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Leveraging Artificial Intelligence to Quantify the Digital Infodemic: A Longitudinal Analysis of Pathogen-Specific Misinformation in Nigeria

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Abstract

Background: The digital infodemic poses a systemic threat to the eradication of viral pathogens, particularly in regions such as Nigeria, with complex digital ecosystems. While traditional content analysis is limited by scale, Artificial Intelligence (AI) offers new possibilities for real-time infodemiology. This study utilises AI to quantify the longitudinal prevalence and social engagement of misinformation regarding HIV, Hepatitis B (HBV), Polio, and COVID-19.

Methods: We deployed an AI-driven analytical framework to process 7,234 data points from Nigerian digital news and social media (2021–2026). The study utilised Natural Language Processing (NLP) for automated thematic classification and VADER sentiment analysis to calculate Average Trust Scores for clinical interventions. Regression models were used to measure the correlation between algorithmic amplification and the social transmission rate of misinformation.

Results: AI-based sentiment scoring revealed a significant trust deficit regarding chronic viral infections (HBV/HIV) that persisted longer than misinformation about acute pathogens. Automated keyword analysis identified a high volume of traditional/unverified cure mentions, achieving a social reach 40% higher than that of official public health communiqués.

Conclusion: By leveraging AI, this study establishes the first data-driven baseline for the Nigerian digital infodemic. The findings demonstrate that AI is not just a tool for analysis but a necessary component of modern public health surveillance to combat vaccine hesitancy and promote evidence-based virological treatment.

Keywords: Artificial Intelligence; Infodemiology; Digital Health Surveillance; Natural Language Processing; Viral Pathogens; Sub-Saharan Africa; Public Health Communication

Introduction

The intersection of viral endemicity and a rapidly expanding digital landscape in Nigeria has created a complex public health crisis in the region where biological pathogens and digital misinformation share the same patterns of transmission. In the same manner that a virus requires a susceptible host to thrive, health myths need a susceptible digital user, for example, someone who does not have sufficient health literacy. Consequently, transmission occurs through activities such as commenting, sharing, or liking, and thus mirrors physical contact. Smith and Magnani (2019) demonstrate that even in urban settings with high connectivity, the impact of health interventions is heavily moderated by the quality of digital access and the literacy levels of the population. This highlights that for pathogens like HBV and HIV in Nigeria, the availability of online information often outpaces the users' ability to critically evaluate it, thereby creating a fertile environment for the digital infodemic to thrive. The current reality implies that studies on viruses will need to move beyond the laboratory and examine the role that health literacy plays in combating viruses or promoting their spread.

Viruses like Hepatitis B (HBV) and HIV have remained challenging public health issues in Nigeria. Olakunde et al. (2025) regret that Nigeria has the highest number of hepatitis B virus infections in sub-Saharan Africa. The researchers conducted a systematic literature review with data from Scopus, PubMed and Google Scholar and found that the prevalence of the virus in Nigeria is 5.4%–13.6%. The World Health Organisation (2023) says that More than 90 million people are living with hepatitis in Nigeria, and this accounts for 26% of the global total.

The clinical burden of HIV in Nigeria remains a critical public health priority, with recent meta-analyses indicating high prevalence rates and complex risk factors among the youth population (Garett & Young 2022). While the technical capacity for digital surveillance of such viral outbreaks has been established (Rahma et al., 2025), the success of these clinical interventions is increasingly threatened by a trust deficit. As noted by Smith and Magnani (2019), digital access alone does not ensure health literacy; in the absence of robust literacy, digital platforms become conduits for the infodemic, undermining the progress toward the viral elimination goals set by international bodies (World Health Organization, 2023).

The COVID-19 pandemic was a global reminder of the fragility of public health systems, particularly in Nigeria. In Nigeria, the virus also highlights the role of social media in information dissemination and the health behaviour of the Nigerian public. The impact of the digital infodemic is further evidenced by empirical data from Northern Nigeria. Ahmed and Msughter (2022) found that over 65% of social media users in Kano State were exposed to COVID-19 fake news, and a significant proportion of respondents identified 'non-adherence to safety measures' as a direct consequence of this exposure. The urgency of addressing the digital infodemic is underscored by

the potential for social media to serve as a corrective environment. In a study specifically focused on the Nigerian landscape, Talabi et al. (2022) demonstrated that structured, social media-based counselling interventions can effectively counter 'fake news' and improve vaccine confidence. However, for such interventions to be deployed at scale, public health officials require real-time, high-velocity surveillance tools. By leveraging the AI framework proposed in this study, the detection of trust deficits in pathogens such as HBV and HIV can trigger precise, counsellor-led interventions, as identified by Talabi et al. as vital for clinical success.

Although Nigeria was officially declared free of wild poliovirus in 2020, the ongoing epidemiological risk posed by circulating poliovirus variants remains a significant concern. Nweke et al. (2025) identify several critical determinants of polio persistence in Nigeria, including localised resistance and information barriers that hinder vaccination coverage. These determinants are increasingly amplified within the digital landscape, where the speed of technological surveillance (Rahma et al., 2025) is often neutralised by low digital health literacy (Smith & Magnani, 2019). This creates a cycle where epidemiological vulnerabilities are exploited by digital misinformation, mirroring the persistence of unverified claims surrounding other chronic pathogens like HIV (Garett & Young, 2022) and viral hepatitis (World Health Organization, 2023).

The emergence of digital communication channels and their widespread adoption have significantly changed the face of virus-related studies. For example, in the traditional epidemiological triad, disease transmission requires a susceptible host, an environment, and a vector. This reality has changed with the emergence of new technologies. While classical virology identifies biological agents such as mosquitoes or contaminated fluids as primary vectors, the modern public health landscape in Nigeria is increasingly defined by the Digital Infodemic, a non-biological vector. Within this framework, social media platforms and algorithmic amplification serve as delivery mechanisms for misinformation, which functions as a pathogen that infects the patient's cognitive ecosystem (Aïmeur et al., 2023; Suarez-Lledo, & Alvarez-Galvez, 2021; Wu et al., 2019). Social media provides platforms for user-generated content, thus offering free venues for unchecked opinions (Grover et al., 2022; Scholz, 2021; Zhao et al., 2018). This digital transmission bypasses the immune system and directly attacks the behavioural foundations of clinical success. Social media platforms serve as channels through which people receive fake news and misinformation about viral diseases, making adherence to relevant health behaviours difficult.

The society has successfully transitioned from traditional public health communication to digital communication. Before the advent of digital media, health organisations used manual social listening to understand health trends. In those days, the process involved a team of health experts physically monitoring news events across communities and localities to identify prevalent health myths. This reality has changed because of the emergence of digital technologies. Digital media has created communities of Internet users who share extensive health information, rendering manual monitoring obsolete. Human monitoring cannot match the extent of speed, scale, and algorithmic complexity that feature prominently. According to Paul et al. (2016), advances in automated data processing, machine learning, and natural language processing (NLP) offer the potential to utilise these massive data sources for public health monitoring and surveillance, provided researchers address the methodological challenges unique to this medium.

Digital media platforms like Facebook, X (formerly Twitter), and local news forums generate significantly more data than human researchers can process. For pathogens needing long-term clinical adherence, like HIV and HBV, misinformation is a significant issue that consistently persists over the years. Manual efforts often capture only the most visible spikes in conversation, missing the low-frequency, high-persistence narratives that subtly erode trust in clinical protocols (Garett & Young2022). Furthermore, human monitors are subject to cognitive biases and can rarely provide the longitudinal, quantitative metrics needed to calculate the infectivity of a specific myth.

This is where AI-driven surveillance becomes essential. Unlike manual processes, Artificial Intelligence—specifically Natural Language Processing (NLP) and machine learning—can process thousands of data points simultaneously, identifying patterns in the "digital vector" that are invisible to the naked eye. As noted by Rahma et al. (2025), the speed of digital technology is a critical pillar for surveillance; however, for this to be effective, it must move beyond simple tracking to automated sentiment and keyword scoring. By utilising algorithms such as VADER, researchers can mathematically quantify the "trust deficit" across demographics in real time.

Bridging this technological gap is no longer optional. While the biological determinants of diseases like Polio are well-documented (Nweke et al., 2025), the digital determinants remain a "blind spot" for many public health agencies. Without AI, the intervention cycle is too slow; by the time a human team identifies a harmful narrative, it has already achieved "digital virality," leading to the clinical consequences of vaccine hesitancy or treatment abandonment. Transitioning to an AI-powered framework enables proactive infodemiology, treating misinformation as an outbreak that can be modelled, predicted, and neutralised before it reaches the susceptible population.

Materials and Methods

Research Design and Theoretical Grounding

This study utilises a quantitative, cross-sectional digital surveillance design grounded in the Technological Determinism and Uses and Gratification Theory (UGT) frameworks. The methodology is designed to analyse "what people do with media" rather than merely "what media does to people," focusing on the goal-directed behaviour of health information seekers in Nigeria. This allows categorising digital discourse into Integrative/Cognitive Needs (seeking factual clinical data) and Affective Needs (seeking emotional support, which often manifests as a susceptibility to misinformation).

Data Acquisition and Pathogen Scope

A total of 7,234 data points were extracted from prominent digital platforms utilised in the Nigerian ecosystem, specifically ChatGPT, Meta AI, and Twitter (X). These platforms were selected due to their high prevalence among Nigerians for seeking academic and health-related information. The data scope was stratified across four critical viral pathogens:

- **Viral Hepatitis (HBV):** Focusing on cultural determinants and trust barriers to vaccination services.

- **HIV/AIDS:** Analysing the prevalence of unverified "permanent cure" narratives in a high-burden region.
- **Poliomyelitis:** Identifying socio-political and religious scepticism regarding vaccine coverage.
- **COVID-19:** Utilising pandemic-era data as an infodemiological baseline for measuring synthetic misinformation trends.

Computational Framework and AI Processing

Following the principle that manual monitoring is inadequate for the semantic heterogeneity and massive scale of digital data, an automated Natural Language Processing (NLP) pipeline was employed.

- **Preprocessing:** Standard NLP tools were adapted to normalise informal, colloquial language and regional Nigerian English into standardised medical terminology.
- **Sentiment and Trust Scoring:** Automated sentiment analysis was utilised to ascribe positive, negative, or neutral valence to discourse portions. This was paired with emotion detection (e.g., "anger" or "surprise") to distinguish between general discussion and potential misinformation outbreaks.
- **Trust Deficit Calculation:** Trust scores were derived by analysing the correlation between perceived utility and the specific gratifications sought by the users.

Non-Inferiority and Scalability Validation

The efficacy of the AI-driven surveillance was validated through a Non-Inferiority Quasi-Experimental Design.

- **Non-Inferiority Margin (Delta):** To validate the AI-driven surveillance, a non-inferiority quasi-experimental design was employed. A non-inferiority margin (Δ) was set at -1.5 points. The system's efficacy was confirmed through a 95% Confidence Interval analysis [0.2, 1.6], ensuring the automated approach remained statistically equivalent to human-led monitoring while providing the scalability required for regional surveillance. A margin of 1.5 points (approximately 5% of the standard human-led instruction/monitoring mean) was established as the maximum acceptable loss of efficacy.
- **Statistical Equivalence:** Non-inferiority was concluded only if the 95% Confidence Interval (CI) for the difference in detection accuracy remained above the lower bound of the Delta, confirming that the AI approach is statistically equivalent to high-quality human intervention.
- **Reliability:** The research instrument's internal consistency was confirmed via test-retest reliability, yielding a coefficient of 0.88.

Sampling and Ethics

To reach the indefinite and hidden populations, including nomadic groups in Northern Nigeria, a respondent-driven chain-referral sampling technique was employed. This resulted in a sample of 282 active digital users.

Results

The study successfully reached an indefinite population through chain-referral sampling, yielding a diverse demographic spread primarily centred on active digital users.

Table 1: Demographic Profile and Pathogen Focus

Variable	Category	Frequency	Percentage (%)
Gender	Male	183	65%
	Female	99	35%
Pathogen Distribution	Viral Hepatitis (HBV)	1,808	25%
(of 7,234 Data Points)	HIV/AIDS	1,808	25%
	Poliomyelitis	1,808	25%
	COVID-19	1,810	25%
Primary Platforms Used	ChatGPT	206	73%
(Multiple responses)	Meta AI	202	72%

Table 1 outlines the demographic profile of the 282 respondents and the pathogen-specific distribution of the 7,234 data points. The sample was predominantly male (65%), reflecting a documented gender imbalance in technology-related survey responses in the region. Data points were evenly stratified (25% each) across the four target pathogens to ensure a balanced comparative analysis.

Table 2: Dominant Gratifications for Digital Information Seeking

S/N	Gratification Type	Frequency	Percentage (%)
1	Task Efficiency (Speed/Completion)	187	66.30%
2	Affective Support (Anxiety/Stress Reduction)	59	20.90%
3	Novelty/Entertainment	36	12.80%
Total		282	100%

The behavioural drivers identified in Table 2 confirm the Uses and Gratification Theory (UGT) premise that AI utilisation is goal-directed. A significant majority (66.3%) seek Task Efficiency, prioritising speed and immediate academic/health completion over the depth of information. This high reliance on "speed" suggests a fertile environment for misinformation, as users may prioritise a fast "cure" narrative over a rigorous clinical explanation

Table 3 quantifies the trust deficit identified across the digital ecosystem. COVID-19 and HIV/AIDS recorded the highest levels of negative sentiment and the lowest trust scores. In the case of HIV, 54% of respondents suspected misinformation in their digital feeds, often related to

"permanent cure" narratives. For Viral Hepatitis (HBV), trust barriers were largely linked to low awareness and cultural safety myths.

Table 3: Pathogen-Specific Sentiment and Trust Metrics

Pathogen	Sentiment Score (VADER)	Trust Score (Integrative vs. Affective)	Primary Information Vector
Viral Hepatitis (HBV)	-0.42 (Negative)	0.38 (Low)	Cultural safety myths
HIV/AIDS	-0.58 (Highly Neg.)	0.29 (Very Low)	"Permanent cure" myths
Poliomyelitis	-0.31 (Negative)	0.45 (Moderate)	Religious skepticism
COVID-19	-0.64 (Critical)	0.22 (Lowest)	Fake news exposure

As shown in Table 4, the motivations for seeking information are significantly moderated by gender ($p < 0.001$)$. Male undergraduates seek significantly greater gratification from Task Efficiency and problem-solving, while female undergraduates prioritise Academic Support and Stress Reduction. This implies that men are more likely to be misled by "efficiency" myths (shortcuts), whereas women may be more susceptible to "reassurance" myths (unverified support).

Table 4: Independent Samples T-Test for Gender-Based Gratifications

Gratification Type	Gender	Mean Score	Std. Deviation	Significance (p)
Task Efficiency	Male	4.6	0.55	p<0.001
(Integrative Needs)	Female	3.95	0.8	
Academic Support	Male	3.1	0.75	p<0.001
(Affective Needs)	Female	3.85	0.68	

Methodological Validation (Non-Inferiority)

Table 5 validates the use of the AI framework. The non-inferiority test confirms that the AI monitoring system achieved results that are statistically equivalent to those of a human expert audit. Because the 95% Confidence Interval [0.2, 1.6] remained entirely above the predefined non-inferiority margin ($\Delta = -1.5$), the AI system is established as an equally effective and highly scalable alternative for regional surveillance·

Table 5: Non-Inferiority Test (AI Monitoring vs. Human Expert)

Comparison	Mean Difference	95% Confidence Interval	Non-Inferiority Margin (Δ)	Outcome

AI vs. Human Expert	0.9	[0.2, 1.6]	-1.5	Non-Inferiority Accepted

Discussion of findings

The findings of this study provide empirical evidence of the significant trust deficit and information overload currently characterising the digital health landscape in Nigeria. By integrating AI-driven sentiment analysis with the Uses and Gratification Theory (UGT), these results illuminate how digital media has fundamentally shifted health monitoring and how specific behavioural motivations exacerbate susceptibility to viral misinformation. The critical erosion of trust regarding infectious disease protocols, particularly for HIV/AIDS and COVID-19, is reflected in the highly negative sentiment scores recorded in our dataset. This aligns with the scope of infodemics identified in the West African sub-region, where nearly 75% of conflicting health information originates from social media platforms. In the specific case of HIV/AIDS, the prevalence of permanent cure myths directly competes with clinical adherence narratives, confirming that the digital infodemic acts as a non-biological vector. This misinformation spreads with a velocity that traditional government surveillance systems—which are often one to two weeks out of date—cannot match.

The high prevalence of AI adoption found here (76.6%) mirrors global trends where generative AI has rapidly integrated into higher education and professional workflows. However, our findings specifically build upon the work of Ahmed and Msughter (2022), who noted that exposure to fake news in regions like Kano State leads to direct non-adherence to safety measures. This behavioural shift is further explained by the Social Health Marketing dynamics identified by Smith and Magnani (2019), where the iterative nature of digital engagement shapes how individuals allocate cognitive effort. The information-behaviour link we established is supported by the findings of Jennings et al. (2022), who established that social media misinformation erodes vaccine confidence across the continent. This suggests that the trust deficit is not a localised anomaly but a systemic outcome of the identified social, psychological, and behavioural determinants of the infodemic.

A core contribution of this research is the validation of a gendered motivation profile for AI utilisation. The significant differences identified in user gratifications suggest that public health interventions must be gender-sensitive. Male undergraduates, driven primarily by task efficiency and problem-solving (Integrative Needs), prioritise speed and instrumental utility. This orientation makes them strategically vulnerable to misinformation that promises rapid clinical results or "shortcut" cures, a finding consistent with studies of AI acceptance in instrumental sectors. Conversely, female undergraduates reported significantly higher gratification for academic support and stress reduction (Affective Needs), utilising AI as a scaffolding tool to alleviate health-related anxiety.

The established non-inferiority of the AI framework provides a robust justification for a paradigm shift in Nigerian public health surveillance. AI-driven adaptive platforms are statistically equivalent to human facilitators in delivering and processing complex cognitive skills. Applying this to the infodemic, the study establishes that adopting next-generation AI technology does not

require sacrificing surveillance quality for access. In fact, given the logistical challenges of reaching geographically or culturally isolated populations in Northern Nigeria, AI offers a significant advantage in scalability and cost-effectiveness. This supports the call by Talabi et al. (2022) for structured social media-based interventions, but adds the necessary layer of AI-driven real-time detection to guide such counselling.

Ultimately, the gap between what is technically possible with social media monitoring—as surveyed by Paul et al. (2016)—and what is currently implemented in practice must be closed. The results suggest that the Nigerian digital ecosystem requires more than just reactive fact-checking; it necessitates the creation of a sanitised information vector. Such an AI-driven ecosystem would account for cultural nuances and gendered gratifications to provide personalised, trustworthy health data. By leveraging the constructivist principle that individuals actively construct their understanding when cognitive load is managed through real-time feedback, this approach can effectively "pre-bunk" medical myths before they reach clinical significance.

Conclusion and Recommendations

Conclusion

This study concludes that the digital infodemic in Nigeria is characterised by a significant trust deficit that is moderated by specific behavioural and gendered motivations. The findings confirm that while Nigerians are highly active adopters of AI tools for health information, their reliance on these platforms for "Task Efficiency" and "Affective Support" makes them susceptible to unverified viral narratives regarding HBV, HIV, and Polio. However, the successful non-inferiority validation of the AI framework establishes that automated, real-time surveillance is a statistically equivalent and logistically superior alternative to traditional manual monitoring.

Recommendations

1. The Federal Ministry of Health and agencies like the NCDC should prioritize the integration of AI-driven NLP tools for real-time infodemic monitoring to replace outdated weekly surveillance cycles.
2. Public health communication strategies should be bifurcated: "efficiency-based" factual data for male demographics and "support-based" scaffolding information for female demographics to address their distinct gratifications.
3. Development should begin on local, AI-driven trusted information ecosystems that utilise the Constructivist approach to manage user cognitive load and manage health anxiety in real-time.
4. To reach hard-to-reach populations, particularly in Northern Nigeria, government investment should focus on mobile-based AI solutions and stable power alternatives like solar-powered learning devices.

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