SEMI-QUANTITATIVE RISK ASSESSMENT OF AVIAN INFLUENZA AND NEWCASTLE DISEASE VIRUS IN BACKYARD CHICKEN IN PERAK

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ABSTRACT. A semi-quantitative risk assessment of Newcastle disease (ND) and avian influenza (AI) infections was conducted on humans having direct contact with infected village chickens in Perak using the modified Risk Ranger tool. ND and AI can be transmitted to humans by direct contact with infected poultry. The symptoms of AI in humans have ranged from conjunctivitis to influenza-like symptoms (e.g. fever, cough, sore throat, muscle aches) and some of the AI strains can cause infections leading to mortality of the patients. While infections of ND can cause mild conjunctivitis and influenza-like symptoms, the ND virus poses no hazard to human health. In this study, data collected based on exposure and also on estimation of approximately 10,000 people who have direct contact with the chickens. This group of people includes farmers, neighbours, field workers, veterinarians and laboratory workers who are involved in diagnostics activities of disease screening. It was estimated that there will be 18.3 cases of AI and ND infections per year having direct contact with backyard chickens, respectively. The risk ranking index for AI and ND were 70 and 53 respectively. Albeit risk estimated in this study is medium, the potential of backyard chickens as a vehicle of transmission of AI and ND in Perak cannot be neglected.

Keywords: avian influenza, Newcastle disease, risk assessment

INTRODUCTION

Semi-quantitative risk assessment method is used to describe risk in relativity by using different scales to characterise the likelihood of adverse events and their consequences. The analysis of probabilities and consequences did not require accurate mathematical data. The objective of this method is to develop the hierarchy of risks against quantification that reflect the order that should be reviewed and no real relationship between them (McNeil *et al.*, 2005). The semi quantitative assessment is useful especially because quantitative risk assessment is hard to perform while the qualitative assessment is too subjective. The combination of those two models can be a solution in some cases, combining the specific advantages of each method and decreasing their advantages (McNeil *et al.*, 2005).

Two poultry diseases are considered to be sufficiently serious to be included in List A of the Office International des Epizooties (OIE, 2015), namely: highly pathogenic avian influenza (HPAI) and Newcastle disease (ND) (Roosevien and Azri, 2011). While HPAI occurs relatively rarely, ND is enzootic in some areas of the world and a constant

threat to most birds reared domestically. Very few commercial poultry flocks are not influenced in some way by measures aimed at controlling ND and spread of the virus (Alexander *et al.*, 1988). A large majority of the countries rearing poultry commercially rely on vaccination to control ND, but ND nevertheless represents a major limiting factor for increasing poultry production in many countries. The greatest impact of ND may be on village or backyard chicken production. In developing countries throughout Asia, Africa, Central America and some parts of South America, the village chicken is an extremely important asset representing a significant source of protein in the form of eggs and meat. However, ND is frequently responsible for devastating losses in village poultry. Social and financial restraints mean that the control of ND in village chickens in developing countries is extremely difficult, if not impossible, and this situation impinges on the further development of commercial poultry production and the establishment of trade links (OIE, 2012).

Malaysia had experienced an outbreak of highly pathogenic avian influenza (HPAI) in 2004 to 2007, followed by outbreaks in Kelantan in 2017 and Sabah in 2018. During the outbreak periods, a huge number of birds were stamped out. A year after the last outbreak, with effective control measures and preventive efforts, Malaysia sent the self-declaration on the recovery of freedom from HPAI on December 2018 to OIE (OIE, 2019). However, active surveillance still needs to be conducted since Malaysia is one of the destinations of migratory birds during the migratory time. Newcastle disease (ND) can be considered as endemic in Malaysia. In 10 years (2000-2010), there were 533 outbreaks of NDV reported to the Department of Veterinary Services (DVS, 2015), Malaysia. These outbreaks occurred not only in backyard chickens but also in commercial farms (Shohaimi *et al.*, 2013). In 2010 to 2012, ND outbreaks occurred in various states in Malaysia mainly in Johor, Perak and Pahang and it was caused by genotype VII (Shohaimi *et al.*, 2013).

Chicken farming in Malaysia can be considered a successful industry with the gross population in 2014 around 290 million (DVS, 2015). The population consisted of a few categories including meat production, eggs production, breed production and village chickens. Village chicken is the commodity which has its own demand and market. In Malaysia, this commodity has been farming either by conventional or commercial scale to fulfill the demand locally or for the international trade. In 2008, there were around 8 million village chickens recorded (Engku Elini, 2010) and the number is believed to have increased to 15 million in 2018. In 2007, there were 334 metric tonnes of processed village chicken meat exported and almost 53% of them were exported to Singapore (Engku Elini, 2010). According to the DVS (2013), the average market price for village chicken was RM10.34 per kg for live birds and the price for processed meat might be increased to RM15 to RM18 per kg. Backyard farming of village chicken is a popular activity in rural areas. The chickens were reared in a free range and open environment with minimum supervision by the owner. There is a lack of data about the disease management of these backyard

village chickens since the farming activity is just for their own needs or small trading activities.

ND and AI affect not only the avian species but also pose a considerable public health (Alexander and Senne, 2008). According to the Centre of Disease Control and Prevention (CDC, 2017), ND and AI can be transmitted to humans either by direct contact with infected live poultry or consumption of undercooked poultry duck meat products including chickens. Thus, the objective of this study is to investigate the potential of infection among workers with ND and AI viruses using semi-quantitative risk assessment.

MATERIALS AND METHOD

In this study, a survey was conducted to gain information about infections of AI and ND from a total of 80 respondents including backyards farmers, DVS Perak staff and laboratory workers who were involved in diagnoses of both diseases. The survey is divided into sections. First section was about the farm and population, second about its history of diseases, third about biosafety and biosecurity practices and the last section was about the role and function of the state DVS in helping them.

All information obtained from the survey were analysed and tabulated. In risk assessment findings, the data were analysed using the modified Risk Ranger tools (Ross and Sumner, 2002) adopted for semi-quantitative estimation of risk infection via direct contact with AI and ND infected chickens. These tools help to analyse the data and generates figures for the predicting of the chance of disease infection in people involved in handling the animals.

RESULTS AND DISCUSSION

From the Risk Ranger information, both AI and ND viruses can infect all members of the population. An HPAI virus can lead to death in most victims. An ND virus is a mild hazard which sometimes requires medical attention because the virus can only be transferred by direct contact with the infected poultry (Alexander and Senne, 2008). From Table 1, it was estimated that around 10,000 people were working closely with animals including farmers, general workers, DVS staff, field veterinarian, village people and laboratory workers involved in diagnoses of both diseases. From the survey questionnaire, all respondents mentioned never having experienced HPAI infections at their farm but they had experienced ND infections. Both infections of AI and ND viruses can be minimised up to 99% by best practices in biosafety and biosecurity. For ND, the use of vaccine is effective in preventing outbreaks, There are no vaccines administered for AI in Malaysia.

Based on this findings, the model indicates that people in selected population have a total annual illness of 18.3 cases for both AI and ND while the risk ranking for AI is 70 and ND is 53 as been shown in Table 1.

Based on the DVS records, there are no positive cases of AI detected in Malaysia since the last outbreak occurred in 2018. Even though AI was known to have a zoonotic potential and can lead to fatality in humans, the public health threat from this event can be considered very low since AI

Table 1. Semi-qualitative risk characterization of infection of AI and ND viruses.

RISK CRITERIA	GENERAL POPULATION (For AI)	GENERAL POPULATION (For ND)
Dose & Severity		
Hazard severity	Severe	Mild
Susceptibility	General – all population	General – all population
Probability of contact		
Frequency of contact	Daily	Daily
Proportion of contact	Very few (5%)	Very few (5%)
Size of contact	10000	10000
Probability of Infection		
Probability of infection of virus among chicken population	Rare (1 in 1000)	Sometimes (10%)
Effect of biosafety & biosecurity practices / vaccine usage	Usually eliminates (99%)	Usually eliminates (99%)
Potential of re-infection	Minor (1%)	Minor (1%)
Post-process control	Not relevant	Not relevant
Increase to infective dose	None	None
Preparation before handling	Usually eliminates (99%)	Usually eliminates (99%)
Total Predicted Illness In Selected Population	18.3 / annum	18.3 / annum
Risk Ranking (0-100)	70	53

virus strains vary in ability for transmission to and infection of humans (Donatelli *et al.*, 2001). For example, there is minimal evidence of human to human transmission of Hong Kong H5N1 AI viruses (Mounts *et al.*, 1999). Overwhelming evidence supports that most of human infections resulted from direct poultry to human transmission either at retail poultry stalls or at the market that sold live poultry (Mounts *et al.*, 1999). Most likely, the AI viruses were obtained from contact with poultry respiratory tract or faecal secretions that contained a high concentration of AI virus. Handling, cooking or consuming of the poultry meat are not a risk factor for human infections of Hong Kong H5N1 AI viruses (Mounts *et al.*, 1999). But, in order to prevent and maintain the free status, DVS needs to maintain active surveillance in all premises including wild and migrating bird population.

Newcastle disease viruses (NDV) have a zoonotic potential which can infect humans. According to the World Health Organisation (WHO, 2013), ND infection can lead to conjunctivitis within 24 hours of the NDV exposure to the eye. The other general symptoms of NDV infections is headache, discomfort, chills and fever with or without conjunctivitis. Both vaccine and virulent strains may infect and cause the clinical signs in humans (Dardiri *et al.*, 1962). Human infections with ND have usually resulted from direct contact with the virus,

infected animal or carcass of a diseased bird. A few types of people are at rish of being infected by ND including laboratory workers, veterinarians and general workers in farms especially when handling live vaccines. There are no reported cases of human to human infections but the potential for human to avian species exists (Rasmussen, 1964).

Risk Ranger is a simple food safety risk calculation tool intended as an aid to determine relative risks from different products, pathogens and processing combinations. Risk Ranger is a semi-quantitative risk assessment tool developed by Ross and Sumner (2002) to characterise risks and estimate the total predicted illnesses per year in a potentially at-risk population. It provides a simple and quick means to develop a first estimate of relative risk. It is a generic but robust model that uses information about all elements of food safety to make risk calculations. In addition to ranking risks, Risk Ranger helps to focus the attention of the users on the interplay of factors that contribute to food-borne diseases. The model can be used to explore the effect of different risk-reduction strategies or the extent of change required to bring about a desired reduction in risk.

In the records of DVS Perak, it was estimated that around 10,000 small backyard farmers and field workers, within the state of Perak, have daily contacts directly with village chickens.

Both AI and ND have similarities with potential zoonosis by direct human contact with infected poultry. Based on the findings of this study, the threat of both diseases can be considered low and the potential impact of humans being infected by consuming poultry meat is also considered low since there is no evidence of AI and ND virus transmission due to food consumption.

CONCLUSION

A risk assessment tool was developed to evaluate mitigation scenarios. Based on the results of prediction using the Risk Ranger as a tool, people in the selected population who were involved directly with poultry infected with AI or ND virus, has an estimated chance of 18.3 human infections per year. AI was found to pose a higher public health with risk ranking 70 compared to ND with risk ranking 53. Both results showed a moderate risk to the farmer and people directly involved with the infected poultry. In conclusion, even though the prevalence of AI in village chickens was not detected in this study, the public health risk for AI was estimated to be higher than ND because AI can cause more serious adverse health effects in humans than ND. Therefore, albeit the medium risk estimated in this study, the potential of village chickens as vehicles of transmission of AI and ND in Malaysia cannot be neglected.

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