Community Measures: A Key to Highly Pathogenic Avian Influenza Control in Developing Nations

Folorunso Oludayo Fasina, DVM[1,2]
Tony M. Joannis, DVM, MSc[1]
Celia Abolnik, BVSc, MSc[3]
Cheryl M.E. McCrindle, BVSc, MSc, PhD[4]
Shahn P.R. Bisschop, BVSc, MSc[2]

[1]*National Veterinary Research Institute*
Nigeria
[2]*Poultry Reference Laboratory*
Faculty of Veterinary Science
University of Pretoria
South Africa

[3]*Biotechnology Center*
Onderstepoort Veterinary Institute
South Africa
[4]*Community Health Section*
Faculty of Veterinary Science
University of Pretoria
South Africa

KEY WORDS: highly pathogenic notifiable form avian influenza (HPNAI), Vom, agar gel immunodiffusion (AGID), hemagglutination inhibition (HI), biosecurity

ABSTRACT

Avian influenza, a transboundary poultry disease of great economic importance, has been ravaging the poultry industry worldwide since the 1950s. The virus usually occurs as waves of epizootics in the poultry industry causing fatality and disruption in trade both locally and internationally. That the virus has the ability to mutate in the avian host has limited effort to control the pathogen. The current wave of outbreaks starting in mid to late 2003 has led to the death of hundreds of millions of poultry flock worldwide in addition to death of other bird and animal species.

The rapidity and mode of spread of the virus is daunting, and epizootiologists as well as authorities are still at a crossroad on the best combination of effective control measures. Surveillance, biosecurity, stamping out, and vaccination are the best available and generally acceptable methods of controlling the disease. While several countries are still undecided whether to adopt vaccination as a control strategy, the highly pathogenic notifiable form of avian influenza continues to ravage the poultry industry.

In countries with outbreaks, the virus spreads so fast that almost whole chicken populations in affected regions are wiped out. This study review the outbreaks in Nigeria, sero-surveillance studies and diagnostics carried out during the outbreaks, and strategies adopted by a community at high risk in the wave of outbreaks in Nigeria to prevent it from being infected. These data are presented as a good measure for developing economies in view of similarities in the poultry sectors.

INTRODUCTION

Avian influenza in its highly pathogenic notifiable form (HPNAI) is a transboundary disease of poultry of great economic and public health importance. Since December 2003, the HPNAI viruses have led to the death of hundreds of millions of chickens

and other poultry birds worth hundreds of millions of dollars with its attendant effects, including compromised food security, major production losses, inhibition of investment in poultry industry, disruption of livestock trade, and loss of high genetic potential, among others.[1] Unarguably, the most highlighted effect is the public health concern that the virus may mutate and cause human pandemic; in fact, laboratory and clinical reports have indicated that the virus has affected more than 224 persons, with death in 127 cases.[2]

The disease spread from its initial stronghold in South East Asia to infect 3 continents and over 50 countries as well as several new hosts.[3-6] Combating its geographical spread seems a daunting task in view of the fact that the epidemiology of the disease is suspected to be closely linked with illegal trade in poultry and poultry products, migratory birds, and farming practices and other management systems.[3,7] The rate of increasing rapidity with which air, sea, and land travels can be accomplished with attendant pet (bird inclusive) carriage by animal lovers may have added to the scourge of the spread.

The disease was first noticed in Africa on January 10, 2006, specifically in Northern Nigeria, and spread rapidly within a period of 7 weeks to cause devastation to nearly half a million chickens in 46 confirmed outbreaks. The outbreaks spread from the northern part of the country southward covering 13 states from the extreme north to the remote south. Of the 46 outbreaks reported, Plateau State alone had 17 of the outbreaks. However, despite the spate of reports of outbreaks and the precarious situation of the Vom community in central Nigeria, not a single outbreak was recorded in the community. This study thus reports the efforts of the community and presents it as a model for the developing economies that operate poultry production systems with vagaries of limiting factors.

MATERIALS AND METHODS

Case Definition

In the earlier months of 2006 (January-March), Nigeria was hit by an outbreak of highly pathogenic avian influenza (HPAI). The epizootic was caused by an H5N1 virus as isolated in the national laboratory and confirmed at the Office International des Epizooties (OIE) reference laboratory in Padua, Italy. Signs and symptoms were consistent with the definition of HPAI as recorded in the OIE manuals.[8] In the first outbreak involving 46,000 birds, there was100% morbidity and about 92% mortality recorded. Flocks within the vicinity of the outbreak soon began recording similar symptoms and disease (Figure 1). The disease affected multiple species totaling 453,325 birds (Table 1).

Table 1. Types and Number of Birds Affected Between January 2006 and February 2006.

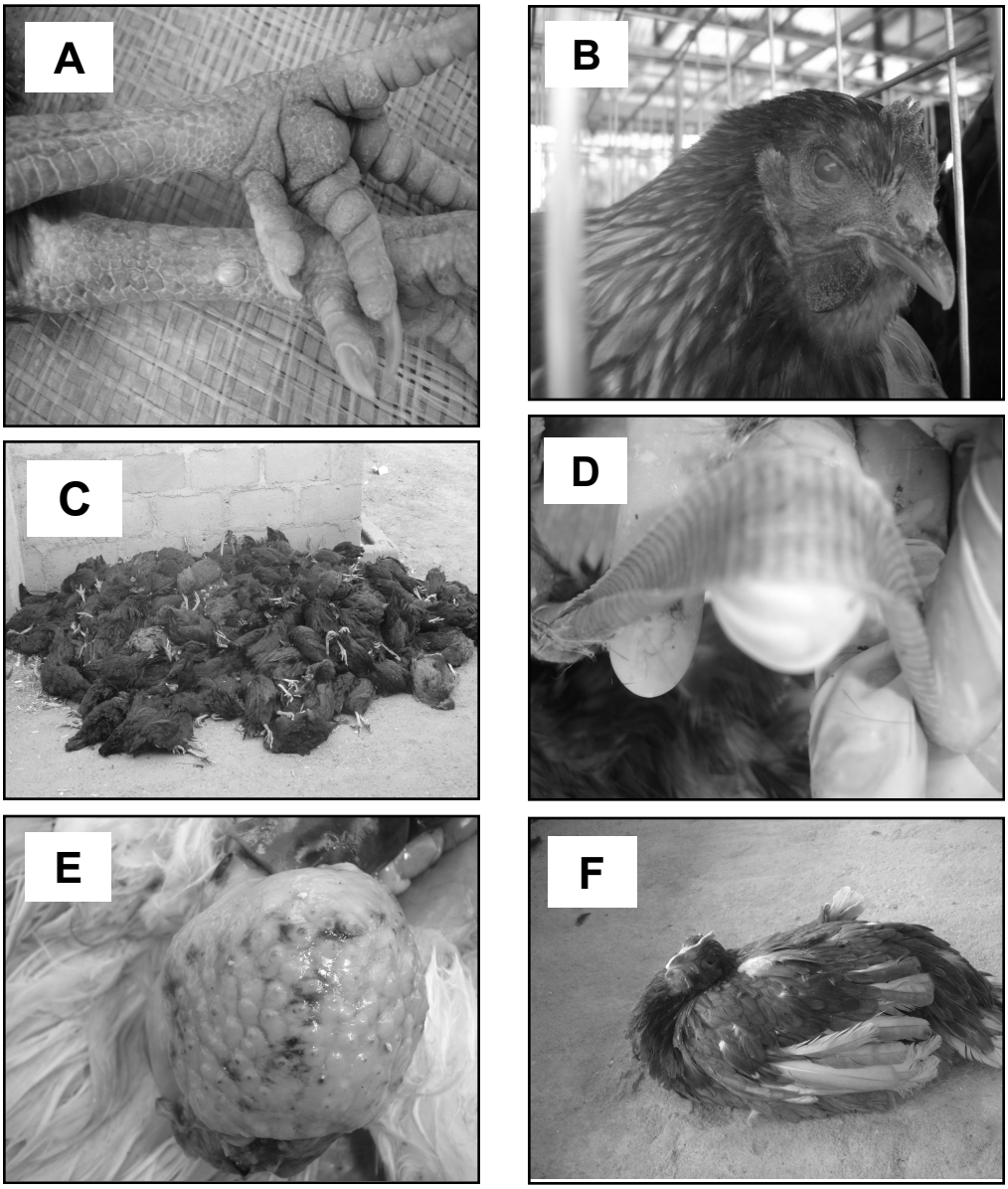
Species Affected	Number	Percentage
Chicken: Layer/Pullet	386,400*	85.2
Chicken: Broiler	2,425	0.5
Chicken: Breeder	63,500	14.0
Guinea Fowl	40	0.01
Duck	457	0.1
Geese	192	0.04
Ostrich	200†	0.04
Pigeon	85	0.02
Turkey	30	0.007
Wild Bird (Multi Species)	6	0.001
TOTAL	**453,325**	**100**

*Include local, backyard, and free-range laying hens.
†Ostriches numbers were estimated based on oral investigation.

Vom Community

Vom is one of the major towns in Jos South Local Government in Plateau State located in the north central zone of Nigeria (Figure 2). It has a sub-tropical climate that is conducive for poultry production with a mean temperature range of 20°C to 35°C and mean relative humidity at noon between 14% and 74%, depending on the period of

Figure 1. Signs and symptoms of the outbreaks. A. Reddening of feet and shank; B. Opacity of the eyelids; C. High mortality rate; D. Severe hemorrhagic tracheitis; E. Proventricular haemorrhage; F. Opisthotonus and prostration.



the year. It is located at 8°45'E, 9°43'N at an altitude of 4,000 ft above sea level with average annual rainfall of about 1300-1500 mm/annum. Its population consists largely of research scientists and farm-related workers. It has a high density of poultry population in Plateau State and some of the highest in Nigeria. It accommodates the National Veterinary Research Institute as well as 4 other government institutes and parastatals.

Sample Collection and Analysis

Tissue samples (liver, lung, trachea, spleen, brain, intestine, and heart) were collected by properly suited field staff on the farms and the samples transported to the laboratory in leak-proof materials kept in cold transport

Figure 2. Map of Nigeria showing states.

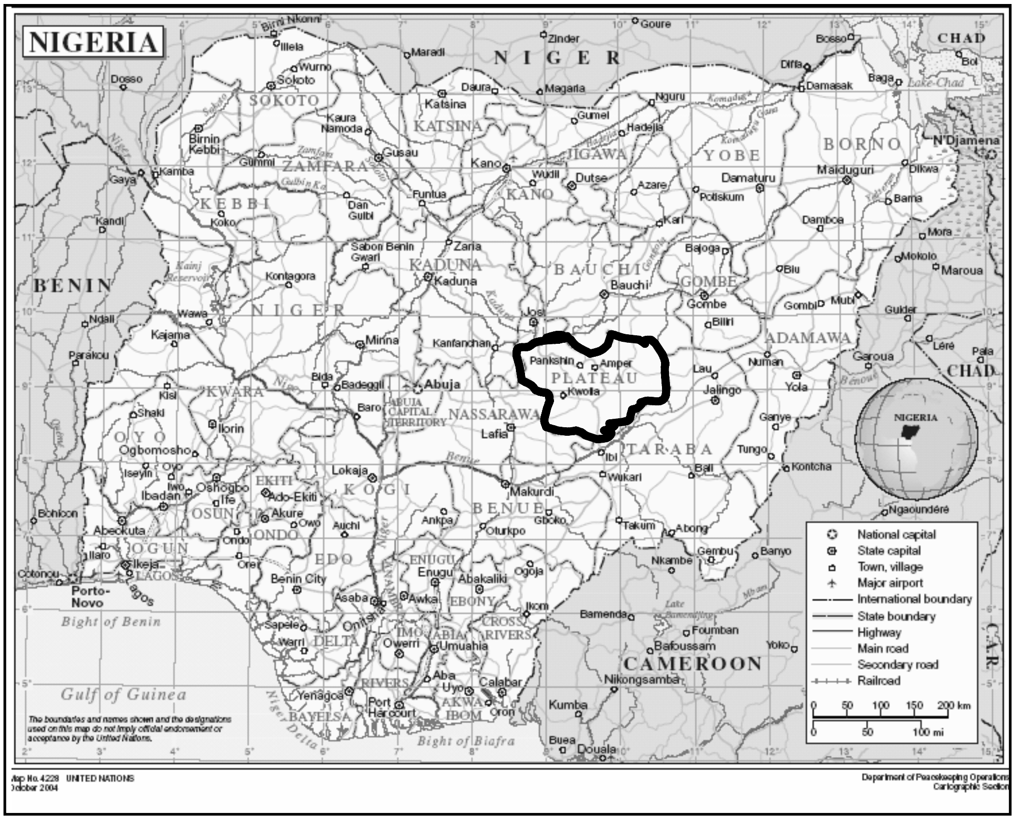


Table 2. States Affected and Number(s) of Outbreaks Recorded.*

States Affected	Sample Size	Number Positive	Percentage of Total Positive
Kaduna	23	7	14.7
Plateau	48	17	35.7
Kano	10	4	8.4
Katsina	11	5	10.5
FCT	8	3	6.3
Bauchi	7	5	8.4
Anambra	2	1	2.1
Yobe	2	1	2.1
Nasarawa	5	1	2.1
Benue	3	1	2.1
Rivers	2	1	2.1
Enugu	1	1	2.1
Ogun	2	1	2.1
TOTAL: 13 States	**124**	**48**	**≈100**

*The remaining 15 samples to make 139 came from 10 states without outbreak.

boxes. The carcasses were destroyed on the farms; every mortality is treated as suspected HPNAI case until proved otherwise.

All samples were analyzed according to standard procedures[8] in the Level 3 biosafety cabinet using appropriate gears. The test conducted were egg inoculation followed by agar gel immunodiffusion (AGID) test. Hemagglutination inhibition (HI) test were also conducted on farms where sera were collected using the group specific antisera and antigen. Subtyping was done at the OIE reference laboratory in Padua, Italy.

RESULTS

Of the 139 cases submitted from 23 states in Nigeria, 46 were posi-

tive for HPAI H5N1 (Table 2); 48 (34.5%) of all the samples submitted were from Plateau State out of which 17 were positive. Samples also came from 8 farms in Vom, and a dead free-flying bird found about 200 m from a farm was also submitted. All the samples from Vom were negative, but the dead free-flying bird was positive.

Calculations

Case fatality rate (Nigeria) = 279,919/453,325 × 100 = 61.75%

Where:

279,919 = Total number of dead birds

453,325 = Total number of exposed birds (died or underwent pre-emptive slaughter)

Case fatality rate (Plateau State) = 24,594/46,607 × 100 = 52.77%

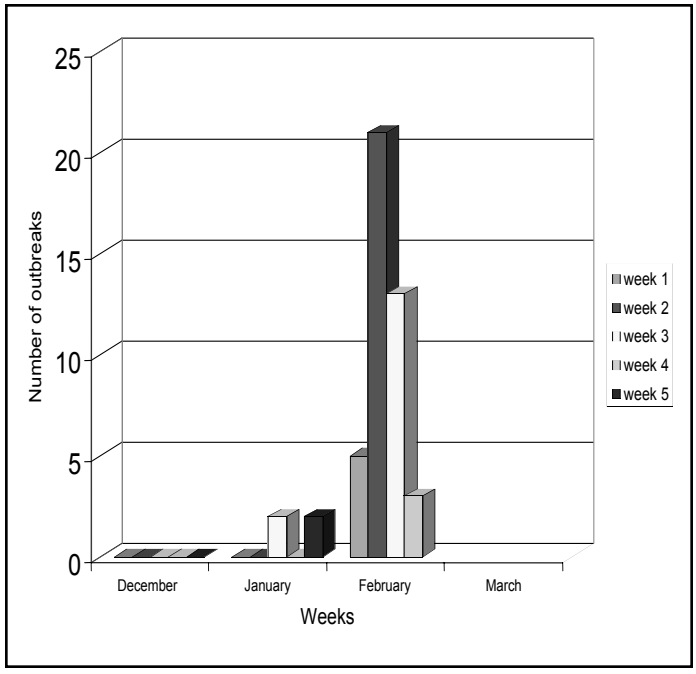
Where:

24,594 = Total number of dead birds

46,607 = Total number of exposed birds

The graph of weekly incidence rate (Figure 3) also indicated that the disease reached its peak in the 5th week from the time of first outbreak.

Figure 3. Weekly incidence rate.



DISCUSSIONS

As shown in the numbers of samples (group or individual) submitted, 34.5% of all the cases submitted nationally came from Plateau State and in suitable conditions. This is not unconnected to the fact that the state hosts the laboratory and lots of poultry production activities go on in the state. These findings explain the necessity of nearness to diagnostic facilities, especially in disease emergencies like avian influenza. Tropical nations will also benefit immensely from closeness of laboratories as samples rapidly undergo post-mortem autolysis due to high environmental conditions. Most African countries, however, currently have such diagnostic facilities only at the central level and non-functional/non-existent laboratory at the regional or local level.

Of the total number of positive cases, approximately 37% came from the state alone, making the disease more prevalent in Plateau State than any other state. The outbreak from the state was recorded mostly from all the high-density poultry production areas in the state except Vom. This was not expected in view of the fact that the community is one of the most densely populated poultry areas in Plateau State.

Similarly, it lies in the major spread route of disease in the country. It also receives large number of individuals who deal in poultry, feed, and poultry products. Furthermore, it serves as a repository for carcass submission (oftentimes transported inappropriately) in the wake of the outbreaks; a dead bird was also diagnosed to be HPAI H5N1 positive within the vicinity of one of the largest farms in the area.

Investigations, however, show that the community took some pre-emptive measures including the following:

- Stoppage of visit of egg buyers. The community agreed to transport eggs to buyers and leave egg trays behind rather than allow buyers visit for collection.
- Biosecurity was upped by regular decontamination (spraying with disinfectant) of vehicles after every such egg transportation.
- Farm workers have to decontaminate regularly and almost all of the free-range poultry in the community were culled by owner or restricted indoors.
- Visitors were strictly restricted from visiting farms in the community.
- Extra care was implemented by decontaminating feed bags and feed mill premises by tow millers or by buying of finished feed.
- The Veterinary Institute also organized awareness programs for farmers in the peak of the outbreaks to stop panic, correct error in sample submission, and engage more in on-farm assessment/sample collection rather than sample transport to the laboratory.

Although all of the above strategies implemented had been advocated by different scientists in time past,[9,10] farmers care less to adhere to them, and this is the situation in the poultry industry in most third world nations. However, the estimated 50-60 farm families raising an estimated >100,000 poultry (mostly layers) did not suffer a single outbreak during the crisis period. That the case fatality rate at 95% confidence interval (0.616-0.624) was higher for the country (61.75%) than for the state (52.77%) was indicative of the fact that some of the farms affected outside the state were a lot larger than most farms within the state. This is due to the fact that most farmers within the state engage in poultry farming to supplement their main income.

The measure of intensive awareness programs engaged in by the Veterinary Institute also contributed tremendously to controlling the disease spread as drastic reduction in incidence rate was noticed from the period of community awareness.

CONCLUSION

This work barely supports the fact that the issue of biosecurity in tackling disease entities is non-negotiable. It further encourages some level of awareness/education in the issue of successful poultry production enterprise. However, it emphasizes the necessity of national governments in the developing economies to develop and functionally equip regional laboratories if combating disease emergencies is to be a successful endeavor. Finally, since poultry production in most of the developing nations is mainly tailored towards aggregation in specific sites due to various factors (especially input supplies and markets), thereby creating several or few high-density poultry production areas, efforts should be directed at a community approach to combat disease entities rather than an individual approach, which predominates presently.

REFERENCES

1. Food and Agricultural Organisation: Manual on the Preparation of National Animal Disease Emergency Preparedness Plan: Animal Disease Emergency- Their Nature and Potential Consequences. 2002. Available from http://www.fao.org/ag/agah/. Accessed April 20, 2006.
2. World Health Organisation: Confirmed human cases of avian influenza A (H5N1). 2006. Available from http://www.who.int/csr/disease/avian_influenza/country/cases_table_. Accessed May 31, 2006.
3. World Organisation for Animal Health: Disease Alert and Updates: Avian Influenza in Animals (type H5). 2006. Available from http://www.oie.int/eng/info/en_urgences_htm. Accessed April 29, 2006.
4. Thornley M: Avian influenza ravages Thai tigers. *Austr Vet J* 2004;82(11):652.
5. Quirk M: Zoo tigers succumb to avian influenza. *Lancet Infect Dis* 2004;4(12):716.
6. Keawcharoen J, Oraveerakul K, Kuiken T, et al: Avian influenza in tigers and leopards. *Emerg Infect Dis* 2004;10(12):2189-2191.
7. Bird Life International: Birdlife's Guidance for Public Authority Culling: An Inappropriate Response. Available at www.birdlife.org/index.html. Accessed March 7, 2006
8. Office International des Epizooties (OIE): Chapter 2.1.14. Highly pathogenic avian influenza. In: *OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals*. 5th edition. 2004.
9. Law WJ, Payne LN: The poultry industry In: Jordan FTW, Pattison M, eds. *Poultry Diseases*. 4th edition. London: W.B. Saunders Co. Ltd; 1996.
10. Bermudez AJ, Stewart-Brown B: 2003. In: Saif YM, Barnes HJ, Glisson JR, et al, eds. *Principles of Disease Prevention and Control: Diagnosis and Control (Disease Prevention and Diagnosis).* 11th edition. Iowa: Blackwell Scientific Publisher; 2003:3-55.