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Investigating an Outbreak of Newcastle Disease among Vaccinated and Unvaccinated Poultry Chicken

Okoli Solomon Chieloka^{1,2*} & Onaga Phelomena³

¹ Nigerian Field Epidemiology and Laboratory Training Program (NFELTP), 50 Haile Selassie Street, Asokoro, Abuja, Nigeria.

² Collage of Veterinary Surgeon of Nigeria (CVSN), Plot 8, Zambezi Cres, Maitama 904101, Abuja, Nigeria

³ Federal Department of Veterinary Services, P. O. Box 15, Amagu GRA Abakaliki, Nigeria

* Author for Correspondence ORCID ID: <https://orcid.org/0000-0003-3981-9710>; Email: Solomon.Okoli.pg96005@unn.edu.ng

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Keywords:

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The burden of Newcastle disease may continue to increase due to non-adherence to poultry vaccination policies among some commercial poultry farmers. The purpose of this study was to investigate a suspected outbreak of Newcastle disease (ND) among clusters of vaccinated and unvaccinated poultry chickens. Poultry Farm (Farm Z) with 600 capacity deep litter pen (A and B) and capacity of 300 birds each procured two sets of poultry at 21 days of life from two separate farms (X and Y mixed layer & broiler) on the 2nd of May 2024. Pen A: was stocked with Layers of chicken from farm (X) poultry chicken has prior vaccination against ND as of 21st of May 2024 (N=242), Pen B were stocked with broilers chicken (N₂=216) from farm Y with no history of vaccination against Newcastle diseases as at 21st of May, 2024. On the 5th of May, 2024, 142 poultry chickens were procured comprising 58 layers and 84 broilers from farm (Y) with no vaccination history against Newcastle disease to make up a poultry flock size of 300 in each pen A (N=58; 242), Pen B (N₂=84;216). The risk of NCD amongst Vaccinated poultry was 3% and 45% in unvaccinated poultry. The relative risk of NCD in the vaccinated poultry population was 7%, and vaccine effectiveness against ND in vaccinated Poultry was 97%. 142(100%) samples from moribund and dead poultry chicken were positive for Newcastle disease by indirect ELISA test of these 8(6%) were from vaccinated poultry and 134(94%) were unvaccinated. Practices such as mixing of vaccinated and unvaccinated poultry flocks may be inimical to the growth of the poultry subsector. Vaccination regimens against ND in poultry should not be compromised as a means to reduce the cost of production by procuring cheap unvaccinated apparently healthy flocks.

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INTRODUCTION

Nigeria has a poultry population of about 180 million: 80 million poultry chickens are raised under an extensive poultry system, 60 million in a semi-extensive system and 40 million chickens as intensive poultry (CSIRO, 2020). Intensive Poultry production in Nigeria is capital intensive and accounts for about 25 million dollars per annum (O. Chieloka et al., 2020), Poultry production provides sources of income for over 50 million Nigerians directly or indirectly employed by the poultry value chain (Adene & Oguntade, 2008). The first outbreak of Newcastle disease (NCD) was reported in 1926 (Shittu et al., 2016) although there was evidence that the incidence of Newcastle may have occurred earlier than reported (Macpherson, 1956). In Nigeria, NCD is enzootic in poultry the first outbreak was reported in 1952 (Hill et al., 1953). Since then outbreaks have been reported in intensively managed commercial poultry, free-ranged flocks, and wild birds (Adu et al., 1985; Echeonwu et al., 1993; Fatunmbi, 1984; Onunkwo & Momoh, 1981). Newcastle disease is a 'notifiable diseases' responsible for severe economic losses in the poultry subsector estimated at over 8.9 billion naira amongst local poultry chicken (International Livestock Research Institute, 2011) and accounts for 58% of all poultry diseases (Olorunshola et al., 2022; Sadiq & Mohammed, 2017). Outbreaks of poultry diseases have stunted the growth of the poultry subsector in Nigeria (O. S. Chieloka et al.,

2020). Newcastle disease (ND) is a viral disease caused by a virulent strain of avian Paramyxovirus type 1 (APMV-1) (Cattoli et al., 2011). it is one of the Transboundary animal diseases listed by the World Organization of Animal Health (WOAH) and reportable to local and veterinary authorities because its lesions are similar to that of Highly pathogenic avian influenza (*Terrestrial Code ND, 2021*). Newcastle disease in poultry is classified into three clinical forms based on its clinical manifestation: Velogenic NDV characterized by high mortality involving respiratory and Neurological symptoms, Mesogenic form which causes low mortality characterized by respiratory and Neurogenic symptoms, lentogenic form involving mild respiratory infection (Alexander, 2000). Newcastle disease is an enzootic vaccine-preventable disease consequently; vaccine antigens are formulated based on circulating NDV strains. vaccination regimens span from day-old chicks to 16 weeks of life without prejudice to other disease prevention and control measures stipulated by the Animal Disease Control Act 2022 (*Animal Dis Contr Law, 2022*.) However, poor biosecurity and ineffective surveillance for Newcastle disease are the bane of effective disease control (O. S. Chieloka, 2022; O. S. Chieloka et al., 2021). The vaccination regimen against Newcastle disease includes the Hitcher B1 vaccine administered intranasal to day-old chicks between 1-7th day, the NDV Lasota strain at 21 days per os, and the Komorov NDV vaccine at 6 weeks (Aliu, 2007).

Although, free-range poultry has been identified as a potential reservoir of velogenic Newcastle disease (Majiyagbe & Nawathe, 1981), however, vaccination of wild and free-range poultry chicken in Nigeria may not be cost-effective. The purpose of these study was to investigate a suspected outbreak of Newcastle disease amongst clusters of vaccinated and unvaccinated poultry chicken, determine the risk of outbreaks of NDV among vaccinated and unvaccinated chicken, and determine the vaccine effectiveness in the prevention of Newcastle disease in a vaccinated flock with a view to provide information necessary for public health action.

METHOD

Report of Suspected Outbreak of Newcastle Disease

On the 21st of May 2024, a suspected outbreak of Newcastle disease was reported to the epidemiology unit of the Federal Department of Veterinary Services at a backyard poultry farm with a capacity of 600 poultry chickens. On the 22nd of May 2024, a Rapid response team was constituted to respond to the outbreak. Chief complaints were: acute mortality in 5-weeks-old layers and broilers characterized by diarrhoea, torticollis, and incoordination (Figure 1) and (Figure 2)

Figure 1: A Cross-section of Pen B Showing Moribund and Dead Poultry Layers



Figure 2: A Cross-section of Pen A Showing Moribund and Dead Poultry Layers



Case definition of a suspected Newcastle disease: Poultry Chicken of any age with symptoms of sudden death, Torticollis, diarrhoea, weightless, acute mortality (*Terrestrial Code ND*, 2021)

Study Area

The study was conducted at a medium-sized commercial farm in Ebonyi State southeast of Nigeria on Latitude. 6°15'N, Longitude. 8°05'E. Nigeria has an estimated poultry population of 180 million, of these 80 million poultry chickens are raised in the extensive system, 60 million in the semi-extensive system and 40 million in the intensive system (O. S. Chieloka, 2021; CSIRO, 2020). The poultry subsector in Nigeria is the most capitalized of the Agricultural sector estimated at 22 billion dollars per annum (O. Chieloka et al., 2020). Farming is the primary occupation of the people of Ebonyi State (Ebonyi Online, 2021). Ebonyi State has an estimated poultry population of 15 million (O. S. Chieloka, 2022). The affected poultry farm

was accessible only on foot. The poultry chickens are managed under a deep litter mixed poultry (Broilers and layers) production system. The farm is located on a land area of about 100 by 50 square area of land. The closest poultry farm to the epicentre of the outbreak was estimated to be at a distance of 25km. There are no stagnant water bodies or ponds within or around the farms.

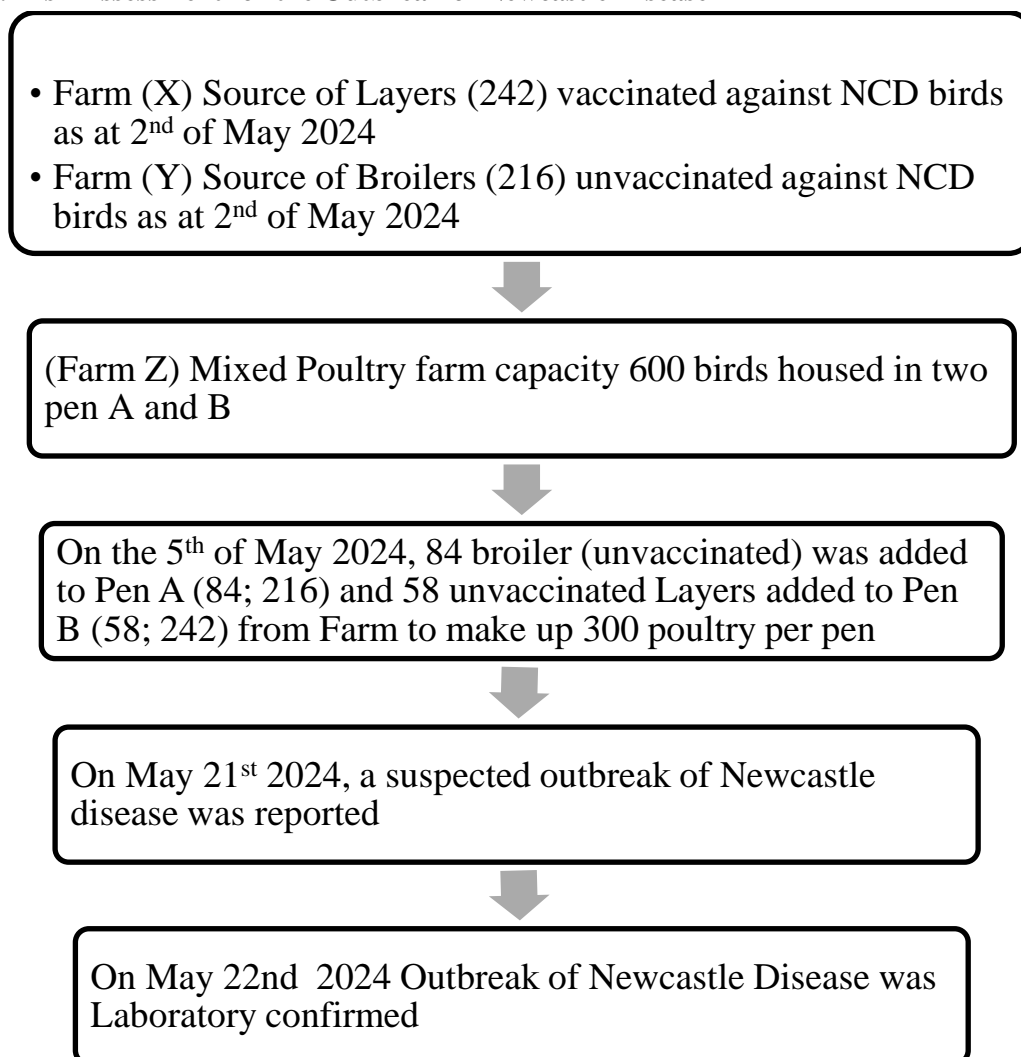
Descriptive Epidemiology Finding

Retrospective and prospective disease investigation was conducted examining poultry vaccination records, sources of poultry flock, feeding and management system. Poultry Farm (Farm Z) with 600 capacity deep litter pen (A and B) and capacity of 300 birds each procured two sets of poultry at 21 days of life from two separate farms (X) and (Y mixed layer & broiler) on the 2nd of May 2024. Pen A: was stocked with Layers of chicken from farm (X) poultry chicken has prior vaccination against Newcastle disease (NCD) as of 21st of May 2024

(N=242), Pen B were stocked with broilers chicken (N₂=216) from farm Y with no history of vaccination against Newcastle diseases (Hitcher B1 and Lasota strain) as at 21st of May, 2024. Flocks were managed under a deep litter system and feeding was adequate. On the 5th of May, 2024, 142

poultry chickens were procured comprising 58 layers and 84 broilers from the farm (Y) with no vaccination history against Newcastle disease to make up a poultry flock size of 300 in each pen A (N=58; 242), Pen (N₂=84;216) (Figure 1)

Figure 3: Risk Assessment for the Outbreak of Newcastle Disease



Sample Collection

Moribund chickens were identified, blood samples were collected via the wing vein and centrifuged to obtain a serum sample, Laryngeal swab was collected from a dead chicken. Swabs were stored in a universal sample bottle and placed in a Ziplock bag, blood sample was stored in an Eppendorf tube and transported to the laboratory (Animal care

lab®) in a Giostyle cool box maintained at a temperature of 4-5°C.

Laboratory Diagnosis

The serum sample was analysed with an Enzyme-Linked Immunosorbent Assay (ELISA) test kit to determine the presence of Newcastle disease antigen in the test serum based on the

manufacturer’s instruction (*Biocheknewcastleelisa*, 2014.).

RESULT

142 apparently healthy unvaccinated layers and broilers chicken aged 5 weeks were introduced into the farm on the 5th of May 2024 mixed with two clusters of poultry chicken with and without prior vaccination against NCD. The risk of NCD amongst

Vaccinated poultry was (0.03) and (0.45) in unvaccinated poultry (Table 1). The relative risk of NCD in the vaccinated poultry population was (0.08), and vaccine effectiveness against NCD in vaccinated Poultry was 97%. 142 (100%) samples from moribund and dead poultry chicken were positive for Newcastle disease by indirect ELISA test of these 8(6%) were from vaccinated poultry and 133(94%) were unvaccinated.

Table 1: Prospective Cohort Study on the Risk of Outbreak of NCD in Vaccinated and Unvaccinated Poultry Chicken 5 Weeks of Age

Exposure factor: suspected NCD Infected poultry	Parameters	No. of chicken dead or lab-confirmed moribund due to NCD	No. of chicken unaffected by NCD	Total	Risk of NCD
	Vaccinated poultry Chicken	8	292	300	0.03
	Unvaccinated Poultry Chicken	134	167	300	0.45

Risk of NCD in Vaccinated poultry Pen A = (Number of infected moribund/total no of chicken in pen) =8/300=0.03 or 3%, similarly, Risk of NCD in Unvaccinated poultry Pen B = (Number of infected moribund/total no of chicken in pen) =134/300=0.45 or 45%. The relative risk of NCD in the poultry population = (Risk of NCD in Vaccinated poultry/ Risk of NCD in Unvaccinated poultry) = 0.03/0.45=0.07 or 7%. Vaccine protection against NCD in vaccinated Poultry cluster = (1- Risk of NCD in Vaccinated poultry Pen A) =1-0.03=0.97 =97%. Protection against NCD in unvaccinated Poultry cluster = (1- Risk of NCD in Vaccinated poultry Pen B) =1-0.45=0.55 =55%.

DISCUSSION

In the event of an outbreak of Newcastle disease of poultry, about 15 million poultry chickens would be

at risk of infection in the State (O. S. Chieloka, 2022), and households that depend on poultry farming, and its value chains may be most affected. It is worth noting that the attendant economic losses due to an outbreak of Newcastle disease of poultry are estimated at over USD 250 million (Anzaku et al., 2014). This study found that the introduction of poultry flocks with no vaccination history against NCD into the farm may be epidemiologically linked to the outbreak of Newcastle. It is plausible that the transfer of apparently healthy, unvaccinated poultry flocks sourced from farm (Y or X) with poor implementation of biosecurity measures on the farm (Z) was responsible for the outbreak of Newcastle disease during the study period. Furthermore, the relatively cheap cost of unvaccinated poultry flocks compared to vaccinated poultry chicken influences the choice of poultry farmers in procuring poultry

from breeder farms. This study noted the variation of cost price between vaccinated and unvaccinated poultry of between 20-22% of the cost price of vaccinated poultry chicken, consequently, identified a putative link between outbreaks of Newcastle diseases to associated cost of poultry flock within the period of study. However, further study may be required to establish an epidemiological link. This study recommends that the cost of the poultry flocks relative to the market price during an epidemic period may be used by clinician/field epidemiologists as a yardstick to raise suspicion about the vaccination and health status of the flocks being investigated especially when there is no documented evidence of vaccination history of flocks being investigated. The risk of an outbreak of ND amongst vaccinated flocks was low at 0.03 and high at 0.45 in unvaccinated poultry. These highlight the importance of preventive measures such as vaccination to reduce the burden of poultry diseases. When poultry chickens are vaccinated against Newcastle disease they develop adaptive immunity to circulating strains of Newcastle Disease viruses consequently exposure to infectious organisms results in none or minimal morbidity and mortality amongst flocks. However unvaccinated flock naïve to infectious agents with no prior innate immunity have no protective antigen against circulating strain of Newcastle disease consequently, may record high morbidity and mortality. This assertion has been documented by (Farnós et al., 2023; Takada & Kida, 1996) Similarly, the vaccine prevented 97% of the risk of Newcastle in vaccinated flock compared to 55% in unvaccinated poultry flock. It's plausible that some of the unvaccinated poultry flocks may have developed adaptive immunity possibly due to contact with vaccinated flock from their primary source (Herd immunity) or possible genetic resistance to Newcastle disease. Genomic analysis of vaccinated, naïve poultry is beyond the scope of the present study. Consequently, further study is recommended in this regard.

CONCLUSION

Newcastle disease is a vaccine-preventable poultry disease. However, poor biosecurity, bio-containment and non-implementation of vaccination policies in intensively managed poultry farms may be responsible increase in the burden of Newcastle disease in Nigeria. Practices such as mixing of vaccinated and unvaccinated poultry flocks may be inimical to the growth of the poultry subsector. Similarly, farmers should practice “all in all out” and ensure that poultry is only procured from farms with good biosecurity pedigree. Vaccination against NCD in poultry should not be compromised or used as an opportunity the cost to reduce the cost of production by procuring cheap unvaccinated apparently healthy flocks. It is imperative for farmers to vaccinate all poultry flocks as at when due rather than the practice of leveraging on the hard immunity of a few vaccinated poultry flocks to confer immunity on unvaccinated poultry when mixed in a poultry production system. Avoid mixing of poultry from different flocks to prevent outbreaks of poultry diseases. Similarly, the Non-availability of biosecurity structures on farms may ensure the spread of infection within and between contiguous farms. Similarly, sales of poultry waste and leftovers to crop farmers who use them as animal manures may contribute to the spread of Newcastle diseases. The State Department of Veterinary Services and her partner agencies should develop and enforce a minimum operating standard towards ensuring biosafety and biosecurity measures for would-be poultry farmers before production licences are granted, sensitize poultry stakeholders on the need to observe and maintain biosecurity/biosafety measures along poultry production value chains. Furthermore, moribund poultry chickens were isolated from the pen and apparently healthy flocks were placed on immune boosters antibiotics. The poultry bedding was changed and the pen was fumigated with virucidal fumigants according to the manufacturer's instructions.

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