4. Preparing for an outbreak

Good preparedness planning can be of enormous benefit in successfully managing an outbreak and minimising its impact. This planning should involve a consideration of how best to rapidly detect an outbreak, confirm the diagnosis and implement a rapid and effective control programme. It requires an assessment of veterinary service capabilities and capacity and the legal framework in which these services operate. The structure of national poultry industries should be examined to determine the potential for entry of virus. Industry support should be sought in the planning process. Provision for good public awareness programmes should be made as it is critical to have public support for disease control activities and good public knowledge to minimise the risk of human infection

4.1 EARLY DETECTION

4.1.1 Wild bird surveillance

Where the risk is from migrating birds, it is essential to identify the migratory habits of different species, their origins, destinations and timing of migration. While disease in wild birds would not be expected, it is of value to alert wildlife personnel to report unusual deaths in wild birds. Active surveillance can be practised by catching wildfowl species and sampling (generally by taking cloacal swabs) to test for the presence of AI viruses.

4.1.2 Domestic poultry surveillance

The identification of poultry at risk should involve poultry flocks located in high-risk agro-ecological systems where migrating birds congregate as well as in high-risk farming systems and practices such as free-grazing ducks associated with rice production systems.

CREDIT: WILLIAM KARESH, WILDLIFE CONSERVATION SOCIETY

Team collecting samples along lake shore (Mongolia).

At times of particularly high perceived risk, such as the arrival of migrating birds, it might be considered useful to undertake active serological and virological surveillance of sentinel birds within flocks, especially domestic ducks which are most likely to be exposed. It is therefore advisable that countries perform risk assessment studies of the introduction of AI in order to define the most appropriate surveillance strategy.

In any event, each country will have particular priorities and surveillance systems which should be refined to reflect these priorities. For example, HPAI-free countries or those with a lower risk of becoming infected will seek access to detailed, updated information on risks and will focus on the detection of incursions — making early warning and surveillance their priority. For infected countries or those at high risk of infection introduction, surveillance priorities will include the collection of detailed, current information on human health risks, ecological zones and production systems representing the highest risk for introduction and maintenance of HPAI infection.

The FAO guidelines for HPAI surveillance are particularly relevant to countries exposed to the risk of HPAI introduction and should be read in conjunction with this document (see Annex 1).

The objectives of HPAI surveillance and monitoring include:

- To detect clinical disease and infection.
- To understand the epidemiology and ecology of AI, as well as its socioeconomic impact, to help to design effective and implementable control programmes for poultry production systems.

Minimum requirements for effective surveillance
(taken from *"FAO Guiding Principles for HPAI Surveillance"*)

The following minimum requirements apply to all countries and compartments:

- HPAI is a notifiable disease (i.e. there should be a legal requirement for suspected cases of disease to be reported to the official veterinary services).
- The official veterinary services must have a formal system for detecting and investigating outbreaks of disease and for reporting confirmed cases internationally, in accordance with OIE guidelines.
- The country and/or region must have the technical capability to diagnose HPNAI and LPNAI (see Annex 2).
- The country and/or region must have a system for recording, managing and analysing diagnostic and surveillance data.
- The country should participate in the regional surveillance and diagnostic network, including the public health sector, to enable sharing of information to characterize risk, prevent disease spread, and enhance control efforts.
- The frequency of surveillance could be a minimum of every six months within a country or could be less than this if selected 'pilot' areas are targeted for more frequent surveillance.

- To assess temporal and spatial patterns and thereby improve the effectiveness of control efforts.
- To understand the evolution in Asia of AI virus variants.
- To help define and control risks to public health.
- To monitor for antigenic drift in AI viruses through frequent analysis at competent laboratories.
- To maintain livelihoods and assist in ensuring food security through the implementation of appropriate control measures.
- To demonstrate freedom from clinical disease and absence of infection in a country or compartment and thereby facilitate trade.
- To assess the efficacy of vaccination when used as part of a comprehensive disease control programme.

In addition to formal surveillance and reporting procedures, raising awareness of the risk of avian influenza is an important means of increasing the likelihood that an outbreak of disease in poultry will be reported rapidly. However, it must also be kept in mind that such public awareness raising should not be undertaken in such a manner that it causes undue concern within the community. Also, veterinary disease control authorities will need to be prepared for an increased work load, since if formal and informal reporting mechanisms work, there will probably be a significant number of investigations that must be made following increased publicity of the risk of disease.

4.2 RAPID RESPONSE

4.2.1 Disease surveillance

Active surveillance should be initiated as soon as a country is considered at high risk of HPAI incursion. In cases of suspected disease, a sample of all domestic species of bird that die in the restricted area should be investigated and specimens submitted to approved laboratories for virus analysis and characterisation. Field surveillance examinations should seek to detect changes in flock health. Trained personnel should be aware of the potential risk to human health and wear protective gear (goggles or face shield, mask, gloves, and disposable gowns or coveralls, and rubber boots that can be disinfected before leaving the investigation site).

Surveillance needs to include:

- integrated commercial level poultry producers carrying out their own surveillance and timely reporting;
- local disease control centre officers carrying out regular telephone surveillance of independent premises; and
- targeted surveillance of premises in the restricted area and control area, particularly focusing on:
  - infected places, suspect places and dangerous contact places; and
  - premises with unusual sickness and/or mortality.

All reports of a decline in the health status of birds or egg production should be investigated and samples taken.

Although surveillance will begin immediately around the infected place or flock, it will have to be extended very quickly to all other sites where birds, products and contaminated materials might have been moved from the infected area. Surveillance of wild birds to determine their potential involvement in the dissemination of the disease may also be attempted, but this is likely to have a limited impact on controlling spread of the disease if biosecurity mechanisms in poultry farms are high.

4.2.2 Planning for avian influenza control

It is difficult to put in place a rapid and effective response to an outbreak of a new disease if the process has not been planned and the required resources made available. FAO has published guidelines in "*Manual on the preparation of national animal emergency preparedness plans*", which recommends the development of four sets of complementary technical contingency plans:

1. Specific disease contingency plans that document the strategies to be followed in order to detect, contain and eliminate the disease.
2. Standard operating procedures that may be common to several or all emergency disease campaigns.
3. Enterprise manuals that set out zoosanitary guidelines for enterprises that may be involved in and emergency animal disease outbreak.
4. Simple job description cards for all individual officers.

Each national veterinary authority needs to consider its particular needs and be careful not to embark on a programme of emergency manual development that is not sustainable with its resources. A critical element of emergency plans is that they must specifically consider the situation and needs of a particular country (e.g. structure of the poultry sector, organisation of veterinary services). In addition, the implementation of contingency plans through simulation exercises is key to defining gaps or overlap in responsibilities or resources during an outbreak.

The Australian veterinary contingency plan, AUSVETPLAN, is a set of such plans, including a Disease Strategy for Highly Pathogenic Avian Influenza. It can be downloaded from the internet (Annex 1). Some of the most important considerations for the contingency planning process are:

1. Consideration of the disease control strategies that are available, the implications of applying them and the most appropriate strategy in different circumstances in a particular country.
2. Financial planning to determine where the necessary funds will come from and ensure that there is a mechanism and commitment to provide them immediately. A particular issue that needs to be considered is whether adequate compensation will be provided to poultry owners whose birds are destroyed. In the current context of the global avian influenza threat, countries might consider negotiating commitments from international donors to assist in control, should a disease incursion occur.
3. Resource planning, which include the needs for personnel, equipment and other physical resources. Plans will indicate resource requirements at the time of an outbreak. However, they should also provide a means to determine requirements in

advance and either obtain them or make provision to obtain them rapidly when they are needed.

4. The need for appropriate legislation must be considered since this requires long-term planning in most administrative systems. Laws, regulations and proclamations are required to give authorised people the power to:
   - proclaim a notifiable disease
   - enter a poultry enterprise to inspect birds or collect specimens
   - define infected areas and disease control zones
   - institute quarantine of affected or suspect premises
   - place movement controls on poultry, poultry products and potentially contaminated materials
   - destroy and dispose of infected or potentially infected birds and contaminated materials
   - undertake other disease control operations, such as compulsory vaccination
   - place controls on the operation of enterprises, such as poultry processing plants.
5. Obtaining consensus and commitment from all regulatory authorities and industry, as appropriate.
6. Undertaking training of personnel so that the appropriate skills are available.
7. Conducting simulation exercises to identify deficiencies and undertaking periodical review of the contingency plan.

4.3 AVIAN INFLUENZA CONTROL STRATEGIES

The primary aim of an early and rapid response to any occurrence of HPAI is to contain the disease before it spreads and eliminate it by stamping out affected premises and establishing proper disposal. Only if this fails should other measures be considered, including vaccination using effective and quality controlled vaccines. This approach is endorsed by OIE, FAO and WHO. Where it proves impossible to eradicate the disease in the short- to medium-term, it may be possible to aim for compartment freedom (e.g., freedom within the commercial sector in which birds are housed and protected from infection), or zone freedom (freedom in defined geographic areas). In the case of compartmentalisation, the poultry industry must take responsibility for its biosecurity (bioexclusion) with the necessary veterinary regulatory oversight in place; and in the latter, commercial compliance must follow national restrictions to ensure infection does not enter the free zone, and regulators prove to be trading with partners of the zone's clean status at any given time.

There is no pre-described strategy to control avian influenza outbreaks. In order to effectively control the disease, countries should have a complete plan of action and the financial and humans resources to implement it under the particular conditions prevailing in the country. A regional approach is also necessary.

4.3.1 Culling

The basis of HPAI eradication by stamping out is to:

- immediately impose quarantine of the affected area (premises or village).
- slaughter all infected and potentially infected birds and dispose of the carcasses.

CREDIT: V. MARTIN

Restriction zone. Outbreak in Anhui province, China (July 2004)

- decontaminate sheds and other poultry housing areas.
- carry out rapid surveillance of surrounding areas to determine the extent of possible spread.
- close and disinfect markets.
- keep sick and dead birds out of the human food chain, and not sell for feed to other animals (i.e. zoos).

Quarantine and movement controls

AI is readily transmitted via contaminated objects, so strict control of movement of anything that may have become contaminated with virus and immediate imposition of tightly controlled quarantine on all places suspected of being infected are essential to a successful eradication programme. Ideally, quarantine should be imposed on all farms/villages on which infection is either known or suspected and should be strictly policed to ensure that no one, including the residents, owners, staff and other visitors, leaves without changing clothes and footwear.

Particular attention needs to be paid to workers on poultry farms who keep backyard poultry at home.

Strict on-farm biosecurity and hygiene is needed to control spread of the disease from wild birds. Access of wild birds to commercial poultry sheds and flocks should also be considered during depopulation operations. In areas where poultry are raised in a village environment, particular consideration needs to be given as to how effective quarantine disposal and decontamination can be imposed.

Effective quarantine of an area requires around-the-clock security to ensure that only authorised personnel in protective clothing are allowed to enter. It will be necessary to

supervise the movements of residents onto and off the property and to ensure that all pets are confined. It is also strongly recommended to ban cockfighting, pigeon racing and other avian concentrations in the outbreak area.

Slaughter of infected and potentially infected poultry

All susceptible poultry species in infected and dangerous contact premises, or in a large area if this is deemed necessary, must be slaughtered whether they are obviously diseased or apparently healthy.

Although it not possible to provide specific and universally applied standards for controlling the disease through zoning for all potential outbreak occurrences, the following definitions and distances should be considered as a guide to rapidly contain HPAI. It must be noted that distances are indicative and subject to changes according to epidemiological characteristics, physical and geographical barriers, poultry density and farming systems (more details are provided in Annex 5).

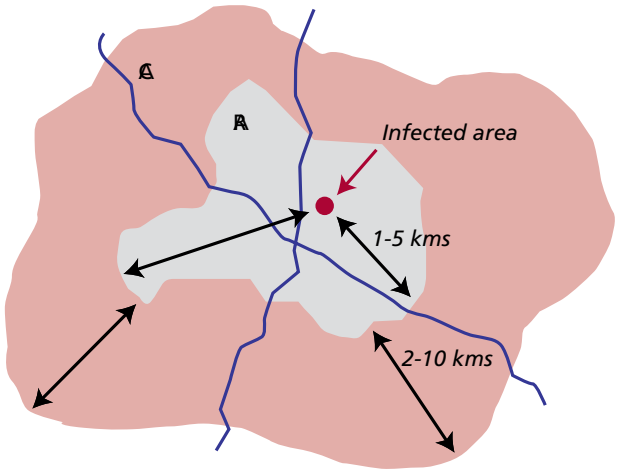
Infected area

An area classified as an infected area (IA) will be a defined area (village, farm) in which HPAI has been detected. Infected premises (IPs) will be subject to quarantine and all susceptible animals will be destroyed in this area.

Restricted area

A restricted area (RA) will be a relatively small declared area (compared to the control area - see below) around infected places which is subject to intense surveillance and movement controls. Movement out of the RA will, in general, be prohibited, while movement into the area would only be through regulatory approval. Multiple RAs may exist within one control area (CA). The RA does not need to be circular but can have an irregular perimeter depending on known physical and geographical barriers, markets, poultry density and

Zoning strategy for the control of avian influenza



farming systems. This distance will vary according to the size and nature of the potential source of virus, but will be approximately 1–5 km around the IP, depending on the density of poultry premises. The boundary could be the perimeter fence of the IP if the IP is in an isolated location. The boundary in a densely populated area will take into account the distribution of susceptible birds and traffic patterns to markets, service areas, abattoirs and areas that constitute natural barriers to movement. If possible hatcheries should be kept out of the RA.

Control area

The CA will be a larger declared geographical area around one or several RAs (possibly as large as a province initially) where restrictions will reduce the risk of disease spreading from the RAs. The boundary of the CA will be adjusted as confidence about the extent of the outbreak becomes clearer but must remain consistent with the OIE Code chapters on surveillance and zoning (Chapters 1.3.4 and 1.3.5; see Appendix 3). In general, surveillance and movement controls will be less intense and animals and products may be permitted to move under permit from the area.

The declaration of a CA also helps to control the spread of the outbreak from within the RA. The perimeter of the CA is a buffer zone between the RA and the rest of the country. The boundary does not have to be circular or parallel to that of the RA but should be 2–10 km from the boundary of the RA. In general, the movement of possibly contaminated articles and materials within the CA is allowed but movement out of the CA is prohibited without approval from the Chief Veterinary Officer. This type of control area allows reasonable and safe commercial activities to continue.

When declaring RAs and CAs, the areas must not be larger than necessary, thus restricting the number of properties to be quarantined to only those deemed prudent. If flocks in a quarantine area are not depopulated, then the cost of keeping the birds beyond their normal market age could be substantial.

Birds should be slaughtered by methods that take account of animal welfare concerns and the safety of operations, preferably without moving them from the site.

- For *small numbers of birds,* the preferred method is dislocation of the neck (using burdizzos, bone cutters, secateurs or bare hands). Burdizzos are particularly useful when large numbers of poultry with strong necks (geese, ducks, etc.) are to be destroyed.
- For *large numbers of birds* in commercial poultry units the preferred method is gassing with carbon dioxide. This method involves lining large garbage waste bins (skips) with plastic sheeting that also forms a canopy over the top of the bin. Birds can be caught using teams of labourers. Experienced catching teams may be available. Chicks are easily caught under heaters and are transferred to skips in plastic garbage bins. Broilers on the ground are driven, using a movable hessian wall, to the catching area where they are caught and placed directly into skips.
- *Caged birds* are more difficult and progress is slower. Each catcher removes 3 or 4 birds from cages and carries them by the legs to skips. Layers on perches are best caught at night or during low light when they are quiet.

  Carbon dioxide (CO_2) is transferred to the bottom of the skips through 2.5 cm gar-

CREDIT: V. MARTIN

Burial site in Ahnui Province, China (July 2004).

den hose fitted to the top of the cylinders. The carbon dioxide should be decanted in 30–45 second bursts. It is essential not to decant too quickly or the bottles will freeze when about half empty. The concentration of CO_2 must be in the range of 60-70 percent in the skip, with the lid tightly closed for a 1-2 minute period to properly stun and kill the birds. On average, half a 45 kg cylinder of carbon dioxide is needed for the three cubic metre skips and three or more cylinders for the 20 cubic metre skips. Carbon dioxide should be added at a sufficient rate to ensure birds succumb before other birds are placed on top of them. Skips should be three quarters (75 percent) filled with birds, sealed and transported to the disposal site. Care must be taken to ensure no bird is still alive when dropped into the burial pit. Should this happen birds must be immediately caught and humanely killed.

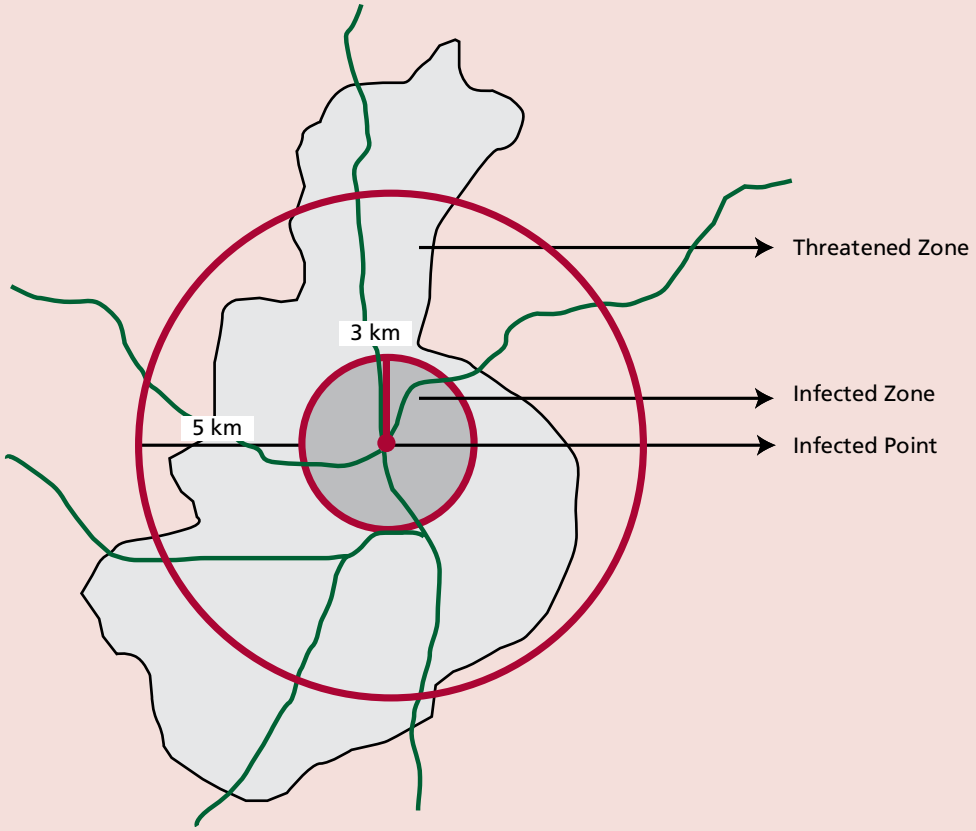
Safe disposal of carcasses

Disposal of dead birds, poultry litter and other contaminated waste is best done by burial. Sometimes this is not practicable or desirable because the required equipment is not available or it would have adverse environmental effects, such as potential contamination of ground water. In these circumstances, the best alternative might be composting.

Burial - Burial is best undertaken at the infected site. It is best to minimise the distance that infected material needs to be transported. A burial place outside infected premises may be the best option in situations where a number of infected foci would have to be depopulated and decontaminated in a given area and where a common burial site would be more efficient. The preferred equipment for digging burial pits is an excavator. This equipment is the most efficient available for the construction of long, deep, vertically sided pits. Other advantages include the ability to easily store topsoil separate to subsoil and the equipment can be used if required to fill the pit with carcasses or other materials and close the pit without disturbance of the carcasses. Loaders, bulldozers, road graders and backhoes (for

Example of zoning: the case of China

Premises with infected poultry or relevant slaughtering houses and other departments are considered as infected points; areas within the 3 km radium are considered as infected zones; areas within 5 km around the infected zones are considered as threatened zones.



Stamping out. All poultry within infected zones should be stamped out.

Emergency vaccination. All susceptible poultry in the threatened zones are vaccinated compulsorily with the vaccines approved by Ministry of Agriculture. Only healthy birds should receive vaccine.

Disposal. All poultry carcasses and poultry products in infected points, and excretion material, contaminated feed, litter and sewerage from the infected points shall be subject to bio-treatment or disposal.

Cleaning and disinfection. All contaminated items within the infected zones, transportation vehicles, utensils, poultry counters and ground must be cleaned and disinfected.

Movement control. Warning signs widely posted around the infected zone, disinfection stations set up in the transportation entrance of infected zones to disinfect vehicles and items entering and exiting zones; movement of all susceptible live birds and their products controlled.

Closing the market. All poultry and poultry product markets in infected zones and live birds markets within a 10 km radius of infected zones must be closed.
Tracing. If poultry and their products are sold out during the incubation and clinical manifestation period or moved out, tracing should be conducted on the suspect contaminated items to prevent these items from spreading disease.
Financial support. Financial support systems are established for all poultry destroyed because of HPAI.
Public health, surveillance of staff of poultry rearing, trade and transportation and processing units, especially of staff in the infected zones, should be intensified, and epidemiological investigation should be conducted. Stringent protective measures must be implemented by staff participating in the destruction of infected birds and cleaning of contaminated premises.
Lifing quarantine. The conditions for lifting a quarantine are stipulated as follows: 21 days for infected point and infected zone after strict treatment according to *"National Contingency Plan for Highly Pathogenic Avian Influenza"* and standard technical requirements for treatment of HPAI; over 14 days for the threatened zone where all the susceptible birds are vaccinated with nationally approved vaccines and after no new cases occur, it is inspected and the findings accepted by the relevant authorities. When quarantine is lifted, live bird trade markets 10 km around the infection zone may be reopened. The infected points are re-stocked 6 months after strict disposal.

small jobs) may be used if excavators are unavailable. With the exception of backhoes, all other equipment requires the continual movement of the machine over the site while digging the pit. Excavators and backhoes essentially remain in a fixed position while digging; hence they move soil faster, with less cost and less damage to the site surrounding the pit. Most excavators have an attachable hammer for rock work if necessary. The dimensions of the burial pit will depend on the equipment used, site considerations and the volume of material to be buried. The preferred dimensions are for pits to be as deep as practically possible (reach of machinery, soil type and water-table level being the usual constraints), with vertical sides.

Gas production from decomposition within unopened carcasses may result in considerable expansion in the volume of the buried material to the extent that the surface of the closed pit may rise and carcasses may be expelled from the pit. Lime may be added to pits to prevent earthworms bringing contaminated material to the surface after pit closure. Covering the carcasses with 40 cm of soil is suggested, and add an unbroken layer of slaked lime [$Ca(OH)_2$] before filling is completed. Lime should not be placed directly on carcasses because it slows, and may prevent, decomposition.

Inspection of the burial site after closure is recommended so that appropriate action can be taken in the event of seepage or other problems.

Composting – Biological decomposition, or composting, is an effective way of dealing with manure and litter waste and can be carried out within sheds or otherwise on site, thus

overcoming the risks of disseminating the virus during transport. Composting should be done in a secure area not accessible to susceptible birds. The procedure requires the piling of carcasses with other bulky contaminated or non-contaminated material, such as wood chips or straw bedding, to allow for proper aeration and covered with a biological filter (i.e. not whole plastic). The pile should not be pressed or otherwise compacted. The site selection is important – away from any residences, with at least 1 m of ground between the pile and any known water source, with any run-off water from the decomposing material collected and treated. Care must be taken to ensure that susceptible animals or pets (dogs) do not have access to the compost pile. Temperatures for proper composition should reach 55-60°C within 10 days and the material kept in place for several weeks; subsequently mix but never press the material within the pile. Properly decomposing material at this time should be dark in colour with minimal foul odour.

Burning/Incineration - A burning area outside an infected place may be the best option in situations where a number of infected foci would have to be depopulated and decontaminated and where a common burning site would be more practical. The principle is to place carcasses on top of sufficient combustible material, ensuring the arrangement of fuel and carcasses allows adequate air flow to enter the pyre from below, thus achieving the hottest fire and the most complete combustion in the shortest time.

When loading of the carcasses is complete and weather conditions suitable, saturate the fire-bed and carcasses with diesel or heating oil (NOT PETROL) and prepare ignition points about every 10 metres along the length of the fire-bed. These can be made of rags soaked in kerosene. Move all vehicles, personnel and other equipment well away from the fire-bed. Start the fire by walking into the wind and lighting the ignition points along the way. The fire must be attended at all times and re-fuelled as necessary; use a tractor with a front-mounted blade or a front-loader. Ensure any carcasses or parts thereof that fall off the fire are replaced on the fire. A well-constructed fire will burn all carcasses within 48 hours. The ashes should be buried and the site restored as well as possible.

Rendering - Rendering is a closed system for mechanical and thermal treatment of waste, and a good way for carcass disposal if the plant has sufficient capacity and if it is possible to effectively decontaminate the rendering plant afterwards. A medium-sized facility could render some 12 tonnes per hour of operation. However, private rendering plants may not be willing to handle infected birds and eggs unless an emergency order is imposed. A disadvantage is that infected material would need to be transported from infected sites to the plant.

Where burial, cremation or rendering are not considered practical or are difficult to carry out in the infected place, permission should be sought to transfer carcasses and/or infectious material to another site for disposal by burial, cremation or rendering. Transport should be in a leak-proof container, such as a large skip, covered with tough polyethylene covers and sealed at the top. It should not be overloaded – half a metre or more (depending on distance to be travelled and temperature) should be left clear for expansion of carcasses. Vehicles should travel slowly to avoid splashing of contaminated material and should be accompanied by a police vehicle to minimise the chances of accidents and to

TABLE 1
Selection and application of decontamination procedures

Item to be disinfected	Disinfectant/chemical/procedures
• Live birds	• Euthanase (carbon dioxide gas; dislocation of neck)
• Carcasses	• Bury or burn
• Animal housing/equipment	• 1, 2, 3 (See key below)
• Humans	• 1
• Electrical equipment	• 5
• Water	• Drain to pasture where possible
• Feed	• Bury
• Effluent, manure	• Bury or burn; 4, 3
• Human housing	• 1, 2
• Machinery, vehicles	• 1, 3
• Clothing	• 1, 2, 3

Key

1. Soaps and detergents: leave in contact for 10 minutes
2. Oxidising agents:
   a. sodium hypochlorite: liquid, dilute to final 2-3 percent available chlorine, not good for organic materials. 10-30 minute contact time.
   b. calcium hypochlorite: Solid or powder, dilute 2-3 percent available chlorine (20 g/litre powder, 30 g/litre solid), not good for organic materials. 10-30 minute contact time.
   c. Virkon®: 2 percent (20 g/litre). 10 minutes contact time.
   d. Virocid®: 0.25 percent (1:400). 10 minutes contact time on non porous surfaces.
3. Alkalis: (do not use with aluminium and similar alloys)
   - sodium hydroxide (NaOH): 2 percent (20 g/litre). 10 minute contact time.
   - sodium carbonate anhydrous (Na2CO3 .10H20): 4 percent (40 g/litre from powder, 100g/litre from crystals), recommended for use in presence of organic materials as above. 10-30 minute contact time.
4. Acids:
   - hydrochoric acid (HCl): 2 percent (20 ml/litre), corrosive, use only when other chemicals are not available
   - citric acid: 0.2 percent (2 g/litre), safe for clothes and body decontamination. 30 minute contact time.
5. Formaldehyde gas: Toxic, only if others cannot be used. 15-24 h exposure time.

prevent breaches of biosecurity. The escorting officer must carry a supply of an approved disinfectant and basic equipment to deal with minor spills en route. All vehicles must be cleaned and disinfected before leaving the infected place and after unloading.

Decontamination

Soapy water and detergents are the first choice for decontamination. The avian influenza virus is more easily destroyed than many other viruses since it is very sensitive to detergents which destroy the outer lipid envelope of the virus. Therefore washing of contaminated surfaces should always be with detergents (soapy water) or specific disinfectants. The most difficult material to decontaminate are bird droppings since the virus can survive in moist environments with high organic content; it is essential to thoroughly clean and disinfect items that have been in contact with bird droppings – cages, shoes, clothes – before working with poultry or entering a place where poultry are kept. Simple hygienic measures can reduce risk - but national authorities are encouraged to prepare and communicate specific guidance for each type of poultry enterprise. More guidance for veterinary services on selection and application of decontamination procedures is given in table 1 (Ausvetplan Manual). Adaptation to specific country circumstances will be needed.

Destocking period

After slaughter, disposal and decontamination procedures have been completed the premises must be left without susceptible species (destocked) for a period of time, determined by the estimating survival time of the pathogen in the particular environment. ***Restocking*** should not take place until at least 21 days after satisfactory cleaning and disinfection has been completed and the outbreak has been brought under control in the area. Restocking should be undertaken by introducing a small number of poultry first, and these ***monitored*** daily for signs of disease. Should this occur, notification to the authorities must be immediate and sampling of the sick or dead birds done to determine the cause. If the poultry remain healthy, full repopulation can be carried out. Of course, improvement of biosecurity should be instituted at all stages of production to decrease the likelihood of AI or other diseases entering the recovered premises. After repopulation, ***monitoring*** should be continuous through the sampling of dead birds to determine whether re-infection has occurred.

4.3.2 Financial Support

The issue of compensation for slaughtered birds, property damaged during decontamination and/or loss of income needs to be carefully considered. In principle, offering compensation encourages owners to report disease. However, it can become a very expensive undertaking and guidelines are usually developed that strictly limit the categories for compensation. It is important to consider what the cost of compensation might be and how it would be funded should a major outbreak of disease occur.

If compensation is paid, it can be controlled as follows:

- Have a registration process
- Only pay for animals slaughtered, not those that have died.
- Pay promptly and at a level that is close to market value (some countries have used innovative strategies such as paying slightly more than market value for healthy in-contact birds, and less for sick birds – which allowed for quick reporting to authorities).
- Do not compensate losses other than livestock (birds).
- Ensure that people with very small flocks are also compensated

There are alternatives to payment of compensation in cash and experience has sometimes shown them to be acceptable.

- Rather than paying cash, provide replacement birds (can be difficult sometimes; governments have to think in advance about logistical questions of where to obtain replacements, their transport and the required destocking times).
- Provide credit for owners to re-establish their poultry production, including village birds or facilitate entry into alternative livelihoods.
- Provide area assistance to enable market conditions to become re-established without undue delay.
- Provide farmers with free technical and veterinary services in re-establishing production schemes.

4.3.3 Vaccination

Vaccination as a support strategy may be considered when the disease has spread to such an extent that it has overwhelmed the resources of disease control authorities or the economic cost of a widespread slaughter campaign cannot be borne. It can also be considered at an earlier stage when veterinary service infrastructures and capacities prove to be very weak and insufficient to curb the spread of the disease. FAO and OIE have made recommendations for the use of OIE-approved AI vaccines, and several such vaccines are commercially available. If used in accordance with FAO/OIE recommendations (*FAO Position Paper, September 2004*) and the *OIE Manual for Diagnostic Tests and Vaccines for Terrestrial Animals*, these vaccines provide excellent protection against clinical disease in chickens by reducing mortality and production losses. Vaccination of poultry also reduces the viral load in the environment, thus decreasing the risk of transmission to poultry and humans. According to current OIE recommendations, HPAI-vaccinated poultry are not excluded from international trade, although specific technical guidelines must be followed to ensure that the vaccine is being applied properly and monitored effectively.

TABLE 2
Vaccine properties

Vaccine type	Advanteges	Disadvantages
INACTIVATED HOMOLOGOUS VACCINE The same H and N antigens as the strain isolated in the outbreak	• Readily available • Rapid onset of immunity with adjuvants • Inexpensive • Safe	• Impossibility of differentiating vaccinated from infected birds serologically. • Monitoring by using sentinel unvaccinated birds (identification, bleeding and swabbing) is time-consuming, requires planning and monitoring • Requires boosters in long-lived species • Requires percutaneous injection
INACTIVATED HETEROLOGOUS VACCINE (DIVA Strategy: Differentiation of Infected from Vaccinated Animals) The same HA subtype and a different NA subtype compared to the virus isolated in the outbreak	NA: marker of field infection. Serology can determine whether birds in a vaccinated flock have also been infected.	• Laboratory capacity to perform the discriminatory test based on the N antigen • Serology is expensive, requires additional reagents and requires a complete knowledge of circulating N antigen sub-types • Requires boosters in long-lived species • Requires percutaneous injection
RECOMBINANT FOWLPOX VIRUS	• Enables the differentiation between infected and vaccinated birds by serologic tests • Specificity of the immune response directed exclusively against HA components • Vaccination is rapid and only one dose is required • Inexpensive	• Can only be used to vaccinate chickens without previous fowlpox exposure. Therefore, usually applied only to day-old chicks • Cannot be used in ducks/geese • Requires percutaneous injection

Vaccination, when it is applied, must be done in combination with other disease control measures, including the slaughter of affected flocks. Efforts to control the disease by vaccination alone, without slaughtering affected birds to reduce the virus load in the environment, will probably not be successful. Depending on the incidence and distribution of outbreaks, vaccination may be undertaken around outbreaks (ring vaccination) or throughout the poultry population (mass vaccination).

Sourcing vaccine

There are a number of different avian influenza vaccines available. Conventional vaccine is prepared from the allantoic fluid of infected eggs, which is inactivated and emulsified with an adjuvant. Attenuated live influenza virus vaccines are not recommended because of the risk that the vaccine virus could either mutate or reassort with other influenza viruses to become virulent. However, recombinant vaccines have been produced, including fowl-pox virus with the influenza haemagglutinin gene inserted.

Generally, conventional inactivated vaccines are used. The main immunogenic component is the haemagglutinin protein. It must be of the same subtype as the outbreak virus (for the current widespread Asian epidemic, this is H5). The neuraminidase antigen can be the same as the outbreak strain. However, if differential serology is to be undertaken for monitoring vaccine response or virus activity (the DIVA method), then a different neuraminidase should be used in the vaccine (e.g., H5N2 or H5N9).

It is also possible to leave a small number of identified sentinel birds unvaccinated which will aid monitoring for flock infection. If sentinel birds show disease symptoms or die, virus isolation and serological test have to be done to confirm flock infection.

The DIVA strategy requires testing of serum samples for antibody to the neuraminidase, to differentiate that of field strain(s) from that of the vaccine strain(s). It assumes that the heterologous N antigen is not circulating in the field; and therefore that knowledge of circulating AI viruses (virulent or not) is known. In circumstances, such as currently prevail in Asia, where there may be several strains of avian influenza virus circulating, and where in some countries there are vaccines in use with several different neuraminidase antigens, it may be difficult to apply the strategy. Also, the differentiating assay involves the use of additional reagents, which may be beyond the scope of most national laboratories because it represents an additional expense. Therefore, a decision to apply the DIVA strategy needs to be carefully considered against these constraints; it may be more appropriate towards the end of a successful control campaign.

For inactivated vaccines, two doses of the vaccine must be given, approximately 30 days apart, to achieve adequate protection. Vaccinated birds are generally not fully protected from infection but have increased resistance to infection, suffer less clinical disease and shed substantially less virus in the event that they become infected. Longer lived species (ducks, geese, yellow chickens) require booster injections of vaccine to maintain protection.

Recombinant fowl pox vaccine can be used for vaccinating day-old chicks. Since it is a live pox virus, it can be applied by stab inoculation into the wing web, which can be performed quickly with minimal training. This vaccine cannot be used in older birds, since they

are likely to have already become exposed to fowl pox and will not respond to vaccination. A disadvantage of the fowl pox-vectored AI vaccine is that it is ineffectual in ducks. Specifications for purchasing vaccine and a list of potential suppliers is provided in Annex 2.

4.4 MANAGEMENT OF DISEASE CONTROL

The *FAO Manual on the Preparation of National Animal Disease Emergency Preparedness Plans* makes recommendations in regard to management of disease control operations. The following recommendations should be considered:

1. To manage disease control on a national basis, there needs to be a suitable command structure for veterinary services. It is essential that information can flow quickly and efficiently from the field to national headquarters and that conversely, control mechanisms are continuous from headquarters to the field. In recent years, government veterinary services in many countries have been restructured, including regionalisation, rationalisation and downsizing, privatisation, separation of policy and operational functions, and separation of authority for field and laboratory operations. Countries may need to consider whether they need to make structural changes or alternative arrangements to adequately deal with animal health emergencies.
2. It is often advisable to have a consultative committee which can meet during the period of an animal disease emergency to provide the best technical advice to outbreak management personnel. The committee might comprise the CVO, national directors of field and laboratory services, head of the epidemiology unit, AI expert, directors of state, regional or provincial veterinary services, representatives of private industry and other key groups, and other technical experts as required. Gaining the cooperation of police, military and public works offices would be beneficial for the success of any plan.
3. At the time of an emergency, it can be a great advantage to have made arrangements in advance for a national animal disease control centre and local animal disease control centres. The control of diseases in difficult or marginalised areas of some countries may require special consideration.
4. Arrangements need to be made in advance of an outbreak. They should include negotiation with all government authorities and others who will be involved in assisting in disease control. Because certain strains of avian influenza viruses can infect humans, the respective roles of human health and veterinary services need to be considered in advance.

Field services capacity

Veterinary services must have the capacity to undertake disease surveillance, investigate and respond to disease outbreaks and report to various levels of the official veterinary service structure. In designing a proposed strategy to control avian influenza, careful consideration needs to be given to the capacity of the field services to assume disease management activities in accordance with legislation that enables and empowers decision makers. Very few national veterinary administrations have the capacity within their own resources to

Lessons learned from the 2004 epidemic in Asia:

As observed in South East Asia during the 2004 epidemic, many countries did not have a plan of action supported by national legislation at the time of HPAI detection.

The following points were particularly lacking in several affected countries:

- A structured surveillance program including surveillance protocols in suspected or at-risk farms.
- Protective equipment not available for workers and animal health personnel.
- Investigation procedures: standardised protocols and sets of epidemiological questions for outbreak investigation and mapping. These protocols should also include information on collection of a standard set of samples for disease investigation from infected farms, neighbouring farms and uninfected farms outside of the control areas to allow for more detailed pathological examination of dead birds.
- Restocking programmes were often incomplete with no detailed method to control the flock after restocking.
- Vaccination plans were often incomplete and did not have a coherent strategy for post-vaccination surveillance activities. Vaccines used were often of unknown quality and of dubious efficacy.
- Declaration of disease freedom from areas or zones were made without proper scientific data supporting such claims and were subsequently proven to be false creating additional uncertainty in the population and loss of consumer confidence.
- Absence of adequate legislation or difficulties of enforcement.

undertake all the necessary measures required to combat a major transboundary disease incursion. Assistance is often sought from police, military, national disaster and other emergency organisations late in the process. The immediate and early needs from other public offices and cooperation from private industry must be anticipated to assist field veterinary services in performing their duties. Access to extra budgetary resources should be part of the contingency planning process and appropriate arrangements for collaboration negotiated in advance.

An electronic disease information database can be a great asset in tracking the huge amount of detail that can be accumulated in the course of a disease epidemic. There are many systems available, including the FAO-designed and supported system, TADinfo. FAO, OIE and WHO have collaborated in establishing a Global Early Warning and Response System (GLEWS) to enable international animal and human health authorities to receive early notice of outbreaks, or the likelihood of certain diseases occurring based on disease intelligence and forecasting risks. Data is analysed and information made available to international and national disease control authorities.

4.5 LABORATORY DIAGNOSIS

Laboratory services must be able to:

- undertake testing of samples collected for surveillance activities.
- test samples collected for diagnosis.
- test samples collected for monitoring response to vaccination.

Consideration needs to be given to the capacity of veterinary services to collect and deliver specimens to a competent national laboratory. There are benefits in having regional laboratories that might have better access to the field. However, in many countries expert personnel are lacking and it may be more effective to have just one central laboratory that is well resourced and properly staffed.

4.5.1 Samples

Samples taken from dead birds should include intestinal contents (faeces) or cloacal and oropharyngeal swabs. Samples from trachea, lungs, air sacs, spleen, kidney, brain, liver and heart may also be collected and processed either separately or as a pool. Intestines (loops) should always be collected last and packaged separately to avoid bacterial contamination. Samples from live birds should include both tracheal and cloacal swabs, although swabs of the latter are the most likely to yield virus. Since small delicate birds may be harmed by swabbing, the collection of fresh faeces may serve as an adequate alternative. To optimize the chances of virus isolation, it is recommended that at least one gramme of faeces be processed either as faeces or coating of the swab. Should the investigator not be sufficiently well trained to perform a necropsy (autopsy), whole birds should be bagged twice (one bag inside another), maintained refrigerated at all times and submitted to a laboratory where a proper necropsy and sample collection can be completed.

The samples should be placed in isotonic phosphate buffered saline (PBS), pH 7.0–7.4, containing antibiotics. The antibiotics can be varied according to local conditions, but could be, for example, penicillin (2000 units/ml), streptomycin (2 mg/ml), gentamycin (50 µg/ml) and mycostatin (1000 units/ml) for tissues and tracheal swabs, but at five-fold higher concentrations for faeces and cloacal swabs. It is important to adjust the pH of the PBS solution to pH 7.0–7.4 following the addition of the antibiotics. Faeces and finely minced tissues should be prepared as 10–20 percent (w/v) suspensions in the antibiotic solution. Suspensions should be processed as soon as possible after incubation for 1–2 hours at room temperature (22-25°C). When immediate processing is impracticable, samples may be stored at 4°C for up to 4 days. For prolonged storage, diagnostic samples and isolates should be kept at –80°C without PBS. Never use alcohol to preserve samples.

Submission of samples to any laboratory outside the country of origin should always be subject to prior agreement with the recipient laboratory (see Annex 4 *Information for shipping International Diagnostic Specimens*) and be transported in containers meeting IATA (International Air Transport Association) regulations. Infectious substances which cause disease only in animals are categorized as UN 2900. Infectious substances which cause disease in humans (or both in humans and animals) must be assigned to UN 2814. All H5 and H7 samples must be assigned to UN 2814. All materials should be in leak-proof containers.

4.5.2 Laboratory tests

National laboratory services should be able to carry out the following tests.

As a minimum requirement:

1. Virus isolation in eggs (SPF or SAN), identification of isolates as "A" influenza virus, haemagglutinin and neuraminidase typing.
2. Serology – including ELISA (for antibody to matrix protein), haemagglutination-inhibition testing.
3. Antigen detection – ELISA or haemagglutinin testing.

In addition, the capacity to perform the following tests is highly desirable:

4. Neuraminidase antigen identification.
5. Pathogenicity testing of virus isolates by chicken inoculation.
6. Polymerase chain reaction (PCR) technology for rapid detection of virus genome.

Methods are described in the *OIE Manual*, Chapter 2.1.14. Consideration needs to be given not just to having the appropriate technology but to having the capacity to handle a large number of specimens in the event of a disease control emergency.

Countries should also have access to international expertise to assist in confirming the identity and characteristics of isolates and undertaking further key studies that are of particular importance at the international level. It is important to monitor field viruses for early detection of changes and this can be done by systematic sampling of birds during an epizootic and in inter-epizootic periods and sending suspect samples to a reference laboratory for confirmation and further characterisation.

A list of the OIE/FAO reference laboratories is in Annex 3.

In April 2005, OIE and FAO launched a joint scientific worldwide network to support the veterinary services in the control of avian influenza – OFFLU. The objectives of the new network are:

- to collaborate with the WHO human influenza network on issues relating to the animal-human interface, including early preparation of vaccines for possible human use.
- to promote research on avian influenza.
- to offer veterinary expertise and new skills to countries to assist in the control and eradication of HPAI.

Through active and permanent scientific cooperation, the network will develop collaborative research proposals, provide multidisciplinary teams to countries requiring assistance, and act as a link between OIE/FAO reference laboratories, and regional and national laboratories. Sharing permanently updated scientific information and expertise on efficient control methods will provide a pro-active approach in helping infected countries to progressively control and eradicate the disease and for disease-free countries to better protect themselves.

For more detailed information, see the OFFLU website www.offlu.net

Field diagnosis

Often decisions need to be made immediately in the field during an emergency. Waiting for a laboratory diagnosis before taking action to quarantine an area can lead to critical

delays. Clinical and pathological findings in the field can often be sufficient to make a presumptive diagnosis of HPAI and actions taken accordingly. Though some rapid on-site diagnostic assays are available, to date these have been of poor sensitivity and expensive. Several institutes are actively researching the development of improved sensitive, specific and cost-effective rapid on-site assays, but these remain in the development stage and require validation in the field before their recommendation.

4.5.3 Communication and Public Awareness

There are several objectives which should be considered in public awareness campaigns:

- Inform farmers and consumers on the infection channels and risks related to AI.
- Communicate information (e.g. time and venues for vaccination, procedures for obtaining compensation).
- Promote better farming practices and improved hygiene.
- Raise awareness of the risk of poultry infection (see Annex 6: poster example).
- Recognise that in many village situations it may be unrealistic to expect to be able to improve biosecurity.
- Seek assistance from the community by having poultry owners report unusual sickness and mortalities in their flocks.
- Cooperate during disease control activities, should an emergency occur.
- In conjunction with human health authorities, raise awareness of the risk of transmission from poultry to human and about disease in humans.

4.5.4 Human health and safety considerations

Certain avian influenza viruses can infect humans, occasionally causing severe disease and sometimes death. The WHO website (www.who.int) provides updates and recommendations with regard to symptoms, patient care and management, and recommendations to reduce occupational risks (i.e., personal protective equipment). The following should be considered:

General considerations for the human population

- vaccination with seasonal human influenza vaccine (which contain H1, H3 and B virus antigens) to minimise the risk of multiple influenza infections causing a new virus to emerge.
- avoid unnecessary contact with infected or exposed poultry, poultry products and poultry waste.
- in particular, people in poor health and children should avoid all contact with affected birds and their environment.
- do not purchase or consume poultry that are not healthy or wholesome.

Specific considerations for all personnel involved in disease control

- selection of workers should avoid those in high risk categories.
- workers should wear protective overalls and, where gross contamination is likely, a waterproof apron.
- disposable or rubber work gloves should be worn.

- a disposable P2 or N97 respirator should be worn.
- goggles or a visor should be worn to protect against eye splash.
- disposable footwear or rubber boots should be worn.
- protective clothing should be disinfected after use.
- hands should be washed after protective clothing is removed.
- use of antiviral drugs is recommended, during and for 7 days after exposure.
- workers should monitor their health, watching for signs of fever, respiratory symptoms (e.g., cough) and conjunctivitis (eye inflammation).
- illness in workers or their close contacts should be reported to public health authorities immediately.