**CHAPTER ONE**

**INTRODUCTION**

**1.1 Background of the Study**

Poliomyelitis, commonly known as polio, is a highly contagious viral disease caused by the poliovirus, which primarily affects children under the age of five (Global Polio Eradication Initiative [GPEI], 2023). The disease can lead to irreversible paralysis and, in severe cases, death. Thanks to widespread vaccination efforts, the global incidence of polio has dramatically decreased over the past few decades, bringing the world closer than ever to eradication (World Health Organization [WHO], 2022). Nigeria, as the most populous country in Africa, has faced significant challenges in eradicating polio due to factors such as vaccine hesitancy, insecurity in certain regions, and gaps in surveillance systems (Nigeria Centre for Disease Control [NCDC], 2021). While acute flaccid paralysis (AFP) surveillance remains the primary method for detecting poliovirus circulation, it has limitations because many infected individuals are asymptomatic (WHO, 2017). To address this gap, environmental surveillance (ES), which involves testing sewage and wastewater for the presence of poliovirus, has been increasingly employed. ES offers the advantage of detecting virus circulation earlier and more comprehensively than AFP surveillance alone (Asghar *et al*., 2014; Manor *et al*., 2014). As Nigeria aims to maintain its polio-free status and contribute to global eradication efforts targeted for 2025, evaluating the effectiveness of its environmental surveillance systems is critical.

**1.2 Statement of Problem**

Despite the implementation of environmental surveillance in Nigeria, challenges such as inconsistent site selection, poor sample collection practices, limited laboratory capacity, and inadequate integration with AFP surveillance data have been reported (Oladejo *et al*., 2020; Abdullahi *et al*., 2019). There remains insufficient empirical evidence to conclusively determine how much ES contributes to timely poliovirus detection and outbreak prevention in Nigeria. Without a comprehensive assessment of ES’s operational effectiveness, gaps in surveillance may persist, risking undetected transmission and delayed responses, which could threaten the country’s polio eradication efforts (WHO, 2021).

**1.3 Justification for the Study**

This study is justified by the need to provide evidence-based evaluation of Nigeria’s environmental surveillance systems. Insights from this research will assist policymakers and health authorities in optimizing surveillance strategies, enhancing early detection of poliovirus, and efficiently allocating resources to sustain polio eradication achievements. Furthermore, this study may serve as a model for other countries with similar epidemiological profiles to strengthen their surveillance programs (GPEI, 2023).

**1.4 Objectives**

**Objectives of the Study**

To assess the effectiveness and operational challenges of environmental surveillance systems on polio eradication in Nigeria.

**Specific Objectives**

To evaluate the contribution of environmental surveillance to the early detection of poliovirus in Nigeria.

To compare environmental surveillance with AFP surveillance in selected high-risk states.

To identify the operational challenges affecting environmental surveillance implementation.

To recommend strategies to improve polio surveillance effectiveness in Nigeria.

**1.5 Research Questions**

How effective is environmental surveillance in detecting poliovirus circulation in Nigeria?

How does environmental surveillance compare with AFP surveillance regarding sensitivity and coverage?

What operational challenges hinder environmental surveillance in Nigeria?

**1.6 Research Hypothesis**

H0: Environmental surveillance does not significantly improve poliovirus detection compared to AFP surveillance alone.

H1: Environmental surveillance significantly improves poliovirus detection compared to AFP surveillance alone.

**1.7 Scope of the Study**

This study focuses on environmental surveillance systems operating in selected high-risk Nigerian states, including Kano, Lagos, and Kaduna, during 2025. It assesses both quantitative surveillance data and qualitative insights from key stakeholders. Surveillance activities unrelated to poliovirus detection are excluded.

**1.8 Operational Terms and Definitions**

Poliomyelitis (Polio): A viral disease causing muscle paralysis, primarily affecting children under five.

Environmental Surveillance (ES): Testing of sewage and wastewater samples to detect poliovirus circulation.

Acute Flaccid Paralysis (AFP) Surveillance: Monitoring of sudden onset paralysis cases to detect poliovirus infection.

**CHAPTER TWO**

**LITERATURE REVIEW**

**2.1 Conceptual Review**

Surveillance is a fundamental public health strategy that facilitates the early detection and control of infectious diseases such as polio. Acute flaccid paralysis (AFP) surveillance involves identifying and investigating cases of sudden paralysis in children but may miss many infections since most poliovirus cases are asymptomatic (WHO, 2017). Environmental surveillance complements AFP by testing sewage for poliovirus presence, thus providing data on silent viral circulation within communities (Asghar *et al*., 2014). Effective environmental surveillance requires careful selection of sampling sites, standardized procedures for sample collection and processing, and robust laboratory networks for virus detection (Manor *et al*., 2014). Integration of environmental and AFP surveillance data enhances the sensitivity and specificity of poliovirus monitoring.

**2.2 Empirical Review**

Empirical studies have demonstrated the value of environmental surveillance in different countries. For instance, in Pakistan, ES detected poliovirus circulation ahead of clinical cases, enabling prompt vaccination responses (Jafari *et al*., 2014). In India, environmental sampling was critical for certifying regions as polio-free (Kew *et al*., 2005). In Nigeria, Oladejo *et al*. (2020) highlighted that while ES contributed to detecting virus circulation, operational challenges such as irregular sampling and data management affected its efficiency. Abdullahi *et al*. (2019) reported that logistical and infrastructural issues, including laboratory capacity and transportation, limited the reach and impact of ES in Nigeria. There remains a lack of comprehensive research comparing ES and AFP effectiveness quantitatively in Nigeria, and stakeholder perspectives on surveillance challenges are underexplored.

**2.3 Theoretical Review**

The study is informed by the Health Systems Framework, which conceptualizes surveillance as an integral component of health system functions involving service delivery, information systems, and governance (WHO, 2007). This framework underscores the importance of coordination across surveillance components, effective data utilization, and sufficient resource allocation to ensure disease control and eradication success. Applying this framework helps to evaluate the operational effectiveness of environmental surveillance within Nigeria’s health system.

**CHAPTER THREE**

**METHODOLOGY**

**3.0 Introduction**

This chapter details the research design, study area, population, sampling, data collection, and analysis methods employed to assess environmental surveillance systems in Nigeria’s polio eradication efforts.

**3.1 Study Area**

The study focuses on selected Nigerian states with high poliovirus transmission risk and established environmental surveillance programs: Kano, Lagos, and kwara. These states represent diverse geographic and demographic profiles relevant for assessing surveillance effectiveness.

**3.2 Accessible Population**

Participants include public health officers, surveillance coordinators, laboratory personnel, and other stakeholders directly involved in polio surveillance activities within the selected states.

**3.3 Study Design**

A mixed-methods design combining quantitative analysis of surveillance data with qualitative interviews was adopted. This approach enables triangulation of findings and a comprehensive understanding of surveillance effectiveness.

3.4 Inclusion Criteria for Selection of Study Subjects

Individuals actively engaged in environmental or AFP surveillance within the selected states.

Health officials involved in polio eradication program management.

**3.5 Exclusion Criteria for Selection of Study Subjects**

Health workers not involved in polio surveillance.

States without operational environmental surveillance systems.

**3.6 Sample Size Determination**

Qualitative sampling will use purposive selection of approximately 20–30 key informants until thematic saturation is achieved (Guest, Bunce, & Johnson, 2006). Quantitative data will comprise all 2025 surveillance records available from national and state databases.

**3.7 Sampling Technique**

Purposive sampling will identify participants with relevant experience. Surveillance data will be collected from official databases managed by the Nigeria Centre for Disease Control (NCDC) and WHO.

**3.8 Research Instruments**

Semi-structured interview guides will explore stakeholder perceptions and operational challenges.

Data extraction forms will collect surveillance metrics from official records.

**3.9 Methods of Data Collection**

Key informant interviews will be conducted face-to-face or via virtual platforms. Quantitative surveillance data will be systematically extracted from the NCDC and WHO databases for analysis.

**3.10 Measurement of Variables and Data Processing**

Variables include poliovirus detection rates, sample collection frequency, site coverage, and turnaround times. Qualitative data will be audio-recorded, transcribed verbatim, and coded.

**3.11 Data Analysis**

Quantitative data will be analyzed using descriptive and inferential statistics via SPSS software. Thematic analysis will be applied to qualitative data using Braun and Clarke’s (2006) methodology.

**3.12 Ethical Consideration**

Ethical approval will be sought from the relevant Institutional Review Boards (IRBs). Participants will provide informed consent and confidentiality will be maintained.

**3.13 Limitations of the Study**

Potential limitations include recall bias during interviews, limited geographic scope reducing generalizability, and incomplete or inconsistent surveillance records.