

## **A PathWayDiagram for introduction and prevention of Avian Influenza in The Netherlands**

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### **Introduction**

Highly pathogenic avian influenza (HPAI) viruses have spread in recent years across broad regions of Europe, Asia and Africa (Boon *et al.*, 2007). The number of outbreaks of HPAI have increased in the last decade, and the impact in terms of number of birds involved and the control costs of the disease have dramatically risen (Capua and Alexander, 2004). In recent years, three large outbreaks occurred in commercial poultry populations in Italy (1999), the Netherlands (2003) and Canada (2004) (Capua *et al.*, 2003; Power, 2005; Stegemen *et al.*, 2004).

The introduction of avian influenza (AI) is a continuing threat to the poultry sector in The Netherlands. In times of increased risk of introduction (e.g. because of (suspicion of) HPAI outbreaks in neighbouring countries and/or trade partners), decision makers face the question whether they should establish or increase the preventive measures. Determining the pathways by which HPAI can be introduced has critical implication for preventing introduction of the virus (Webby and Webster, 2003). If the risk of HPAI introduction for a country is highest through the movement of migratory birds, surveillance at migratory stopovers and eliminating contact between wild birds and commercial poultry could reduce the chance of introduction. Alternatively, if the risk of HPAI introduction is higher via the import of poultry (products), monitoring and/or eliminating imports from high-risk countries should be given a high priority for reducing the probability of introduction (Kilpatrick *et al.*, 2006).

In crisis situations, a qualitative aid and decision support tool in the form of a PathWayDiagram would therefore be helpful in showing the theoretically possible pathways leading to the adverse event 'introduction of HPAI in the domestic commercial poultry population'. Furthermore, the PathWayDiagram could be helpful in inventorizing pathways-countries-combinations, and in the qualitative assessment of risk and / or ranking of the pathways. As in a paper of De Vos *et al.* (2003) where a similar tree-like approach for Classical Swine Fever introduction in The Netherlands was developed, a PathWayDiagram for the introduction of HPAI in The Netherlands was developed including the procedure for using this diagram. Based on published scientific literature, an effort was made to describe and consolidate knowledge of (1) all theoretically possible pathways leading to the event 'introduction of HPAI in the domestic commercial poultry population', and (2) possible preventive measures in The Netherlands.

### **Description of the PathWayDiagram**

In Figure 1, a general set-up of the PathWayDiagram is presented. The diagram consists of different layers. The first level shows the direct pathways for exogenous virus introduction into a region (virus outside the region), and the second level shows the direct escape pathways for endogenous viruses (virus inside the region). The third level shows the presence of virus in the four sub-populations (1) domestic migratory birds, (2) non-commercial poultry and birds other than poultry, (3) humans and (4)

mammals, whereas the fourth level shows the adverse event, an outbreak in domestic commercial poultry. The events leading to a primary outbreak of HPAI in domestic commercial poultry, as shown in the PathWayDiagram, are all conditional, i.e. the occurrence of an outbreak of HPAI depends on the occurrence of all the previous events. As shown in the detailed elaboration of the PathWayDiagram (Figure 2), for instance virus introduction by the pathway ‘legal import of live poultry’ will only occur (1) if live poultry is imported from an HPAI-affected region, (2) if the poultry is infected and/or contaminated with the virus, (3) if the poultry is screened insufficiently at the border inspection post or if the affected poultry shows no clinical signs, (4) if the poultry have a destination for live instead of a destination for slaughter, and (5) if the poultry is added to susceptible domestic commercial poultry. With respect to this last step, in case of e.g. contaminated livestock trucks, the virus dose conveyed should be at least the minimum infective dose.

### **Procedure for use**

A structured way to take short term decisions in times of a possibly increased risk on the introduction of HPAI is given by a flow-chart of the procedure for using the PathWayDiagram (Figure 3). The procedure can be split up into three phases. The first phase, developments preceding a crisis meeting, consists monitoring the HPAI-situation outside The Netherlands, and collecting up-to-date information. The second phase, crisis meeting, consists of an inventory of countries-pathways-combinations, a qualitative assessment of risk and / or ranking the direct and indirect pathways, identification and selection of preventive measures with respect to direct and indirect pathways, and composing a set of preventive measures based on the previous steps. After deciding on the set of preventive measures, phase three, the implementation of preventive measures can start. In case of a new situation (e.g. change in risk, and additional relevant information), it may be necessary to repeat phase two. The PathWayDiagram and the procedure were tested in a workshop in which a crisis meeting was simulated with AI experts from the Dutch Ministry of Agriculture, Nature and Food Quality (MinLNV) and the Food and Consumer Product Safety Authority (VWA). The PathWayDiagram and the procedure for using the diagram showed to be useful tools in times of (perceived) increased risk of introduction of HPAI.

### **Conclusion**

Use of the PathWayDiagram and applying the described procedure results in a systematic checklist focused on (1) possibilities of (increased risk of) introduction and (2) possible preventive measures, resulting in a coherent and well-harmonized set of preventive measures covering the pathways involved. The PathWayDiagram and the procedure were experienced as useful qualitative aids and decision tools to support decision making in crisis situations.

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