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Research Article

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When Information Backfires: Digital Misinformation, Vaccine Hesitancy, and the Erosion of Health Worker Trust in HPV Vaccination Among Parents in Rural and Urban North Central Nigeria

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Abstract

Background: *In Kogi State, Nigeria, higher parental HPV knowledge correlates with lower vaccination rates, driven by side-effect misinformation and an 83% deficit in reliable data. This mixed-methods study examines how information pathways, misinformation, unstable attitudes, and limited health worker outreach suppress vaccine uptake to inform the national communication strategy.*

Methods: *In 2025, 336 parents of girls aged 9–14 years across three Kogi State LGAs (Lokoja, Igalamela, Ibaji) were enrolled. Quantitative tools included an HPV knowledge composite (α=0.70), an attitude scale (α=0.44), a barrier inventory among non-vaccinators (n=275), and multivariable logistic regression. Qualitatively, inductive thematic analysis evaluated a focus group discussion in Ibaji LGA, comparing findings across regions.*

Results: *Unvaccinated parents scored higher on HPV knowledge than vaccinated parents (M=11.16 vs. 8.70, p<0.001), with higher knowledge predicting lower vaccination odds (aOR=0.244, 95% CI: 0.164–0.364, p<0.001). This paradoxical relationship reflects high misinformation prevalence. Among non-vaccinators, 28.3% believed the vaccine promotes early sexual activity, while 71.7% lacked formal information. Overall, 83.0% reported insufficient data, and 55.1% were unaware of vaccine availability. Parental attitudes were highly unstable (α=0.44) and statistically non-significant in the regression (aOR=0.649, p=0.197), indicating malleable beliefs vulnerable to rumours. Although*

86.0% of parents prioritize a healthcare professional's recommendation, health workers reached only 39.5% of the population, leaving 35.6% completely unexposed to official channels.

Conclusions: *Proliferating misinformation drives HPV vaccine hesitancy in Kogi State. Standard mass awareness campaigns risk aggravating the issue. Nigeria's HPV program must shift from broad broadcasting to targeted, localized interventions utilizing trusted healthcare workers, directly reaching underserved communities currently isolated from formal health information channels.*

Keywords: HPV Vaccination, Misinformation, Vaccine Hesitancy, Knowledge Contamination, Information Quality, Health Worker Trust, North Central Nigeria, Kogi State, Digital Health Communication

Abbreviations

AOR: Adjusted Odds Ratio
CI: Confidence Interval
FGD: Focus Group Discussion
FMOH: Federal Ministry of Health
HBM: Health Belief Model
HPV: Human Papillomavirus
LGA: Local Government Area
LMIC: Low- and Middle-Income Country
NS: not statistically significant
OR: Odds Ratio
SAGE: Strategic Advisory Group of Experts
SBCC: Social and Behavior Change Communication
WHO: World Health Organization

1. Background

Vaccine hesitancy, defined by the WHO Strategic Advisory Group of Experts (SAGE) as the delay in acceptance or refusal of vaccination despite the availability of vaccination services, is one of the ten threats to global health identified by the World Health Organization [1]. In sub-Saharan Africa, hesitancy increasingly involves communities that have access to vaccines but choose not to use them, driven less by structural barriers than by circulating misinformation and low institutional trust.

HPV vaccination is the primary prevention strategy for cervical cancer, which kills approximately 342,000 women annually, and in which Nigeria carries one of the highest national burdens globally [2]. Despite integration into Nigeria's national immunisation programme and a stated government commitment to cervical cancer elimination national HPV vaccine uptake remains critically low, with coverage rates consistently below 30% in population surveys and substantial regional variation that reflects deeper structural and social determinants [3-5].

The standard assumption in low- and middle-income countries (LMIC) vaccine programming is that knowledge deficits drive hesitancy: inform the parent, increase uptake. That assumption has been challenged by growing evidence from high-misinformation environments. Studies in urban Nigeria have shown that parents who actively seek health information are more likely to encounter fear-inducing vaccine narratives and perceived barriers to HPV vaccination frequently involve misinformation about vaccine safety and moral concerns rather than simple knowledge gaps [6-8]. This pattern, more information, more hesitancy, has been documented in Northern Nigeria specifically, including in a mixed-methods study in North Central Nigeria, which found that community-level vaccine resistance is sustained by informal information networks operating outside the reach of formal health education [9-12].

The health worker-patient communication interface is where this dynamic can be intercepted. Health workers are the most trusted information authority for most Nigerian parents, and they have the credibility to counter misinformation that mass media channels lack. However, health system underinvestment in interpersonal communication, combined with the growing penetration of social media as an informal health information source has left health workers marginalised in the information ecosystem even as their trust currency remains high [13].

Kogi State in North Central Nigeria, with its mixed urban-rural geography, ethnically and religiously diverse communities, and variable health infrastructure provides a context in which the interaction between information environment, misinformation exposure, and health worker reach can be directly examined [14-16]. This study uses a mixed-methods design to investigate the mechanisms through which information pathways, misinformation exposure, attitudinal instability, and eroded health worker trust suppress HPV vaccine uptake, drawing on an integrated quantitative-qualitative framework informed by the Health Belief Model, the Theory of Planned Behavior, and the information-hesitancy-trust conceptual framework developed for this study [17-19].

2. Methods

2.1. Study Design and Setting

We used a cross-sectional mixed-methods design: a structured quantitative survey paired with an embedded qualitative FGD component, following a sequential explanatory framework [20]. The study was conducted in 2025 across three purposively selected LGAs in Kogi State: Lokoja (state capital, urban), Igalamela-Odolu (semi-rural), and Ibaji (rural, most remote). The three LGAs were selected to represent the urban-rural information environment gradient hypothesised to shape vaccine uptake patterns.

2.2. Participants and Sampling

The study population comprised parents and primary caregivers

of girls aged 9–14 years. Multistage cluster sampling across three stages, LGA, ward, and community, yielded a final analytic sample of 336 participants (response rate: 93.0%). Sample size was calculated using Cochran's formula ($n=Z^2pq/d^2$; $Z=1.96$, $p=0.50$, $d=0.05$), giving a minimum of 384; the achieved 336 reflects field attrition and the exclusion of incomplete questionnaires.

For the qualitative component, seven participants in Ibaji LGA were purposively selected by community role: two health workers, two religious' leaders, two community elders, and one teacher.

2.3. Instruments

Five instruments were applied, aligned to the information-hesitancy-trust framework developed for this study.

i. **Knowledge Composite (9 items, binary-scored, Cronbach's α=0.70). This assessed** HPV awareness, transmission knowledge, cancer linkage, and vaccine-specific knowledge. Responses were categorised using Bloom's modified criteria: High (7–9), Moderate (5–6), Low (0–4).

ii. **Attitude and Perception Scale (7 Likert items, 4-point scale, Cronbach's α=0.44). This assessed** vaccine safety perceptions, willingness, health worker influence, side-effect concerns, sexual-activity beliefs, information sufficiency perceptions, and religious influence. The poor internal consistency is reported as a substantive finding rather than as a measurement limitation.

iii. **Misinformation Proxy Items.** Three items were identified a priori as misinformation proxies: (a) 'HPV vaccine promotes early sexual activity' (promiscuity myth); (b) 'I am concerned about side effects' (fear narrative); and (c) 'There is not enough information about the vaccine' (information insufficiency indicator). These were analyzed both individually and as a composite misinformation exposure profile.

iv. **Information Source Inventory.** A multiple-response item identified primary HPV vaccine information sources: health workers, mass media, social media, community sensitisation, school programmes, friends/family, and no prior exposure.

v. **Multivariable Logistic Regression.** Binary outcome (HPV vaccine uptake: yes/no) was regressed on knowledge score, attitude score, and sociodemographic covariates (sex, ethnicity, education, income, marital status, religion) in separate unadjusted and combined adjusted models.

2.4. Qualitative Analysis

The Ibaji FGD transcript was analyzed using inductive thematic analysis with specific attention to: (i) information exposure patterns and community communication networks; (ii) trust in information sources; (iii) misinformation themes and their community origins; and (iv) preferences for vaccine communication channels and messengers [21].

2.5. Ethics

Ethical approval was granted by the Kogi State Ministry of Health Ethical Research Committee (Approval Number: MOH/PRS/465/V.1/130). Written informed consent was obtained from all participants before enrolment.

3. Results

3.1. Sociodemographic Profile

Of 336 participants, 70.2% were female, 64.3% Christian, 82.1% married, and 61.6% Igala. Mean age was 41.23 ± 8.40 years. Educational attainment was moderate-to-high (62.2% tertiary). Monthly income was predominantly in the ₦50,000–₦100,000 range (39.6%). HPV vaccine uptake was 18.2% (n=61; 95% CI: 14.2–22.9%), lowest in Ibaji (5.9%) and highest in Lokoja (23.8%).

3.2. Information Landscape

Table 1 maps the diversity and reach of HPV vaccine information sources across the study population. Three structural vulnerabilities stand out. First, 35.6% of respondents had received no information about the HPV vaccine from any source, an information vacuum that informal networks readily fill. Second, formal high-trust channels (health workers at 39.5%; mass media at 25.0%) are outreached by a combination of informal and zero-information conditions. Third, social media reaches only 5.4% of this population, which means the primary threat is not digital misinformation but community oral networks.

Information Source	Frequency (n)	% of Total Sample	Source Domain
Health worker	132	39.5%	Healthcare system
Never heard of vaccine	119	35.6%	No exposure
Television/Radio	28	8.4%	Mass media
Internet/social media	18	5.4%	Digital unregulated
Community sensitization	14	4.2%	Community outreach
School programme	13	3.9%	Educational system
Friends/Family	10	3.0%	Informal social network

Table 1: HPV Vaccine Information Sources and Population Reach, Kogi State, Nigeria (n=334)

3.3. Misinformation and Attitudes

Table 2 presents the three misinformation-proxy perception items, their prevalence, and their contextual interpretation. The side-effect concern item (80.6%) is the dominant fear narrative in this population, far exceeding the promiscuity belief (28.3%). Critically, 83.0% of respondents reported insufficient vaccine information, and 55.1% were unsure whether the vaccine is available in Nigeria, a finding that reflects information insufficiency, not vaccine unavailability.

Item	Strongly Disagree n (%)	Disagree n (%)	Agree n (%)	Strongly Agree n (%)
ATTITUDE ITEMS				
HPV vaccine is safe for children	16 (4.8%)	54 (16.1%)	241 (71.7%)	25 (7.4%)
I would allow my child to be vaccinated	20 (6.0%)	66 (19.6%)	208 (61.9%)	42 (12.5%)
Health professional recommendation influences decision	14 (4.2%)	33 (9.8%)	191 (56.8%)	98 (29.2%)
MISINFORMATION-PROXY PERCEPTION ITEMS				
**Concerned about side effects (fear narrative)	17 (5.1%)	48 (14.3%)	203 (60.4%)	68 (20.2%)
**Vaccine promotes early sexual activity (promiscuity myth)	24 (7.1%)	217 (64.6%)	87 (25.9%)	8 (2.4%)
**Insufficient information about the vaccine (information gap)	16 (4.8%)	41 (12.2%)	200 (59.5%)	79 (23.5%)
OTHER PERCEPTION ITEMS				
Religious beliefs affect my decision	43 (12.8%)	204 (60.7%)	68 (20.2%)	21 (6.3%)
Cultural/religious objections in my community	59 (17.6%)	185 (55.1%)	85 (25.3%)	7 (2.1%)
*** = Misinformation-proxy item. The side-effect concern item (80.6%) demonstrates that fear of adverse events is the dominant perception item in this population, far exceeding the promiscuity belief (28.3%). Critically, 83.0% of parents simultaneously report feeling that there is insufficient information about the vaccine, confirming that information insufficiency and fear coexist as a compound vulnerability to misinformation.*				

Table 2: Parental Attitudes, Perceptions, and Misinformation-Proxy Items (n=336)

3.4. Regression Findings

Table 3 presents a multivariable logistic regression. The large negative beta coefficient for knowledge (β=1.410) and the aOR of 0.244 (a 75.6% reduction in uptake odds per unit increase in knowledge score; 95% CI: 0.164–0.364, p<0.001) constitute the central empirical finding of this study. Attitudes were not significant in the adjusted model (aOR=0.649, p=0.197). Higher education was independently associated with lower uptake (aOR=0.543, p=0.015), consistent with the misinformation-seeking interpretation.

Predictor Variable	β	S.E.	Wald	df	p-value	aOR	95% CI Lower	95% CI Upper
Constant	3.337	1.539	4.699	1	0.030	28.128	—	—
**Knowledge Score (composite)	1.410	0.203	48.150	1	<0.001*	0.244	0.164	0.364
Attitude/Perception Score	0.432	0.334	1.666	1	0.197	0.649	0.337	1.251
Sex	0.205	0.350	0.342	1	0.559	1.227	0.618	2.439
Ethnic Group	0.272	0.180	2.272	1	0.132	1.312	0.922	1.868
Level of Education	0.610	0.251	5.930	1	0.015*	0.543	0.332	0.888
Monthly Income	0.369	0.214	2.984	1	0.084	1.447	0.951	2.199
Marital Status	0.138	0.352	0.154	1	0.695	1.148	0.576	2.288
Religion	−0.015	0.310	0.003	1	0.960	0.985	0.537	1.807
*** = Key information-pathway predictor. * p<0.05. aOR: adjusted odds ratio; NS: not statistically significant; S.E.: standard error. The large negative beta coefficient for knowledge (β=−1.410) and the aOR of 0.244 (a 75.6% reduction in uptake odds per unit increase in knowledge) represent the strongest association in the model, stronger than any demographic or attitudinal predictor.*								

Table 3: Multivariable Logistic Regression: Knowledge Score and Attitude Score as Predictors of HPV Vaccine Uptake (n=336)

3.5. Attitudinal Fragility

Table 4 synthesises the attitudinal profile findings, including the Cronbach's α evidence for scale fragility, the attitude score distribution by vaccination status, and the non-significant adjusted regression result. Seventy-eight-point three percent of parents hold moderate attitudes, neither strongly positive nor strongly negative.

Only 5.4% demonstrate stable, coherent positive vaccination support. This moderate majority is the most vulnerable group in the population: not resistant enough to be moving, not convinced enough to act. They are the population most susceptible to a single credible voice, positive or negative.

Measure	Result
Cronbach's alpha (attitude scale, 7 items)	**α = 0.44**
Attitude distribution: Positive (80–100%)	5.4% (n=18)
Attitude distribution: Moderate (60–79%)	78.3% (n=263)
Attitude distribution: Negative (<60%)	16.4% (n=55)
Mean attitude score: Vaccinated parents	21.98 ± 2.76
Mean attitude score: Non-vaccinated parents	21.12 ± 2.48
Bivariate t-test (attitude by uptake)	t(334)=2.412, p=0.016, d=0.34
Adjusted regression (attitude → uptake)	**aOR=0.649, 95% CI: 0.337–1.251, p=0.197**
Health worker recommendation influence	**86.0% agree**
Parents reporting insufficient information	83.0% agree

Table 4: Attitudinal Profile and Internal Consistency HPV Vaccine Uptake, Kogi State (n=336)

3.6. Qualitative Findings: Information Dynamics in Ibaji LGA

The FGD conducted in Ibaji LGA, the most rural site, revealed a community at the earliest stage of the information diffusion curve: no prior exposure to HPV, no misinformation, and no fear. The community's response to the information presented during the FGD was uniformly receptive. This contrasts sharply with the urban Lokoja findings, where information exposure was higher, but misinformation contamination was also more advanced.

"I have not heard it... I don't know what it means... please enlighten us."
— Community Elder 1, Ibaji LGA FGD

The absence of misinformation in Ibaji is directly attributable to the absence of prior information exposure. This is theoretically significant: misinformation does not precede information; it accompanies or follows it. In communities where health literacy is low and formal health system reach is limited, the first information source to arrive shapes the attitudinal architecture. The FGD data show that trust in health workers and government remains intact in Ibaji precisely because neither has yet been tested by competing narratives.

"If a doctor or nurse tells us... we will take it."
— Health Worker 1, Ibaji LGA FGD

"I will allow my daughter to be vaccinated... once it comes from the government."
— Community Elder 1, Ibaji LGA FGD

These statements capture the community's trust architecture: government and health workers are the only legitimate information authorities. FGD participants did not reference social media, WhatsApp, or community gossip networks as information sources, consistent with the 5.4% social media penetration recorded in the quantitative survey. The promiscuity myth endorsed by 28.3% in the survey had not reached Ibaji:

"It will not encourage early sexual activity."
— Religious Leader 2, Ibaji LGA FGD

This rejection was based not on accurate knowledge but on the absence of exposure to the myth. The implication is direct: in communities like Ibaji, the window for establishing accurate vaccine norms before misinformation arrives is open. That window closes as information networks expand and communities become connected to the informal channels that carry fear narratives faster than health systems carry reassurance.

4. Discussion

This study traces the mechanisms through which information dynamics suppress HPV vaccine uptake in Kogi State. The five findings, the knowledge-uptake paradox, misinformation proxy prevalence, information source inequity, attitudinal fragility, and the health worker trust deficit, are not independent phenomena. They describe a single interconnected system in which information volume without quality control produces hesitancy rather than confidence.

4.1. Knowledge Contamination as the Operative Mechanism

The inverse association between knowledge and uptake (aOR=0.244, p<0.001; Cohen's d=0.73) is the largest and most significant predictor in the multivariable model. When combined with the finding that 83.0% of parents feel there is insufficient reliable vaccine information, this pattern points to a specific mechanism: parents are acquiring knowledge, but the knowledge they are acquiring is predominantly fear-laden and inaccurate. This is not a knowledge deficit; it is knowledge contamination.

This pattern fits the Elaboration Likelihood Model of persuasion, which predicts that individuals who engage more deeply with information are more susceptible to adopting negative attitudes

when the information they process is negatively framed [22]. Parents who actively seek vaccine information in Kogi State are more likely to encounter fear narratives than accurate clinical data, and their deeper engagement with that contaminated information produces stronger negative attitudes. The parallel education-uptake inverse association (aOR=0.543, p=0.015) supports this interpretation: more educated parents seek more information, and in this information environment, more information-seeking means more misinformation exposure. This is not an argument against education; it is an argument for controlling the information environment to which educated parents are exposed.

4.2. Misinformation Penetration: Promiscuity Myth and Side-Effect Fear

Two specific misinformation themes are quantitatively documented in this study. The sexual promiscuity belief (endorsed by 28.3% of parents) is a misconception documented across sub-Saharan Africa and specifically linked to reduced HPV vaccine acceptance in Nigeria [9,10]. Its persistence in a population where 71.7% have had no formal vaccine information confirms that this myth travels through community oral networks independently of any formal information campaign [23]. It does not need a formal trigger; it needs only an informal carrier.

The side-effect fear (endorsed by 80.6%) is more prevalent still and constitutes the dominant fear narrative in this population. As a stated barrier to vaccination, side-effect concern was cited by 21.4% of non-vaccinators, second only to lack of awareness (42.0%). The critical point is that this fear narrative is not grounded in clinical evidence about known adverse events; it is a community fear that amplifies through informal networks in the absence of credible clinical reassurance. Evidence from sub-Saharan Africa, Indonesia, Uganda, and China consistently shows that perceived side-effect risk functions as a primary vaccination barrier when it is not counteracted by trusted clinical sources [24-26].

The FGD data from Ibaji support this interpretation directly. In a community with zero prior information exposure, no side-effect fear was expressed. Fear is not a baseline attitude; it is a downstream product of contaminated information environments. The implication for programme design is that reducing fear narratives requires not more information but better information from more credible sources.

4.3. Health Worker Trust: The Decisive Variable Under Strain

The finding that 86.0% of parents would change their vaccination decision based on a health professional's recommendation makes health workers the decisive mediating variable in this system, where health workers communicate and trust-based compliance can override contaminated community knowledge. No other channel in the information landscape commands this level of behavioural authority. Yet, health workers reached only 39.5% of the study population as an information source. The gap between 86% who trust health workers and the 39.5% who have actually been reached is a direct measure of the health system's underperformance on its most important communication task.

Expanding health worker HPV communication is the primary available intervention. International evidence on vaccine hesitancy interventions, including the use of trusted messenger models in infodemic management and the Fogg Behaviour Model applied to Nigerian HPV acceptance, consistently shows that interpersonal communication from trusted sources outperforms mass media in shifting hesitant populations. The data from this study confirm that the same principle applies at the community level in North Central Nigeria [27,28].

4.4. Attitudinal Fragility: A Structural Vulnerability

The attitude scale's poor internal consistency (Cronbach's α=0.44) is not merely a measurement limitation; it is a substantive finding about the nature of parental attitudes toward HPV vaccination. A α of 0.44 indicates that parents are endorsing individual attitude items inconsistently: they may agree that the vaccine is safe while also agreeing that it promotes sexual promiscuity, or express willingness to vaccinate while reporting insufficient confidence to act. This incoherence is precisely what makes attitudes susceptible to misinformation and nonsignificant in regression.

The distribution of attitude categories confirms this: 78.3% of parents hold moderate attitudes, with only 5.4% demonstrating stable positive vaccination support. This moderate majority is the population segment most movable by a single intervention, positively, by a health worker recommendation, or negatively, by a fear narrative. The attitudinal fragility finding suggests that the communication problem in Kogi State is not fixed opposition but unstable ambivalence, a condition that health worker-led communication is well positioned to address.

4.5. Urban-Rural Information Environment Gradient

The multi-LGA design reveals a gradient rather than a binary. Urban Lokoja combines higher health literacy with greater exposure to both formal and informal information channels, higher awareness, but also higher misinformation penetration. Rural Ibaji has minimal information exposure of any kind but intact institutional trust. Igalamela-Odolu sits between the two: partial formal information reach, partial misinformation penetration, intermediate uptake. This gradient has direct implications for programme sequencing: rural communities like Ibaji require immediate vaccination outreach before informal networks expand; urban communities like Lokoja require misinformation correction paired with health worker endorsement.

4.6. Limitations

The cross-sectional design limits causal inference. Knowledge was measured as a composite of correct responses and cannot distinguish accurately between accurate and inaccurate information content, preventing direct measurement of misinformation exposure. Social desirability bias may affect self-reported vaccine uptake. The single-LGA qualitative component (Ibaji only) limits the generalizability of the FGD findings to the most rural context. The attitude scale's poor internal consistency constrains what can be inferred from attitudinal data. Future research should directly measure misinformation exposure volume using validated

instruments such as the Misinformation Susceptibility Test.

5. Conclusions

Information is not the solution to low HPV vaccine uptake in Kogi State; information quality is. When more information means more misinformation, awareness campaigns that increase information volume without controlling information quality accelerate hesitancy rather than reversing it. The knowledge-uptake paradox documented here is not a paradox at all; it is the predictable result of community misinformation circulating faster than accurate clinical communication.

Two priorities follow this evidence. First, the health system must redirect its communication investment from mass awareness toward health worker-led interpersonal communication. With 86% of parents reporting that a health professional's recommendation would change their vaccination decision, and only 39.5% having ever received information from a health worker, the trust infrastructure for rapid uptake already exists; it is simply not being activated.

Second, rural communities like Ibaji represent time-limited opportunities. The absence of misinformation in Ibaji is a product of information isolation, not immunological reasoning. These communities are reachable before the fear narratives arrive. Deploying accurate, health worker-delivered vaccine communication to Ibaji-type communities before informal information networks expand is the intervention most likely to convert receptive ambivalence into actual vaccination. The window is open. The evidence of what to do is clear. The question is how quickly the programme can act.

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