Health System Gaps Influencing Early Detection and Treatment of HIV/AIDS in Semi-Urban Communities in Nigeria

Okechukwu Cajethan Madu [1, 2], **Chinaza Faith Patrick** [1], **Oluchukwu Jennifer Agufusi** [1, 3], **Chidera Ruth Agufusi** [1, 4], **Somtochukwu Genevieve Agufusi** [1]

[1] *Jennifer Oluchukwu Maternal & Childcare Foundation*
1 Jideofor St, Thinkers Corner, Enugu 400001, Enugu, Nigeria

[2] *Joseph Sarwuan Tarka University, Makurdi*
P. M. B. 2373, Makurdi, Nigeria

[3] *Godfrey Okoye University*
FGCG+CHC, Jideofor St, Thinkers Corner, Enugu 400001, Enugu, Nigeria

[4] *Enugu State University of Science & Technology*
P. M. B. 01660, Agbani, Enugu State, Nigeria

DOI: 10.22178/pos.126-31

LCC Subject Category: R5-920

Received 27.12.2025
Accepted 29.01.2026
Published online 31.01.2026

Corresponding Author:
Okechukwu Cajethan Madu

Abstract. This study examined health system gaps influencing early detection and treatment of HIV/AIDS in semi-urban communities in Nigeria, focusing on the availability and accessibility of HIV/AIDS testing services, infrastructural and logistical challenges, and the effectiveness of health information systems. Guided by Systems Theory, the study employed a descriptive survey design and multistage sampling. Five high-prevalence states: Benue, Lagos, Taraba, Akwa Ibom, and Imo were purposively selected, with two semi-urban LGAs drawn from each, totalling 12 LGAs. Systematic sampling identified households, and one adult (18+) per household completed the questionnaire. Of 720 electronically distributed questionnaires, 657 were returned. Data were collected between November and December 2025 using a closed-ended instrument and analysed in SPSS v.26 using frequencies and simple percentages. Findings revealed that HIV/AIDS testing in semi-urban areas is inadequate, costly, and difficult to access, with long waiting times and unfriendly staff. Infrastructural gaps, such as shortages of equipment, skilled personnel, and reliable power, delay diagnosis. Logistical barriers such as poor roads, weak transport systems, slow laboratory processes, and ineffective mobile clinics further hinder timely testing. Inefficient health information systems also contribute to delays and missed diagnoses. The study concludes that multiple health system challenges undermine early HIV/AIDS detection in semi-urban Nigeria and recommends improved funding, staffing, infrastructure, service delivery, transport networks, and stronger information systems to support timely diagnosis and care.

Keywords: Early detection; HIV; AIDS; semi-urban communities; infrastructural challenges; logistical barriers; health information systems.

INTRODUCTION

It is often said that "Health is Wealth," meaning that good health is just as important as the food we eat every day. This principle implies the importance of proactive health measures, including early detection of diseases such as HIV/AIDS, which has been a serious public health problem for decades. How well HIV is detected and treated depends largely on the health system. Weak or fragmented health systems delay diagnosis and starting antiretroviral therapy (ART), keep-

ing people infectious for longer and increasing the risk of developing AIDS. According to [1], people diagnosed late have a much higher risk of death than those diagnosed early. Also, starting ART soon after diagnosis reduces viral reservoirs, supports immune recovery, and improves long-term health outcomes [2].

According to authors [3], a health system includes all public and private organisations, institutions and resources that work to improve, maintain or restore health, such as a country's health service, disease control and prevention centers, telehealth, health information exchange systems, and actors like the mass media that enable the dissemination of accurate health information [4, 5]. HIV is a virus that attacks the immune system, particularly the CD4+ T-cells. The term HIV/AIDS refers to the whole process from initial HIV infection to the development of AIDS if untreated [6]. Early detection means finding the infection before it becomes advanced, and effective treatment means starting ART, staying in care and keeping the virus suppressed, all of which depend on how well the health system works [7].

HIV often shows no symptoms at first, but people can still spread it to others. Some may have flu-like symptoms, while many remain symptom-free for years [8]. HIV spreads mainly through unprotected sex, sharing needles, contaminated blood transfusions and from mother to child. Early diagnosis is important to prevent AIDS, which severely weakens the immune system. Quick access to testing and early ART can reduce viral reservoirs and strengthen the immune system. Starting ART soon after infection, including for newborns, is more effective than waiting [9, 10].

Globally, HIV/AIDS continues to pose a public health challenge. There were 39.9 million people across the globe living with HIV in 2023. Of these, 38.6 million were adults (>15 years old) and 1.4 million were children (<15 years old). In addition, 53% were women and girls [11, 12]. Regional disparities are stark: for example, in 2023, some 20.8 million people with HIV were located in eastern and southern Africa alone, while other regions such as Asia-Pacific and Western Europe/North America accounted for 6.7 million and 2.3 million, respectively [11]. Inequalities persist not only in prevalence but also in access to services: the 2023 global figures show that 86% of people living with HIV knew their status and 77% were accessing ART, figures that vary considerably by region [13].

Nigeria ranks third among countries with the highest burden of HIV infection in the world. In terms of new infections, the country also ranks among the highest in sub-Saharan Africa [14]. In 2019, Nigeria accounted for nearly 70% of all new infections in West and Central Africa [15]. In Nigeria, the adult HIV prevalence (aged 15-49) has been estimated at approximately 2.1% in 2020-21 (corresponding to an estimated 2 million people living with HIV) according to Bayesian state-level modelling [16]. Sub-national geospatial analysis revealed considerable heterogeneity, with state-level prevalence ranging from ~0.3% to ~4.3% and local government area (LGA) prevalence peaking at 8.5% (O'Brien-Carelli, 2022). Among the states with the highest prevalence were Benue State (~5.7%), Rivers State (~5.2%) and Akwa Ibom State (~3.5%) [14].

Nigeria has several HIV programs, including community testing, facility-based ART and outreach services. Despite this, gaps remain, especially in semi-urban areas. Testing in community settings, such as pharmacies, remains low, and service implementation is inconsistent [17, 18]. Other challenges include understaffed clinics, weak data and referral systems and poor integration of HIV services into primary care. Older adults face additional difficulties with multiple health conditions and limited access [19]. These problems are often worse in semi-urban areas, where resources and community awareness are lower, affecting timely diagnosis and treatment.

Previous studies have shown health system weaknesses affecting HIV care in Nigeria and other low-resource settings. For example, social media campaigns and peer support have helped increase early testing among young men authors [20] due to the media's far-reaching reach [4, 5] and its ability to deliver ethnocentric, locally tailored health messages [4, 21]. Mapping ART coverage has revealed large gaps in service access and outcomes across different regions [22]. However, most research focuses on urban areas or national data, leaving semi-urban and peri-urban communities understudied. Very few studies examine how health system gaps in these areas affect early HIV detection and treatment, which is the focus of this study.

Statement of the Problem. Despite considerable efforts to achieve the global HIV targets, signifi-

cant health-system deficiencies continue to undermine early detection and treatment of HIV in Nigeria, particularly within semi-urban communities. For example, many people still do not use traditional clinic-based HIV testing because of distance and poor infrastructure, especially in rural areas. Also, barriers to early detection include poverty, gender inequality—a barrier that has also affected the training of health professionals authors [23], few local ART centres, and weak political support authors [24, 25]. According to authors [36], many primary healthcare centres lack essential registers or sample-collection capacity for early infant HIV diagnosis, which is also applicable to prenatal and maternal care contexts [26]. In semi-urban localities, these gaps create a double burden, as people are neither served by robust urban infrastructure nor receive the tailored outreach typical of rural programs. As a result, delayed diagnosis, missed linkage to care, and interrupted treatment pathways persist, hence hindering efforts to curb HIV transmission and improve outcomes in these vulnerable settings. It is against this backdrop that this study assesses health system gaps influencing early detection and treatment of HIV/AIDS in semi-urban communities in Nigeria.

Research Questions

1) How available and accessible are HIV testing services in semi-urban health facilities in Nigeria?

2) What infrastructural challenges hinder timely HIV diagnosis and treatment initiation in semi-urban areas?

3) What logistical challenges affect timely HIV diagnosis and treatment initiation in semi-urban areas?

4) How effective are existing health information systems in ensuring prompt HIV diagnosis in semi-urban areas in Nigeria?

Conceptual Clarification

HIV/AIDS. Since the early 1980s, when Acquired Immune Deficiency Syndrome (AIDS) first appeared among previously healthy individuals, debates have emerged regarding its origin, nature and social implications. Initial reports often employed stigmatising labels such as "gay-related immune deficiency (GRID)," reflecting societal prejudice rather than scientific understanding [27]. Over time, the discourse shifted toward rigorous virological and epidemiological investigation, focusing on how it spreads and its impact on global health. The emergence of Human Immunodeficiency Virus (HIV) was a major milestone in understanding AIDS. First isolated in 1983 by researchers at the Pasteur Institute and confirmed by others, the virus was officially named HIV in 1986. Phylogenetic analyses trace its origin to multiple cross-species transmissions, showing that HIV originated from simian immunodeficiency viruses (SIV) in nonhuman primates, especially chimpanzees in Central Africa, with the main global strain, HIV-1 group M, entering humans in the early 1900s [28].

In its most widely accepted definition, HIV is classified as a retrovirus within the genus Lentivirus of the family Retroviridae and specifically targets critical immune cells, including $CD4^+$ T-helper lymphocytes, macrophages and dendritic cells [25]. This targeted immune suppression gradually undermines the host's ability to combat infections, ultimately progressing to AIDS if untreated [29]. Structurally, HIV has a protective outer layer and contains RNA, along with key enzymes such as reverse transcriptase and integrase. Once it infects a cell, the virus converts its RNA into DNA and inserts it into the host's genome; this allows HIV to replicate or remain hidden for long periods, which makes it dangerous because people can appear healthy while their immune system is gradually weakened [25]. Because HIV compromises immune function, infected individuals are at elevated risk of severe infections, including tuberculosis, fungal infections and certain cancers. If untreated, this can lead to morbidity and mortality [29].

Health Systems. The idea of a "health system" has been widely discussed in public health, especially about what exactly counts as a "system" and how broadly the term should be used. Some scholars argue for a broad definition that includes social, political, and economic factors affecting health, while others prefer a narrower focus on formal institutions and processes. This raises the question of whether a health system should include only healthcare services or also community networks and informal care. The word "system" means a group of connected parts working together toward a common goal. In a health system, this includes institutions, people and resources working together to maintain, restore or improve health. As the authors [30] explain, a system is an interconnected set of components that pursue a shared objective.

Several definitions of the health system exist. According to authors [29], a health system comprises all organisations, institutions, resources, and people whose main purpose is to promote, restore, or maintain health. Authors [31] define health systems as the resources, people, and institutions involved in financing, regulating, and delivering health actions, which are any activities aimed at improving or maintaining health. Modern discussions focus on the function of a health system: it is more than just a collection of parts; it is a network that can respond to health needs, new risks, and changing situations [32]. So, a health system includes both structure (institutions, workforce and funding) and processes (information sharing, decision-making and adaptation).

Empirical Literature Review. Early HIV detection in Nigeria's semi-urban communities is still inconsistent, even though testing coverage has improved nationally. Data shows some areas continue to have low diagnosis rates, which delays linking people to antiretroviral therapy (ART). Problems with how services are organised and delivered at the local level mean testing is uneven. Adolescents, young adults and marginalised groups are often missed in routine testing [33, 34]. Limited diagnostic capacity, such as weaknesses in testing methods, quality checks, and supply chains, also contributes to late diagnosis, especially in low-resource areas [3, 34]. When tests are inconsistent or supplies run out, people lose confidence and may avoid retesting or follow-up.

A shortage of trained healthcare workers further slows HIV detection and treatment. Uneven staff distribution, lack of training and limited expertise make it hard to consistently follow testing protocols and 'test-and-treat' approaches [35]. Accessibility issues, such as long distances to clinics, indirect costs, inconvenient hours, and unfriendly clinic environments, combined with social and cultural barriers, reduce early testing [25, 36]. Weak referral and health information systems worsen delays, causing loss to follow-up and long waits between diagnosis and ART [3, 25]. Strategies such as HIV self-testing, community-based testing, and differentiated service delivery can be effective when well-integrated, properly funded, and linked to care [37, 38].

For early infant diagnosis (EID), authors [15] studied HIV-exposed infants at 22 primary health centres (PHCs) in Lagos State. They found that only about 55% of PHCs collected dried blood spot (DBS) samples, and just 41% had complete documentation of collection and test results. Interviews with staff revealed key problems: many PHCs didn't provide EID services, communication about service availability was unclear, referrals to other facilities led to loss of follow-up, and delays in obtaining results. Authors [39] assessed PHC readiness in Ekiti State to deliver HIV, TB and malaria services. The study found PHCs were poorly prepared for HIV and TB services, lacking diagnostic tools, trained staff, medicines and proper infrastructure. Malaria services were better; this shows that HIV/TB services at the primary care level are underfunded and poorly prioritised, limiting early diagnosis and treatment in non-urban areas.

In another study, authors [40] looked at how COVID-19 worsened gaps in HIV prevention, testing and treatment. The study noted service disruptions due to travel restrictions, reduced ART and testing availability, funding shortfalls, stigma, transport issues, health worker shortages, and the diversion of resources to the COVID response. Before the pandemic, only 67% of people with HIV knew their status, and 53% were on ART. What this means is that early HIV detection and treatment face multiple barriers in Nigeria.

Theoretical Framework

Systems Theory. Systems theory was first introduced by Ludwig von Bertalanffy, an Austrian biologist, in the 1940s [41]. He later explained his main ideas in his book General System Theory. He developed this theory because traditional scientific methods, which break things down into separate parts, were insufficient for fully understanding living systems [42]. At its core, systems theory perceives things as a whole rather than just individual parts. The key postulates of the theory, according to [43], are:

a) A "system" is composed of interconnected parts (or subsystems) that work together as a whole.

b) Systems are often "open," meaning they interact with their environment by exchanging information, energy or matter.

c) You cannot fully understand a system by looking at its parts alone; new properties can emerge from how parts interact.

d) Systems try to maintain balance (homeostasis) while adjusting to changes in their environment.

e) Different starting points or conditions can still lead to similar outcomes (equifinality).

f) Systems can be organised into layers, with smaller subsystems within larger systems, allowing analysis from small to large scales.

Systems theory is appreciated for helping researchers and practitioners see the bigger picture rather than focusing only on separate parts; this is especially useful in complex areas like health care, where patients, hospitals, supply chains, and governance interact [44]. However, it also has some limitations. Because it tries to apply to everything, it can sometimes oversimplify specific situations or ignore social, cultural or political factors [45]. Its broad perspective can make it harder to predict exact outcomes or provide precise solutions, especially in rapidly changing systems such as health care in low-resource settings.

This theory is well-suited to this study. A health system in semi-urban Nigerian communities is not just a set of separate clinics or workers. It is a complex system made up of interdependent parts, including clinical services, supply chains, health workers, governance, community engagement, and funding. Weaknesses in one part, such as poor diagnostic tools, lack of trained staff or social barriers, can affect the entire system and reduce early detection and treatment of HIV.

METHODS

This study utilised a descriptive survey design. A stratified multistage sampling technique was employed to select responses and states affected in the affected regions in Nigeria. First, purposive sampling was used to select states in Nigeria: Benue, Lagos, Taraba, Akwa Ibom and Imo, identified as the most HIV prevalent as of early 2024 [35]. The researchers selected two semi-urban Local Government Areas (LGAs) within each state, resulting in a total of 12 LGAs: Gboko and Katsina Ala (Benue); Ikeja and Ikorodu (Lagos); Jalingo and Wukari (Taraba); Uyo and Eket (Akwa Ibom); and Owerri Municipal and Obowo (Imo). The researchers used systematic random sampling to select households, and from each household, they selected one adult aged 18 years or older as the respondent. A total of 720 questionnaires were distributed electronically via Google Forms, with 657 returned. Data collection occurred from November to December 2025 using a closed-ended questionnaire, and analysis was conducted in SPSS version 26, employing descriptive statistics (frequencies and simple percentages) for summarisation.

RESULTS AND DISCUSSION

Table 1 shows the demographic characteristics of the respondents.

Table 1 – Demographic Characteristics of Respondents

Variable	F	%
Gender		
Male	280	42.62
Female	377	57.38
Age		
18–25	150	22.83
26–35	230	35.01
36–45	150	22.83
46–55	90	13.70
56+	37	5.63
Marital Status		
Single	320	48.71
Married	280	42.62
Divorced	30	4.57
Widowed	27	4.11
Educational Attainment		
No formal education	20	3.04
Primary	100	15.22
Secondary	200	30.44
Tertiary	337	51.29
Occupation		
Civil servant	150	22.83
Trader/Business	220	33.49
Farmer	80	12.18
Student	130	19.79
Others	77	11.72
Total	657	100

Findings show that 280 respondents (42.62%) were male while 377 respondents (57.38%) were female; 150 respondents (22.83%) were between 18–25 years, 230 respondents (35.01%) were aged 26–35 years, 150 respondents (22.83%) were 36–45 years, 90 respondents (13.70%) were 46–55 years and 37 respondents (5.63%) were 56 years and above; 320 respondents (48.71%) were single, 280 respondents (42.62%) were married, 30 respondents (4.57%) were divorced and 27 respondents (4.11%) were widowed; 20 respondents (3.04%) had no formal education, 100 respondents (15.22%) had primary education, 200 respondents (30.44%) had

secondary education and 337 respondents (51.29%) had tertiary education; 150 respondents (22.83%) were civil servants, 220 respondents (33.49%) were traders or engaged in business, 80 respondents (12.18%) were farmers, 130 respondents (19.79%) were students while 77 respondents (11.72%) fell into other categories; this implies that the residents of the semi-urban areas in Nigeria are largely young, educated and predominantly female, with a significant proportion engaged in business activities.

Table 2 captures the availability and accessibility of HIV testing services in semi-urban health facilities in Nigeria.

Table 2 – Availability and Accessibility of HIV Testing Services in Semi-Urban Health Facilities

Item	Response	F	%
Availability of HIV Testing Services in Your Community	Partially Available	310	47.2
	Not Available	220	33.5
	Readily Available	127	19.3
Distance to the Nearest HIV Testing Facility	Above 5 km	300	45.7
	1–5 km	180	27.4
	Within 1 km	177	26.9
Affordability of HIV Testing Services	Expensive	350	53.3
	Low Cost	220	33.5
	Free	87	13.2
Waiting Time at HIV Testing Centres	More than 1-hour	427	65.0
	30–60 minutes	230	35.0
	Less than 30 minutes	0	0
Perceived Staff Attitude Toward Clients	Unfriendly	320	48.7
	Fair	240	36.5
	Friendly	97	14.8
Accessibility of HIV Testing Services	Moderately Accessible	300	45.7
	Not Accessible	240	36.5
	Easily Accessible	117	17.8
Total		657	100

Findings show that most of the respondents, 310 representing (47.2%) indicated that HIV testing services are partially available in their community; 300 respondents (45.7%) live more than 5 km away from the nearest HIV testing facility; 350 respondents (53.3%) perceive HIV testing services as expensive; 427 respondents (65.0%), reported waiting times of more than 1 hour; 320 respondents (48.7%) described staff as unfriendly; 300 respondents (45.7%) indicated that services are moderately accessible; this implies that HIV testing services in semi-urban areas are largely insufficient, financially burdensome and difficult to access, compounded by unfriendly staff attitudes and long waiting times.

Table 3 shows the infrastructural challenges affecting timely HIV diagnosis and treatment in semi-urban areas.

Table 3 – Infrastructural Challenges Affecting Early HIV Diagnosis and Treatment

Item	Response	F	%
A limited number of laboratories are equipped for HIV testing	Major Challenge	420	63.9
	Minor Challenge	237	36.1
Unreliable power affecting laboratory operations and storage of reagents	Major Challenge	398	60.6
	Minor Challenge	259	39.4
Shortage of rapid test kits, ELISA machines or CD4 count machines	Major Challenge	435	66.2
	Minor Challenge	222	33.8
Cramped or poorly ventilated clinics are deterring patient attendance	Major Challenge	375	57.1
	Minor Challenge	282	42.9
Inefficient record-keeping delays test results and follow-up	Major Challenge	360	54.8
	Minor Challenge	297	45.2
Lack of e-health platforms for remote diagnosis or counselling	Major Challenge	345	52.5
	Minor Challenge	312	47.5
Affecting hygiene standards in testing and treatment centres	Major Challenge	330	50.2
	Minor Challenge	327	49.8
Shortage of skilled staff to perform tests accurately and promptly	Major Challenge	400	60.9
	Minor Challenge	257	39.1

Findings show that a shortage of rapid test kits, ELISA machines or CD4 count machines was identified by majority of respondents, 435 representing (66.2%) as a major challenge; limited number of laboratories equipped for HIV testing was cited as a major challenge by 420 respondents (63.9%); Shortage of skilled staff to perform

tests accurately and timely was also a major challenge by 400 respondents (60.9%); unreliable power affecting laboratory operations and storage of reagents was considered a major challenge by 398 respondents (60.6%); Cramped or poorly ventilated clinics deterring patient attendance was highlighted by 375 respondents (57.1%) as a major challenge; inefficient record-keeping delaying test results and follow-up was identified as a major challenge by 360 respondents (54.8%); lack of e-health platforms for remote diagnosis or counseling was reported by 345 respondents (52.5%) as major challenge; hygiene standards affecting testing and treatment centers were seen as a major challenge by 330 respondents (50.2%); this implies that infrastructural deficits, including shortages of equipment, skilled personnel and reliable power, pose a significant barrier to early HIV diagnosis and treatment in semi-urban areas in Nigeria.

Table 4 shows the logistical challenges affecting timely HIV diagnosis and treatment initiation in semi-urban areas in Nigeria.

Table 4 – Logistical Challenges Affecting Early HIV Diagnosis and Treatment

Item	Response	F	%
Poor roads make it hard for me to reach the clinic, especially in the rainy season.	Agreed	472	71.8
	Disagreed	185	28.2
Limited transport means I often walk long distances or pay extra to get tested.	Agreed	431	65.6
	Disagreed	226	34.4
Slow lab results make me wait longer to know my HIV status.	Agreed	389	59.2
	Disagreed	268	40.8
I sometimes lose follow-up when referred to another facility.	Agreed	362	55.1
	Disagreed	295	44.9
Crowded clinics reduce the care I receive and increase waiting time.	Agreed	410	62.4
	Disagreed	247	37.6
Test supplies, such as reagents and gloves, are not always available.	Agreed	398	60.6
	Disagreed	259	39.4
Mobile clinics are weak, so I can't always access care locally.	Agreed	367	55.9
	Disagreed	290	44.1
Rivers, hills and remote areas make reaching the clinic difficult.	Agreed	345	52.5
	Disagreed	312	47.5
I don't always get test results on time.	Agreed	334	50.8
	Disagreed	323	49.2

Findings show that most respondents 472 respondents (71.8%) agreed that poor roads make it difficult to reach the clinic, especially during the rainy season; 431 respondents (65.6%) agreed that they often have to walk long distances or pay extra to get tested; 389 respondents (59.2%) reported that slow lab results make them wait longer to know their HIV status; 362 respondents (55.1%) agreed that they sometimes lose follow-up when referred to another facility; overcrowded clinics reduced quality of care and increased waiting times, with 410 respondents (62.4%) agreed; 398 respondents (60.6%) agreed that reagents and gloves are not always available; 367 respondents (55.9%) agree that mobile clinics are weak, geographical barriers such as rivers, hills and remote locations were challenges for 345 respondents (52.5%); 334 respondents (50.8%) agreed they do not always get reminders or results on time; this implies that logistical barriers, including poor roads, limited transport, slow lab processes and weak mobile clinics, impede early HIV diagnosis and treatment initiation in semi-urban areas.

Table 5 shows the effectiveness of existing health information systems in ensuring early HIV diagnosis in semi-urban areas in Nigeria.

Table 5 – Effectiveness of Existing Health Information Systems in Ensuring Prompt HIV Diagnosis in Semi-Urban Areas in Nigeria

Item	Response	F	%
Are you aware of any existing health information systems for HIV diagnosis in your community?	Aware	412	62.7
	Not Aware	245	37.3
Have you ever interacted with or used any of these systems?	No	367	55.9
	Yes	290	44.1
Which of the following health information systems have you used or are you aware of?	DHIS2 (District Health Information Software 2)	125	19.0
	OpenMRS / Electronic Medical Records (EMR)	100	15.2
	Patient Identity Management System (PIMS)	95	14.5
	Laboratory Information Management Systems (LIMS)	85	12.9

Item	Response	F	%
	ENHANCE Community Level Data Collection Tools	80	12.2
	Open Data Kit (ODK) for HIV testing and outreach programs	140	21.3
	mHealth S MS-based reporting tools	32	4.9
How often do you receive feedback from these health information systems during HIV testing or outreach?	Rarely	40	6.1
	Regularly	617	93.9
How effectively do health information systems improve prompt HIV diagnosis in your area?	Ineffective	610	92.8
	Effective	47	7.2

Findings show that most respondents 412 representing (62.7%) indicated that they are aware of health information systems for HIV diagnosis in their communities; 367 respondents (55.9%) reported that they have never interacted with or used any of these systems; 140 respondents (21.3%) are familiar with or have used the Open Data Kit (ODK) for HIV testing and outreach programs, 125 respondents (19.0%) are aware of DHIS2 (District Health Information Software 2), 100 respondents (15.2%) know about OpenMRS/Electronic Medical Records (EMR), 95 respondents (14.5%) are aware of the Patient Identity Management System (PIMS), 85 respondents (12.9%) know about Laboratory Information Management Systems (LIMS), 80 respondents (12.2%) are aware of ENHANCE community-level data collection tools while 32 respondents (4.9%) reported knowledge or use of mHealth SMS-based reporting tools; 617 respondents (93.9%) reported rarely receiving feedback from these health information systems during HIV testing or outreach; 610 respondents (92.8%) considered the systems ineffective; this implies the inefficiency in the current health information systems for early HIV diagnosis in semi-urban areas in Nigeria.

Table 2 makes it clear that HIV testing services in semi-urban areas are largely insufficient, financially burdensome and difficult to access, worsened by unfriendly staff attitudes and long waiting times. The study conducted by the authors supports this finding [46] in Ibadan, which found that despite pre- and post-testing counselling, there were several barriers to effective HIV testing services, which include "insufficient consumables, insufficient staff, no privacy and lack of infrastructure." This study indicates that, despite the potential for testing, there are resource gaps that act as barriers to accessibility, similar to the findings of authors [47] regarding COVID-19 vaccine hesitancy and uptake. Adding credence to this, a study by authors [48] supports that cost, which includes user charges, consumables and indirect costs, remains a huge barrier for HIV testing services for sub-Saharan African countries.

In the area of infrastructure, as indicated in Table 3, the semi-urban areas in Nigeria appear to face various needs and challenges, including a lack of equipment, healthcare professionals, and electricity. This study confirms the already identified shortage of Nigeria's healthcare infrastructure. In Ekiti State, authors [39] observed that many facilities, especially semi-urban and rural facilities, were poorly prepared to provide HIV testing and diagnosis services. Also, authors [49] confirm that the use of most laboratories for diagnosis in Nigeria has been very limited, as many lack the necessary reagents and supplies for operation, making it difficult for them to provide services. The semi-urban environments, therefore, without well-equipped laboratories, basic consumables, healthcare professionals and electricity, as are common characteristics of the semi-urban and rural facilities, make the process of diagnosing and testing for HIV irregular, which often delays and makes the process impossible. The above findings make it difficult for the semi-urban areas to achieve the "first 95" of the 95-95-95 HIV targets.

Table 4 makes it clear that logistical factors, such as poor roads, limited transport, slow laboratory processes, and mobile clinic outreach, undermine early HIV detection, diagnosis, and the initiation of subsequent care; this aligns with empirical literature available for sub-Saharan Africa. A classic systematic review by the authors [50] on transportation and geographic barriers in SSA found that distances and transportation problems are linked to suboptimal linkage and maintenance across the HIV continuum, including testing, linkage, and maintenance. In such areas, the distances and costs of transport make people decide

against early testing, and if tested, they would decide against care and follow-up. Even when sample collection (e.g., dried blood spot (DBS) for early infant diagnosis) is offered at PHCs, weak systems for specimen transport and delayed return of lab results have been documented as major barriers. In Lagos, authors [51] found that most primary healthcare facilities lacked the equipment for dried blood spot sampling. Although healthcare workers collected dried blood spot samples, delays in laboratory results—caused by referrals to secondary or tertiary facilities—led to loss to follow-up (LTFU).

Data in Table 5 indicate that the present healthcare information and surveillance system is inefficient for ensuring early detection by people living with HIV/AIDS. This finding corroborates contemporary discussions that emphasise improving healthcare, particularly the testing and surveillance network, for the benefit of Nigeria. In authors [52], an assessment of Nigeria's infectious disease surveillance system observed "serious weaknesses," including limited diagnostic capacity, delays, and limited coverage. In the case of HIV, such aspects as, for example, the lack of records, the delay for the return of test results, the unreferred and the disconnection between the testing and care for that matter, would mean the delay and the missed diagnosis. Moreover, the lack of laboratory capacity and supplies, as already explained above, would jeopardise the entire process, as well as the information and healthcare systems.

CONCLUSIONS

This study shows that HIV testing and early detection in Nigeria's semi-urban areas face several challenges that make them less effective. Such problems include poor infrastructure, poorly skilled health workers, unreliable electricity, limited lab capacity, and long waits, high costs, and unfriendly staff. Transportation issues, poor roads, and slow lab results also delay testing and follow-up care. Weak health information systems add to the delays and missed diagnoses. All these challenges make it hard to detect HIV early and meet national and global targets. As the saying goes, you can't fetch water with a broken bucket; efforts can be wasted if the system itself is weak.

Based on the foregoing, the study makes the following recommendations:

a) Federal and State Health Ministries should provide additional funding, equipment, supplies, and trained staff to improve HIV testing services in semi-urban areas.

b) Health facility managers and local authorities should train staff, ensure they are friendly, reduce waiting times, and protect patient privacy during testing.

c) Transport and infrastructure authorities should fix roads and improve transport to make it easier for people and samples to reach HIV testing and care services.

d) National and state health information agencies should improve health data and reporting systems so that test results are shared quickly, and patients receive timely follow-up care.

REFERENCES

1. Shaik, R. A., Holyachi, S. K., Ahmad, M. S., Miraj, M., Kazmi, S. Y., Asad, M. R., Faraz, A., Ramozi, M., & Ahmad, R. K. (2025). The impact of delay in HIV diagnosis on patient survival: analysis of HIV infection trends from 2007 to 2023. *BMC Infectious Diseases, 25*(1), 177. doi: 10.1186/s12879-024-10412-1

2. Hiner, C. R., Mueller, A. L., Su, H., & Goldstein, H. (2024). Interventions during Early Infection: Opening a Window for an HIV Cure? *Viruses, 16*(10), 1588. doi: 10.3390/v16101588

3. World Health Organisation. (2023). *HIV rapid diagnostic test market landscape*. Retrieved from https://cdn.who.int/media/docs/default-source/hq-hiv-hepatitis-and-stis-library/eic-hiv-market-landscape-report_june2023.pdf?sfvrsn=6072a75b_5

4. Madu, U. A. (2021). Effectiveness of social media in unifying fragmented Nigerian societies. *Path of Science, 7*(12), 3001–3010. doi: 10.22178/pos.77-5

5. Patrick, C. F. (2022). Role of the newspaper in political mobilisation in Nigeria. *Path of Science, 8*(12), 1008–1013. doi: 10.22178/pos.88-2

6. Hingrat, Q. L., Sereti, I., Landay, A. L., Pandrea, I., & Apetrei, C. (2021). The Hitchhiker's Guide to CD4+ T-Cell depletion in lentiviral infection. A critical review of the dynamics of the CD4+ T cells in SIV and HIV infection. *Frontiers in Immunology, 12,* 695674. doi: 10.3389/fimmu.2021.695674

7. Thompson, M. A., Horberg, M. A., Agwu, A. L., Colasanti, J. A., Jain, M. K., Short, W. R., Singh, T., & Aberg, J. A. (2020). Primary care guidance for persons with Human Immunodeficiency Virus: 2020 Update by the HIV Medicine Association of the Infectious Diseases Society of America. *Clinical Infectious Diseases, 73*(11), e3572–e3605. doi: 10.1093/cid/ciaa1391

8. Chou, R., Dana, T., Grusing, S., & Bougatsos, C. (2019). Screening for HIV infection in asymptomatic, nonpregnant adolescents and adults. *JAMA, 321*(23), 2337. doi: 10.1001/jama.2019.2592

9. Garcia-Broncano, P., Maddali, S., Einkauf, K. B., Jiang, C., Gao, C., Chevalier, J., Chowdhury, F. Z., Maswabi, K., Ajibola, G., Moyo, S., Mohammed, T., Ncube, T., Makhema, J., Jean-Philippe, P., Yu, X. G., Powis, K. M., Lockman, S., Kuritzkes, D. R., Shapiro, R., & Lichterfeld, M. (2019). Early antiretroviral therapy in neonates with HIV-1 infection restricts viral reservoir size and induces a distinct innate immune profile. *Science Translational Medicine, 11*(520). doi: 10.1126/scitranslmed.aax7350

10. Wang, J., Xiao, N., Zhu, Z., Qiao, H., Zhao, F., Zhang, L., Gou, J., Lu, M., He, Y., Lu, H., & Li, Q. (2025). Comparing acute versus AIDS ART initiation on HIV-1 integration sites and clonal expansion. *Signal Transduction and Targeted Therapy, 10*(1), 23. doi: 10.1038/s41392-024-02113-7

11. HIV.GOV. (2026). The Global HIV and AIDS Epidemic. Retrieved from https://www.hiv.gov/hiv-basics/overview/data-and-trends/global-statistics

12. Swinkels, H. M., Nguyen, A. D., & Gulick, P. G. (2024). *HIV and AIDS.* StatPearls Publishing

13. Van Schalkwyk, C., Mahy, M., Johnson, L. F., & Imai-Eaton, J. W. (2024). Updated data and methods for the 2023 UNAIDS HIV estimates. *JAIDS Journal of Acquired Immune Deficiency Syndromes, 95*(1S), e1–e4. doi: 10.1097/qai.0000000000003344

14. Nwachinemere, O. L., Nyegenye, S., Mwesigwa, A., Bulus, N. G., Gmanyami, J. M., Mukisa, K. A., & Isiko, I. (2025). Trends in HIV-related knowledge, behaviours, and determinants of HIV testing among adolescent women aged 15–24 in Nigeria. *Tropical Medicine and Health, 53(*1), 79. doi: 10.1186/s41182-025-00737-1

15. UNAIDS. (2020). *UNAIDS Data 2020*. Retrieved from https://www.unaids.org/sites/default/files/media_asset/2020_aids-data-book_en.pdf

16. Onovo, A. A., Adeyemi, A., Onime, D., Kalnoky, M., Kagniniwa, B., Dessie, M., Lee, L., Parrish, D., Adebobola, B., Ashefor, G., Ogorry, O., Goldstein, R., & Meri, H. (2023). Estimation of HIV prevalence and burden in Nigeria: a Bayesian predictive modelling study. *EClinicalMedicine, 62*, 102098. doi: 10.1016/j.eclinm.2023.102098

17. Nwanja, E., Nwaokoro, P., Akpan, U., Toyo, O., Ezeh, G., Elechi, I., Idiong, H., Badru, T., Sanwo, O., Idemudia, A., Pandey, S. R., Khamofu, H., & Bateganya, M. (2023). Improved access to HIV diagnosis and linkage to antiretroviral therapy among children in Southern Nigeria: a before-and-after study. BMC Pediatrics, 23(1), 253. doi: 10.1186/s12887-023-04050-w

18. Oseni, Y. O., & Erhun, W. O. (2024). Implementation strategies and outcomes in the delivery of HIV test services (HTS) in community pharmacies in Nigeria. *BMC Primary Care, 25*(1), 315. doi: 10.1186/s12875-024-02568-1

19. Folorunsho, S., & Suleman, B. (2025). Ageing with HIV in Nigeria: A Narrative review of multimorbidity and healthcare access challenges. *Health Science Reports, 8*(8), e71184. doi: 10.1002/hsr2.71184

20. Garofalo, R., Adetunji, A., Kuhns, L. M., Omigbodun, O., Johnson, A. K., Kuti, K., Awolude, O. A., Berzins, B., Janulis, P., Okonkwor, O., Oladeji, B., Muldoon, A. L., Amoo, O. P., Atunde, H., Kapogiannis, B., & Taiwo, B. O. (2022). Evaluation of the ICARE Nigeria pilot intervention using social media and peer navigation to promote HIV testing and linkage to care among High-Risk young men. *JAMA Network Open, 5*(2), e220148. doi: 10.1001/jamanetworkopen.2022.0148

21. Madu, U. A., & Nworie, C. S. (2022). Influence of Ethnocentric Billboard Advertising Messages on Product Consumption in Nigeria: A Study of Hero Lager. *Path of Science, 8*(5), 7001–7011. doi: 10.22178/pos.81-13

22. O'Brien-Carelli, C., Steuben, K., Stafford, K. A., Aliogo, R., Alagi, M., Johanns, C. K., Ibrahim, J., Shiraishi, R., Ehoche, A., Greby, S., Dirlikov, E., Ibrahim, D., Bronson, M., Aliyu, G., Aliyu, S., Dwyer-Lindgren, L., Swaminathan, M., Duber, H. C., & Charurat, M. (2022). Mapping HIV prevalence in Nigeria using small area estimates to develop a targeted HIV intervention strategy. *PLoS ONE, 17*(6), e0268892. doi: 10.1371/journal.pone.0268892

23. Madu, C. O. (2024). Gender imbalance in STEM programs in Nigeria. *Path of Science, 10*(10), 1016–1023. doi: 10.22178/pos.109-26

24. Oturu, K., O'Brien, O., & Ozo-Eson, P. I. (2024). Barriers and enabling structural forces affecting access to antiretroviral therapy in Nigeria. *BMC Public Health, 24*(1), 105. doi: 10.1186/s12889-023-17271-6

25. Eleje, G. U., Emmanuel, G. O., Akinsolu, F. T., & Foláyan, M. O. (2024). Assessment of the acceptability and detection rate of HIV self-testing in Nigeria: a systematic review and meta-analysis. *Discover Epidemics, 1*(1). doi: 10.1007/s44203-024-00003-6

26. Madu, O. C., Agufusi, O. J., Agufusi, C. R., & Agufusi, S. (2025). Determinants of antenatal care utilisation among pregnant women in Nigeria. *Path of Science, 11*(10), 3001. doi: 10.22178/pos.123-5

27. Britannica. (2026). AIDS. Retrieved from https://www.britannica.com/science/AIDS

28. Alexiev, I., & Dimitrova, R. (2025). The origins and genetic diversity of HIV-1: evolutionary insights and global health perspectives*. International Journal of Molecular Sciences, 26*(22), 10909. doi: 10.3390/ijms262210909

29. World Health Organisation. (2025). HIV and AIDS. Retrieved from https://www.who.int/news-room/fact-sheets/detail/hiv-aids

30. Choudhury, A., Asan, O., & Mansouri, M. (2019). Role of Artificial Intelligence, Clinicians & Policymakers in Clinical Decision Making: A Systems Viewpoint. *5th IEEE International Symposium on Systems Engineering,* 1–8. doi: 10.1109/isse46696.2019.8984573

31. Rajan, D., Papanicolas, I., Karanikolos, M., Koch, K., Rohrer-Herold, K., & Figueras, J. (2022). Health system performance assessment. A primer for policymakers. *Policy Brief, 49*

32. Reid, R. J., Wodchis, W. P., Kuluski, K., Lee-Foon, N. K., Lavis, J. N., Rosella, L. C., & Desveaux, L. (2024). Actioning the Learning Health System: An applied framework for integrating research into health systems. *SSM - Health Systems, 2*, 100010. doi: 10.1016/j.ssmhs.2024.100010

33. NACA. (2021). *National HIV and AIDS Strategic Framework 2021–2025.* Retrieved from https://naca.gov.ng/wp-content/uploads/2022/03/National-HIV-and-AIDS-Strategic-Framework-2021-2025-Final.pdf

34. Patel, H. K., Ikpe, S., Bronson, M., Birhanu, S., Abimiku, A., Jahun, I., Detorio, M., Lupoli, K., Yavo, D., Bassey, O. O., Jelpe, T. D., Kagurusi, B., Iriemenam, N. C., Patel, D., Okoye, M. I., Dalhatu, I. T., Ohakanu, S., Voetsch, A. C., Aliyu, S., & Parekh, B. (2022). Performance of HIV rapid testing algorithm in Nigeria: Findings from a household-based Nigeria HIV/AIDS Indicator and Impact Survey (NAIIS). *PLOS Global Public Health, 2*(7), e0000466. doi: 10.1371/journal.pgph.0000466

35. NACA. (2024). *Government Expenditure on Human Resources for HIV in Nigeria: An Assessment of Government Expenditure on Human Resources for HIV in Nigeria.* Retrieved from https://naca.gov.ng/wp-content/uploads/2024/08/NACA_HR_Assessement_.pdf

36. Obiezu-Umeh, C., Gbajabiamila, T., Ezechi, O., Nwaozuru, U., Ong, J. J., Idigbe, I., Oladele, D., Musa, A. Z., Uzoaru, F., Airhihenbuwa, C., Tucker, J. D., & Iwelunmor, J. (2021). Young people's preferences for HIV self-testing services in Nigeria: a qualitative analysis. BMC *Public Health, 21*(1), 67. doi: 10.1186/s12889-020-10072-1

37. Adepoju, V. A., Umebido, C., Adelekan, A., & Onoja, A. J. (2023). Acceptability and strategies for enhancing uptake of human immunodeficiency virus self-testing in Nigeria. *World Journal of Methodology, 13*(3), 127–141. doi: 10.5662/wjm.v13.i3.127

38. Idigbe, I., Gbaja-Biamila, T., Asuquo, S., Nwaozuru, U., Obiezu-Umeh, C., Tahlil, K. M., Musa, A. Z., Oladele, D., Kapogiannis, B., Tucker, J., Iwelunmor, J., & Ezechi, O. (2022). Using a designathon to develop an HIV Self-Testing intervention to improve linkage to care among youths in Nigeria: Qualitative approach based on a participatory Research action framework. *JMIR Formative Research, 7*, e38528. doi: 10.2196/38528

39. Adeniran, A., Chieme, C. F., Ojo, Y. O., Oluwole, E., Olujobi, B., & Ilesanmi, M. (2022). HIV, TB and malaria service readiness at the Primary Healthcare Centres (PHCs) in Ekiti State, Nigeria. *Pan African Medical Journal, 43*, 116. doi: 10.11604/pamj.2022.43.116.35883

40. Bassey, A. E., Olisaeloka, L. C., & Adebisi, Y. A. (2020). Identifying the gaps in HIV prevention and treatment during the COVID-19 pandemic in Nigeria. *International Journal of Infection, 8*(1). doi: 10.5812/iji.109546

41. Von Bertalanffy, L. (1968). *General System Theory: Foundations, Development*. New York: George Braziller.

42. Berlin, R., Gruen, R., & Best, J. (2017). Systems Medicine—Complexity within, simplicity without. *Journal of Healthcare Informatics Research, 1*(1), 119–137. doi: 10.1007/s41666-017-0002-9

43. Issitt, M. (2024). General Systems Theory. Retrieved from https://www.ebsco.com/research-starters/history/general-systems-theory

44. Anderson, B. R. (2016). Improving health care by embracing Systems Theory. *Journal of Thoracic and Cardiovascular Surgery, 152*(2), 593–594. doi: 10.1016/j.jtcvs.2016.03.029

45. Cuofano, G. (2024). General Systems Theory. Retrieved from https://fourweekmba.com/general-systems-theory/

46. Oluwamotemi, C. A., Okanlawon, F. A., Edoni, E. R., & Adelekan, A. L. (2020). Barriers to effective HIV testing services and strategies to promote them at primary health care facilities in Ibadan, Nigeria. *International STD Research & Reviews*, 24–32. doi: 10.9734/isrr/2020/v9i230111

47. Madu, C. O. (2024). Understanding COVID-19 vaccine hesitancy in Nigeria through a university community lens. *Path of Science, 10*(11), 3053. doi: 10.22178/pos.111-10

48. Ahmed, N., Ong, J. J., McGee, K., D'Elbée, M., Johnson, C., Cambiano, V., Hatzold, K., Corbett, E. L., Terris-Prestholt, F., & Maheswaran, H. (2024). Costs of HIV testing services in sub-Saharan Africa: a systematic literature review. *BMC Infectious Diseases, 22*(1), 980. doi: 10.1186/s12879-024-09770-7

49. Bankole, O. T., & Ajayi, I. O. (2022). Evaluation of diagnostic microbiology capacity and barriers in testing for HIV and TB at peripheral Hospital-Based laboratories in Oyo State, Nigeria. *Microbiology Spectrum, 10*(1), e0045921. doi: 10.1128/spectrum.00459-21

50. Lankowski, A. J., Siedner, M. J., Bangsberg, D. R., & Tsai, A. C. (2014). Impact of Geographic and Transportation-Related Barriers on HIV Outcomes in Sub-Saharan Africa: a Systematic Review. *AIDS and Behaviour, 18*(7), 1199–1223. doi: 10.1007/s10461-014-0729-8

51. Okusanya, B., Nweke, C., Akeju, D., & Ehiri, J. (2023). Early infant diagnosis of HIV infection: a mixed-method study of uptake and challenges at primary health centres in Lagos State, Nigeria. *BMC Health Services Research, 23*(1), 1038. doi: 10.1186/s12913-023-09824-7

52. Adewumi, I. P. (2025). Critical analysis of the infectious disease surveillance and response system in Nigeria. *Discover Public Health, 22*(1). doi: 10.1186/s12982-025-00668-6