

The role and restraints of animal health service providers in foot-and-mouth disease vaccination in Nigeria

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ABSTRACT: The persistence of transboundary animal diseases such as foot-and-mouth disease (FMD) continues to undermine animal health and production, posing significant challenges for farmers, policymakers, and the livestock sector in Nigeria. Although vaccination is a proven tool for FMD control, vaccine adoption in Nigeria remains suboptimal. A major factor is the limited engagement of animal health service providers (AHSPs) in recommending vaccines, which hampers uptake and leaves livestock populations vulnerable to outbreaks. This study, therefore, explores the contribution of AHSPs to FMD vaccination and the challenges that limit their role in disease control. Using semi-structured questionnaires, 201 AHSPs from 12 states across four geopolitical zones were interviewed to assess their knowledge, experience, and practices regarding FMD vaccination. Data were cleaned in Microsoft Excel and analysed in IBM SPSS®. Most respondents were veterinarians (75.1%) with over five years' professional experience (80.6%). Although 81.6% were aware of FMD vaccine availability, only 71.3% had recommended the vaccines, and just 52.7% recognized the different FMDV serotypes circulating in Nigeria. Notably, 75.4% of AHSPs advised treatment for managing the disease, reflecting persistent gaps in vaccine use by the farmers. The findings in this study highlight barriers, including limited vaccine availability, logistical constraints, and low farmer compliance. Therefore, strengthening vaccine supply, surveillance systems and farmer sensitisation are crucial to enhance AHSPs-driven FMD control in Nigeria.

Keywords: Disease control, FMD vaccination, Foot-and-Mouth Disease, veterinarians.

INTRODUCTION

The livestock industry is one of the fastest-growing sectors in low and middle-income countries, driven by increasing demand and new market opportunities for animal-based products (FAO, 2023). In many regions globally, especially in low- and middle-income countries, livestock serve as a key source of nutrition (Alonso *et al.*, 2019) and household income (Bettencourt *et al.*, 2014), but the persistence of transboundary diseases like foot-and-mouth disease (FMD) threatens animal health and production, posing major challenges to farmers, policy makers, and the livestock industry at large (Knight-Jones and Rushton, 2013).

FMD is a highly contagious disease that affects cloven-hoofed livestock and wildlife animals, and it is caused by

the foot-and-mouth disease virus (FMDV) (Grubman and Baxt, 2004). There are seven serotypes of FMDV, namely O, A, C, SAT-1, SAT-2, SAT-3, and Asia1 (Mason *et al.*, 2003; Wang and Liu, 2020; Li *et al.*, 2023). Six of these serotypes (O, A, C, SAT-1, SAT-2, SAT-3) have occurred in Africa (Rweyemamu *et al.*, 2008; Maree *et al.*, 2014), while A, O, SAT-1, and SAT-2 have been reported in Nigeria (Fasina *et al.*, 2013; Wungak *et al.*, 2017; Ehizibolo *et al.*, 2020). FMD negatively impacts livestock health and productivity (Knight-Jones and Rushton, 2013), and causes significant economic losses (Young *et al.*, 2013; Ansari-Lari *et al.*, 2017). These in turn have deleterious effects on food security and the livelihood of livestock-dependent communities (Di Nardo *et al.*, 2011). FMD

outbreaks also impact international trade of livestock and livestock products (Webb *et al.*, 2018). Due to the implementation of trade bans and restrictions designed to prevent disease spread, countries infected with FMD are unable to trade live animals with FMD-free countries (Knight-Jones and Rushton, 2013). In African countries, including Nigeria, the livestock sector contributes to food security and the livelihoods of farmers. Therefore, the burden and endemicity of FMD in this region remain a persistent threat (Mashinagu *et al.*, 2024).

Globally, FMD prevention and control strategies have included a combination of biosecurity and zoo-sanitary measures such as quarantine, movement restriction and permits, vaccination, and culling of affected herds (Olabode *et al.*, 2014; Kompas *et al.*, 2015; Mashinagu *et al.*, 2024). Among these, vaccination has been identified as a particularly effective tool that reduces the burden of animal infections and limits transmission (Naranjo and Cosivi, 2013; Ugochukwu and Phillips, 2019), especially in pastoral-dominated regions where the regulation of animal movement is challenging (Barasa *et al.*, 2008). Notably, vaccination has played a key role in the control and eventual eradication of FMD in Europe, large regions of South America (Paton *et al.*, 2009), and some parts of Africa, like Botswana, Namibia, Madagascar, and South Africa (FAO, 2020).

Despite the documented effectiveness of vaccination for FMD control and its importance to the livestock industry, adoption of FMD vaccines in Nigeria remains suboptimal (Sopeju *et al.*, 2025). Regarding the usage of FMD vaccine for disease control, while farmers frequently encounter barriers, the engagement of animal health service providers (AHSPs) in recommending the vaccine is low, which limits FMD vaccine uptake, resulting in compromised disease control, leaving the cattle population vulnerable to FMD outbreaks.

AHSPs, including veterinarians (in the government and private sector), livestock extension officers, community animal health workers (CAHWs), animal scientists and technologists, play a central role in vaccination efforts. Their responsibilities encompass vaccine administration, adequate cold chain management, disease diagnosis and surveillance, farmer education and support (Gizaw *et al.*, 2021). However, their effective execution of these responsibilities is often hindered by poor farmer compliance, insufficient training, lack of resources and logistical constraints with vaccine storage, transportation, and distribution (Acosta *et al.*, 2019; Bugeza *et al.*, 2017). Although these challenges are acknowledged, there is limited empirical research investigating the firsthand experiences of AHSPs, especially within the context of FMD vaccination in the Nigerian setting. Gaining insights into the perspectives of AHSPs would ultimately lead to a deeper understanding of day-to-day challenges with FMD control, inform more effective policies, promote FMD vaccine adoption, and ultimately, FMD eradication.

Therefore, this paper seeks to investigate the contribution and the challenges of AHSPs in implementing FMD vaccination and, ultimately, eradication in Nigeria. With the

use of semi-structured questionnaires, we assess AHSPs' knowledge and experience with FMD and its vaccines, their perception of farmers' behaviours and experiences, and how these factors influence vaccine uptake in this cross-sectional study.

METHODOLOGY

Ethical consideration

The ethical approval for the project, questionnaire, consent forms and other participant information materials was obtained from the University of Ibadan (UI) UCH Ethics Committee of the Institute for Advanced Medical Research and Training (IAMRAT), College of Medicine, University of Ibadan (registration number: NHREC/05/01/2008a; UI/UCH Ethics Committee assigned number: UI/EC/24/0256), dated 08/04/2024 to 07/04/2025. This was obtained as it is required for international publication, but not a requirement for questionnaire administration in human subjects in Nigeria.

Study area

This study was carried out in 12 states across four geopolitical zones in Nigeria: North-Central (Federal Capital Territory (FCT), Kwara, Niger and Plateau States), North-East (Adamawa and Bauchi States), North-West (Kaduna and Sokoto States), and South-West (Lagos, Ogun, Osun and Oyo States) zones (Figure 1).

Study population

A total of 201 animal health service providers who catered to livestock in different capacities were interviewed.

Data collection

Informed consent of each participant was obtained prior to the interview. A questionnaire, composed of both closed and open-ended questions, was uploaded onto the Kobocollect App®. It was then read out in-person to participants in the most preferred language (English or local language) by licensed animal health service providers (veterinarians or animal health technologists).

Data analysis

The data were entered into Microsoft Excel (Version 2506, Microsoft Corporation, Redmond, WA, USA) software for data cleaning, and later exported to IBM SPSS® Statistics version 25 software (IBM Corp.) for statistical analysis. A Chi-square test of independence was performed to examine the relationship between categorical variables. All tests of significance were two-tailed, and p-values of <0.05 were taken to indicate statistical significance.



Figure 1. Map of study locations.

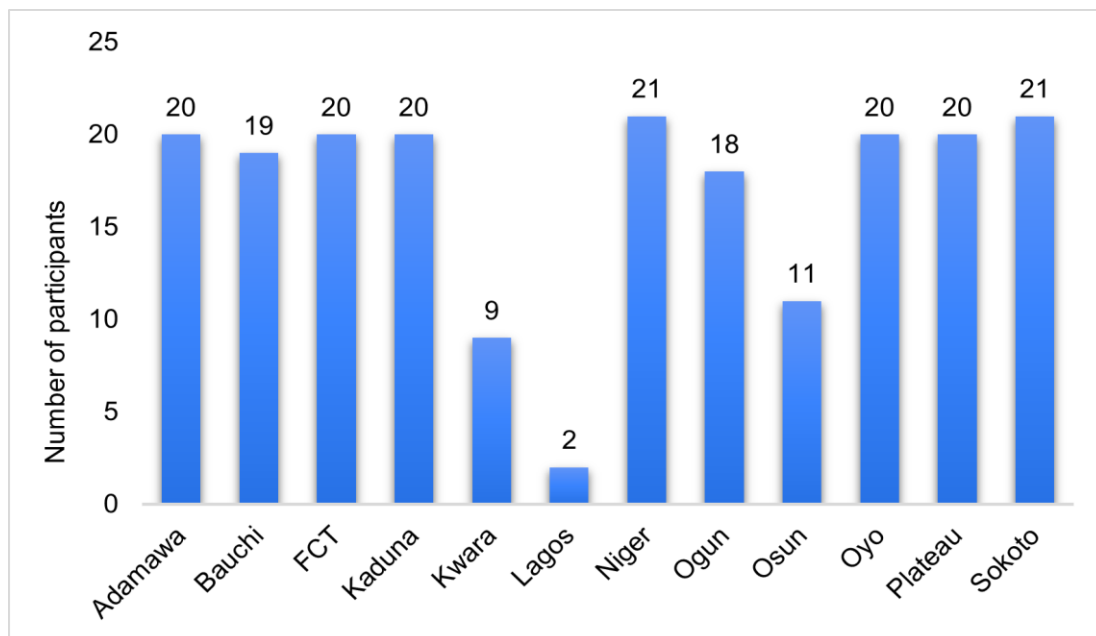


Figure 2. Distribution of study participants per state.

RESULTS

Participant information

Respondents were mainly from Niger and Sokoto (10.4% each), the least from Lagos (1%) state (Figure 2), and were predominantly male, aged 31-50 years. The most common highest qualification was a first degree (44.3%), and it was mostly held by veterinarians (75.1%). Most had over five

years' experience as AHSPs (80.6%), with 76.1% of these professionals currently consulting for 1-5 farms. However, 46.8% reported that they have consulted for up to 10 cattle farms in their careers (Table 1).

Experience with FMD

87.1% of respondents had observed FMD cases on their

Table 1. Summary of study participant characteristics.

Characteristics	Response	Number of participants	Proportion of participants (%)
Gender	Female	37	18.4
	Male	164	81.6
Age	31-40	101	50.2
	41-50	53	26.4
	51-60	20	10.0
	61-70	4	2.0
	Above 70	1	.5
	Less than 30 years	22	10.9
Occupation	Animal Scientist/Technologist	49	24.4
	Sales Representative	1	0.5
	Veterinarian	151	75.1
Highest level of education	First Degree (DVM, B.Sc.)	89	44.3
	HND	30	14.9
	Masters	64	31.8
	ND	9	4.5
	PhD	9	4.5
Years of experience as a professional	Less than 5 years	39	19.4
	5 to 10 years	69	34.3
	11 to 15 years	35	17.4
	16 to 20 years	30	14.9
	Over 20 years	28	13.9
Years of experience consulting for cattle farms	Less than 5 years	56	27.9
	Over 5 to 10 years	65	32.3
	Over 10 to 15 years	38	18.9
	Over 15 to 20 years	19	9.5
	Over 20 years	23	11.4
How many cattle farms have you consulted for?	1 - 5 farms	73	36.3
	6 - 10 farms	34	16.9
	More than 10	94	46.8
How many farms do you currently consult for?	1 - 5 farms	153	76.1
	6 - 10 farms	20	10.0
	More than 10 farms	28	13.9

farms, with 41% encountering cases within the preceding 12 months and 4% within the preceding six months. A substantial proportion of the respondents (40.1%) reported observing cases annually, although some respondents reported FMD occurs all year-round; July-September were most frequently reported (Table 2; Figure 3).

The proportion of respondents who have experienced FMD cases was significantly higher in the North-Eastern zone (97.4%) and lowest in the South-West (80.4%).

Similarly, respondents consulting for more than 10 farms reported higher exposure to FMD cases (46.8%), whereas those consulting for 1–5 farms reported lower exposure (36.3%) (Tables 1 and 2).

Slightly over half of respondents (52.7%) reported that they were familiar with the different serotypes of FMD virus; according to the respondents, all viral serotypes (O, A, C, SAT 1, SAT 2, SAT 3, Asia 1) were believed to be circulating across study regions except Asia 1 in the South-

Table 2. FMD experience and knowledge.

Variable	Response	Number of participants	Proportion of participants (%)
Have you seen a case of Foot and Mouth Disease (FMD) in the cattle farms you are consulting for? (n=201)	Yes	175	87.1
	No	26	12.9
When did you last encounter FMD? (n=173)	Within the last 6 months	7	4.0
	This year	71	41.0
	Last year	43	24.9
	Two years ago	23	13.3
	More than 2 years ago	2	1.2
	Three years ago	11	6.4
	More than three years ago	16	9.2
How often do you encounter FMD cases on farms? (n= 172)	Yearly	69	40.1
	Rarely	44	25.6
	Frequently, but not following a particular pattern	24	14.0
	Quarterly	22	12.8
	Once in two years	11	6.4
What month do you frequently encounter FMD cases? (n=161) *	Monthly	2	1.2
	January	29	18.0
	February	23	14.3
	March	15	9.3
	April	26	16.1
	May	33	20.5
	June	49	30.4
	July	66	41.0
	August	60	37.3
	September	68	42.2
	October	57	35.4
	November	59	36.6
December	42	26.1	
How do you usually conclude on FMD in cattle farms you consult for? * (n = 175)	Clinical Presentation	172	98.3
	Laboratory diagnosis	32	18.3
	Postmortem examination	8	4.6
What do you advise in the case of FMD? (n=175)*	Treatment	132	75.4
	Biosecurity	105	60.0
	Vaccination	91	52.0
Have you ever experienced an incidence of FMD after vaccination before? (n=175)	Yes	14	8.0
	No	161	92.0
Are you familiar with different serotypes of FMD virus? (n=201)	Yes	106	52.7
	No	95	47.3
Which brand of FMD vaccine produces the best protection for these serotypes in your area? (n=32)	NVRI	31	96.9
	MEVAC	1	3.1

*Participants were allowed to select multiple options.

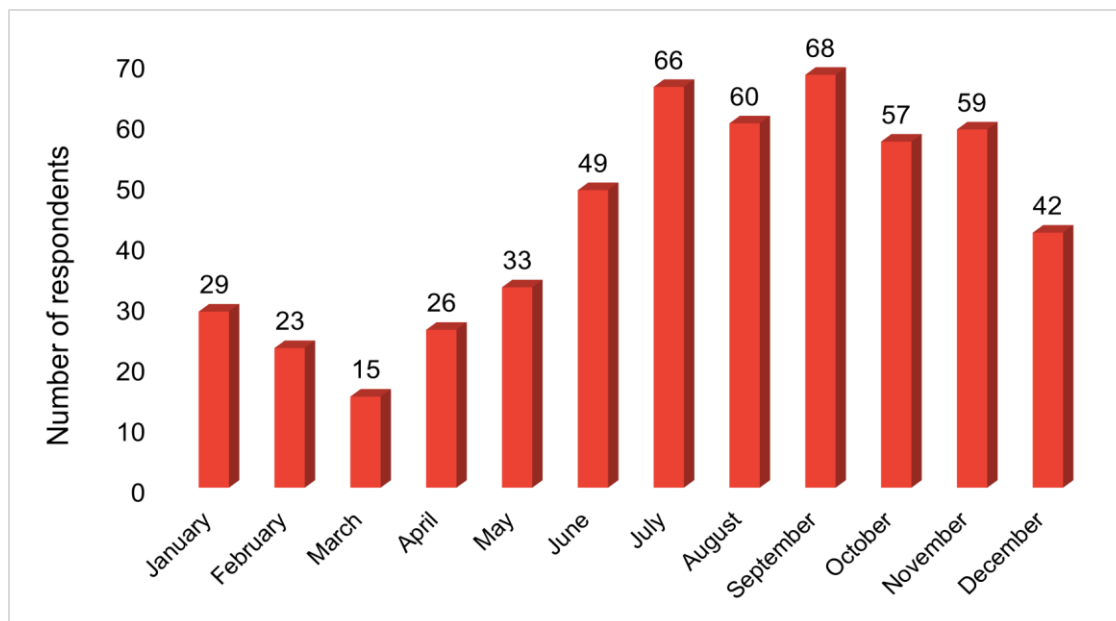


Figure 3. Frequency of FMD occurrence by months.

Table 3. Distribution of FMD Virus serotypes by Region and State.

Region	States	Number of Respondents per serotype						
		A	C	O	SAT1	SAT2	SAT3	Asia1
North Central	FCT (n=4)	4	4	4	4	4	3	3
	Kwara (n=3)	3	1	3	2	2	1	0
	Niger (n=4)	4	1	3	3	2	0	0
	Plateau (n=3)	2	2	2	3	3	3	2
Total	14	13	8	12	12	11	7	5
North East	Adamawa (n=4)	1	1	2	3	3	1	1
	Bauchi (n=7)	5	2	5	7	7	2	2
	Total	11	6	3	7	10	10	3
North West	Kaduna (n=12)	5	1	3	12	11	6	0
	Sokoto (n=6)	2	1	2	6	5	3	1
	Total	18	7	2	5	18	16	9
South West	Ogun (n=3)	3	3	2	3	3	2	0
	Osun (n=4)	2	0	1	4	3	1	0
	Oyo (n=6)	4	4	6	4	4	2	0
	Total	13	9	7	9	11	10	5

West (Table 3). A greater proportion of these respondents (96.9%) believed that the NVRI vaccine produced the best protection against locally circulating serotypes (Table 2).

The proportion of respondents who were aware of FMD serotypes was significantly higher in veterinarians compared to other professions (61.6%; $p < 0.0001$). On the other hand, the proportion of respondents who were aware

of FMD serotypes was significantly lower in those who reported National Diploma (ND) (11.1%; $P = 0.01$) and Higher National Diploma (HND) certification (33.3%; $P = 0.02$) as their highest level of education. Conversely, awareness was higher in the South-West (62.7%) than in other regions, but this was not statistically significant ($P = 0.1$). Details of the comparisons are reported in Tables 1

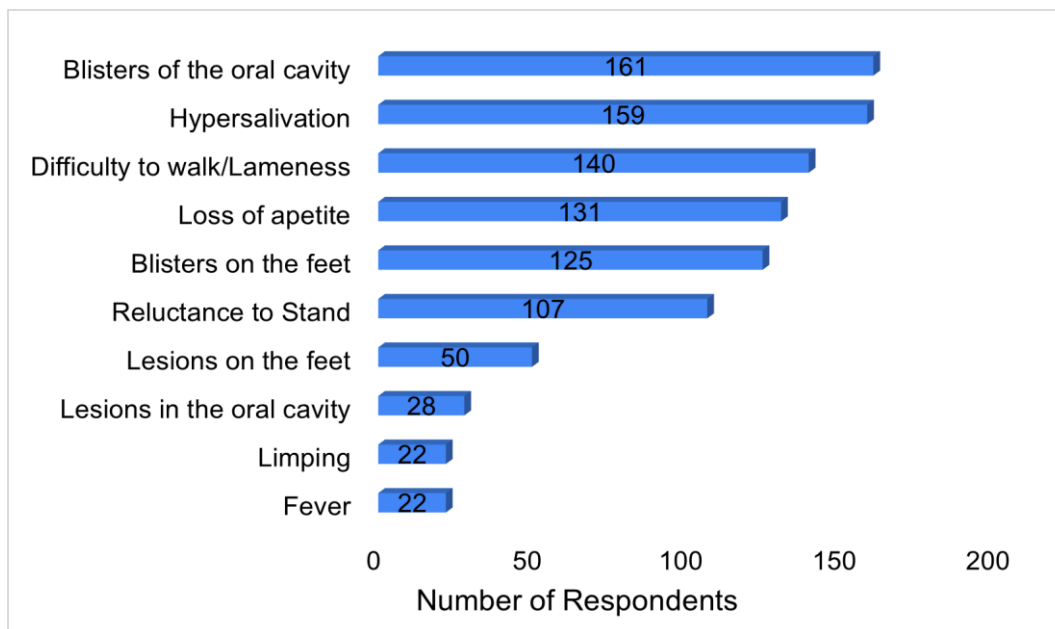


Figure 4. Most Common clinical signs of FMD as reported by study participants.

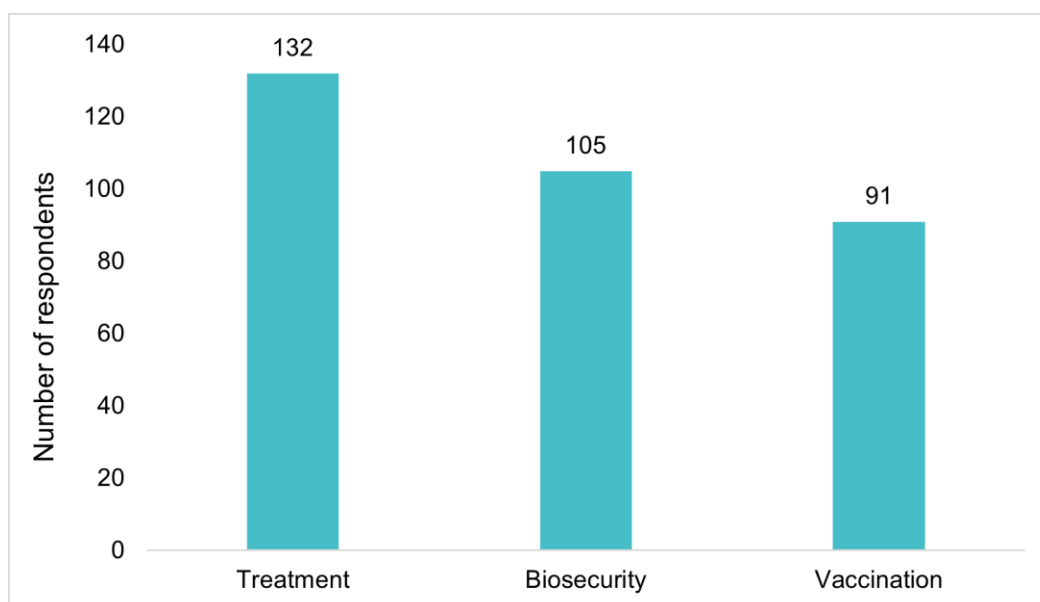


Figure 5. Summary of recommended approaches to FMD management.

to 2.

98.3% of respondents used clinical presentation for their diagnosis (Table 2). The clinical signs mostly used as reported in this study were blisters in the mouth, hypersalivation and difficulty to walk (Figure 4). Other methods used for diagnosis were laboratory diagnosis (18.3%) and postmortem examination (4.6%). Managing the disease, treatment was the most recommended option (75.4%) (Table 2, Figure 5), with an average cost of

treatment and vaccination being USD 15.35 (₦ 6602.52) and USD 9.4 (₦ 4043.85), respectively, per animal. However, 8% of respondents reported that they had seen cases of FMD after vaccination.

FMD vaccine knowledge

Most respondents (81.6%) were aware of FMD vaccine

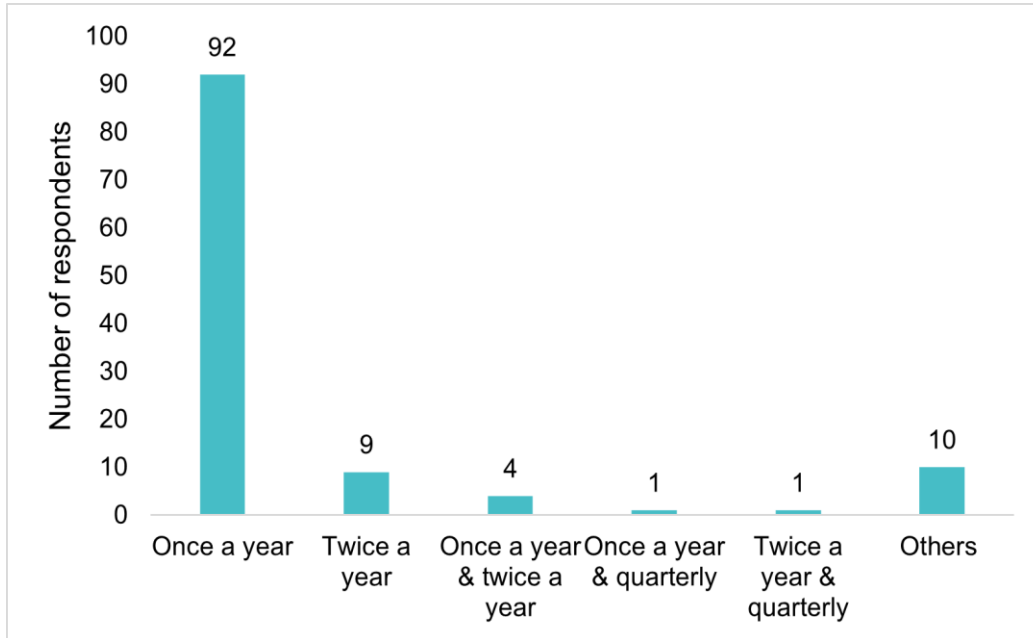


Figure 6. Summary of vaccine protocols recommended by study participants.

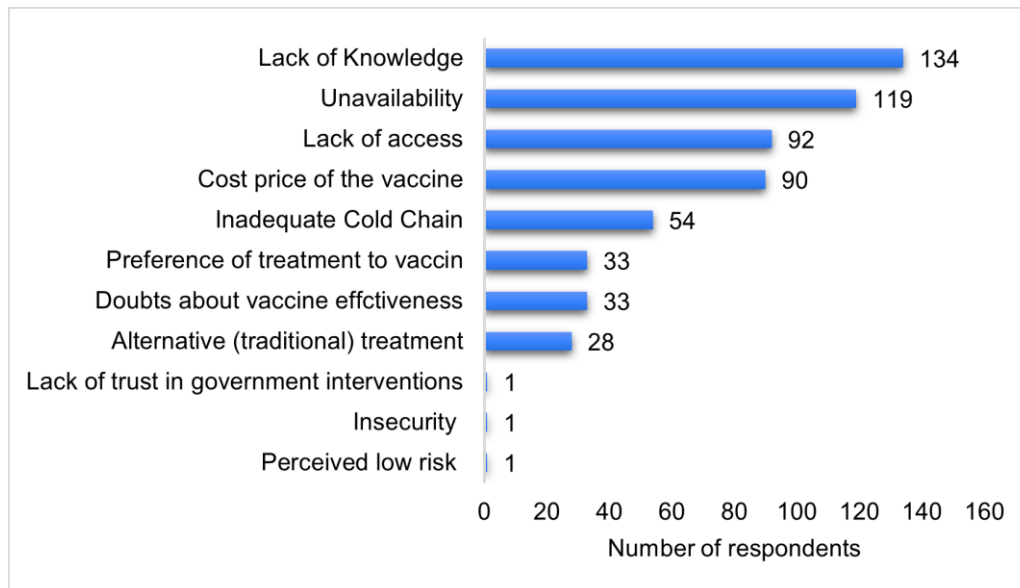


Figure 7. Challenges faced by farmers with respect to FMD vaccine usage.

availability in Nigeria, and 71.3% (92/129) of these have recommended FMD vaccine to farmers annually (Figure 6) - 85.4% were veterinarians (Tables 7-8). Out of various reasons for recommending the FMD vaccine, prevention of FMD spread to other livestock farms during epidemics was the most common (87.6%) (Table 4).

Out of all the factors that drive the use of FMD vaccine by farmers, 34.9% was as a result of recommendations by AHSP (Table 5). According to AHSPs, lack of knowledge

of vaccine availability by the farmer was the highest challenge to its usage (67%) (Table 5; Figure 7).

FMD vaccine market survey

The most common reasons for recommending FMD vaccine marketing were improvement of vaccine availability (28.7%) (Table 7). A high percentage of the

Table 4. FMD vaccine knowledge in study participants.

Variable	Response	Number of participants	Proportion of participants (%)
Do you know if FMD vaccines are being sold in Nigeria? (n=201)	Yes	164	81.6
	No	37	18.4
Which of the FMD vaccines are you very familiar with? (n=152) *	NVRI	151	99.3
	MEVAC	6	3.9
	CEVA	1	0.7
	Merial	1	0.7
What is the packaging of the smallest doses of FMD vaccine you are familiar with? (n=125)	25 doses	1	0.8
	40 doses	2	1.6
	50 doses	97	77.6
	100 doses	25	20.0
Have you recommended the FMD vaccine to farmers before? (n=164)	Yes	117	71.3
	No	47	28.7
Why did you recommend the FMD vaccine? (n=113)*	Prevention of FMD	99	87.6%
	Response to FMD Outbreak	31	27.4%
	Routine vaccination purposes	6	5.3%
	Reduction of economic losses	2	1.8%
	Insurance requirements	2	1.8%
	Treatment failure/inefficacy	1	0.9%
Which brand of FMD vaccine did you recommend? (n=111)*	NVRI	105	98.2
	MEVAC	3	2.7
Which vaccine protocol do you recommend? N = 117	Once a year	92	78.6
	Twice a year	9	7.7
	Once a year & twice a year	4	3.4
	Once a year & quarterly	1	0.9
	Twice a year & quarterly	1	0.9
	Others (Total)	10	8.5
	Day 0 and repeated at day followed by a dose annually	1	
	Day 1, day 28, then 6 months	1	
	First dose for the cattle at 3 months and booster dose 3-4months	1	
	First shot at 6months and annual booster shots	2	
	One shot at 6 months of age. Then a booster dose after a month. Then, once annually in subsequent times	1	
	Two shots 28 days apart, then annual booster shots	1	
	Two shots 30 days apart, a Booster shot 6 months later, and then Annual booster shots.	1	
Not applicable	2		

*Participants were allowed to select multiple options.

respondents (90.5%) stated that they would be willing to buy FMD vaccine from distributors in Nigeria. Similarly, 86.6% of respondents were in support of organisations engaging in the marketing of FMD vaccines in Nigeria

(Table 6). Availability of the vaccine was identified as the strongest driver of vaccine sales in Nigeria (71.4%) (Table 6).

Most of these respondents (99.3%) reported that they

Table 5. Use of FMD vaccine among farmers.

Variable	Response	Number of participants	Proportion of participants (%)
What commonly informs the use of FMD vaccines among farmers in Nigeria? (n=190)*	Outbreak occurrence	103	54.2%
	Preventive purposes	79	41.6%
	Based on professional recommendation	72	37.9%
	Routine vaccination	10	5.3%
	Recommendation from a cattle farmer	1	0.5%
	Awareness of the vaccine	1	0.5%
What are the challenges of using FMD vaccine among farmers in Nigeria? (n=200)*	Lack of Knowledge	134	67.0
	Unavailability	119	59.5
	Lack of access	92	46.0
	Cost price of the vaccine	90	45.0
	Inadequate Cold Chain	54	27.0
	Preference of treatment to the vaccine	33	16.5
	Doubts about vaccine effectiveness	33	16.5
	Alternative (traditional) treatment	28	14.0
	Perceived low risk in local breeds	1	0.5
	Insecurity	1	0.5
Lack of trust in government interventions	1	0.5	

*Participants were allowed to select multiple options.

were familiar with NVRI, and it was more frequently recommended (98.2%) than the Middle East for Vaccines (MEVAC) brand (2.7%). CEVA and Merial were also listed as familiar FMD vaccine brands. The 50-dose vaccine vial was indicated by 77.6% of respondents as the smallest packaging they were aware of (Table 4). Furthermore, most of the respondents (94.7%) listed NVRI as the FMD vaccine brand as the vaccine they would recommend; 6.1% reported that they would recommend the MEVAC brand. Perceived effectiveness of the vaccine was the most common reason indicated for recommending both the NVRI (51.3%) and the MEVAC (80%) brands. A greater proportion of the respondents (60.2%) did not believe that one FMD vaccine brand was more preferred than the others in Nigeria (Table 6).

DISCUSSION

This study provides valuable insights into the awareness, experiences, and challenges associated with the use of Foot and Mouth Disease (FMD) vaccines among animal health service providers (AHSPs) in Nigeria. The high proportion (87.1%) of AHSPs who had previously encountered FMD cases affirmed the endemic nature of the disease in Nigeria and highlighted the need for effective and sustainable strategies for controlling FMD. According to Acosta *et al.*, 2019; familiarity with the intricacies of animal health service delivery, farmers' priorities and the systemic and practical restraints faced in vaccination are crucial for effective vaccine implementation strategies. In this study, most of the

respondents had greater than five years of experience serving as AHSPs and consulting for cattle farms, 46.8% of respondents had consulted for over 10 farms. This indicates that the insights gathered in this study are well informed by a deep understanding of various farm management systems, farmer needs and prolonged engagement with the realities of animal health service delivery in Nigeria.

Furthermore, the predominance of veterinarians among respondents (75.1%) suggests that this study captured perspectives from individuals with advanced training in animal health. Studies have similarly highlighted the roles of veterinarians as key influencers in disease control and strategic partners for scaling up vaccination awareness, training, and policy implementation in the livestock sector (Elelu *et al.*, 2017; Gizaw *et al.*, 2021).

The knowledge of circulating FMDV strains is crucial to vaccine efficacy and adoption (Paton *et al.*, 2005; Byamukama *et al.*, 2025); notably, the proportion of respondents who were aware of FMD serotypes and the availability of FMD vaccine was significantly higher among veterinarians compared to other professions (ND – 11.1%; $P=0.01$ and HND – 33.3%; $P = 0.02$). Interestingly, this study highlights some knowledge gaps. Just over half (52.7%) of respondents were familiar with the actual FMDV serotypes circulating in their region. Although all FMDV serotypes were reported in this study. However, only serotypes A, O, SAT 1, and SAT 2 have been documented in Nigeria (Fasina *et al.*, 2013; Wungak *et al.*, 2017; Ehizibolo *et al.*, 2020). This shows that the respondents' assumptions on the circulation of FMDV serotypes in Nigeria are very different from reality, despite

Table 6. FMD Vaccine market survey.

Variable	Response	Number of participants	Proportion of participants (%)
Would you be willing to buy FMD vaccine from distributors in Nigeria? (n=201)	Yes	182	90.5
	No	35	9.5
Would you recommend any organization to go into FMD vaccine marketing in Nigeria? (n=201)	Yes	174	86.6
	No	27	13.4
What are the strong drivers of FMD vaccine sales in Nigeria? (n=199) *	Availability	142	71.4
	Effectiveness	123	61.8
	Price	119	59.8
	Accessibility	101	50.8
	Logistics	52	26.1
	Proper cold chain management	13	6.5
	Professional Recommendation	13	6.5
	Awareness	4	2.0
	Insecurity	1	0.5
Which FMD vaccine brand would you strongly recommend to farmers? (n=131)*	NVRI	124	94.7
	MEVAC	8	6.1
Why would you recommend the vaccine brand above (NVRI)? (n=115)	Perceived effectiveness of the vaccine	59	51.3
	Availability	40	34.8
	Familiarity	17	14.8
	Accessibility	11	9.6
	Affordability	11	9.6
	Personal preference/Sentiment	2	1.7
Why would you recommend the vaccine brand above (MEVAC)? (n=5)	Perceived effectiveness of the vaccine	4	80
	Availability	1	20
Generally, do you think that one brand is more preferred than the others in Nigeria? (n=201)	Yes	41	20.4
	Maybe	39	19.4
	No	121	60.2

the relatively high percentage of professionals with advanced knowledge. These gaps could prevent the development of effective, locally tailored vaccination strategies.

In addition, professional recommendation was reported as one of the most common factors which informed vaccination, further affirming the influence of AHSPs on vaccination. However, respondents do not appear to be following the standard vaccination protocol as described by the NVRI on the vaccine document. In this study, some of the AHSPs that recommended FMD vaccines did not specify the vaccination regime. This is particularly significant because adhering to vaccination protocols,

including the schedule and timing, as outlined by the manufacturers, is critical for ensuring optimal vaccine efficacy (Schat, 2014). In many instances, non-large animal specialists are found treating large animals and recommending vaccines. The informed knowledge gap identified in this study may be accounted for, in part, by the small number of AHSPs who specialise in large animal medicine in Nigeria.

For the detection of FMD, the World Organisation for Animal Health (WOAH) recognises laboratory assay as the gold standard for FMD diagnosis (WOAH, 2024). However, only 18.3% of respondents employed laboratory diagnosis, while 98.3% of respondents used clinical signs

Table 7. Summary of respondent's reasons in support of FMD vaccine marketing (n=171).

Reason	Number of participants	Proportion of participants (%)
Vaccine Availability	49	28.7
Market Demand and avoidance of monopoly	47	27.5
Prevention/Control of FMD	36	21.1
Promote Accessibility to the vaccine	17	9.9
Improve affordability of vaccines	15	8.8
Economic impact of FMD	12	7.0
Improved awareness	8	4.7
Risk of disease outbreak	7	4.1
To provide benefit to farmers, livestock producers and owners	7	4.1
Profitable business opportunity	6	3.5
Negative impact of FMD on livestock sector	5	2.9
Cost of vaccines	4	2.3
Vaccine quality	3	1.8
Emerging market opportunity	3	1.8
Effective disease control and eradication progress	2	1.2
Strengthen animal health services	1	0.6

Table 8. Summary of respondent's reservations against FMD vaccine marketing (n=25).

Reason	Number of participants	Proportion of participants (%)
Low demand/poor uptake of vaccine	8	32
Limited Stakeholder awareness	7	28
Doubts about vaccine effectiveness/ strain relevance	4	16
Inadequate cold chain maintenance	3	12
High cost of vaccines	3	12
Uncertainty about business potential/venture	1	4
Improper vaccine handling	1	4
Concerns with introduction of new FMD serotypes	1	4

to conclude on an FMD diagnosis. This limited use of laboratory confirmation presents a constraint which affects the accuracy of FMD diagnosis and restricts the ability to identify circulating viral serotypes, which is crucial for selecting appropriate vaccines (Byamukama *et al.*, 2025). The management strategies recommended in the suspected cases of FMD include biosecurity, treatment and vaccination, with treatment being the most recommended option in 75.4% of respondents and vaccination recommended by 52%. This observed preference for treatment over vaccination reflects a reactive rather than preventive approach to FMD control, further emphasising systemic barriers to FMD vaccination.

Despite a high level of awareness (81.6%), not all AHSPs recommended FMD vaccination to farmers. Also, it was estimated that only 12.2% of Nigerian farmers administer the FMD vaccine. This is due to common challenges like lack of knowledge, unavailability of the vaccine, lack of access and cost of the vaccine, which creates reluctance to vaccinate, despite the recommendations. These challenges are similar to those

reported by other studies conducted in Ethiopia (Robi *et al.*, 2024) and Tanzania (Williams *et al.*, 2022).

Notably, only 8% of AHSPs reported FMD incidence following vaccination, which ordinarily suggests perceived effectiveness of the vaccine. However, doubts about vaccine effectiveness were still reported as a challenge faced by farmers in adopting vaccines. This may be due to inadequate cold chain management, which was also reported as a challenge in this study. This is consistent with the findings of Kompas *et al.*, 2015; that link cold chain management to vaccine effectiveness in low-and-middle income countries.

In this study, respondents still believed there is a market potential for FMD vaccines in spite of the challenges associated with FMD vaccine usage (listed in Table 8). A high proportion of respondents (90.5%) expressed willingness to purchase vaccines locally, and 86.6% supported vaccine marketing initiatives in Nigeria. However, to drive vaccine uptake, availability, effectiveness, affordability and accessibility were identified as key drivers. Among the respondents who recommend

vaccination, 99.3% reported that they were familiar with the National Veterinary Research Institute (NVRI) vaccine and believed that it produced the best protection against FMD viral serotypes common in their area. This is consistent with earlier studies, which suggest that locally produced vaccines may offer greater serotype relevance and logistical accessibility (Olabode *et al.*, 2014; Naranjo and Cosivi, 2013; NVRI, 2021).

Limitations

First, this study captured self-reported data, which may be subject to recall bias. Second, while the sample size was distributed over 12 states across four geopolitical zones, the findings may not be generalizable to all regions of Nigeria. Nonetheless, substantial experience of the study participants enhances the credibility and applicability of the insights. Lastly, the study participants were veterinarians, animal scientists/technologists and sales representatives. Therefore, the insights from community-based paraprofessionals or informal providers, particularly those in more remote settings, are less reflected in the data.

Conclusion

Animal health service providers play a pivotal role in the control of FMD in Nigeria, yet their efforts are limited by systemic challenges, including low farmer awareness, limited vaccine availability and access, and inconsistencies in vaccine effectiveness. To address these challenges and strengthen their role in FMD vaccine uptake, there is a need for bridging the gap in knowledge of FMD epidemiology and economic impact, diagnostic capacity building, appropriate vaccine protocols, farm record keeping and disease communication. Addressing these AHSP's needs while improving vaccine access and farmer education, and establishing supportive policy and market structures, is essential to increasing vaccine uptake and consequently mitigating the persistent burden of FMD in Nigeria.

Recommendations

With respect to farmers, the findings highlight the need to address farmer education and supply-related issues such as vaccine availability, access, affordability, and cold chain logistics; and also strengthen demand for FMD vaccines through improved awareness of both the disease and the vaccine, and increased trust in the efficacy of the vaccines. The regional variation in reported serotypes underscores the need for localised training and access to diagnostic tools. Therefore, AHSPs should be equipped with region-specific training and guidance to ensure that the most appropriate vaccination strategies for each region are recommended.

To encourage a shift from a reactive to a preventive approach in FMD control, it is essential to prioritise vaccination as a routine practice in livestock health management. AHSPs should be equipped with targeted communication tools and training on the long-term economic and herd health benefits of preventive vaccination. Additionally, efforts targeted towards highlighting the cost-effectiveness of vaccination could enhance AHSPs' influence over farmer decision-making. Examples of these include the incorporation of testimonies from farmers who have experienced losses from FMD.

Lastly, it is important to strengthen laboratory capacity through the establishment of well-equipped regional diagnostic centres. This would reduce reliance on clinical diagnosis alone and improve the accuracy of FMD surveillance. Efforts made to subsidise laboratory costs and improve access to laboratories would promote routine use of laboratory services.

CONFLICT OF INTEREST

No conflict of interest was declared by the participating authors.

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