



Addressing avian influenza A(H7N9)

Risk management along the food chain



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INTRODUCTION

This document describes options for mitigating human exposure to the avian influenza A(H7N9) virus via birds and their by-products, and options for mitigating the spread of H7N9 in birds. It applies both to countries where H7N9 exists and to those that have not yet identified the virus. It should be read in conjunction with FAO's current H7N9 risk assessment and surveillance guidelines and will be updated as the situation evolves and new data become available.

All countries are advised to review existing contingency and control plans (FAO, 2009; 2011) to ensure that they take into account the emergence of avian influenza A(H7N9). The options suggested in this document should be considered when developing or revising local, national and regional contingency plans for managing avian influenza viruses. They should be adapted

to take into account country-specific factors and local contexts, along with social and economic factors that may influence the efficacy and sustainability of proposed interventions.

Prior to implementing selected control measures, the competent authorities need to consider and mitigate the potential impacts of these measures on target populations, particularly the people who rely on poultry for their livelihoods. Ultimately, as discussed throughout this document, controlling the spread and impact of avian influenza A(H7N9) in birds, and limiting human exposure and infection will require both short-term measures and long-term engagement among the competent authorities and people involved in the production, transport, marketing and purchase of live poultry and other birds.

The document is organized into six sections and a conclusion. The first section discusses general considerations for interventions and describes the important role of measures in live bird markets (LBMs). The second section looks at specific control and prevention measures for LBMs. Section 3 outlines control and prevention measures in poultry farms. Section 4 briefly addresses control in wild birds. Section 5 examines the promotion of general awareness among the public, consumers and people involved in poultry production and marketing. The sixth section discusses the long-term agenda for addressing risk behaviour at the animal-human interface. The conclusion stresses that while there is an immediate need to respond, all stakeholders should also prepare for long-term engagement.

This document is not prescriptive, but should be considered as a guide to possible risk management options, their objectives, expected outcomes and limitations. Although many of the interventions may be the same as those for H5N1 highly

pathogenic avian influenza (HPAI), the following options highlight specific risk management measures for the avian influenza A(H7N9) virus along poultry production and market chains, from farms, to purchasers and consumers.

1. GENERAL CONSIDERATIONS AND FOCUSED CONTROL MEASURES

The options proposed in this document should not be considered in isolation but as part of a comprehensive and integrated management approach encompassing interventions at critical points along the poultry market chain. It is important that these options are regularly evaluated and adjusted as the situation evolves, to include evidence from updated risk assessments, epidemiological data and social and economic analysis.

Appropriate interventions may include conventional veterinary control measures for avian influenza, such as stamping out, movement controls, cleaning and disinfection, as well as measures including vaccination campaigns and public awareness campaigns that focus on those working with or purchasing poultry. Long-term engagement with these key stakeholders is necessary for effecting and sustaining behaviour change. Current risk assessments suggest that the competent authorities should first focus their control and prevention measures on LBMs, and should then extend these measures back along the chain to cover transport, farms and other sites where birds are raised and sold.

LBMs have been identified as the source of human infection with influenza A viruses of the H5N1, H9N2 and H7N9 subtypes. Although the reassortment of genes that formed the current H7N9 virus may have occurred in an LBM, the presence of virus in multiple markets is most likely the result of the virus cycling among poultry farms or trading yards and LBMs.

Market restructuring and improved market hygiene and control of the poultry supply should be considered as part of long-term programming, drawing from past approaches – including the Healthy Cities Project (World Health Organization [WHO]) and the *Public-Private Partnership in Poultry Markets project* (FAO, 2012) – and existing research (Samaan *et al.*, 2012). The primary objective of these interventions is to mitigate public health risks and halt the spread of avian influenza infection upstream to other farms, downstream to other birds marketed along the food chain, and to humans.

Programmes for containing the spread and impact of avian influenza viruses in LBMs have been implemented widely, with mixed results. In Hong Kong SAR of China, for example, temporary market closure and culling were followed by the cessation of human cases of influenza A(H5N1) in 1997; subsequent measures – including improved market hygiene, species segregation, strict control of the sources and movement of poultry, market rest days, vaccination, and restrictions on poultry movement – were all required to prevent H5N1 virus from re-establishing itself in poultry and LBMs. Application of the control measures outlined in *A guide to healthy food markets* (WHO, 2006), in two markets in Indonesia, demonstrated that many of the recommended interventions can be implemented quickly and cost-effectively in low-resource settings (Samaan *et al.*, 2012). However, it proved difficult to change the behaviours of poultry traders in the two Indonesian markets. Despite the many education sessions held with poultry traders, most of them chose not to wear personal protective equipment (PPE) after the intervention. Long-term engagement is necessary to ensure systemic behaviour change. Social and economic factors, as well as considerations regarding the biology of the virus, should therefore guide the development of interventions in LBMs to ensure effective and sustainable results.

The following measures have been effective in reducing the spread and impact of H5N1 viruses and should be largely applicable to the current outbreak of avian influenza A(H7N9). These measures are introduced and discussed with reference to practical considerations that should inform the authorities in charge of implementing interventions.

2. POULTRY MARKET CHAINS, INCLUDING LIVE BIRD MARKETS

2.1 Market closure

Temporary closure of markets

When there is evidence that a particular poultry market poses risk to human health (e.g., there is a link to human cases or an infected farm, or the virus is detected in poultry or environmental samples at the market), the competent authorities may choose to close the market temporarily as an immediate measure to halt virus spread in poultry and prevent human exposure to the virus. Temporary



market closure should be a short-term measure to allow market depopulation, cleaning and disinfection, and – if applicable – restructuring.

It is important to note that when markets are closed (temporarily or permanently), poultry trade in the local community does not necessarily stop, although trade may be depressed in the face of an outbreak (Fournie *et al.*, 2013). Rather, market closure may disperse poultry traders, resulting in the slaughter and sale of live birds at unregulated sites and making it difficult to control and monitor virus spread and risk. When a market is temporarily closed, alternative, hygienic facilities should be offered to poultry traders, to prevent the development of informal, unregulated trade, slaughter and processing. When alternative venues are not available, financial support for poultry traders should be considered as a way of preventing illegal trade and supporting livelihoods. Temporary closure of markets is best implemented when it is planned in consultation with stakeholders, prior to outbreaks that might lead to the temporary closure of markets.

Any necessary structural modifications should be implemented during market closure. To reduce the risk of disease re-emergence when the market is reopened, the competent authorities should implement and support sustainable and proven control measures, such as routine cleaning and disinfection and the establishment of poultry-free rest days. Throughout this process, consultations with poultry traders will promote transparency, build trust among key stakeholders, and facilitate more sustainable, long-term programming.

Permanent closure of markets

Before closing an LBM permanently, it is necessary to give careful consideration to the costs and benefits of this control measure. As discussed in the previous subsection, market closure can have negative impacts on the individuals and communities who rely on poultry for their livelihoods, and can shift poultry trade into unregulated environments, increasing the likelihood of virus spread and human exposure.

Permanent closure of an LBM is not necessary if the market can be managed appropriately with strict control of the sources of birds. Permanent closure should be considered only when alternative, hygienic venues for trade are available, such as poultry slaughterhouses. Before deciding to close an LBM permanently, the competent authorities should consider the impact on livelihoods and, when possible, should provide support in finding alternative employment for people no longer able to continue their trade.

In some countries, the authorities have already permanently closed live poultry markets in major urban centres, and traders rely on sales of centrally slaughtered poultry. In these cases, informal routes for poultry trade should be monitored for disease emergence and dissemination, and rules on live poultry trading properly enforced.

Decisions on permanent closure may not apply in the context of rapid response to avian influenza A(H7N9) events, but may be considered as part of a long-term programme to restructure poultry market chains, moving away from LBMs to more industrial marketing systems. Such significant restructuring requires coordination and compliance among many stakeholders, as well as regulatory frameworks, and it should be recognized that such action might not halt trade in live birds.

2.2 Strict controls on the sources and movement of poultry

If the source of poultry is known and controlled, and if measures are applied upstream from the market to ensure that poultry are not, or are unlikely to be, infected – or are properly vaccinated



against the agent in question (see section 3.1) – the risk of infection in markets can be decreased. When vaccination is used, appropriate post-vaccination monitoring should be implemented (including the provision of reliable and timely test results by laboratories), along with reliable certification and enforcement of transport controls. These control measures are necessary to achieve the desired effect, but they may be difficult to enforce.

Birds sold in LBMs often come from multiple farms and breeders, and are not always transported in cages on trucks. Poultry trade at LBMs should be viewed as a dynamic network connected to and supplied by multiple sources, including individuals selling a few birds at a time to meet their basic needs; traders collecting poultry from diverse sources in communities adjacent to the market; and large commercial farms. Some LBMs act as trade hubs, with the birds sold moving on to other communities and markets. Such markets pose a very high risk for the introduction and persistence of avian influenza viruses.

In the trading environment, it can be difficult to determine the source of birds and to control their movement. Greater effort should be made to understand the incentives that motivate actors in this complex trade network.

2.3 Market rest days and bans on keeping poultry overnight in markets

If implemented thoroughly, scheduled rest days – when all poultry are sold or slaughtered the previous evening, and all stalls are emptied and thoroughly cleaned and disinfected – can temporarily eliminate avian influenza viruses and other pathogens. Past implementation of such measures includes establishing one or two rest days per month or an outright ban on keeping poultry in LBMs overnight. Care has to be taken to ensure that birds are not moved to other locations and sold through parallel marketing chains. Appropriate dates for market rest days need to be determined and coordinated with poultry traders so they can make the necessary arrangements to sell birds prior to rest days and restock promptly when the market is reopened. Such planning will help to avoid the emergence of parallel markets by ensuring that traders do not end up with excess stock.

Bans on keeping birds overnight in LBMs can reduce the risk of virus spread, but it is important to ensure that birds are not simply removed in the evening and returned to the market

the following morning; properly enforced bans require traders to slaughter unsold birds at the end of each day. Such bans are therefore not generally attractive to poultry traders, because they alter the manner in which many markets have operated for many years, and may increase the cost of doing business. For example, when sellers are not permitted to remove their unsold stock at the end of each day, they have to slaughter it, forcing them to sell poultry at below the market value of live birds. Parallel markets and unregulated movement of poultry are highly likely if this control measure is not rigorously enforced.

2.4 Species segregation or bans on the sale of certain bird species

Transporting, caging and selling domestic waterfowl together with or close to terrestrial poultry can facilitate disease spill-over and viral reassortment. LBMs should therefore have separate areas allowing segregation by species or supply source, or should sell only certain species of bird. If the competent authorities opt to ban certain species from LBMs, measures must be in place to avoid the parallel marketing of these birds.

The success of this control measure depends in part on the preferences for particular birds or bird by-products of local cultures and communities. These preferences may reflect seasonal or cultural celebrations, or dietary preferences. Knowledge of such issues can help determine the feasibility of control measures and limit the informal marketing of birds.

Enforcing species segregation may require additional market infrastructure, such as cages or holding areas, and changes in transportation practices. The cost of compliance may be prohibitive for poultry traders and should be covered by external sources.

2.5 Barriers between people and live poultry and slaughter areas

To avoid human exposure to avian influenza viruses and other pathogens it is recommended that physical barriers be used to separate customers from poultry cages, slaughtering and de-feathering areas, and bird carcasses ready for sale. Transparent barriers can be installed, creating physical separation while allowing customers to choose their poultry and follow the subsequent slaughtering process. Physical separation may not be

possible in small retail markets because of space constraints.

Physical separation may also be difficult to impose when customers want to touch birds before they buy them. The touching of birds is often a normal part of determining the value and (apparent) health of the bird. Altering such behaviour will require long-term engagement to understand the social and economic incentives that drive it. If barriers are used they should be introduced uniformly in all markets to ensure that poultry traders do not lose customers to markets where there are no barriers.

2.6 Regular cleaning and disinfection of markets and disposal of by-products

Regular cleaning of markets and surrounding areas – including the surfaces and cages used to prepare and display poultry, cutting boards and knives – helps to reduce the overall pathogen load in LBMs, thus reducing the risk of human exposure to avian influenza viruses and other zoonotic pathogens. Cleaners should be provided with appropriate cleaning materials and disinfectant to ensure that there are no economic barriers to proper disinfection.

By-products such as feathers and manure should be disposed of in secure, designated areas, to reduce the overall pathogen load in LBMs. This task should be designated to trained cleaners wearing PPE, to ensure that all by-products are contained and separated from contact with humans and animals. As many markets do not have a designated area for by-products, the competent authorities should facilitate the development of such infrastructure, working with existing cleaning personnel.

2.7 Proper drainage

Proper drainage facilities will help customers to avoid contact with poultry faeces and bodily fluids and wastewater, thus reducing human exposure to infectious pathogens. Avian influenza viruses can be spread via contaminated shoes and clothing. Proper drainage in LBMs will prevent the pooling of wastewater, thereby hindering virus spread.

2.8 Poultry transport and cage washing facilities

Thorough cleaning of poultry transport and cages reduces the reinfection of farms with avian influenza viruses that are circulating in LBMs, and virus spread among farms. Disinfectant and high-



pressure washers should be provided at the market's exit, for cleaning transport cages and vehicles after poultry stocks are delivered to the market and before the vehicles return to their places of origin. A certification system for vehicle and cage cleaning should be put in place. A similar process should be utilized for cleaning the crates and trays used to transport eggs.

This intervention is cost-intensive as it requires specialized equipment, washing facilities and a designated area at the market exit that can accommodate large transport vehicles; it is thus best suited to wholesale markets, which usually have more space. It can be implemented through cost-sharing arrangements, as in China through FAO's Public-Private Partnership in Poultry Markets project (FAO, 2012), where it was found to bolster cooperation among stakeholder groups. In this project user fees are collected from market vendors, but in some contexts such a cost may limit usage of the washing facility. The competent authorities should consider bearing the cost of implementing this intervention, to ensure adherence and sustainability.

Market management should ensure that registers of the origins of birds are available for inspection by the competent authorities.

2.9 Hygienic slaughtering, de-feathering and processing

Good-hygiene practices during the slaughter, de-feathering and processing of poultry are essential to prevent occupational exposure to zoonotic pathogens and avert disease spread in the market environment. Such practices include the use of PPE, frequent hand washing, and the use of hot water in the de-feathering process.

All personnel in direct contact with poultry, including those who deliver birds to markets, should use PPE, including masks, gloves, goggles, disposable plastic aprons and appropriate footwear, such as rubber boots. Given the propensity of other H7 viruses to infect conjunctival cells, goggles or face shields are highly recommended. Although PPE reduces exposure to viruses, poultry traders and transporters rarely use it. In some contexts, the use of PPE can lead to stigmatization of sellers, promoting a perception that they or their products are diseased or unhygienic. Some sellers find that PPE slows them down, or is too hot, uncomfortable or expensive – all of which are legitimate concerns. The competent authorities should discuss the barriers preventing PPE use with people working at the animal–human interface, to determine the equipment that creates problems and consider appropriate alternatives: for example, face shields do not fog as rapidly as goggles. When introduced, PPE should be worn by all the sellers at the market to avoid stigmatization, and should be provided free of charge to promote usage.

Frequent hand washing should be practised by all the people in direct contact with poultry, including the customers of LBMs. The competent authorities should ensure that markets have hygienic hand-washing facilities that are physically separated from the areas where birds are kept, slaughtered or sold. Care should be taken to ensure that these facilities do not amplify virus spread, as avian influenza viruses can survive in stagnant water for several days. Proper drainage is required. The barriers to hand washing should be explored with people working in the markets. The importance of hand washing should be communicated clearly, along with advice on hand-washing techniques.

During de-feathering, birds are often immersed in hot water to loosen their feathers. The water used in this scalding process should be boiling, to reduce the likelihood of feathers being contaminated with virus shed in faeces or bodily fluids released during slaughter. The water should be changed at least daily and disposed of in an appropriate drainage system.



2.10 Regular market testing to detect the presence of viruses

In addition to providing early warning of the potential build up or occurrence of a potentially zoonotic virus, systematic testing for the presence of avian influenza viruses in markets is also a means of verifying the effectiveness of the biosecurity measures and other controls implemented. The competent authorities and market operators should collect sufficient samples to provide a reasonable chance of detecting the presence of viruses. Pools of swabs can be used. Other testing measures, including microbiological indicators, may be used to assess the efficacy of hygiene measures, cleaning and disinfection.

These tests should be done regularly to allow comparison of results over time and to capture the rapid turnover of stock in LBMs. The process should be transparent and discussed with all the people working in the market. Individuals with infected birds or virus in their environments should not be singled out; if there is virus at one location it is highly likely that the wider environment is contaminated. This consideration will both facilitate routine testing and make sure that individual sellers are not stigmatized.

2.11 Batch processing

Poultry should be processed in batches to avoid having birds from different sources in close proximity to each other. This measure limits virus spread among birds and should be promoted by the competent authorities. Market personnel should be informed that batch processing is the preferred method for slaughtering, so they can make appropriate preparations with their suppliers. However, it should be recognized that batch processing is not the preferred strategy for most traders, who often buy stock from more than one source.

2.12 Education and awareness

Practical and clear messages regarding food preparation and hygiene should be widely disseminated among customers and market workers via public media, such as newspapers, television and radio. Messages could include "Cooked meat is safe", "Do not consume sick or dead poultry" and "Wash your hands with soap and water after touching live or raw birds or eggs and before touching the face, or items that are brought close to the face". It is essential to publicize the known risks and preventive measures,

to reduce unnecessary product avoidance, which can have major negative impacts on people who rely on poultry for their livelihoods.

It is essential to involve the people who work with or buy live birds in the development of avian influenza control programmes, to ensure that any intervention is acceptable and sustainable. Programmes for promoting healthy behaviour among these populations often take the form of education and awareness campaigns, based on knowledge, attitudes and perceptions (KAP) studies, which identify what people at the animal–human interface do not know about avian influenza. These gaps in people’s knowledge provide an important indication of where to focus attention, but greater efforts should also be directed to identifying what people do know about the diseases that affect their birds (Nichter, 2008). This process helps identify barriers to behaviour change and makes it possible to build on existing knowledge and strengths, but it requires long-term engagement and in-depth research.

2.13 Market restructuring/rehabilitation

Market restructuring is a costly intervention and should be part of a medium- to long-term policy guided by the recommendations in this document and in WHO’s *Guide to healthy food markets* (WHO, 2006). It may be implemented in parallel to interventions for promoting market workers’ awareness of zoonotic disease risk. Market restructuring should be coordinated among all appropriate stakeholders, including local, provincial or state authorities, the central government and all the people working in the poultry trade.

Experience from two markets in Indonesia illustrates that it is important to plan the market restructuring process with inputs from those working in the market (Samaan *et al.*, 2012). It is also important to note that even when markets have been restructured and market workers have been informed about disease risk, sustained behaviour change does not always follow. Communication of risks needs to be carefully planned when restructuring markets.

2.14 Consider alternatives to live bird markets

Alternative marketing chains for poultry should be considered as a long-term intervention. Dialogue among all stakeholders will assist

this process. People working in the poultry trade must be informed throughout this process, so that their livelihoods are not negatively affected. Consumer preferences should be taken into account. It is important to communicate that well managed, hygienic LBMs can provide poultry to consumers safely and with extremely low risk of disease exposure.

3. CONTROL OF AVIAN INFLUENZA A(H7N9) AT THE FARM LEVEL

3.1. Vaccination

- a. None of the vaccines currently available have been tested against avian influenza A(H7N9) in poultry (vaccines for other H7 viruses have been used or are being used in countries that include Mexico, Italy and Pakistan, and may provide cross-protection). It is recommended that China produce vaccines for preparedness. A bivalent product (H5N1/H7N9) could be envisaged.
- b. If the prevalence of H7N9 in poultry is found to be high and widespread, and the virus in poultry cannot be controlled by stamping out and market closures or restructuring, the vaccination of targeted poultry populations/species should be considered, to increase flock resistance to infection, reduce potential virus shedding and, consequently, diminish human exposure to the virus. If this option is implemented, it should be supported by sound epidemiologic information to guide the targeting of types of poultry for vaccination and the specific production and market chains where vaccination is likely to offer the best protection to the public.
- c. The immediate goal of poultry vaccination is to increase immunity and reduce virus shedding, with the aim of reducing the threat to human health.
- d. In general, when a suitable vaccine is available, application of the Differentiating Infected from Vaccinated Animals (DIVA) approach is recommended to assist the shift to an eradication campaign and the monitoring of infection in vaccinated poultry. (However, as the initial objective of vaccination is to reduce the risk to human health, an appropriate vaccine that does not allow for a DIVA approach could be used during the first



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phase, to dampen down the infection in poultry.) Once the initial goal of vaccination has been achieved (reducing the risk for human health), an exit strategy should be established, stipulating when and how to stop vaccination. If infection is endemic and widespread, it may be some time before vaccination can be stopped. Although low pathogenic avian influenza (LPAI) is generally regarded as an eradicable disease, LPAI H7 viruses have remained endemic in poultry in some countries, such as Mexico.

- e. In China, the H5N1 vaccination of most poultry is compulsory, and proof of vaccination is required for poultry movements from farms to LBMs.¹ This approach could also be used for vaccination against H7N9.
- f. At present, avian influenza A(H7N9) is asymptomatic in birds, so people would have no clear incentive for vaccinating their flocks. If an effective poultry vaccine is developed, it should be subsidized, as the objective is to reduce human exposure and there are no direct benefits to animal health for poultry farmers.
- g. Pre-emptive vaccination against H7N9 is not recommended, unless there is high risk of introduction and the use of vaccine is strictly controlled. Lessons from past programmes should guide vaccination policies. Some countries may be more prepared for vaccination, as they have experience of H5N1 vaccination programmes (Indonesia and Viet Nam); other countries do not have experience of mass poultry vaccination for avian influenza H5N1 (Cambodia, Lao People's Democratic Republic and Thailand). Experiences should be shared among countries.
- h. It should be noted that even the most effective vaccine will fail if people who raise poultry withhold or hide their birds from vaccinators. Some communities have resisted mass vaccination campaigns against avian influenza because the vaccinators were perceived to be infecting birds with the disease rather than protecting them. Building the public's trust in vaccination campaigns takes time and should be

prioritized by the authorities implementing a poultry vaccination programme. In all vaccination campaigns, there is a trade-off between ideal coverage and actual coverage. In an emergency, vaccines may have to be deployed quickly, reducing the time for ensuring full support for the programme. In these cases, it is essential that the benefits of vaccine be highlighted through transparent means, taking into consideration the importance of maintaining public trust, which may have an impact on future interventions.

3.2 Stamping out (humane culling)

In the past, stamping out was the main method for controlling outbreaks of HPAI and was also sometimes used for LPAI strains. The objective of stamping out for H7N9 virus control is to prevent infected poultry from infecting humans and other poultry. If stamping out is used it should be part of a package including tracing back to find the source of infection, strict controls on animal movement in the places to be depopulated, and compensation for people who lose their birds. Humane culling techniques should be applied.

Stamping out appears to be the method of choice for controlling zoonotic diseases when flocks are known to be shedding virus, especially when a suitable vaccine that minimizes virus transmission is not available. Given the risk that avian influenza A(H7N9) currently poses to human populations, stamping out may be considered an appropriate, short-term intervention, with compensation.

When the competent authorities implement stamping out, compensation at market value should be provided promptly to all the people who lose birds. Adequate compensation ensures that the livelihoods of people who raise poultry are less severely interrupted, limits the marketing of birds through informal channels, and helps to build trust between at-risk communities and the authorities.

The efficacy of future control programmes against avian influenza (and other diseases) may hinge on whether the communities targeted by control measures are willing participants. Efforts to understand the social and economic incentives that encourage these populations to participate in disease interventions

¹ This situation applies to foot-and-mouth disease (FMD), for which a progressive pathway has been developed to guide countries on their way to disease freedom. The pathway includes progressive stages during which countries that use vaccination routinely as a control tool can move towards disease freedom without vaccination.



should be prioritized. As the necessary studies are ideally undertaken prior to an outbreak, they should begin now, because current interventions will have an impact on the programming of future interventions and accompanying measures.

The competent authorities should consider the following points before culling poultry:

- a. Stamping out will not result in virus eradication unless a very high percentage of infected premises are found, isolated and depopulated of poultry. This requires very well developed surveillance and testing systems, strong veterinary services capable of managing a complex disease eradication programme, and rigorous enforcement of movement controls.
- b. If only a small percentage of flocks in an area are tested, the flocks that are found to be positive probably represent only a small percentage of the total number of flocks that are shedding virus. If these few flocks are culled, the benefits for disease control and protection of public health are very limited.
- c. Stamping out is labour-intensive and creates public health risks for slaughtering crews, as occurred in the Netherlands with H7N7 viruses in 2003. In terms of the number of people exposed to the virus, there may be greater public health risks from culling birds than from letting the infection run its course. However, in this case, strict movement controls from infected premises, and use of appropriate PPE must be ensured.
- d. Stamping out creates a large amount of waste (carcasses and litter), which has to be handled and disposed of correctly to avoid disease spread and environmental contamination. Procedures that minimize the generation of dust and debris from the affected flock should also be applied, to reduce the risk of virus spread. Contingency plans must include appropriate measures for handling waste, based on local conditions and facilities.
- e. Announcing plans for stamping out can lead to illegal movement of birds in the areas where culling is imminent. This movement can facilitate virus spread. To reduce this practice, the competent authorities should ensure that affected communities know that they will receive adequate compensation.
- f. Given the increased potential for human exposure in LBMs, humane culling should be considered inevitable if LBMs test positive for H7N9. These culling activities must be linked to adequate compensation schemes and thorough cleaning and disinfection of the market place and stalls.
- g. If H7N9 in poultry is found to be widespread or endemic, stamping out is unlikely to be a viable control option and other methods should be explored, such as those used for the control of LPAI viruses in the past in some countries (Halvorson 2009). These options include strict bans on movement on and off farms known to be infected, followed by controlled slaughter off-site once there is no evidence of viral shedding. In some situations, vaccination has also been used on quarantined farms as an additional measure to reduce virus shedding and increase resistance to infection.
- h. Culling should be envisaged only for flocks that are found to be virus positive through polymerase chain reaction (PCR) techniques, and should not be based on positive serological results alone.
- i. Prior to implementing a stamping out programme, the competent authorities should ensure that at-risk communities know that they will receive prompt compensation for their destroyed birds.

3.3 Biosecurity measures

Farms should apply the same biosecurity measures as for HPAI prevention. The importance of these measures needs to be emphasized to at-risk communities, taking into account the different production systems and wider social and economic costs involved. Biosecurity programmes must emphasize that to halt the spread of H7N9 virus to and from farms, and to limit human exposure, the comprehensive control measures outlined in this document should be applied. As avian influenza A(H7N9) has the potential to be transmitted to, and possibly among, mammals, biosecurity messages should also involve pig producers, where applicable.



3.4 Movement and transport controls

The competent authorities should prioritize controls on bird movement from commercial poultry farms in infected areas. When birds are moved from these farms, vehicles and cages should be washed and disinfected, as discussed in Section 2.8. Transport personnel should disinfect their footwear and use PPE to avoid virus spread and exposure. Strict movement controls should be backed by a certification system, which should be used as a catalyst to improve the enforcement of border controls.

Strict movement controls backed by certification should also be applied to all consignments of poultry moving out of border provinces and between countries. Trade in poultry and poultry products across borders should be conducted in line with the World Organisation for Animal Health (OIE) Terrestrial Animal Health Code guidelines.² In places where unsanctioned movement of live poultry across borders has been known to occur, concerted efforts should be made to enforce existing laws. Any consignments without appropriate certification should be destroyed. All intercepted consignments should be tested serologically and for virus shedding to determine the magnitude of the threat posed by the movement of poultry.

4. WILD BIRDS

Even if H7N9 virus is found in wild birds no actions should be taken to disturb these birds or their habitat. Decoys and other measures can be used to prevent the roosting of certain bird species. Bans on the feeding of wild birds in parks are recommended, to avoid the congregation of pigeons and other bird species. Trade in wild birds should be strictly controlled, with regular testing of these birds in markets and new consignments.

² <http://www.oie.int/international-standard-setting/terrestrial-code/access-online/>

5. PROMOTING GENERAL AWARENESS

As stated in section 2.12, practical messages on food preparation and hygiene should be widely disseminated via public media. It is essential to publicize known risks and preventive measures for reducing unnecessary product avoidance, as this can have negative ramifications for people who rely on poultry for their livelihoods. Given the potential for avian influenza A(H7N9) virus to be transmitted to, and possibly among, mammals, biosecurity messages should also be directed to pig producers, where applicable. Transparent communication between governments and the general public is essential for long-term programming.

While these recommendations guide responses to the current outbreak of avian influenza A(H7N9), new avian influenza viruses are certain to arise in the future. Ensuring public trust in official messaging will positively affect control measures, making interventions more likely to succeed.

6. RISK BEHAVIOURS

Zoonotic disease spill-over is often facilitated by human behaviour. Social and behavioural factors affect the basic reproductive rate of avian influenza viruses, among other pathogens (Janes *et al.*, 2012). Greater attention needs to be directed towards understanding the social and economic incentives that drive behaviours deemed to be epidemiologically risky. Such engagement should begin promptly, and long-term investment in understanding these behaviours is required. For example, studies may help to untangle why older men currently appear to be the most at-risk demographic for H7N9 infection (Arima *et al.*, 2013). Although the lessons derived from such studies may not be universally relevant, efforts should be made to extrapolate key lessons for informing policy.

During a public health emergency, there is need to ensure an appropriate balance between regulatory measures for controlling the biological risk and efforts to ensure stakeholder engagement. Failure to engage stakeholders may hinder efforts to control the disease.



CONCLUSION

This document outlines risk management methods for avian influenza A(H7N9) and is informed by current risk assessments. Many of the control measures it recommends need to be implemented promptly to limit human exposure and spread of the virus in birds. However, effective response requires a long-term vision that brings together the people implementing interventions and those targeted by the measures. Ensuring that the people who work and live with birds are not negatively affected by control and prevention measures assists in building public trust and ensuring the success of interventions. Lessons learned from influenza A(H5N1) should be applied, especially those that protect vulnerable producers and traders. One of the key lessons is that product avoidance and market closures have adverse effects on farmers and traders whenever a zoonotic avian influenza virus emerges. These affects cannot be avoided, but measures can be developed to support people who are severely affected by the disease and the control measures. Outbreaks of new zoonotic diseases, including avian influenza viruses, will continue to occur. The effective control of these novel pathogens will hinge, in part, on the response to avian influenza A(H7N9) today.

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