasteur de Bangui BP: 923 Bangui, Central African Republic.

Correspondence: A. Farra, MD, MSc, Diploma (Medical Biology), Enteric Viruses and Measles Laboratory, Institut Pasteur de Bangui, BP 923, Central African Republic (farra_alain@yahoo.fr).

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lines and observed for a maximum of 14 days, according to the WHO protocol [12, 13].

Intratyptic Differentiation and Vaccine-Derived Poliovirus

If poliovirus was suspected, the viral genome was amplified by real-time, reverse-transcriptase polymerase chain reaction (PCR) in a Fast 7500 (Applied Biosystems) to determine whether it was a Sabin-like strain. If it was, it was amplified in a second real-time PCR to determine whether it was a pure vaccine strain or a vaccine-derived poliovirus [14–21].

Statistical Analysis

The results were analyzed with Epi Info 7, and graphs were plotted in Excel. Descriptive analyses of sociodemographic characteristics included age, sex, vaccination status, and health district. The χ^2 test was used, with $P < .05$ as the threshold for significance.

Ethical Approval

This surveillance project (Arrêté n°0277/MSPP/CAB/DGSP/DMPM/SMEE du 05 Août 2002) was ethically approved by the expert committee for AFP control program of the Ministry of Health in CAR [22].

RESULTS

Annual Numbers of Samples Collected by Acute Flaccid Paralysis Surveillance Between 2007 and 2014

To clarify the impact of the crisis on surveillance in 2013 and 2014, we quantified the numbers of samples registered in the laboratory from 2007, the year in which the data were available, until 2012, calculated the mean, and compared it with those received in 2013 and 2014. Figure 1 shows that a mean of 274 samples (minimum 265; maximum 295) were collected each year before 2013, well above the 150 samples per year requested by WHO. In 2013, only 118 stools had been registered at the laboratory, representing 43% (118 of 274) of the mean notified before 2013. In 2014, with 177 samples registered, active monitoring of the AFP had reached 64% (177 of 274) of the mean before 2013.

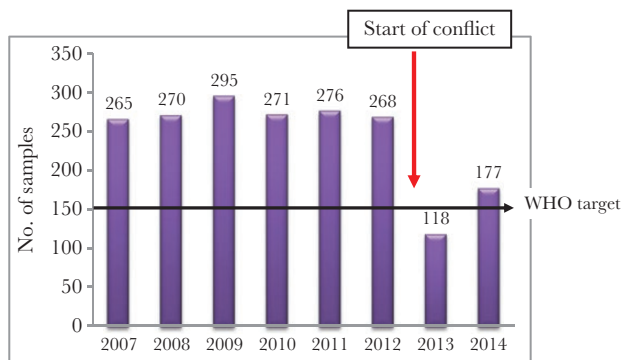


Figure 1. Numbers of samples received, 2007–2014. Abbreviation: WHO, World Health Organization.

State of the Samples on Arrival at the Laboratory

On arrival at the laboratory, 81% (95 of 118) of the samples were of adequate quality in 2013 and 86.4% (153 of 177) in 2014.

Numbers of Samples by Age Group, Sex, and Vaccination Status

Most samples were collected from children aged 0–5 years in both 2013 (52.5%, 62 of 118) and 2014 (68.4%, 121 of 177) (Figure 2). Three samples in 2014 were from people over 15 years of age. The difference between the age groups was statistically significant ($\chi^2 = 4.4$; $P = .02$). Males gave 64.4% of the samples (76 of 118) in 2013 and 52.3% (92 of 177) in 2014, but the difference between the 2 sexes was not significant ($\chi^2 = 2.16$; $P = .07$). The records of samples indicate only the date of the latest dose of vaccine; the number of doses of oral poliovirus vaccine was not reported. The date of the latest dose of vaccine was reported for only 37.3% (44 of 118) of samples in 2013 and 49.7% (88 of 177) in 2014.

Numbers of Samples per Health District

Most samples were from health district 7 in both 2013 and 2014, followed by health districts 2 and 4; the fewest samples were registered from health district 6 (Figure 3). The difference between health district 7 and the others was not significant ($\chi^2 = 0.11$; $P = .37$).

Virus Isolation by Cell Culture

Only 2.5% (3 of 118) of cultured samples were suspected of containing poliovirus in 2013 and 8.5% (15 of 177) in 2014. Samples suspected of containing poliovirus are L20B positives [12, 23]. Nonpolio enteroviruses represented 26.3% (31 of 118) of isolates in 2013 and 29.4% (52 of 177) in 2014 (Table 1).

Intratyptic Differentiation and Vaccine-Derived Poliovirus

No wild-type poliovirus was isolated in either 2013 or 2014. Three vaccine strains were found in 2013 and 12 were found in 2014, with a predominance of type 1 in 2014 (9 of 12). No vaccine-derived poliovirus was isolated (Table 2).

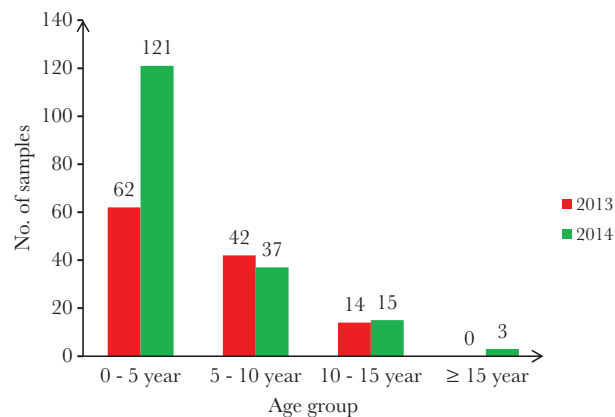


Figure 2. Numbers of samples per age group, 2013 and 2014.

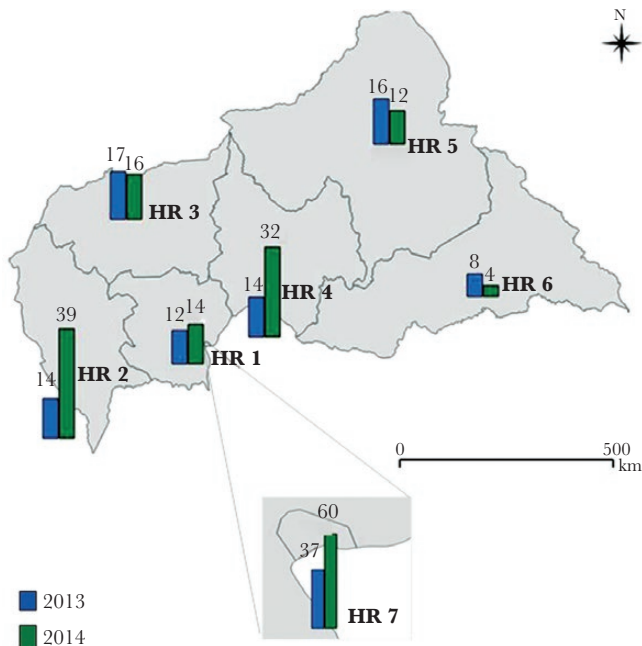


Figure 3. Numbers of samples per health region (HR), 2013 and 2014.

Performance of Surveillance and the Laboratory

The criteria for evaluating the performance of surveillance were as follows: (1) collecting 2 samples within 14 days of the appearance of AFP, (2) reception by the laboratory no longer than 3 days after the second sampling, and (3) the adequacy of the samples. The criteria for the performance of the laboratory were as follows: timeliness of cell culture and intratypic differentiation and vaccine-derived poliovirus results (Table 3).

In 2013 and 2014, the target of collecting samples within 14 days (80%) of the appearance of paralysis was met (90.7% and 81.4%, respectively); however, the delay for sending samples to the laboratory was not met in 2013 (72.4%) nor in 2014 (70.5%) (Table 3). Neither criterion of laboratory performance was met in 2013 (65% for cell culture and 66.7% for intratypic differentiation and vaccine-derived poliovirus), but both were attended in 2014 with 95.5% and 100%, respectively (Table 3).

DISCUSSION

This study shows a significant decrease in surveillance activities in 2013 and 2014, with markedly fewer samples registered at the laboratory and a clear decrease in laboratory performance in 2013. Between 2007 and 2012, before the conflict, the laboratory

Table 1. Results of Cell Culture, 2013 and 2014

Result	2013	2014	Total
Suspected poliomyelitis	3 (2.5%)	15 (8.5%)	18 (6.1%)
Nonpolio enterovirus	31 (26.3%)	52 (29.4%)	83 (28.1%)
Negative	84 (71.2%)	110 (62.1%)	194 (65.8%)
Total	118 (100%)	177 (100%)	295 (100%)

registered more than 260 samples per year, well above the target of 150 samples required by WHO. In 2013, a 57% decrease in registered samples was seen. In 2014, in response to this disquieting situation, the Ministry of Health and partners, in particular WHO, strengthened surveillance despite the security problems, and the laboratory recorded 177 samples, for a 50% improvement over 2013.

Surveillance in Africa is strongly affected in zones of insecurity, such as certain cities in Nigeria and in North Kivu in the Democratic People's Republic of the Congo, where there are armed militias, which make it difficult to conduct active case finding for AFP [24, 25]. However, it should be noted that even in countries such as South Africa, the number of samples collected between 2005 and 2009 did not meet the target, even though there was no armed conflict [9]. Thus, surveillance performance can be affected not only by military and political crises and the presence of armed groups but also by inadequate surveillance.

Although we found a predominance of cases in males, the difference between the sexes was not statistically significant, in accordance with other studies [9, 26]. More cases were found among children under 5 years than in older children, as reported elsewhere [9, 27], underlining their vulnerability to several endemic diseases, including poliomyelitis.

Although all 7 health districts sent samples, most samples were received from health district 7, which includes Bangui, the capital, and its surroundings, and from health district 2, which is a region neighboring Cameroon. In Bangui and nearby areas, activities were resumed during the crisis due to the strong presence of international forces. Health district 2 was less affected by the security crisis, and, furthermore, isolation of wild poliovirus among Central African refugees from health district 2 in Cameroon in 2013 led to intensified surveillance in this region. In the other health districts, the security situation seriously compromised active case-seeking for AFP and the transport of samples to Bangui, because the focal points were not present. The recent epidemic of Ebola virus disease, which affected some provinces of the Democratic People's Republic of the Congo, made certain humanitarian organizations unwilling to transport samples. Nevertheless, the literature shows that surveillance varies from one region to another, even in the absence of conflict [9, 28].

No wild virus was isolated in the laboratory; only vaccine strains were identified. Because the last case of poliomyelitis due to wild strains was found in 2011, the CAR should be moving towards certification as poliomyelitis-free; however, the low national vaccination rates of 37% in 2013 and 49% in 2014 might compromise the strategy for eradication in the country [29].

Only 3 vaccine strains were isolated in 2013, probably due not only to the small number of samples registered in the laboratory that year but also to the reduction in vaccination and surveillance activities because of the conflict. The resumption of activities in 2014 explains the finding of 4 times as many vaccine strains that year.

Table 2. Results of Intratypic Differentiation and Vaccine-Derived Poliovirus Screening in 2013 and 2014

Year	Wild Poliovirus	Poliovirus Vaccine			Nonpolio Enterovirus	Vaccine-Derived Poliovirus	Total
		Type 1	Type 2	Type 3			
2013	0	1	2	0	0	0	3
2014	0	9	1	2	3	0	15

In both years, the type 1 vaccine strain predominated (11 of 15; 73%) over type 3. Similar results were reported from Ghana, where 75% of samples (21 of 28) were of type 1 [30]. However, a study in Bangladesh, China, the Islamic Republic of Iran, the Philippines, the Russian Federation, Sri Lanka, and Tunisia showed a predominance of types 2 and 3 vaccine poliovirus [31].

The rate of nonpolio enteroviruses was higher than in other countries in both 2013 and 2014 [9, 30]. This may be because the poliovirus laboratory at the Institut Pasteur in Bangui received fewer samples than in other countries, resulting in a low denominator and thus a higher rate. A study should be conducted on the role of nonpolio enteroviruses in the occurrence of AFP in the CAR.

The performance targets for surveillance with regard to sampling within 14 days of paralysis and the adequacy of the samples were met in both 2013 and 2014. However, transport to the laboratory took longer than the 3 days required by WHO, owing to the difficulty of movement in the provinces. Even in South Africa between 2005 and 2009, only 65% of samples were transported within 3 days, and in the African Region as a whole only 79% of samples were of adequate quality [9, 32, 33]. Good surveillance implies real commitment, mobilization of health personnel, and involvement of communities; otherwise, the performance targets cannot be met, irrespective of whether the country is in conflict.

In 2013, the timeliness of viral isolation and intratypic differentiation results were not met (65.5% and 66.7%), whereas the other countries in the WHO African Region reached at least 88% [32]. Because of the security situation, the Institut Pasteur

in Bangui was closed for 2 months, between December 5, 2013 and February 3, 2014. Furthermore, the only real-time PCR apparatus was not working. In 2014, when the security situation had improved and the machine had been repaired, the laboratory resumed optimal functioning, with rates of 95.5% for cell culture and 100% for intratypic differentiation.

CONCLUSIONS

This study demonstrates a decrease in active surveillance from cases of AFP in 2013 and 2014 during the military and political crisis in the CAR. The decrease was most marked in 2013, when both surveillance and laboratory performance were affected. The number of samples was reduced, and there were delays in transporting samples to the laboratory and in providing results. From 2014, all the performance indicators for both surveillance and laboratory work began to improve consistently.

Many children still live in internal displaced camps, and some regions of the country remain inaccessible because of the presence of armed militias. Peace and security are essential to allow health workers to resume their activities and become operational again to restore health services throughout the country.

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Table 3. Surveillance and Laboratory Performance, 2013 and 2014

Performance Indicator	Target	2013	2014
Samples taken within 14 days ^a	80%	90.7%	81.4%
Reception within 3 days ^b	80%	72.4%	70.5%
Adequacy of samples ^c	80%	81.0%	86.4%
Cell culture results within 14 days ^d	80%	65.5%	95.5%
Intratypic differentiation and vaccine-derived poliovirus results within 7 days ^e	80%	66.7%	100%

^aPercentage of cases of acute flaccid paralysis for which 2 samples were collected within 14 days.

^bPercentage of samples that arrived at the laboratory within 3 days.

^cPercentage of samples that arrived at the laboratory under good conditions (temperature <8°C, correct sample volume, no desiccation).

^dPercentage of samples for which results were provided within 14 days of their arrival at the laboratory.

^ePercentage of samples for which results were provided within 7 days of their arrival at the laboratory for intratypic differentiation.

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