Evaluating a surveillance system: live-bird market surveillance for highly pathogenic avian influenza, a case study

Ndadinlasiya Endie Waziri1,2,3, Patrick Nguku1, Adebola Olayinka1, Ike Ajayi2, Junaidu Kabir1, Emmanuel Okolocha1, Tesfai Tseggai4, Tony Joannis5, Phillip Okewole1, Peterside Kumbish1, Mohammed Ahmed6, Lami Lombin3, Peter Nsubuga4

1Nigeria Field Epidemiology and Laboratory Training Program, Nigeria, 2Department of Epidemiology, Medical Statistics and Environmental Health, University of Ibadan, Nigeria, 3Department of Veterinary Public Health, Ahmadu Bello University, Zaria, Nigeria, 4ECTAD Unit, Food and Agriculture Organization, Bangladesh, 5National Veterinary Research Institute, Vom, Nigeria, 6Global Public Health Solutions, Decatur GA, USA

*Corresponding author:
Ndadinlasiya Waziri, Nigeria Field Epidemiology and Laboratory Training Program, Nigeria

Cite this article: Ndadinlasiya Endie Waziri, Patrick Nguku, Adebola Olayinka, Ike Ajayi, Junaidu Kabir, Emmanuel Okolocha, Tesfai Tseggai, Tony Joannis, Phillip Okewole, Peterside Kumbish, Mohammed Ahmed, Lami Lombin, Peter Nsubuga. Evaluating a surveillance system: live-bird market surveillance for highly pathogenic avian influenza, a case study. Pan Afr Med J. 2014;18(Supp 1):11

Key words: Live bird market, highly pathogenic avian influenza, surveillance, Nigeria

Permanent link: http://www.panafrican-med-journal.com/content/series/18/1/11/full

DOI: 10.11694/pamj.supp.2014.18.1.4188

Received: 16/03/2014 - Accepted: 19/04/2014 - Published: 21/07/2014

This article is published as part of the supplement "Building a public health workforce in Nigeria through experiential training" Supplement sponsored by Nigeria Field Epidemiology and Laboratory Program © Ndadinlasiya Endie Waziri et al. The Pan African Medical Journal - ISSN 1837-8688. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/2.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract

Introduction: Highly pathogenic avian influenza H5N1 was first reported in poultry in Nigeria in February 2006. The only human case that occurred was linked to contact with poultry in a live bird market (LBM). LBM surveillance was instituted to assess the degree of threat of human exposure to H5N1. The key indicator was detection of H5N1 in LBMs. We evaluated the surveillance system to assess its operations and attributes.

Methods: We used the US Centers for Disease Control and Prevention (CDC) updated guidelines for evaluating public health surveillance systems. We reviewed and analyzed passive surveillance data for HPAI (January 2006-March 2009) from the Avian Influenza National Reference Laboratory, and live bird market surveillance data from the Food and Agriculture Organization of the United Nations, Nigeria. We interviewed key stakeholders and reviewed reports of live bird market surveillance to obtain additional information on the operations of the system. We assessed the key system attributes.

Results: A total of 299 cases occurred in 25 (72%) states and the Federal Capital Territory (FCT). The system detected HPAI H5N1 virus in 7 (9.5%) LBMs; 2 (29%) of which were from 2 (18.2%) states with no previous case. A total of 17,852 (91.5%) of samples arrived at the laboratory within 24 hours but laboratory analysis took over 7 days. The sensitivity and positive predictive value (PPV) were 15.4% and 66.7% respectively.

Conclusion: The system is useful, flexible, complex and not timely, but appears to be meeting its objectives. The isolation of HPAI H5N1 virus in farms within 3 km radius, movement control and improved bio-security management are being monitored efficiently and effectively and periodic evaluation is necessary in order to ensure problems of public health importance are being monitored efficiently and effectively and that the system should involve an assessment of system attributes such as simplicity, flexibility, data quality, acceptability, sensitivity, predictive value positive, representativeness, timeliness, and stability. It is important to note that because public health surveillance systems vary in methods, scope, purpose and objectives, attributes that are important to one system might be less important to another. An outbreak of highly pathogenic avian influenza (HPAI) was first reported in Nigeria in February, 2006. Despite control measures including depopulation of affected farms and farms within 3 km radius, movement control and improved bio-security measures implemented to stop the spread of the disease, the virus rapidly spread to 25 states including the Federal Capital Territory (FCT) [4,5] causing loss of over 1 million poultry. Although the World Health
Organization (WHO) reported more than 628 confirmed human cases of avian influenza A (H5N1) globally, approximately two thirds of whom died [6], the first and only confirmed human H5N1 infection in Nigeria was reported in February 2007 [4] which was traced back to contact with infected poultry in a live bird market (LBM). LBMs are said to be the most important mixing point for all birds and have been implicated in the spread of H5N1 HPAI. While birds from large and small-scale commercial sectors and scavenging poultry mix in these markets, traders and other intermediaries also serve as vehicles for HPAI transmission. Live bird market surveillance (LBMS) for HPAI was instituted by the Nigeria government in collaboration with the Food and Agriculture Organization (FAO) to improve the understanding of the role of LBMs in the epidemiology of HPAI in Nigeria and the degree of threat of human exposure to HPAI virus. We evaluated the LBMS for HPAI to assess its operations, evaluate its key system’s attributes and assess whether the system is meeting its objectives.

Methods

Data collection and review

We obtained monthly passive surveillance data for HPAI (January 2006-March 2009) from the Avian Influenza National Reference Laboratory, and live bird market surveillance data from the FAO, Nigeria. The data were compiled and reviewed for errors. A case of HPAI was one with a positive laboratory result by agar gel immune diffusion test. We analyzed the data and compared monthly trends of the disease. We performed descriptive epidemiology to summarize the data in person, place and time. A state with a positive laboratory test either from the passive surveillance or the live bird market surveillance was considered infected. We analyzed data from the surveillance for both the infected and non-infected states.

System evaluation

We used the US Centers for Disease Control and Prevention (CDC) updated guidelines for evaluating public health surveillance systems [3]. We assessed the operations of the system and the system’s attributes. We interviewed key stakeholders and reviewed reports of live bird market surveillance to obtain additional information on the operations of the system. We reviewed data collection tools and raw data from two states; one each from an infected and non-infected state to check for consistency in data collection and entry, and the ease of use of the laboratory. Results in the reports were compared with the results in the laboratory. We assessed the key system attributes (simplicity, flexibility, acceptability, data quality, stability, timelines, sensitivity and predictive value positive).

Results

Operation of the live bird market surveillance for highly pathogenic avian influenza system

Funding was provided by United States Agency for International Development (USAID) and the European Union (EU) with FAO acting as implementing partner. The indicators of the system are the detection of HPAI virus in LBMs, increased capacity of government to respond to HPAI occurrence in these markets, improved hygienic/biosecurity practices in LBMs and reduced risk of human exposure to HPAI virus. It has 13 stakeholders comprising international agencies, federal, state and local government agencies, private organizations and vocational associations and was operated in 2 phases. Phase I was instituted in the 26 states (including the Federal Capital Territory) that recorded cases during the H5N1 avian influenza outbreak in Nigeria that occurred between February 2006 to November 2008, while Phase II was done in the 11 states with no poultry outbreak of H5N1 avian influenza (Figure 1). In both activities, two markets per state comprising of one major market in the capital of each of the state which serves as the receiving depot for in-coming birds and distribution outlet to other parts of the state and a second market outside the state capital chosen based on size, number as well as types of birds sold. Sampling was done in each market at forth nightly intervals.

Usefulness of the System

The system generated data of LBMs operations and bio-security practices in the markets. It highlighted the need for Newcastle disease (ND) surveillance in Nigeria, as samples were collected in duplicates for future ND virus test. The system also detected HPAI H5N1 virus in 7 (9.5%) LBMs, 2 (29%) of which were from 2 (18.2%) states with no previous case or outbreak of H5N1.

System Attributes

Simplicity:Although forms and questionnaires used in LBMS are easy to fill and the questions direct, diagnosis is strictly laboratory-based thus requiring specialized trainings for personnel. The test carried out was polymerase chain reaction, agar gel immuno-diffusion, and virus isolation. These tests are expensive, highly specialized and need trained personnel to carry out. Case definition for inclusion as HPAI also requires a positive result from one of the test procedures. No rapid test was used on the field and samples were shipped to the national reference laboratory for...
Discussion

The LBM surveillance system has helped in the generation of data on LBMs, their operations, biosecurity practices and the role they play in the epidemiology of H5N1 in Nigeria. It also identified markets that could be re-positioned due to the possible public health risk they pose. It has also highlighted the need for Newcastle Disease surveillance in Nigeria as an integral part of Avian Influenza control. The avian influenza epidemic in Nigeria started in January 2006 and seems to have come to an end in February of 2007. These are the coldest time of the year in Nigeria and influenza viruses have been found to thrive more during cold winters [5,6].

We found the live bird market surveillance for highly pathogenic avian influenza to be useful with good data quality. The system was able to detect H5N1 virus in poultry in two markets that are situated in states that had recorded no case of HPAI during the epidemic. These cases from two previously uninfected states. As at December 2012, no additional case has been reported. This could be attributed to the control measures of depopulation and decontamination of infected farms instituted by the Government. More cases were recorded in January and February of 2006 and 2007. These are the coldest time of the year in Nigeria and influenza viruses have been found to thrive more during cold seasons [7,8].

We found the live bird market surveillance for highly pathogenic avian influenza to be useful with good data quality. The system was able to detect H5N1 virus in poultry in two markets that are situated in states that had recorded no case of HPAI during the epidemic. These cases would have otherwise been missed and the birds sold out putting handlers and consumers at risk of infection. These findings further support that LBMs are a potential source of H5N1. HPAI viruses have been isolated from live birds and poultry meat sold at markets in Thailand [9,10]. Even though the system was first designed for infected states and only avian influenza, uninfected states were later included and also surveillance for Newcastle disease done alongside avian influenza. Of note is the quality of personnel in the system. This was reflected in the quality of data collected by the system.

We found the system to be complex, not timely and not stable. We judged the system as complex based on the fact that every case had to be lab confirmed and the tests carried out needed specialized training. The delay in the laboratory analysis and results is a pointer that positive birds could have been sold to the public for consumption.

Conclusion

The System is useful, flexible and, has good data quality; however it is not timely and not stable, but appears to be meeting its objectives. It is important to note that even though the number of LBMs studied might not be representative the isolation of HPAI H5N1 virus in some of these markets is an indication that the markets are possible reservoirs of the virus in Nigeria and the delay in Lab analysis could result in selling of infected birds. Based on our findings, we recommended that the Federal Government of Nigeria should dedicate more funds for surveillance for HPAI as this will aid early warning and reduce the risk of a pandemic. Also, a rapid field test with robust sensitivity and specificity should be incorporated in the diagnostics procedures as this would reduce the time interval between sample collection and receipt of laboratory result. Finally, the isolation of HPAI H5N1 virus in LBMs is an indication that these markets are possible reservoirs of the virus in Nigeria therefore surveillance in more LBMs should be done. Surveillance is now being done in more markets to ensure that apparently healthy birds are not serving as a reservoir for the virus and also to help rapid response in case of an outbreak.

Competing interests

The authors declare no competing interests.

Authors’ contributions

All the authors have contributed to this articles in ways that conform to ICMJE authorship criteria. All the authors have read and approved the final version of the manuscript.

References

1. Thacker SB. Historical development. In: Teutsch SM, Churchill RE, eds. Principles and practice of public health surveillance, 2nd ed. New York, NY: Oxford University Press, 2000.
2. Teutsch SM, Thacker SB. Planning a public health surveillance system. Epidemiological Bulletin. Pan American Health Organization. 1995;16(1):1-6.
3. Centers for Disease Control and Prevention. Updated guidelines for evaluating public health surveillance systems: recommendations from the guidelines working group. MMWR 2001;50: (RR-13).
4. Monne I, Joannis TM, Fusaro A, De Benedictis P, et al. Reassortant avian influenza virus (H5N1) in poultry, Nigeria, 2007. Emerging Infectious Diseases. 2008; 14(4):637-40.
5. Fasina FO, Nyam DC, Nwosu CI, Makinde AA and Rivas AL. Centripetal spatial spread of the highly pathogenic avian influenza H5N1 in selected states of Nigeria. Vom Journal of Veterinary Science. 2008;5(1):18-26.
6. World Health Organization. Cumulative number of confirmed cases of avian influenza A (H5N1). http://www.wpro.who.int/mediacentre/releases/2013/20130714/en/index.html.
7. Liu C-M, Lin S-H, Chen Y C, Lin KC-M, Wu T SJ, et al. Temperature Drops and the Onset of Severe Avian Influenza A H5N1 Virus Outbreaks. 2007; PLoS ONE 2(2) e191 doi10.1371/journal.pone.0000191.
8. Reperant LA, Fucar LA, Osterhaus ADME, Dobson AP, Kuiken T. Spatial and Temporal Association of Outbreaks of H5N1 Influenza Virus Infection in Wild Birds with the 0°C Isotherm. PLoS Pathog 6(4) e1000854. Doi 10.1371/journal.ppat.1000854.
9. Wisedchanwet T, Wongpatcharachai M, Boonyapitsitsopa S, Bunpapong N, et al. Influenza A virus surveillance in live-bird markets: first report of influenza A virus subtype H4N6, H4N9, and H10N3 in Thailand. Avian Diseases. 2011; 55(4):593-602.
10. Amonsin C, Choatralok C, Laptundai J, Tantilertcharoen R, Thanawongnuwech R, et al. Influenza Virus (H5N1) in Live Bird Markets and Food Markets, Thailand. Emerging Infectious Diseases. 2008; 14(11):1739-1742. DOI: 3201/eid1411.080683.
PAMJ is an Open Access Journal published in partnership with the African Field Epidemiology Network (AFENET)