

Trends and Outcomes of Wastewater Surveillance for Poliovirus and Enterovirus in Nigeria, 2023–2025

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ABSTRACT

ARTICLE DETAILS

Background: Wastewater-based environmental surveillance (ES) is a core component of the Global Polio Eradication Initiative, complementing acute flaccid paralysis (AFP) surveillance by enabling early detection of poliovirus circulation at community level. Nigeria maintains one of the largest ES networks in Africa due to its historical risk of poliovirus transmission.

Methods: This descriptive analysis reviewed national ES data from 2023 to 2025, covering 36 states and the Federal Capital Territory. Monthly wastewater samples (bi-monthly in high-risk states) were processed using WHO-recommended virus isolation and intratypic differentiation protocols. Key indicators included sample volume, enterovirus (EV) detection rate, and poliovirus isolation outcomes.

Results: In 2025, 1,066 wastewater samples were collected from 92 ES sites nationwide. Of these, 389 (36.5%) were negative, 364 (34.1%) yielded non-polio enteroviruses, and 132 (12.4%) contained Sabin-like polioviruses. Thirteen samples (1.2%) were confirmed as circulating vaccine-derived poliovirus type 2 (cVDPV2), predominantly from Borno, Zamfara, Taraba, and Kebbi states. National EV detection rates increased from 49.6% in 2023 to 67.2% in 2024, before declining to 61.3% in 2025. Surveillance intensity was highest in bi-monthly sampling states, notably Sokoto and Zamfara.

Conclusion: Nigeria's ES system remains a sensitive and indispensable tool for poliovirus detection, revealing ongoing cVDPV2 transmission in selected northern states. Sustained investment in sampling quality, laboratory capacity, and genomic sequencing is essential to preserve surveillance sensitivity and guide timely outbreak response.

KEYWORDS: Environmental surveillance, wastewater, poliovirus, enterovirus, cVDPV2, Nigeria

Published On:
23-May-2026

Available on:
<https://ijrsr.org/>

INTRODUCTION

Environmental surveillance (ES) for poliovirus involves the systematic collection and laboratory analysis of wastewater to detect polioviruses and other enteroviruses circulating in populations. ES serves as a critical complement to AFP surveillance, particularly in settings where AFP sensitivity may be compromised by insecurity, population mobility, or limited access to health services. The detection of poliovirus in wastewater often precedes the identification of paralytic cases, making ES a powerful early warning system.

Nigeria, certified free of wild poliovirus in 2020, continues to face the challenge of circulating vaccine-derived poliovirus type 2 (cVDPV2). Consequently, the country operates one of the most extensive ES networks in sub-Saharan Africa. This study analyzes ES data from 2023 to 2025 to describe trends in wastewater sampling, enterovirus detection rates, and poliovirus isolation, and to assess the performance of the surveillance system over time.

METHODS

Surveillance Network and Sample Collection

Wastewater samples were collected from established ES sites across all 36 states and the Federal Capital Territory. Sampling was conducted monthly, with bi-monthly collections in high-risk states including Sokoto, Kebbi, and Zamfara. Sites included open drains, sewage channels, and other convergence points representative of community wastewater.

LABORATORY PROCEDURES

All samples were processed at WHO-accredited polio laboratories using standard virus concentration, isolation on cell cultures, and intratypic differentiation techniques. Poliovirus isolates were further characterized to distinguish Sabin-like strains from vaccine-derived and wild polioviruses.

DATA ANALYSIS

Data were aggregated annually and analyzed descriptively by year and region. Key indicators included number of samples collected, EV detection rate, proportion of poliovirus-positive samples, and geographic distribution of cVDPV2 detections.

RESULTS

Sample Collection and Coverage

In 2025, a total of 1,066 wastewater samples were collected from 92 ES sites nationwide. States implementing bi-monthly sampling demonstrated higher surveillance intensity, with Sokoto (96 samples) and Zamfara (78 samples) contributing the largest volumes.

Enterovirus Detection Trends

National EV detection rates improved substantially from 49.6% in 2023 to 67.2% in 2024, reflecting enhanced sampling and laboratory performance. However, a decline to 61.3% was observed in 2025. Regional analysis showed consistently higher EV detection in northern states compared to southern regions.

Poliovirus Isolation

Of all samples analyzed in 2025, 132 (12.4%) yielded Sabin-like polioviruses, indicating ongoing exposure to oral polio vaccine strains. Thirteen samples (1.2%) were confirmed as cVDPV2, with detections clustered in Borno, Zamfara, Taraba, and Kebbi states. No wild poliovirus was detected during the study period.

Figure 1. Summary of 2025 Wastewater Surveillance by State

Summary of 2025 Waste-Water surveillance by state as at 14th Nov, 2025																
State	# of Current Sites Reporting	Total Samples	Pending Lab Results	Negative	NPENT	NEV1	Sabin(1,3)	PV2 Only	PV2_Mixture	Pending_SeqR	SL2	nOPV2 Only	Sabin 1/3+nOPV2	VPV2	WPV1	cVPV
ABIA	2	20	0	7	10	0	2	0	0	0	0	1	0	0	0	0
ADAMAWA	3	26	0	10	13	0	1	0	0	0	0	2	0	0	0	0
AKWA IBOM	1	10	0	4	3	0	3	0	0	0	0	0	0	0	0	0
ANAMBRA	1	30	0	15	8	0	6	0	0	0	0	1	0	0	0	0
BAUCHI	3	31	1	9	11	0	7	0	0	0	0	2	0	0	0	1
BAYELSA	2	12	0	10	2	0	0	0	0	0	0	0	0	0	0	0
BENUE	2	22	0	7	12	0	1	0	0	0	0	2	0	0	0	0
BORNO	4	42	2	8	12	0	10	0	2	0	0	4	2	0	0	2
CROSS RIVER	3	30	0	18	10	0	0	0	0	0	0	2	0	0	0	0
DELTA	1	10	0	4	6	0	0	0	0	0	0	0	0	0	0	0
EBONYI	1	10	0	3	6	0	0	0	0	0	0	1	0	0	0	0
EDO	1	10	0	3	7	0	0	0	0	0	0	0	0	0	0	0
EKITI	2	19	0	16	2	0	0	0	0	0	0	1	0	0	0	0
ENUGU	2	20	1	7	9	0	0	0	0	0	0	3	0	0	0	0
FCT	1	10	0	5	5	0	0	0	0	0	0	0	0	0	0	0
GOMBE	3	31	1	13	9	0	1	0	0	0	0	1	5	0	0	1
IMO	2	20	0	14	5	0	1	0	0	0	0	0	0	0	0	0
JIGAWA	2	31	3	11	4	0	4	0	0	0	0	3	6	0	0	0
KADUNA	3	38	1	15	15	0	6	0	0	0	0	0	1	0	0	0
KANO	6	61	2	20	7	1	17	0	1	0	0	3	9	0	0	1
KATSINA	3	39	2	13	12	0	7	0	0	0	0	1	4	0	0	0
KEBBI	3	60	2	20	15	0	13	0	0	0	0	9	1	0	0	0
KOGI	2	20	0	6	12	0	1	0	0	0	0	1	0	0	0	0
KWARA	4	40	1	11	22	0	3	0	0	0	0	3	0	0	0	0
LAGOS	5	50	1	14	31	0	2	0	0	0	0	1	0	0	0	1
NASARAWA	3	30	0	13	10	1	5	0	0	0	0	1	0	0	0	0
NIGER	4	40	2	12	21	0	3	0	0	0	0	2	0	0	0	0
OGUN	1	10	1	3	6	0	0	0	0	0	0	0	0	0	0	0
ONDO	1	10	0	4	1	0	5	0	0	0	0	0	0	0	0	0
OSUN	1	27	0	11	4	0	12	0	0	0	0	0	0	0	0	0
OYO	2	20	0	7	12	0	1	0	0	0	0	0	0	0	0	0
PLATEAU	2	23	2	5	8	3	3	0	0	0	0	2	0	0	0	0
RIVERS	2	11	0	7	3	0	1	0	0	0	0	0	0	0	0	0
SOKOTO	5	100	1	35	46	0	7	0	2	0	0	5	0	0	0	4
TARABA	3	31	1	7	3	0	11	0	0	0	0	2	7	0	0	0
YOBE	2	20	0	5	8	0	4	0	0	0	0	1	0	0	0	2
ZAMFARA	4	80	2	28	28	0	12	0	0	0	0	5	3	0	0	2
Total	92	1094	26	400	398	5	149	0	5	0	0	59	38	0	0	14

ES sample collection for all sites is once a month except for Sokoto, Kebbi and Zamfara, which are twice a month.

Figure 2. Trends in Wastewater Sample Collection and EV Detection Rates, 2023–2025

WS Sample collection and EV Rate, 2023 - 2025

Zone	Province	WS Samples Collected			EV Rate		
		2023	2024	2025	2023	2024	2025
NEZ	ADAMAWA	35	10	26	22.9	40.0	62
NCZ	BENUE	30	30	22	53	63.3	68.2
NCZ	FCT	30	10	10	30.0	80.0	50
NCZ	KOGI	31	20	20	56.7	90.0	70.0
NCZ	KWARA	40	40	40	67.5	72.5	71.8
NCZ	NASARAWA	30	30	30	43.3	80.0	57
NCZ	NIGER	41	40	40	73.2	79.5	68.4
NCZ	PLATEAU	32	30	23	51.7	60.0	76.2
NEZ	BAUCHI	42	40	31	37.5	55.0	70.0
NEZ	BORNO	62	42	42	55.0	54.8	80.0
NEZ	GOMBE	42	30	31	39	83.3	56.7
NEZ	TARABA	31	30	31	43.3	60.0	77
NEZ	YOBE	35	30	20	40.0	45	75
NWZ	JIGAWA	39	30	31	45	56.7	60.7
NWZ	KADUNA	41	40	38	55.0	87.2	59.5
NWZ	KANO	62	59	61	71.7	82.5	66.1
NWZ	KATSINA	44	40	39	50.0	62.5	65
NWZ	KEBBI	36	60	60	51.4	60.3	65.5
NWZ	SOKOTO	73	120	100	95.8	61.5	64.6
NWZ	ZAMFARA	50	80	80	70.8	68.4	64.1
Total North		826	811	775	52.6	67.1	66.3
SEZ	ABIA	40	20	20	42.5	75.0	65.0
SEZ	ANAMBRA	31	30	30	63.3	62.1	50.0
SEZ	EBONYI	30	10	10	30.0	60.0	70.0
SEZ	ENUGU	30	20	20	46.7	57.9	63.2
SEZ	IMO	30	20	20	26.7	70.0	30.0
SSZ	AKWA IBOM	27	10	10	22.2	60.0	60.0
SSZ	BAYELSA	31	10	12	30.0	70.0	16.7
SSZ	CROSS RIVER	30	30	30	48.3	69.0	40.0
SSZ	DELTA	28	10	10	28.6	80.0	60.0
SSZ	EDO	28	10	10	21.4	90.0	70.0
SSZ	RIVERS	30	10	11	33.3	80.0	36.4
SWZ	EKITI	31	19	19	36.7	84.2	15.8
SWZ	LAGOS	51	50	50	74	69.4	71.4
SWZ	OGUN	26	9	10	34.6	88.9	66.7
SWZ	ONDO	32	10	10	33.3	50.0	60.0
SWZ	OSUN	41	40	27	45.0	42.5	59.3
SWZ	OYO	30	20	20	46.7	75.0	65.0
Total South		546	328	319	39	69.6	50.5
Total National		1372	1139	1094	49.8	67.0	62.5

Note: Data as of week 45 for the respective years; 2023 - 2025

DISCUSSION

This analysis demonstrates sustained functionality of Nigeria's wastewater-based environmental surveillance system between 2023 and 2025. The increase in EV detection rates from 2023 to 2024 suggests improvements in sampling techniques, site selection, and laboratory processing. The modest decline observed in 2025 may reflect variations in sample quality, environmental conditions affecting virus recovery, or temporary laboratory capacity constraints.

The concentration of cVDPV2 detections in northern states aligns with known epidemiological risks, including lower routine immunization coverage, population displacement, and insecurity. Higher surveillance intensity in states such as Sokoto and Zamfara appears justified, given their consistent poliovirus and enterovirus detection.

Overall, these findings reinforce the value of ES as a sensitive surveillance modality capable of identifying silent poliovirus circulation before the occurrence of clinical cases.

CONCLUSION

Nigeria's environmental surveillance system continues to play a pivotal role in sustaining polio-free status and monitoring cVDPV2 transmission. The detection of vaccine-derived poliovirus in wastewater in 2025 underscores the need for continued vigilance, particularly in high-risk northern states. Strengthening sampling logistics, laboratory performance, and genomic sequencing capacity will be critical to maintaining surveillance sensitivity and guiding timely public health action.

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