CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Result Presentation

Table 4.1: Sociodemographic Characteristics of Respondents (N = 450)

Variable	*n*	%
Gender		
Female	244	54.22
Male	206	45.78
Age group		
18–30	96	21.33
31–40	195	43.33
41–50	124	27.56
51+	35	7.78
Current position		
Environmental Health Officer	194	43.11
Laboratory Scientist	113	25.11
Surveillance Officer	72	16.00
Health Facility Worker	66	14.67
Other	5	1.11
Years of experience		
Less than 5 years	86	19.11
5–10 years	210	46.67
11–15 years	111	24.67
Over 15 years	43	9.56

Sociodemographic Characteristics of Respondents

A total of 450 respondents participated in the study (Table 4.1). With respect to gender, 244 (54.2%) were female and 206 (45.8%) were male. In terms of age distribution, the largest proportion of respondents were aged 31–40 years (n = 195, 43.3%), followed by those aged 41–50 years (n = 124, 27.6%). Respondents aged 18–30 years accounted for 96 (21.3%), while those aged 51 years and above constituted the smallest group (n = 35, 7.8%). Regarding professional positions, Environmental Health Officers represented the largest category (n = 194, 43.1%), followed by Laboratory Scientists (n = 113, 25.1%), Surveillance Officers (n = 72, 16.0%), and Health Facility Workers (n = 66, 14.7%). A small proportion (n = 5, 1.1%) reported “Other” positions. With respect to years of professional experience, nearly half of the respondents (n = 210, 46.7%) reported 5–10 years of experience. This was followed by 111 (24.7%) with 11–15 years of experience, 86 (19.1%) with less than 5 years, and 43 (9.6%) with more than 15 years of professional experience.

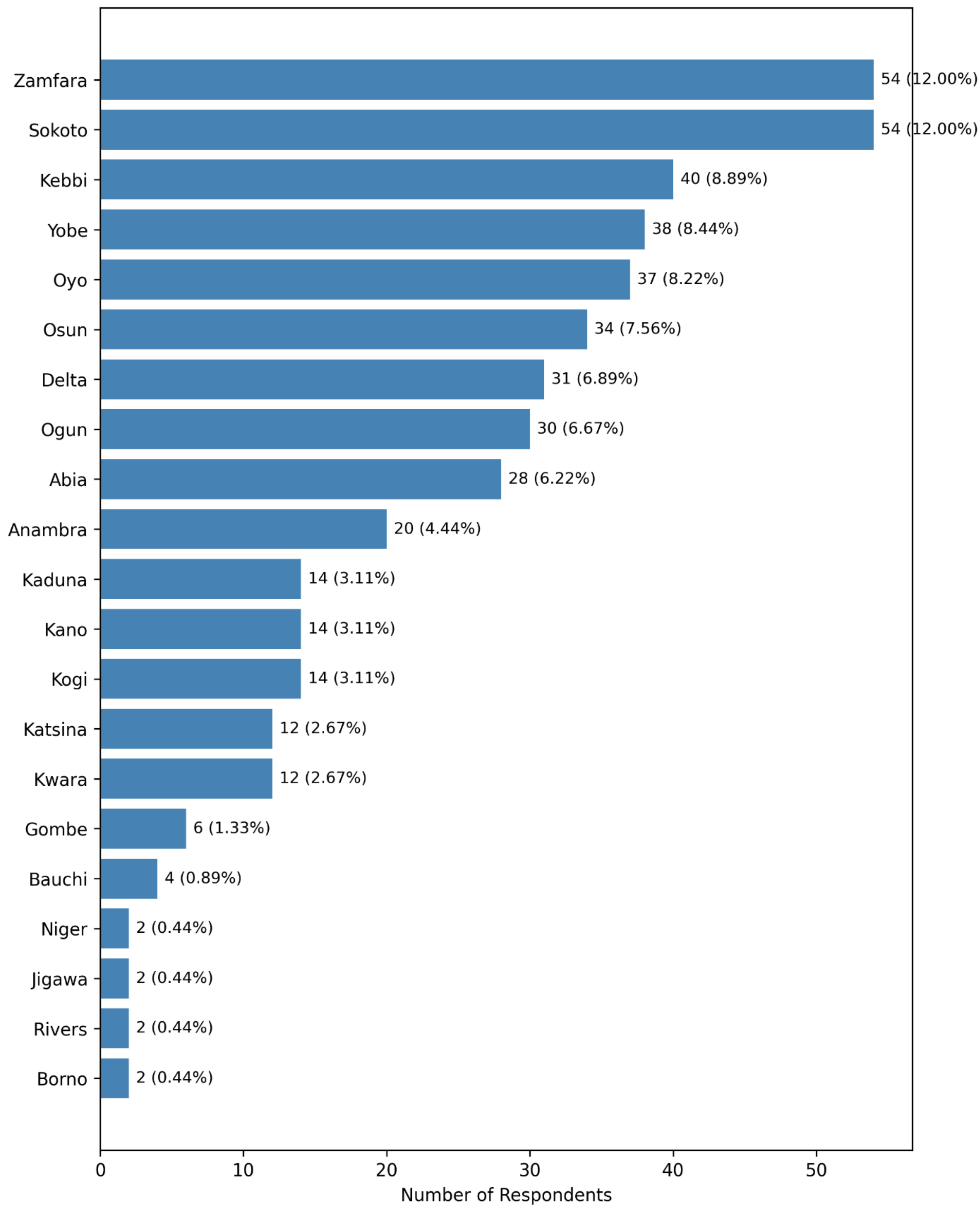

Figure 1: Location/State of Primary Assignment

State of Primary Assignment

Respondents were distributed across 21 states in Nigeria (Figure 1). The highest representation came from Zamfara (n = 54, 12.0%) and Sokoto (n = 54, 12.0%), followed by Kebbi (n = 40, 8.9%), Yobe (n = 38, 8.4%), Oyo (n = 37, 8.2%), and Osun (n = 34, 7.6%). Other notable states included Delta (n = 31, 6.9%), Ogun (n = 30, 6.7%), and Abia (n = 28, 6.2%). A smaller proportion of respondents were drawn from Anambra (n = 20, 4.4%), Kano (n = 14, 3.1%), Kaduna (n = 14, 3.1%), Kogi (n = 14, 3.1%), Katsina (n = 12, 2.7%), and Kwara (n = 12, 2.7%). Very few participants were from Gombe (n = 6, 1.3%), Bauchi (n = 4, 0.9%), Niger (n = 2, 0.4%), Jigawa (n = 2, 0.4%), Rivers (n = 2, 0.4%), and Borno (n = 2, 0.4%).

Table 4.2: Chi-Square Test of Association between Awareness/Training and Environmental Surveillance (ES) Participation

Variable	No (%)	Not Sure (%)	Yes (%)	χ^2	df	p-value
Awareness of ES activities				103.09	2	<0.001***
No	59 (13.1%)	50 (11.1%)	16 (3.6%)			
Yes	68 (15.1%)	43 (9.6%)	214 (47.6%)			
Formal training on ES				85.98	2	<0.001***
No	61 (13.6%)	56 (12.4%)	30 (6.7%)			
Yes	66 (14.7%)	37 (8.2%)	200 (44.7%)			
Familiarity with ES processes				104.93	4	<0.001***
Not familiar	15 (3.3%)	11 (2.4%)	27 (6.0%)			
Somewhat familiar	50 (11.1%)	37 (8.2%)	91 (20.2%)			
Very familiar	62 (13.8%)	45 (10.0%)	112 (24.9%)			

*** = p < 0.001; ** = p < 0.01.*

The results in Table 4.2 show a strong and statistically significant association between respondents' awareness, training, and familiarity with environmental surveillance (ES) activities and their participation in ES. Awareness of ES was significantly associated with participation, $\chi^2(2, N = 450) = 103.09$, $p < .001$. Among those who reported awareness of ES, 214 (47.6%) confirmed participation compared with only 16 (3.6%) among those not aware. Similarly, formal training on ES showed a significant association, $\chi^2(2, N = 450) = 85.98$, $p < .001$. Respondents who had received training were more likely to report ES participation (200, 44.7%) than those without training (30, 6.7%). Familiarity with ES processes (such as sewage sampling and laboratory testing) was also strongly associated with participation, $\chi^2(4, N = 450) = 104.93$, $p < .001$. Respondents who reported being very familiar with ES processes showed the highest participation (112, 24.9%), followed by those somewhat familiar (91, 20.2%), while those not familiar had much lower participation (27, 6.0%). These results suggest that awareness, training, and familiarity with ES processes are critical predictors of active engagement in ES activities. Increased sensitization and capacity building may therefore enhance participation rates.

Table 4.3: Cross-tabulation of State-by-State Environmental Surveillance Contribution to Early Detection of Poliovirus

State	No (%)	Not sure (%)	Yes (%)
Abia	21.43	57.14	21.43
Anambra	80.00	10.00	10.00
Bauchi	0.00	100.00	0.00
Borno	0.00	0.00	100.00
Delta	54.84	19.35	25.81
Gombe	0.00	0.00	100.00
Jigawa	100.00	0.00	0.00
Kaduna	0.00	0.00	100.00
Kano	0.00	0.00	100.00
Katsina	33.33	16.67	50.00
Kebbi	10.00	5.00	85.00
Kogi	28.57	71.43	0.00
Kwara	0.00	50.00	50.00
Niger	100.00	0.00	0.00
Ogun	46.67	33.33	20.00
Osun	47.06	23.53	29.41
Oyo	70.27	18.92	10.81
Rivers	0.00	100.00	0.00
Sokoto	22.22	22.22	55.56
Yobe	5.26	15.79	78.95
Zamfara	3.70	0.00	96.30

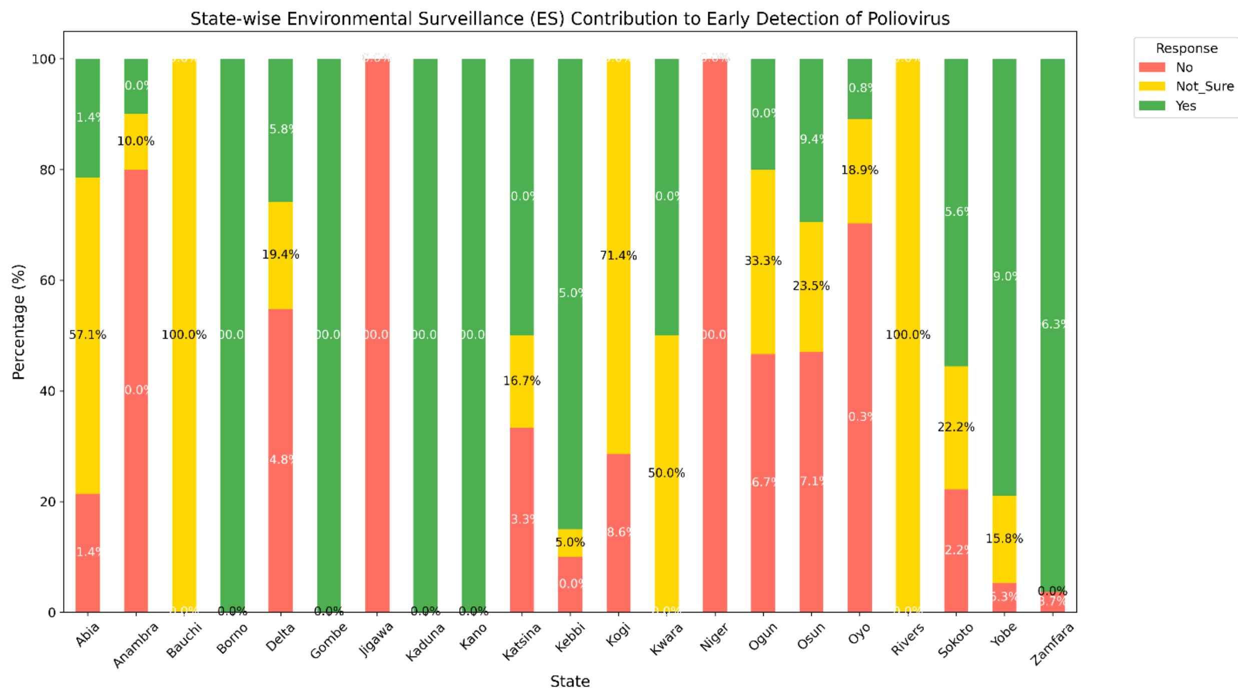

Figure 2: State-wise Environmental contributions to early detection of Poliovirus

Table 4.3 and figure 2 summarizes the perceived contribution of environmental surveillance to early detection of poliovirus across states. In states such as Borno, Gombe, Kaduna, Kano, Kebbi, Yobe, and Zamfara, respondents unanimously or predominantly reported that ES has contributed to early detection, with percentages ranging from 78.95% to 100%. Conversely, states including Anambra, Jigawa, Niger, and Rivers reported very low or zero affirmative contributions which show possible gaps in ES implementation or awareness. Several states, notably Abia, Delta, Ogun, Osun, and Oyo, showed substantial proportions of respondents unsure about ES contribution, ranging from 18.92% to 57.14%. These findings highlight significant variation in ES effectiveness perception by state, with some states demonstrating high operational contribution and others revealing either uncertainty or low impact. This state-level heterogeneity provides insight into geographical disparities in ES implementation and awareness.

Table 4.4: Chi-Square Test of Association between Roles/Effectiveness and Environmental Surveillance (ES)

Variable	No (%)	Not Sure (%)	Yes (%)	χ²	df	p-value
Primary role in ES for polio eradication				36.64	10	<0.001***
Data management/reporting	36 (8.0%)	12 (2.7%)	62 (13.8%)			
Laboratory analysis	31 (6.9%)	20 (4.4%)	42 (9.3%)			
Nurse officer	0 (0.0%)	0 (0.0%)	2 (0.4%)			
Routine inspection	30 (6.7%)	37 (8.2%)	42 (9.3%)			
Sample collection	4 (0.9%)	13 (2.9%)	22 (4.9%)			
Supervision/coordination	26 (5.8%)	11 (2.4%)	60 (13.3%)			
Work with both AFP and ES systems				113.89	2	<0.001***
No	69 (15.3%)	72 (16.0%)	40 (8.9%)			
Yes	58 (12.9%)	21 (4.7%)	190 (42.4%)			
Effectiveness of ES vs. AFP	AFP (%)	Both (%)	ES (%)	Not sure (%)	128.07	9
Don't know	2 (0.4%)	7 (1.6%)	0 (0.0%)	22 (4.9%)		
Equally effective	48 (10.7%)	98 (21.8%)	18 (4.0%)	13 (2.9%)		
Less effective	16 (3.6%)	39 (8.7%)	5 (1.1%)	6 (1.3%)		
More effective	38 (8.4%)	112 (24.9%)	18 (4.0%)	8 (1.8%)		

*** = p < 0.001; ** = p < 0.01.*

Table 4.4 presents the associations between respondents' roles, engagement with AFP surveillance, and perceptions of ES effectiveness. There was a significant association between respondents' primary role in polio eradication and ES participation, $\chi^2(10, N = 450) = 36.64$, $p < .001$. Those involved in supervision/coordination (60, 13.3%) and data management/reporting (62, 13.8%) reported higher ES participation compared with sample collection (22, 4.9%) or nursing officers (2, 0.4%). Working across both AFP and ES systems was also significantly associated with participation, $\chi^2(2, N = 450) = 113.89$, $p < .001$. Respondents engaged in both systems were far more likely to report ES participation (190, 42.4%) compared with those not working with both systems (40, 8.9%). Perceptions of effectiveness further revealed significant differences, $\chi^2(9, N = 450) = 128.07$, $p < .001$. Most respondents believed ES was more effective (112, 24.9%) or equally effective (98, 21.8%) when compared to AFP, while only a minority rated ES as less effective (5, 1.1%). Notably, a substantial group considered both systems complementary in effectiveness. These findings highlight the importance of role specialization, integration of AFP and ES, and perceptions of comparative effectiveness. Respondents most engaged in supervisory and dual-system roles were significantly more likely to recognize and participate in ES, underscoring the synergistic value of combining AFP and ES in polio detection.

Table 4.5: Cross-tabulation of Environmental Surveillance (ES) Effectiveness vs. System with Faster Virus Detection

ES Effectiveness	Acute Flaccid Paralysis (AFP)	Both	Environmental Surveillance (ES)	Not sure
Don’t know	6.45%	22.58%	0.00%	70.97%
Equally effective	27.12%	55.37%	10.17%	7.34%
Less effective	24.24%	59.09%	7.58%	9.09%
More effective	21.59%	63.64%	10.23%	4.55%

Table 4.5 presents respondents’ perceptions of environmental surveillance effectiveness relative to the system that detects poliovirus faster. Among respondents who did not know the effectiveness of ES, 6.45% indicated that Acute Flaccid Paralysis (AFP) detects faster, 22.58% indicated both systems detect at the same speed, 0.00% indicated ES alone detects faster, while the majority, 70.97%, were unsure. For respondents who rated ES as equally effective, more than half (55.37%) perceived that both systems detect viruses at similar rates, 27.12% indicated AFP, 10.17% indicated ES, and 7.34% were unsure. Among those who viewed ES as less effective, 59.09% reported that both systems detect faster, 24.24% indicated AFP, 7.58% indicated ES, and 9.09% were unsure. For respondents who perceived ES as more effective, 63.64% considered both systems equally fast, 21.59% indicated AFP, 10.23% indicated ES, and 4.55% were unsure.

Table 4.6: Chi-Square Test of Association between Operational Challenges and Environmental Surveillance (ES)

Challenge	No (%)	Not Sure (%)	Yes (%)	χ^2	df	p-value
Poor funding	52 (11.6%)	38 (8.4%)	106 (23.6%)	1.23	2	.542
Inadequate training	38 (8.4%)	38 (8.4%)	110 (24.4%)	10.83	2	0.004**
Sample collection difficulties	100 (22.2%)	61 (13.6%)	126 (27.9%)	20.50	2	<0.001***
Delay in lab analysis	98 (21.8%)	63 (14.0%)	92 (20.4%)	52.24	2	<0.001***
Insecurity in sampling areas	113 (25.1%)	69 (15.3%)	118 (26.2%)	55.24	2	<0.001***
Logistical/transport issues	100 (22.2%)	53 (11.8%)	80 (17.8%)	64.59	2	<0.001***
Lack of community awareness	72 (16.0%)	33 (7.3%)	148 (32.9%)	22.43	2	<0.001***

*** = p < 0.001; ** = p < 0.01.*

The associations between operational challenges and ES participation are presented in Table 4.6. Poor funding was not significantly associated with ES participation, $\chi^2(2, N = 450) = 1.23$, $p = 0.542$. This suggests that although funding constraints exist, they did not show a strong direct relationship with individual-level participation in ES activities. In contrast, inadequate training was significantly associated, $\chi^2(2, N = 450) = 10.83$, $p = 0.004$. Respondents citing inadequate training were more likely to report participation (110, 24.4%), indicating that lack of skills influences engagement patterns. Other operational challenges also showed strong significant associations with participation. These include sample collection difficulties, $\chi^2(2, N = 450) = 20.50$, $p < 0.001$; delays in laboratory analysis, $\chi^2(2, N = 450) = 52.24$, $p < .001$; insecurity in sampling areas, $\chi^2(2, N = 450) = 55.24$, $p < .001$; logistical/transport issues, $\chi^2(2, N = 450) = 64.59$, $p < 0.001$; and lack of community awareness, $\chi^2(2, N = 450) = 22.43$, $p < .001$. While funding was not statistically significant, most operational challenges which include training deficits, security risks, laboratory delays, logistics, and low community awareness were significantly associated with ES participation. These findings emphasize that strengthening technical capacity, ensuring timely laboratory analysis, addressing transport barriers, and engaging communities are crucial for effective ES implementation.

Table 4.7**:** High-Risk States Summary: ES Contribution, AFP Faster Detection, and Operational Challenges

State	ES Contribution (%)	AFP Faster (%)	Avg. Number of Challenges	High-Risk Flags
Bauchi	0.00	0.0	3.00	Low ES Contribution
Kogi	0.00	0.00	2.14	Low ES Contribution
Niger	0.00	0.00	5.00	Low ES Contribution, High Challenges
Jigawa	0.00	0.00	5.00	Low ES Contribution, High Challenges
Rivers	0.00	100.00	6.00	Low ES Contribution, AFP Faster than ES, High Challenges
Anambra	10.00	20.00	2.50	Low ES Contribution
Oyo	10.81	43.24	1.62	Low ES Contribution
Ogun	20.00	33.33	3.20	Low ES Contribution
Abia	21.43	14.29	2.57	Low ES Contribution
Delta	25.81	32.26	2.16	Low ES Contribution
Osun	29.41	23.53	2.09	Low ES Contribution
Kwara	50.00	16.67	3.00	None
Katsina	50.00	0.00	3.50	High Challenges
Sokoto	55.56	14.81	4.52	High Challenges
Yobe	78.95	31.58	2.74	None
Kebbi	85.00	10.00	3.80	High Challenges
Zamfara	96.30	29.63	3.93	High Challenges
Gombe	100.00	66.67	4.00	AFP Faster than ES, High Challenges
Kaduna	100.00	14.29	5.00	High Challenges

State	ES Contribution (%)	AFP Faster (%)	Avg. Number of Challenges	High-Risk Flags
Kano	100.00	14.29	4.29	High Challenges
Borno	100.00	0.00	4.00	High Challenges

Note. “High-Risk Flags” indicate states with low ES contribution, high number of operational challenges, or AFP detection faster than ES.

Table 4.7 integrates three dimensions which includes ES contribution, AFP faster detection, and the average number of operational challenges to identify high-risk states. Several states, including Bauchi, Kogi, Niger, and Jigawa, showed zero ES contribution, while others such as Rivers reported zero contribution combined with AFP detecting faster than ES which suggest potential gaps in ES efficacy. The average number of operational challenges ranged from 1.62 in Oyo to 6.00 in Rivers, show variable operational difficulty across states. The “High-Risk Flags” column identifies specific risk factors, such as low ES contribution, high operational challenges, and instances where AFP detects faster than ES. For example, Rivers is flagged for all three criteria, which is a critical need for targeted intervention. States like Kwara and Yobe, which do not exhibit significant high-risk indicators, represent more effective ES implementation. This table provides a synthesized overview of states requiring priority attention to strengthen poliovirus surveillance and highlight both operational and performance-related vulnerabilities.

Table 4.8: Model Fit Statistics for Logistic Regression Predicting ES Contribution

Statistic	χ^2	df	p	Pseudo R^2
Model	143.74	17	<.001	.31

Table 4.9: Binary Logistic Regression Predicting ES Contribution (N = 357)

Predictor	B (SE)	Wald z	p	OR	95% CI for OR
Intercept	-2.92 (0.79)	-3.71	<.001	0.05	[0.01, 0.25]
Awareness of ES (Yes)	1.40 (0.41)	3.40	<.001	4.04	[1.81, 9.02]
Formal training on ES (Yes)	0.89 (0.40)	2.22	.026	2.44	[1.11, 5.37]
Familiar with ES (Moderate)	-1.49 (0.62)	-2.39	.017	0.23	[0.07, 0.77]
Familiar with ES (High)	-0.66 (0.63)	-1.04	.300	0.52	[0.15, 1.79]
Experience: 6–10 yrs	0.85 (0.45)	1.89	.058	2.35	[0.97, 5.69]
Experience: 11+ yrs	1.92 (0.61)	3.16	.002	6.83	[2.08, 22.47]
Works with AFP & ES (Yes)	0.69 (0.34)	2.05	.040	1.99	[1.03, 3.85]
Faster detection: ES	1.13 (0.55)	2.07	.039	3.10	[1.06, 9.03]
Faster detection: Both	0.71 (0.34)	2.12	.034	2.04	[1.06, 3.93]
Number of challenges	0.34 (0.12)	2.84	.005	1.41	[1.11, 1.79]

Note. OR = Odds Ratio; CI = Confidence Interval. Only statistically significant predictors at $p < .05$ are bolded in interpretation.

A binary logistic regression was conducted to examine predictors of respondents' perceived contribution of environmental surveillance (ES) to early detection of poliovirus. The overall model demonstrated good fit, χ^2 (17, N = 357) = 143.74, $p < .001$, with a Pseudo R^2 of .31, indicating that the predictors explained approximately 31% of the variance in ES contribution (table 4.8). The model showed strong discrimination, with an area under the ROC curve (AUC) of .86. Awareness of ES activities significantly predicted contribution, with those aware being over four times more likely to report ES contribution compared to those unaware (OR = 4.04, 95% CI [1.81, 9.02], p <

.001). (table 4.9) Similarly, respondents who had received formal ES training were more than twice as likely to report contribution (OR = 2.44, 95% CI [1.11, 5.37], $p = .026$). Familiarity with ES processes showed a mixed pattern. Moderate familiarity was associated with reduced odds of contribution (OR = 0.23, 95% CI [0.07, 0.77], $p = .017$), whereas higher familiarity was not significant ($p = .300$). Length of experience also mattered. Respondents with more than 15 years of experience had significantly higher odds of reporting ES contribution (OR = 6.83, 95% CI [2.08, 22.47], $p = .002$), while those with fewer years of experience showed non-significant effects. Those who worked with both AFP and ES systems were nearly twice as likely to report contribution (OR = 1.99, 95% CI [1.03, 3.85], $p = .040$). Perceptions of which system provided faster detection also mattered: selecting AFP (OR = 3.10, 95% CI [1.06, 9.03], $p = .039$) or both systems (OR = 2.04, 95% CI [1.06, 3.93], $p = .034$) was associated with significantly greater odds of contribution compared to other responses. Finally, the number of reported challenges significantly predicted contribution. Each additional challenge increased the odds of reporting ES contribution by 41% (OR = 1.41, 95% CI [1.11, 1.79], $p = .005$).