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Exploring digital tools in promoting anti-rabies and DHLPP vaccine uptake at the Veterinary Teaching Hospital, University of Ibadan: A pilot study

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ABSTRACT

Digital tools have found applications in various fields including health promotion. Rabies, Canine Distemper, Hepatitis, Leptospirosis, Parvovirus, and Parainfluenza (DHLPP) cause morbidity and mortality in dogs and are vaccine-preventable. We deployed digital tools in community sensitization and awareness campaigns on anti-rabies vaccine (ARV) and DHLPP vaccination. We also assessed its effects on the uptake at the Veterinary Teaching Hospital (VTH), University of Ibadan, Nigeria from November 2023 to February 2024.

A retrospective and a quasi-experimental study designs were adopted. A review of ARV and DHLPP vaccination records from 2020 to 2023 was conducted. Social media platforms and websites were deployed in the vaccination campaign for three months. Online metrics and vaccine uptake were monitored. Monthly records of ARV and DHLPP vaccinations before and during the vaccination campaign were compared and correlated with the digital metrics. Data were analyzed at a 5% significant level.

The highest annual total ARV and DHLPP vaccine uptake was in 2022. The ARV uptake increased from 16 to 48, while DHLPP decreased from 47 to 31. The mean ± standard deviation (SD) monthly ARV uptake from January to October 2023 increased non-significantly from 27.3 ± 9.5 to 31.3 ± 14.5 during the vaccination campaign; while DHLPP uptake increased significantly ($p = 0.013$) from 25.7 ± 6.2 to 40.0 ± 6.6 during the same period. There was a positive correlation between Facebook reach and ARV uptake ($r = 0.94$), page views and DHLPP uptake ($r = 0.90$), and unique visitors and DHLPP uptake ($r = 0.99$).

Digital tools contribute to ARV and DHLPP vaccination uptake at the VTH, University of Ibadan, Nigeria. Long-term digital effect studies on vaccine uptake and institution-based online presence are recommended.

Keywords: Facebook, Whatsapp, Getresponse website, vaccination awareness, dogs, uptake, Nigeria

INTRODUCTION

Rabies is a viral zoonotic disease of humans and animals, caused by *rabies lyssavirus*. It is a fatal neglected tropical disease affecting the central nervous system in both humans and animals with a case fatality rate of almost 100% following the onset of clinical signs (WHO, 2023). The disease is endemic in Africa and accounts for over 21,000 deaths annually (Hampson *et al.,* 2015). It is a vaccine-preventable disease in humans and

animals especially dogs which are part of the range of reservoir hosts and a major source of exposure to humans (Hampson *et al.,* 2015). It is much cheaper to control human rabies through vaccination in dogs than in humans (WHO, 2023). Human rabies vaccines are more expensive than dog rabies vaccines and are also in short supply (Audu *et al.,* 2019; Mbilo *et al.,* 2021). The World Health Organization (WHO), Food and Agriculture Organization (FAO), World Organization for Animal Health (WOAH) and Global Alliance for Rabies Control (GARC) in 2015 set a global goal to reduce to zero the incidence of human dog-mediated rabies deaths by 2030 through several public health interventions including mass vaccination in dogs (WOAH, 2018); also known as Zero By Thirty (ZBT) goal. A ≥ 70% herd immunity in the dog population is recommended by WHO to prevent outbreaks of dog rabies (WHO, 2013). Nigeria has a score of 1.5 out of 5 based on the Stepwise Approach towards Rabies Elimination (SARE), which indicates endemic status (Rupprech *et al.,* 2022). In most states in Nigeria, the coverage of dog antirabies vaccination is estimated at between 15 to 38% (Mshelbwala *et al,* 2021), while less than 50% of the dog owners were aware of antirabies vaccination. Only 5.7% of the confined dogs screened in Oyo State, Southwest, Nigeria had optimal rabies virus antibody titres (Oluwayelu *et al.,* 2015). There is a need to make a concerted effort to raise awareness about dog anti-rabies vaccination to progress towards attaining the ZBT goal. The National Veterinary Research Institute, Vom-Jos, Plateau State in Nigeria is saddled with the responsibility of producing killed dog anti-rabies vaccines among others.

On the other hand, the DHLPP is a polyvalent attenuated vaccine, an acronym for five canine diseases that can cause various morbidity and mortality in dogs, but are also vaccine-preventable. These canine diseases include Distemper (Canine distemper virus), Hepatitis (Infectious canine hepatitis), canine Leptospirosis, Parvovirus (Canine parvovirus enteritis) and Parainfluenza (Canine parainfluenza virus). Of these diseases, canine Leptospirosis is zoonotic, with potential spillover from dogs to humans (Awosanya *et al*., 2013). Prevalence ranging from 1.12% to 68% has been reported for canine parvovirus enteritis among clinical cases and cases of gastroenteritis presented at veterinary hospitals and clinics in Nigeria (Francis *et al.,* 2019; Ogbu *et al.,* 2021; Shima *et al.,* 2021; Agada *et al.,* 2022; Ukwueze *et al.,* 2022). DHLPP-vaccinated dogs were two times more likely to be protected against parvovirus enteritis when compared to non-vaccinated dogs (Ukwueze *et al.,* 2022). Though few studies on DHLPP vaccination reported a range from 52.5% to 96.0% (Ishola *et al.,* 2016; Ukwueze *et al.,* 2022), there is still a need to upscale DHLPP vaccination in dogs to reduce associated morbidity and mortality.

Digital tools are technological platforms or software applications that are used to enhance learning and understanding, and optimized functions in various aspects of endeavour (van Bommel and Palmer, 2021) including but not limited to Facebook, Instagram, Whatsapp Business, Web platforms, Zoom Video Communication, Microsoft Teams, Google Workspace, etc. In public health, challenges associated with data collection and management on vaccination activities, dose tracking, and vaccine-preventable disease surveillance can be addressed using digital tools to provide important information to guide immunization programmes (Tozzi *et al.,* 2016). Digital health tools had been deployed before the COVID-19 era for case management, contact tracing, evidence-based surveillance, training, risk communication and vaccine delivery in some countries (Mason *et al.,* 2022). However, during the COVID-19 pandemic, digital tools were rapidly launched and scaled up for deployment in low-, middle- and high-income countries due to their user-centred design and potential to proffer solutions to public health challenges (Mark *et al.,* 2021; Mason *et al.,* 2022). Digital tools such as health apps on mobile phones have been shown to

improve vaccination uptake in low- and middle-income countries (Oliver-Williams *et al.,* 2017). To attain the achievement of the ZBT goal, the WHO (2023) recommends key effective rabies elimination programme to include a One-health approach involving multisectoral engagement, government buy-ins, local communities' engagement to build awareness and conduct of mass dog vaccination campaigns, among others. There is suboptimal uptake of dog anti-rabies and DHLPP vaccines with inadequate awareness levels among at-risk populations in Ibadan. To optimize vaccination uptake, we explored the use of digital tools (Facebook, WhatsApp and Web platforms) in online community sensitization and awareness creation and assessed its effects on dog Anti-Rabies Vaccine (ARV) and DHLPP vaccine uptake at the Veterinary Teaching Hospital (VTH), University of Ibadan, Ibadan from November 2023 to February 2024. We hypothesized that the use of digital tools (Facebook, Whatsapp and Web platforms) has no effect on the uptake of ARV and DHLPP vaccine at the Veterinary Teaching Hospital, University of Ibadan, Nigeria.

MATERIALS AND METHODS

Study site

The study site is the Veterinary Teaching Hospital (VTH), Faculty of Veterinary Medicine, University of Ibadan, Ibadan, Oyo State, Nigeria (Figure 1). The VTH, Ibadan is a tertiary veterinary hospital established in 1981. The VTH, Ibadan is at the forefront of animal health and veterinary care, clinical training of veterinary students at both undergraduate and postgraduate levels, and research in the southwest of Nigeria (FVM, 2024). It has an average clientele base of about 1000 annually. Among other servicing arms of the VTH, the Veterinary Public Health and Preventive Medicine (VPHPM) clinic is responsible for vaccination activities. The ARV has been administered free of charge since 2020 till date to all eligible dogs (3 months and above, with an annual booster dose) presented at the VPHPM clinic of the VTH. However, the DHLPP vaccine is administered at a cost to all eligible dogs, with each dog receiving about three to four shots depending on the maternal vaccination history. The last shot is received at not less than 16 weeks of age followed by an annual booster. The VTH marks World Rabies Day annually on September 28 in collaboration with other stakeholders, with an ARV mass vaccination campaign.

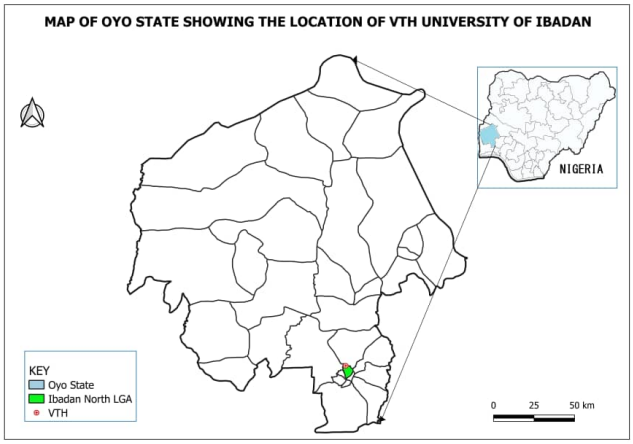

Figure 1: Map of Nigeria showing Oyo State (right inset) and the location of the study site, the Veterinary Teaching Hospital, University of Ibadan (red dot), in Ibadan North Local Government Area (Green area) of Oyo State

Study design and period

The study design was a mixed model of a retrospective study from January 2020 to October 2023 and a quasi-experimental design from November 2023 to January 2024.

Study Variables and Operational descriptions

The outcome variable is the ARV and DHLPP vaccine uptake, while the independent variables included VTH clients who reported to have seen the Facebook ads, digital metrics such as Facebook Reach, Instagram Reach, Facebook visits, Instagram profile visits, Facebook Follows, Instagram Follows, Paid Reach, Paid

Impression, Account Center Accounts, Estimated Metrics, Page Views, Page Visits, Unique Visitors, Session, Views, Clicks, Click-Through Rate (CTR) and Leads.

ARV and DHLPP vaccine uptake – the number of dogs that received shots of ARV and DHLPP vaccine.

VTH clients that reported to have seen the Facebook ads – The number of clients who reported to have seen the Facebook ads among those who brought their dogs for vaccination at the VTH, Ibadan

Facebook Reach – An estimated metric that counts reach from the organic or paid distribution of Facebook content, including posts, stories and ads. It also includes reach from other sources, such as tags, check-ins and Page or profile visits. This number also includes reach from posts and stories that were boosted. Reach is only counted once if it occurs from both organic and paid distribution.

Instagram Reach – An estimated metric that counts reach from the organic or paid distribution of Instagram content, including posts and stories that were boosted. Reach is only counted once if it occurs from both organic and paid distribution.

Facebook Visits – The number of times the page or profile was visited.

Instagram Profile Visits – The number of times the profile was visited.

Facebook Follows – The number of times accounts followed the ad account in the selected period.

Instagram Follows – The number of times accounts followed the ad account in the selected period.

Paid Reach – An estimated metric that counts the number of Accounts Center accounts that saw the ads at least once, reported in the time zone of the ad account. Reach is different from impressions, which may include multiple views of the ads by the same Accounts Center accounts.

Paid Impression – The number of times the ads were on screen, reported in the time zone of the ad account.

Account Center Accounts – An Accounts Center account refers to either (1) an individual Facebook or Instagram account that has not been added to the same Accounts Center as another account, or (2) the two or more Facebook and Instagram accounts that have been added to the same Accounts Center. Accounts that have not been added to the same Accounts Center are counted as separate Accounts Center accounts, and accounts that have been added to the same Accounts Center are counted as one Accounts Center account. For example, if a person has one Facebook account and two Instagram accounts and they have been added to the same Accounts Center, they will be counted as one Accounts Center account. But if those same accounts have not been added to the same Accounts Center, they will be counted as three Accounts Center accounts.

Estimated Metrics – An estimated metric is derived through statistical sampling or modeling, rather than a straight count. These metrics help one measure activities that are hard to count due to the number of Accounts Center accounts that use Facebook and Instagram and the data processing required to calculate them. Estimated metrics can also be helpful when measuring actions or events where data are partial or missing.

Page Views – The total number of times the landing page was viewed or refreshed over the period selected.

Page Visits – The number of browsing sessions initiated on the landing page.

Unique Visitors – The number of people who visited the landing page over the period selected, counted only once.

Session – A session is a 30-minute time frame that begins when someone navigates to the webpage for the first time. Any page the user visits or any activity they complete within one session counts as one unique visitor.

Views – The number of times the forms and popups were loaded and displayed.

Clicks – The total clicks on forms and popups displayed on the site.

CTR – The number of clicks divided by the number of views for all the forms and popups, shown as a percentage. For example, if 100 people view them and 10 people click, the CTR is 10%.
Leads – The total number of confirmed and unconfirmed contacts who have signed up via forms and popups.

Data Collection

Data abstraction
The monthly records of ARV and DHLPP vaccine administered at the Veterinary Public Health and Preventive Medicine Clinics of the VTH, University of Ibadan from January 2020 to October 2023 were abstracted.
Primary data collection
An interventional material, a sensitization and awareness creation video on ARV and DHLPP, was developed and hosted on the Facebook business page of one of the authors engaging all the ads placements on Facebook. The link to the video is available at https://www.facebook.com/profile.php?id=61552626466063&mibextid=LQQJ4d. In addition, a website (Getresponse Landing Page) containing more detailed information on rabies awareness and responsible dog ownership targeting DHLPP vaccination was developed to serve as a landing page for those interested in more information and signing up. The link to the website is available at https://vthuivaccinationproject-91761.gr-site.com. All the digital tools including the Facebook page, Instagram account and Web page were all linked to increase visibility for the video. The digital advertising campaign on Facebook ran for three months (November 2023 to January 2024), while monitoring and recording monthly ARV and DHLPP vaccination activities at the VPHPM clinics of the VTH. The area of the broadcast was set at a 50-mile radius of the VTH, other specifications included the target audience which was dog owners; the objective of the advert which was awareness creation; and finally, the budget, which was set on daily charge for the period of the campaign. Facebook offers robust targeting options based on demographics, interests, behaviours, and more. Facebook provides tools to help one estimate the potential reach and outcome based on the budget. The performance of the ads in real-time was periodically tracked using the digital metrics on all digital tools explored, and monthly records were taken.

Data analysis
Data were entered into and analyzed using Microsoft Excel version 16. Time series analysis for trends was done for monthly records of ARV and DHLPP vaccinations from January 2020 to October 2023 with a forecast from November 2023 to December 2024. A further prediction was done based on exponential smoothing to minimize noise. The mean ± standard deviation (SD) monthly ARV and DHLPP vaccination uptake from January to October 2023, the period before the digital sensitization and awareness campaign, and from November 2023 to February 2024, the period during and a month after the digital sensitization and awareness were calculated. The significant differences in the mean ± SD were determined using the student "t" test. The relationship between the digital metrics and the ARV and DHLPP vaccination uptake was determined using correlation analysis. All tests were performed at a 5% level of significance.

RESULTS
Trend of Anti-Rabies and DHLPP vaccine uptake from January 2020 to February 2024
The annual total vaccine uptake for ARV increased steadily from 198 in 2020 to 392 in 2022 with a decline to 323 in 2023. However, the total DHLLP vaccine uptake oscillates from 334 in 2020 to 345 in 2023 (Figure 2). The monthly ARV uptake from January 2020 to October 2023 followed a weak exponential trend ($y = 11.073e^{0.0258x}$; $R^2 = 0.29$) and produced a

vaccine uptake forecast of 35 (95% Confidence Limit (CL): 14 – 56), 35 (95% CL: 15 - 57), 36 (95% CL: 15 - 58), and 37 (95% CL: 16 - 58) in November, December 2023, January and February 2024, respectively (Figure 3). The monthly DHLPP vaccine uptake from January 2020 to October 2023 followed a very weak polynomial trend ($y = -0.0075x^2 + 0.3666x + 24.03$; $R^2 = 0.0113$), and based on these values the vaccine uptake forecast for November 2023 through to February 2024 was constant at 26 (95% CL: 2 – 49) (Figure 4). The ARV uptake from November 2023 to February 2024 was 16, 23, 38 and 48, respectively. However, the ARV uptake forecast values based on exponential smoothing for the same months were 37, 22, 23 and 33, respectively (Figure 5). The actual DHLPP vaccine uptake for the same period was 47, 41, 41 and 31, while the forecast values were 28 and 41 each for November and December 2023 to February 2024, respectively (Figure 6).

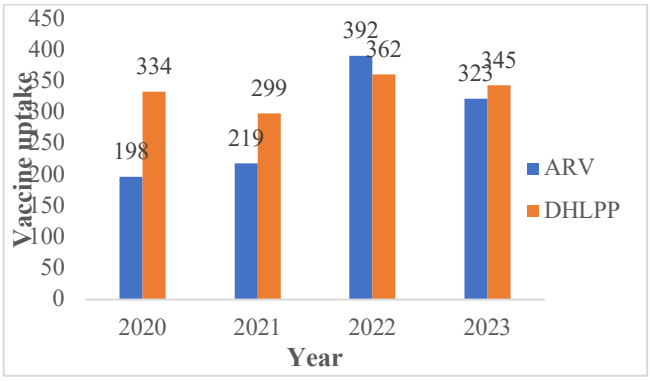

Figure 2: Annual uptake for anti-rabies and DHLPP vaccines at the Veterinary Teaching Hospital, University of Ibadan, Nigeria, 2020 – 2023

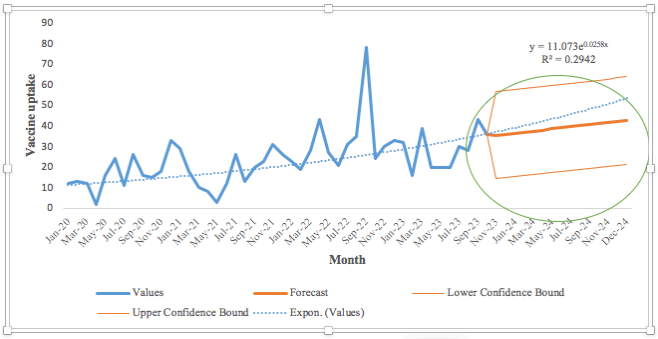

Figure 3: Trend for monthly Anti-rabies vaccine uptake at the Veterinary Teaching Hospital, University of Ibadan, Nigeria with a forecast for November 2023 to December 2024 based on values from January 2020 to October 2023.

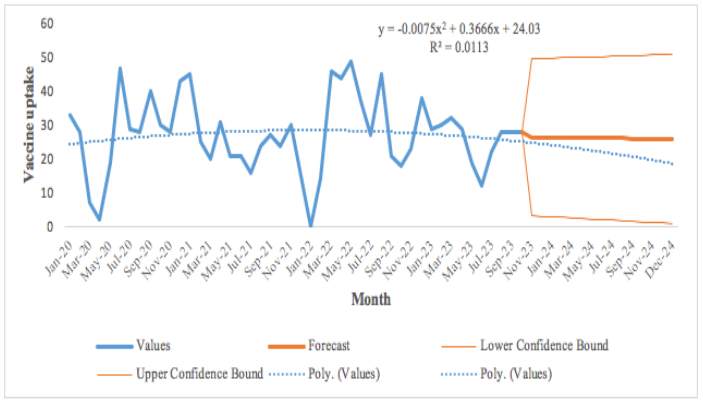

Figure 4: Trend for monthly DHLPP vaccine uptake at the Veterinary Teaching Hospital, University of Ibadan, Nigeria with a forecast for November 2023 to December 2024 based on values from January 2020 to October 2023

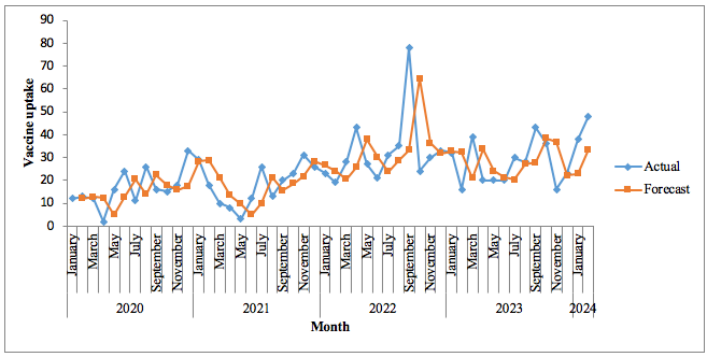

Figure 5: Figure 4: Monthly forecast based on exponential smoothing for Anti-rabies vaccine uptake at the Veterinary Teaching Hospital, University of Ibadan, Nigeria from January 2020 through to February 2024

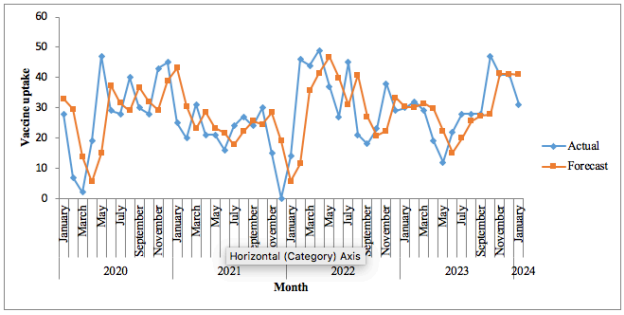

Figure 6: Monthly forecast based on exponential smoothing for DHLPP vaccine uptake at the Veterinary Teaching Hospital, University of Ibadan, Nigeria from January 2020 through to February 2024

Anti-rabies and DHLPP vaccination uptake before and during digital sensitization and awareness, January 2023 – February 2024

The means ± SD monthly ARV uptake from January to October 2023 before the digital intervention was 27.3 ± 9.5, and 31.3 ± 14.5

during and a month after the digital sensitization and awareness campaign period from November 2023 to February 2024. There was no statistical difference in the ARV uptake before and during the intervention. The mean ± SD monthly DHLPP uptake was 25.7 ± 6.2 and 40.0 ± 6.6 before and during the intervention, respectively. The difference in the mean values was statistically significant (p = 0.013) (Table I). The number of clients that brought their dogs to the VTH for either ARV or DHLPP vaccination during the digital campaign increased steadily from 45 in November 2023 to 64 in January 2024, of these less than 4% reported seeing the sensitization and awareness campaign (Table II).

Digital metrics and relationship with ARV and DHLPP vaccine uptake

The highest records for Facebook Reach, Instagram Reach, Paid Reach, and Paid Impression were in January 2024, with the lowest records in December 2023 (Table III). On the Getresponse website, the highest records for Page Views, Page Visits, Unique Visitors and leads were in November 2023, with the lowest in December 2023 (Table IV). There was a positive correlation between Facebook Reach and ARV uptake (r = 0.94). However, there were negative correlations between Page Views and ARV uptake (r = -0.96) and Unique Visitors and ARV uptake (r = -0.64) (Table V). There was a positive correlation between Page Views and DHLPP vaccine uptake (r = 0.90) and Unique Visitors and DHLPP vaccine uptake (r = 0.99). However, a negative correlation existed between Facebook Reach and DHLPP vaccine uptake (r = -0.48) (Table VI).

DISCUSSION

We explored the use of digital tools in sensitization and awareness creation on anti-rabies and DHLPP vaccination and assessed its effect on vaccine uptake in a pilot study at the VTH, University of Ibadan, Nigeria. Our study revealed a steady increase in the uptake of ARV and a decline in DHLPP vaccine uptake during the digital sensitization and awareness creation intervention. February, a month post-intervention, had the highest ARV uptake ever since January 2020, except in September 2022, a month with radio and television awareness creation during the celebration of World Rabies Day.

Table I: Monthly Anti-Rabies and DHLPP vaccine uptake before and during the digital sensitization and awareness campaign, January 2023 to February 2024

Variable	Mean	SD	P value
Monthly ARV uptake before the campaign (Jan – Oct. 2023)	27.3	9.5	0.64
Monthly ARV uptake during the campaign (Nov. 2023 – Feb. 2024)	31.3	14.5	
Monthly DHLPP uptake before the campaign (Jan – Oct. 2023)	25.7	6.2	0.013*
Monthly DHLPP uptake during the campaign (Nov. 2023 – Feb. 2024)	40.0	6.6	

SD: Standard deviation; * statistically significant

Table II: Records of clients who brought their dogs to the VTH for Anti-rabies and DHLPP vaccination during the digital campaign

Month	Total Clients	Clients from digital campaign (%)
November	45	1 (2.22)
December	49	1 (2.04)
January	62	3 (4.84)
February	64	3 (4.69)
Total	220	8 (3.64)

Table III: Facebook and Instagram metrics based on the Advert

Metrics/ Months	November 2023	December 2023	January 2024
Facebook Reach	6,600	98	310,200
Facebook Visits	164	16	122
Facebook Followers	20	3	12
Instagram Reach	3	0	2,700
Instagram Visits	0	0	0
Instagram Followers	0	0	0
Paid Reach	10,661	264	322,136
Paid Impression	12,574	269	373,101
Amount Spent (Naira)	13,714.13	103.42	15,000

The observed increase or decline in the monthly vaccine uptake for ARV or DHLPP, respectively, though above or sometimes below the predicted values based on previous monthly vaccine uptake trend, were all within the 95% CL of the exponential trend predictions for ARV and polynomial trend for DHLPP. It should, however, be noted that both the exponential and polynomial forecasts for ARV and DHLPP were weak predictors but the best available compared to other time series analyses in understanding our data. Polynomial regression models have been used to precisely forecast the trend of COVID-19 in India (Suriya and Krishna, 2023).

Table IV: Getresponse website (landing page) performance metrics

Metrics/ Months	**November 2023**	**December 2023**	**January 2024**
Page Views	86	13	30
Page Visits	82	11	23
Unique Visitors	79	11	22
Click	2	0	1
CTR (%)	1	0	2
Leads	2	0	1

Table V: Relationship between Facebook and website metrics and Anti-rabies vaccine uptake during the digital sensitization and awareness campaign

Month/ Metrics	Facebook Reach	Facebook Visits	Facebook Follows	Page Views	Page visits	Unique Visitors	Leads	ARV Uptake
November	6,600	164	20	86	82	79	2	16
December	98	16	3	13	11	11	0	23
January	310,200	122	12	30	23	22	1	38
Correlation Values (r)	0.94	-0.07	-0.28	-0.96	-0.63	-0.64	-0.31	

Table VI: Relationship between Facebook and website metrics and DHLPP vaccine uptake during the digital sensitization and awareness campaign

Month/ Metrics	Facebook Reach	Facebook Visits	Facebook Follows	Page Views	Page visits	Unique Visitors	Leads	DHLPP Uptake
November	6,600	164	20	86	82	79	2	47
December	98	16	3	13	11	11	0	41
January	310,200	122	12	30	23	22	1	41
Correlation Values (r)	-0.48	0.72	0.85	0.90	0.99	0.99	0.87	

More so, increased vaccination uptake has been associated with the use of digital tools (Oliver-Williams *et al.,* 2017). The cost price of the vaccine could be responsible for the increase or decline because the ARV is received at no charge courtesy support received from sponsors at the Federal level, but the DHLPP vaccine comes with a cost price. However, the potential increase in ARV or decline in DHLPP vaccine uptake, cannot emphatically be attributed to the intervention based on the difference in the actual vaccine uptake and predicted lower and upper limits. More so, the difference in average monthly vaccine uptake before and during the intervention was not statistically significant for ARV, though, it was for DHLPP vaccine uptake. In addition, other extraneous factors like peer influence, positive credibility of the VTH, and individual preferences were not considered in the study design and could have confounded the outcome.

Furthermore, the three to four-month intra- and post-intervention assessment may not be enough

to adequately assess the effect of the intervention. Deployment of digital tools has been reported to improve sales of products and services (Fuxman *et al.*, 2014; Alamsyah *et al.,* 2021). The use of mixed methods including branding, email invitations and updates, Microsoft booking system, campaign website, digital media and personal communications cum bit of enforcement has been reported to increase COVID-19 vaccination uptake to 98% in a university community in Lebanon within three months (Bardus *et al.,* 2023).

We reported that less than 4% of the clients who brought their dogs to the VTH for vaccination had direct engagement with the digital campaign material. Costantino *et al* (2020) reported that individuals were less likely to trust and base their vaccination decision on a non-institution-based webpage, which could in part be responsible for our observation in this study. There is also the possibility of underreporting because the data were obtained retrospectively through phone calls and some few could not be reached. There are the possible ripple effects of the digital campaign on vaccine uptake through peer influence. Peer influence has been reported to be associated with rabies awareness (Awosanya and Adebimpe, 2013). The highest annual ARV and DHLPP vaccination uptake was recorded in 2022 and then a decline in 2023 in this study. Intense activities surrounding the World Rabies Day celebration could have been responsible for this observation. However, a general downward turn in the national economy substantiated by the increasing headline inflation rate could have contributed to the decline in 2023 (NBS, 2023; newspaper article). Vaccine uptake has been reported to be positively influenced by the good economic status of the recipient (Recio-Román *et al,* 2023).

The analysis of Facebook reach and engagement revealed intriguing patterns across the three months. January emerged with the largest Facebook reach, indicating a substantial audience reached through our social media campaigns. However, November witnessed the highest number of Facebook visits and followers, suggesting strong initial engagement with our content, also buttressed by the website metrics. Conversely, December exhibited the least favourable outcomes in terms of Facebook metrics and also the month with the least committed amount of money, which could probably explain the poor metrics for the month. The website metrics underscore the importance of continuous monitoring and optimization of our online presence to maximize user engagement and conversion. The non-translation of the broad Facebook reach into proportional website engagement could be due to issues of mistrust and non-reliance on the use of personal Facebook accounts. Overall, the page views, page visits and unique visitors, which are Getresponse website metrics had better correlation coefficient values, an indication of relationship with both ARV and DHLPP vaccine uptake, than the Facebook metrics in this study. This could also be explained from the perspective of interest expressed by the viewers in following up on the ads seen on Facebook on the Getresponse website page. Page views which is the total number of times the landing page on the Getresponse website was viewed or refreshed during the digital intervention from November 2023 to January 2024 was highly negatively and positively correlated with ARV and DHLPP vaccine uptake, respectively. Costantino *et al* (2020) also engaged website metrics including unique visitors, page visits and page views in assessing knowledge, attitude and behaviour on vaccination and vaccine hesitancy and found a significant difference in both the unique visitors and page views before and after vaccination counselling in Italy. Individuals who reported frequent use of social media networks daily or up to two or three times a week are more likely to get vaccinated than those who do not (Recio-Román *et al.,* 2023). Of particular, note also is the kind of information being disseminated on the social media network which could either positively impact in case of proper information or negatively impact vaccine uptake in case of

misinformation or disinformation on COVID-19 (Wilson and Wiysonge, 2020; Bardus *et al.,* 2023).

This study is limited first by the issue of mistrust from online users because of its launch on a personal Facebook page and doubt about the authenticity of the website that is not linked to the institution. There is no institutional-based Facebook account at the time of the study and institution-based websites have records of being most consulted and reliable on issues of vaccination (Costantino *et al.,* 2020). Scammers frequently create fake profiles, impersonate reputable organizations, or engage in identity theft. Consequently, users are wary of trusting any online source. Secondly, this study assessed the short-term effect of the intervention due to time constraints. An assessment of the long-term effect would provide better insight. Thirdly, the study did not consider other extraneous factors highlighted above that could confound direct assessment of the effect of the intervention. Finally, information on the apriori vaccination coverage would also contribute to a direct assessment of the effect of the intervention. However, being a pilot study, it has provided insight into the proper design of future studies and further hypothesis generation. The limitations were considered in the interpretation of the results and conclusion reached.

There seems to be an apparent positive suboptimal effect of digital intervention on ARV and DLHPP vaccination uptake. The study underscores the need for tailored digital strategies for different vaccines and highlights the importance of understanding the nuances of digital engagement in health campaigns. Digital campaign has the potential to boost vaccination uptake if properly marshalled. These findings imply that reach alone is not a sufficient indicator of campaign success. Engagement metrics might be more critical in driving actual health behaviours. Page views, page visits and unique visitors are good web metrics for vaccination uptake. The findings of this study provide valuable insights for optimizing future campaigns and adjustments to our strategies. The use of digital interventions in promoting vaccination uptake is recommended. Further studies should consider the long-term assessment of the effect of digital intervention on vaccine uptake and coverage incorporating identified necessary changes in strategy adopted. Finally, the VTH, Ibadan should have sustained social media presence and website engagement by creating compelling content and fostering online communities to improve on the issue of trust and credibility associated with successful vaccination digital campaigns.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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