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Livestock Risks and Opportunities: Newcastle Disease and Avian Influenza in Africa[1]

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Abstract – Newcastle disease is an endemic and devastating disease in African countries, and is a differential diagnosis for Highly Pathogenic Avian Influenza (HPAI). The objective of this study was to analyze the reporting data from African Union member countries of Newcastle disease to OIE's World Animal Health Information Database (WAHID), and to characterize the data within the context of Avian Influenza H5N1. Data were gathered from the WAHID database on 54 African Union member countries from January 2000- December 2011. Paired t-tests were performed on reported Newcastle disease outbreaks pre- and post- HPAI introduction to the African continent. Of the 54 countries included, 40.7% had reported ND outbreak information to the OIE consistently over the study period. Three countries demonstrated a significant difference in mean number of outbreaks reported from 2000-2005 (prior to confirmed outbreaks of HPAI subtype H5N1 on the African continent) compared to 2006-2011. Surveillance for Newcastle disease in Africa has not improved despite response to outbreaks of HPAI subtype H5N1, which included strengthening diagnostic infrastructure. An analysis and evaluation of Newcastle disease surveillance in Africa would aid in determining how to improve the control of an economically important poultry disease in addition to facilitating the rapid detection of HPAI. Improving Newcastle disease surveillance would benefit the farmers and families who rely on poultry for nutrition and livelihood. It would also benefit the global vigil against emerging infectious diseases.

Keywords – *Newcastle disease, Highly pathogenic avian influenza, poultry, outbreak preparedness.*

1. Introduction Or Background

Newcastle disease (ND) virus, or avian paramyxovirus-1, is a paramyxovirus known to infect over 200 species of birds, and is likely capable of infecting many others not documented (OIE, 2012a). There are three types of clinical disease, representing degrees of severity – lentogenic, mesogenic, and velogenic. Lentogenic strains cause mild or sublinical respiratory disease, mesogenic strains cause clinical disease (usually respiratory) but low mortality. Velogenic strains can cause sudden and high mortality levels in flocks along with lethargy, swelling of the head and neck, diarrhea, respiratory signs, and neurological signs. Although signs and lesions can be suggestive, they are not pathognomonic. Despite the classification of the virus according to severity, the disease does not always behave accordingly. The clinical picture depends on the ND strain and avian species involved, the host immune status and concurrent infections, and vaccine status. Newcastle disease has the greatest impact on chickens where it can produce a highly lethal disease, but other poultry also demonstrate varying degrees of clinical signs. Causing up to 100% mortality in affected chicken flocks, it has a high impact in village and smallholder poultry, where it is a barrier to food security and poverty alleviation for millions of rural Africans (Alders 2009: 96). It is frequently cited as the most important disease of chickens in Africa (Alders 2001: 3, 20, 43). As a disease reportable to the World Organization for Animal Health (OIE), it also impacts international trade and national movement of poultry. The clinical picture of Newcastle disease is similar to highly pathogenic avian influenza (HPAI), which can also cause diarrhea, respiratory signs, swelling of the head and neck, and sudden death (Spickler 2009: 235). The

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zoonotic risk of HPAI adds an alarming human health factor to the accurate diagnosis of disease in poultry consistent with these signs. A definitive diagnosis of both HPAI and Newcastle disease requires laboratory testing, although the tests available and requirements for each are different. Since ND and HPAI are clinically indistinguishable, an understanding of ND surveillance will help facilitate the global vigil against HPAI.

2. The Case Study

Newcastle disease is listed by the World Organization for Animal Health (OIE), and as such, countries are required to regularly report all cases and outbreaks to the international animal health regulatory organization. The OIE list is a tool intended to help prevent the transboundary spread of important animal diseases by providing regulatory guidelines and information to member countries. Certain trade restrictions are associated with a disease being listed, such as regulations and documentation proving disease-free status, and restriction of animal movement to regions with the same disease status. Reports to the OIE consist of epidemiological information, including the number of outbreaks and cases according to region, and surveillance and control strategies. All of this epidemiological information is accessible to the public through the OIE's World Animal Health Information Database (WAHID).

Newcastle disease in many African countries is endemic with frequent outbreaks, yet due to poor surveillance, is grossly under-reported to the OIE (Ogundipe et al., 1989:127; Cattoli et al., 2010:169). Current surveillance efforts are lacking in many countries, causing a significant knowledge gap in the epidemiology of the disease and hampering effective control measures. highly pathogenic avian influenza subtype H5N1, on the other hand, is relatively new to African countries. It was first suspected on the continent in late 2005, and first reported to the OIE in January 2006.

The purpose of this analysis is twofold: 1) to gain an overview of the reporting habits of African Union member states with respect to ND and 2) to determine if there were any significant changes to ND reporting once HPAI H5N1 was introduced to the continent.

3. Methods

Annual outbreak reports from January 2000 – Dec 2011 (a twelve year period) were collected for 54 African Union (AU) member countries from the World Animal Health Information Database (OIE, 2012b). Morocco is currently not an AU member, and so was left out. Of those 54 countries, South Sudan was removed from the data set since it did not exist for most of the period examined. A country was considered to have submitted a report if at least one six-month report had been submitted for a given calendar year. Microsoft Excel was used to create a spreadsheet of annual reported outbreaks of Newcastle disease in each African Union member country from 2000-2011, inclusive. Descriptive and analytical statistics were conducted only on the 22 countries who submitted reports at least 10 out of 12 years from 2000-2011. Microsoft Excel was used to create graphs and run t-tests. Outbreak rates were calculated by dividing the number of outbreaks by the national poultry census number for each year, obtained from the Food and Agriculture Organization database (FAO, 2013). After logarithmic transformation, a t-test was performed on each country to compare mean number of outbreak rates reported from 2000-2005 and 2006-2011; the 6 years prior to and 6 years after the introduction of HPAI H5N1 on the African continent.

3.1. Results

Table 1 lists the outbreak rates (by national poultry population) for each of the twenty-two countries with good reporting history. The coefficient of variation follows the mean outbreak rate. Egypt and Algeria both reported the absence of Newcastle disease outbreaks in those countries while Ghana, Togo, and Lesotho each reported the highest number of outbreaks per 1000 head of poultry. The coefficient of variation was measured across all twelve years, and was markedly high in all countries. Benin was the only country with less than 50% variation in outbreak rates.

Table 1: Mean number of outbreaks of Newcastle disease reported annually to OIE (per 1000 head of poultry), averaged over 12 years (2000-2011). Coefficient of variation is in parentheses (CV)

Country	Mean Annual Outbreak rates 2000-2011 (CV)	Country	Mean Annual Outbreak rates 2000-2011 (CV)
Egypt	0.0	Namibia	0.62 (0.66)
Algeria	0.0	Zimbabwe	0.77 (1.47)
Senegal	0.13 (1.40)	Burkina Faso	0.95 (1.03)
Swaziland	0.25 (1.80)	Botswana	1.01 (1.40)
Mozambique	0.28 (0.87)	Ethiopia	1.26 (0.59)
Kenya	0.31 (1.85)	Guinea	1.85 (0.80)
Nigeria	0.31 (2.27)	Tanzania	1.99 (0.80)
South Africa	0.32 (1.45)	Zambia	2.05 (0.82)
Benin	0.38 (0.43)	Ghana	4.06 (0.97)
Angola	0.47 (1.08)	Togo	6.04 (0.90)
Cameroon	0.51 (0.66)	Lesotho	9.3 (1.65)

Paired t-tests were conducted on transformed mean outbreak data from the countries that consistently submitted Newcastle disease reports. Of these twenty-two countries, three demonstrated significant changes in the number of outbreaks reported to the OIE, in the six years previous to, and six years following (and including) 2006 (Table 2). Two countries had a significant increase in outbreak reports (Burkina Faso, p=0.01 and Zambia, p=0.01), and one (Burkina Faso) had HPAI H5N1 positive poultry, first reported in 2006. Guinea demonstrated a significant decrease in outbreaks reported to the OIE before and after 2006. The coefficient of variation indicates high variability in the number of outbreaks reported year to year.

3.2. Discussion

WAHID data used here is, in part, a proxy for national epidemiological knowledge of Newcastle disease. Although countries may have a good national database of disease outbreaks, that information is not necessarily submitted to the OIE. OIE reports require human resources that may not necessarily be spared. On the other hand, using OIE data is an important resource for surveillance knowledge in its own right. Sharing surveillance data with the OIE fosters tranparency, international cooperation, and allows the consolidation of global disease information. The most striking revelation from this data is the paucity of information being communicated to the OIE on a disease that is devastating to poultry. Almost 60% of African Union member countries did not submit ND outbreak reports consistently enough to be able to conduct meaningful data analyses. Countries may fail to submit epidemiological reports to the OIE for various reasons, including a lack of resources to complete the required diagnostic tests and paperwork, the low priority typically assigned to poultry health and diseases, or a reluctance to share national data with the international community. For those countries that did consistently submit information to the OIE, outbreaks ranged from 0 (Algeria and Egypt) to 4 (Ghana) outbreaks per 1000 head of chickens. Egypt has the one of the largest poultry industries in Africa (FAO, 2013). While a true abscence of ND within the country is possible, it is more likely that surveillance and disease information are reported only for the commercial sector, leaving the possibility that ND and other poultry diseases may circulate in the non-industrialized sectors. Other forms of poultry production, including smaller commercial operations, family, and village flocks typically have varying degrees of biosecurity and more fluid movement of birds between flocks. Vaccination against ND is furthermore less consistent or absent in these sectors. Thus small-scale and village poultry production may circulate poultry diseases undetected.

The variability in outbreak rates was markedly high in all countries. This may reflect the natural pattern of disease outbreaks, although inconsistency in surveillance may also contribute to the wide differences in outbreak reports from year to year. Livestock disease surveillance in developing countries is subject to socio-political instability and conflict, changes in external funding sources and allocation, and changes in national budget and resources for animal health, among other things.

This case study is premised on the assumption that ND is under-surveyed, and thus an increase in ND surveillance would be reflected in an increase in reported outbreaks. Moreover, given that HPAI H5N1 triggered widespread poultry testing, if testing for other poultry diseases (especially differentials for HPAI) was likewise increased, this would be reflected in an increase in reported ND outbreaks. Based on paired t-tests of the mean of each country's outbreak rate in the six years previous and subsequent to HPAI H5N1's first reported appearance on the African continent in January 2006, only three countries demonstrated a significant change. Given the high coefficient of variation for the mean outbreak rates, however, the significance of the found differences are questionable. The lack of improvement in ND surveillance, based on OIE reporting data, indicates that African countries are still at risk of future outbreaks of HPAI or other high-impact poultry diseases going undetected. Furthermore, that external funding for the surveillance of high-profile HPAI H5N1 did not improve the detection and surveillance of other poultry diseases of arguably greater importance to poultry keepers.

4. Conclusions

The surveillance and detection of ND, a disease indistinguishable in the field from HPAI, has demonstrated no measurable improvement according to OIE data. These results question the sensitivity and sustainability of HPAI detection, especially once targeted surveillance is halted. In order to reduce the risk of allowing a potential pandemic or zoonotic disease such as HPAI H5N1 to circulate and spread undetected, funding and support toward cost-effective surveillance for poultry diseases should be prioritized. Incorporation of all levels of poultry production into a surveillance strategy would necessitate building appropriate animal health infrastructure and resources, especially for the rural poor. This would also facilitate more targeted surveillance in outbreak scenarios. Integrated surveillance that includes locally important diseases would be more sustainable, beneficial to poultry keepers, as well as serve as an opportunity to reduce the risk of future pandemics.

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Table 2: Countries with significant changes to mean outbreak rates before and after 2006, according to paired t-test

Country	Mean outbreak rate by poultry pop. 2000-2005	CV	Mean outbreaks by poultry pop. 2006-2011	CV	p value
Burkina Faso	0.29	2.27	1.60	0.51	0.01
Zambia	1.19	3.27	2.92	1.46	0.03
Guinea	2.90	0.37	1.61	1.42	0.01

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