Questions & Answers on potential transmission of avian influenza (H5N1) through water, Sanitation and Hygiene and ways to reduce the risks to human health

April 2007

World Health Organization
Department of Public Health and Environment
&
WASH Inter Agency Group

**Purpose and Scope**

The purpose of these Q & As is to provide the latest information based on available studies and findings on avian influenza pertaining to water resources, water supplies, sanitation (human excreta, sewerage systems and health care waste) and hygiene. Q & As are categorized into two of the 6 WHO phases; Phase 3 for Pandemic alert period and phase 6 as pandemic period. At this stage, most developed recommendations fit both, phase 3 and phase 6.

These Q & As are intended to provide practical information and recommendations that are directed at public health authorities, the general public and others involved in pandemic influenza planning.

Although the “pandemic H5N1” virus does not yet exist, it may behave like avian influenza H5N1 virus in many respects. In this paper, information is provided where available. As new or revised information is received the questions and answer will be periodically updated.

For information about the current situation or for answers to frequently asked questions about avian influenza and the possible progression to pandemic influenza, please visit WHO's website at:

http://www.who.int/csr/disease/avian_influenza/en/index.html.

http://www.who.int/water_sanitation_health/emerging/en/index.html

## key findings

Avian influenza viruses can persist for extended periods of time in water depending on temperature, pH and salinity but information on environmental persistence of H5N1 in water is lacking .

Sources of drinking water that may be susceptible to avian influenza virus deposition include surface water bodies (e.g., reservoirs, ponds, lakes and rivers), groundwater aquifers and rainwater collection systems.

Avian influenza viruses are known to persist for extended periods of time in water depending on environmental conditions, including temperature, pH and salinity, but information on the persistence of highly pathogenic avian influenza (HPAI) viruses, including H5N1, in water is lacking.

Due to their structure, all influenza viruses are relatively susceptible to disinfectants, including oxidizing agents such as chlorine, as well as enzymes like proteases, peptidases, neuraminidases and haemagglutinases. They are also readily inactivated by heating. Predation by bacteria and other microbes may also play a role in virus inactivation.

Prevention and control measures can be suggested to minimize, if not eliminate, the risk from the consumption of virus-contaminated water. If the water from open water reservoirs is to be used for a potable water supply, treatment, specifically disinfection, as recommended by the WHO Guidelines is strongly recommended.

Hand hygiene remains a pre-requisite requirement to prevent from the transmission of diseases. In H5N1 environment, hand hygiene, which includes hand washing and the use of alcohol-based hand rubs is critical to prevent possible inoculation of the nose, mouth, and conjunctivae by contaminated hands. But, one must bear in mind that hand hygiene is also necessary to prevent from the transmission of other nosocomial infections.

Studies on the survival of viruses in human faecal wastes and agricultural animal wastes indicate that persistence is dependent on several factors, including the virus type, waste type, temperature and other environmental conditions and processes. The period of avian influenza infectivity in bird faeces and secretions depends primarily on pH and temperature conditions, but generally four weeks after infection, avian influenza virus can no longer be detected. The H5N1 virus could potentially enter into sewage in urine or faeces excreted by infected humans or in animal waste that is combined with human sewage.

**In health care settings**, a potential risk exists through possible direct inoculation (e.g., via contaminated hands) into the respiratory mucosa (e.g., nose).

Cleaning MUST precede disinfection. Items and surfaces cannot be disinfected if they are not first cleaned of any kind of organic matter (patients' excretions, secretions, dirt, soil, etc).

Standard precautions when working with solid waste (clinical and non-clinical) that may be contaminated with avian influenza H5N1 virus are required and plan for increased waste volumes with increased patient numbers.

**In public buildings**, minimizing the exposure of humans to the virus is a key way to reduce the risk of human infection. The focus of prevention measures by building owners/managers should be (1) encouraging frequent hand washing, (2) ensuring that occupants and visitors have access to facilities for proper personal hygiene and (3) ensuring that surfaces in frequently populated areas are cleaned regularly.

## WHO Phases for pandemic influenza[1]

WHO phases are designed as a system for informing the world of the seriousness of the threat of pandemic influenza and to facilitate pandemic planning. The world was in phase 3 as of early 2006 and still is at the date of this updated document: a new influenza subtype causing disease in humans, but not as yet spreading efficiently and sustainably among humans.

| | | |
|---|---|---|
| Inter-pandemic phase<br>New virus in animals, no human cases | Low risk of human cases | 1 |
| | Higher risk of human cases | 2 |
| Pandemic alert<br>New virus causes human cases | No or very limited human-to-human transmission | 3 |
| | Evidence of increased human-to-human transmission | 4 |
| | Evidence of significant human-to-human transmission | 5 |
| Pandemic | Efficient and sustained human-to-human transmission | 6 |

### WHO pandemic phases and planning goals

| NEW PHASES | PUBLIC HEALTH GOALS |
|---|---|
| **Inter-pandemic period** | |
| **Phase 1.** No new influenza virus subtypes have been detected in humans. An influenza virus subtype that has caused infection may be present in animals. If present in animals, the risk of human infection or disease is considered to be low. | Strengthen influenza pandemic preparedness at the global, regional, national and sub-national levels. |
| **Phase 2.** No new influenza virus subtypes have been detected in humans. However, a circulating animal influenza virus subtype poses a substantial risk of human disease. | Minimize the risk of transmission to humans; detect and report such transmission rapidly if it occurs. |
| **Pandemic alert period** | |
| **Phase 3.** Human infection(s) with a new subtype, but no human-to-human spread, or at most rare instances of spread to a close contact. | Ensure rapid characterization of the new virus subtype and early detection, notification and response to additional cases. |
| **Phase 4.** Small cluster(s) with limited human-to human transmission but spread is highly localized, suggesting that the virus is not well adapted to humans. | Contain the new virus within limited foci or delay spread to gain time to implement preparedness measures, including vaccine development. |
| **Phase 5.** Larger cluster(s) but human-to human spread still localized, suggesting that the virus is becoming increasingly better adapted to humans, but may not yet be fully transmissible (substantial pandemic risk). | Maximize efforts to contain or delay spread, to possibly avert a pandemic and to gain time to implement pandemic response measures. |
| **Pandemic period** | |
| **Phase 6.** Pandemic: increased and sustained transmission in the general population. | Minimize the impact of the pandemic. |

Actions taken during phase 6 will differ in affected versus non-affected areas

[1] Source: WHO. Pandemic influenza preparedness and mitigation in refugee and displaced population, WHO guidelines for humanitarian agencies. WHO/CDS/NTD/DCE/2006.2

## Q & As - Open to updates[2]

| | Emergency phase 3<br>(also for emergency phase 6) |
|---|---|
| **Do we know how avian influenza viruses are transmitted to humans?** | Although the virus strain currently circulating among some bird populations has demonstrated some ability to infect humans, H5N1 avian influenza remains principally a disease of birds, and not of humans. In no instance has the virus spread beyond a first generation of close contacts or caused illness in the general community. Data from these incidents suggest that transmission requires very close contact with an ill person.<br><br>The rarity of human cases at present, despite the infection of tens of millions of birds over a wide geographical area for almost two years, in a situation with abundant opportunities for human exposure, suggests that currently there is a significant species barrier. The virus can improve its transmissibility among humans via two principal mechanisms. The first is a "reassortment" event, in which genetic material is exchanged between human and avian viruses during co-infection of a human or pig. The second mechanism is a more gradual process of adaptive mutation, whereby the capability of the virus to bind to and replicate in human cells increases during subsequent infections of humans.<br><br>Human influenza is transmitted by inhalation of infectious droplets and droplet nuclei, by direct contact, and perhaps, by indirect (fomite) contact, with self-inoculation onto the upper respiratory tract or conjunctival mucosa. The relative efficiency of the different routes of transmission has not been defined. |
| | |
| **Water supply** | |
| **Is there a risk from drinking water?**<br>**Potentially Yes.**<br><br>Avian influenza viruses can persist for extended periods of time in water depending on temperature, pH and salinity but information on environmental persistence of H5N1 in water is lacking.<br>As influenza A (H5N1) infection is frequently accompanied by gastrointestinal symptoms this could mean that H5N1 might enter the host also through Gastrointestinal tract.<br>Based on no evidence but considering a potential risk. Knowing that water supplied for multiple use and for drinking water in health-care facilities, minimum standards are required based on national protocols.<br>WHO recommends: | **1. Microbiological quality**<br>*E. coli* or thermotolerant coliform bacteria must not be detectable in any 100-ml sample<br>**2. Disinfection**<br>Free residual chlorine content at discharge points:<br>- 0.5mg/l (pH < 8) minimum 30 minutes contact time<br>- 0.5-1.0mg/l (pH > 8) minimum 60 minutes contact time<br>**3. Chemical and radiological quality**<br>Water meets the WHO Guidelines for Drinking-Water Quality or National standards concerning chemical and radiological parameters<br>**4. Turbidity**<br>Maximum turbidity is 5 NTU<br>**5. Acceptability**<br>There are no tastes, odours or colours that would discourage consumption of the water or lead to consumer drinking from more contaminated but aestically pleasing sources<br><br>See also the Guidelines for drinking-water quality, WHO |

[2] contact: Yves Chartier - chartiery@who.int

| | |
|---|---|
| **How does avian influenza virus get into drinking water sources?**<br><br>Sources of drinking water that may be susceptible to avian influenza virus deposition include surface water bodies (e.g., reservoirs, ponds, lakes and rivers), groundwater aquifers and rainwater collection systems. Of these sources, open water bodies where infected waterfowl gather are the most likely potential route of entry of virus into the drinking water supply. It is worth to note that viral inactivation rates can be quite slow, especially in colder temperatures though it is not known how long the H5N1 strain can persist in the environment. | Infected waterfowl carry avian influenza viruses in their gastrointestinal tract, where the virus replicates. Birds infected with avian influenza virus shed large quantities of virus in their faeces as well as in their saliva and nasal secretions. Recent studies of ducks inoculated with H5N1 isolates from 2003 and 2004 showed infective virus shedding up to 17 days post-infection. Thus, it is likely that infected droppings or other secretions from both symptomatic and asymptomatic waterfowl will enter water environments where these birds gather. Avian influenza virus has been isolated from unconcentrated lake water where ducks gathered and deposited large amounts of faeces, but virus concentrations were not determined in these studies. Still, avian influenza virus detection in unconcentrated water and in small sample volumes suggests that levels could be relatively high.<br><br>Besides direct deposition of infected faeces into water by waterfowl, it has been suggested, but not observed, that AI virus in faecal waste from duck and chicken farms could spread to water bodies via wind or surface runoff. While there have been no quantitative studies on the transport of avian influenza virus to groundwater underlying poultry operations, the disposal and composting of infected waste on poultry farms could create a potential pathway for the virus to enter groundwater. Similarly, interconnected surface water and groundwater systems might provide a potential route to groundwater if surface waters are carrying high concentrations of the virus. |
| **Do we know how long avian influenza viruses persist in drinking water sources?** | Avian influenza viruses are known to persist for extended periods of time in water depending on environmental conditions, including temperature, pH and salinity, but information on the persistence of highly pathogenic avian influenza (HPAI) viruses, including H5N1, in water is lacking.<br><br>Persistence of avian influenza in water is most sensitive to temperature. One study showed the avian influenza subtype H3N6 resuspended in untreated Mississippi River (USA) water was detected for over 30 days at 0 °C and was undetectable after 4 days at 22 °C. In a second study, which used five low-pathogenicity avian influenza viruses (H3N8, H4N6, H6N2, H12N5, and H10N7), infectivity of virus in distilled water was retained for up to 207 days at 17 °C and 102 days at 28 °C. In a study that showed a high level of positive water samples (23%) for a strain of influenza A virus in a lake where ducks were nesting, the proportion of positive samples remained high (14%) in the autumn after the ducks had left for migration, indicating that the virus is able to persist in natural waters.<br><br>Persistence of avian influenza viruses in water appears to be less sensitive to pH and salinity. In general, avian influenza virus viability in natural water (fresh, brackish, seawater) decreases with increasing salinity and pH. One modeled system predicts that infectivity is potentially greatest in cooler, freshwater habitats ranging 7.4-7.8 pH. |

| | |
|---|---|
| **Do we know how to remove or destroy avian influenza virus in drinking water?** | Due to their structure, all influenza viruses are relatively susceptible to disinfectants, including oxidizing agents such as chlorine, as well as enzymes like proteases, peptidases, neuraminidases and haemagglutinases. They are also readily inactivated by heating. Predation by bacteria and other microbes may also play a role in virus inactivation. General studies on viruses demonstrate less persistence of virus inoculated into natural waters compared to virus that is inoculated into sterilized or pasteurized waters.<br><br>More information is needed about the inactivation of HPAI viruses in drinking water management processes and systems. Specifically, information on the effectiveness of disinfection and other treatment processes (e.g., chemical disinfectants, ozonation, thermal and thermophilic treatment processes, UV radiation, drying and desiccation, pH, biological activity, etc.) and the virus's resistance to treatment will help to refine risk management strategies. Where such treatment processes are not available the sanitary risk assessment approach could be promoted here for both source protection and household storage. |
| **Should any precautions be taken? If yes, what are these?**<br><br>The fact that waterfowl excrete influenza viruses into water does not confirm waterborne transmission between birds; nor does it offer an indication of the extent of the risk of infection to humans exposed to the water. Other viruses are likewise excreted into water environments without being transmitted to a meaningful extent via that route. Based on the little evidence available regarding modes of transmission and infection, there is a small but potential risk. | Prevention and control measures can be suggested to minimize, if not eliminate, the risk from the consumption of virus-contaminated water. If the water from open water reservoirs is to be used for a potable water supply, treatment, specifically disinfection, as recommended by the WHO Guidelines is strongly recommended.<br><br>Authorities charged with managing any potential risk in drinking water may consider ensuring chlorination or alternative disinfectant residuals be maintained throughout distribution. For effective disinfection of adequately pre-treated water, there should be a residual concentration of free chlorine of at least 0.5 mg/litre after at least 30 min contact time at pH <8.0.<br><br>Where there is no access to community drinking water treatment systems and where household water safety is suspect, authorities should consider advising families to treat their drinking water with available and acceptable household-level interventions, including home chlorination (addition of bleach) and boiling, that are effective when carried out correctly at inactivating viruses. The following are important considerations when applying household-level interventions:<br><br><u>Using Chlorine to treat water</u><br><br>▪ Chlorine is a chemical of choice used for the disinfection and decontamination of water and particularly drinking water because of its strong oxidizing properties against almost all pathogenic micro-organisms which can be found in water.<br><br>▪ On the market chlorine is found in powder, tablets, gas or pre-mixed solution in plastic bottles. Common household bleach has between 4-5% of active chlorine and is in liquid form.<br><br>▪ Chlorine should be stored in airtight glass or plastic containers and protected from excessive light and heat to maintain its active power level. It must be stored out of reach of children. |

| | |
|---|---|
| | ▪ The amount of chlorine required depends on the quantity and on the quality of water (mainly turbidity and pH). Usually, 4 to 5 drops of chlorine are needed to treat 1 litre of clear water.<br><br>▪ A minimum of 30 minutes is needed to ensure oxidation of all pathogenic micro-organisms.<br><br>▪ The free residual chlorine is the fraction of chlorine left in water after oxidizing all pathogenic micro-organisms and has the power to react on eventual post contamination of the water. An adequate free residual chlorine level present in treated water is a guarantee of water safety.<br><br>▪ Turbid water has suspended particles that can protect micro-organisms from chlorine. A pre-treatment such as sedimentation (let particles settle down) or filtration will be required first.<br><br>Keeping treated drinking water safe<br><br>▪ Once your chlorine dosage is set, test the free residual chlorine from time to time as water quality may change (e.g. once a month).<br><br>Storing safe water<br><br>▪ Use a dedicated container for storing safe drinking water.<br>▪ Protect safe water from contact with animals.<br>▪ If affordable, use a covered storage container, equipped with a tap and a lid.<br>▪ Keep an attached single cup to your storage to fetch water to protect your water from contamination.<br>▪ Do not store chlorinated water in metal containers as metal consumes chlorine.<br>▪ Keep containers in the shade as light and heat will decrease free residual chlorine levels. |
| | |
| **Hygiene** | |
| **What is the role of personal hygiene in responding to the threat of pandemic influenza?** | To date, human infections with avian influenza viruses (detected since 1997) have not resulted in sustained human-to-human transmission. If the current avian influenza H5N1 virus changes to produce a strain that is more transmissible to humans, it could signal the start of a pandemic. Strengthening personal hygiene practices to reduce human-to-human transmission will be an essential tool to help stop or slow the spread of pandemic virus.<br><br>Personal hygiene includes individual practices that serve to promote or preserve health such as habits of cleanliness. In the case of highly contagious diseases such as influenza, special attention should be paid to personal behaviour in community settings as well as the household and at community level. Public education, including public health messages, is an important part of national and local planning for pandemic influenza. |

| | |
|---|---|
| **What role do fomites play in HPAI spread?** | Fomites are any inanimate object (e.g., linens, money, clothing, dishes, doorknobs, toys etc.) that can transmit infectious agents from one person to another. Transmission of influenza viruses by fomites has not been extensively documented but is believed to occur.<br><br>One study observed that the transmission of virus from donors who are shedding large viral loads could occur for 2-8 hr via stainless steel surfaces and for a few minutes via paper tissues. Influenza A virus placed on hard, non-porous surfaces (steel and plastic) could be cultured from the surfaces at diminishing titre for <24 to 48 hours and from cloth, paper, and tissues for <8 to 12 hours at conditions of 35% to 40% humidity and a temperature of 28°C. Higher humidity shortens virus survival. Virus on non-porous surfaces could be transferred to hands 24 hours after the surface was contaminated, while tissues could transfer virus to hands for 15 minutes after the tissue was contaminated. On hands, virus concentration fell by 100- to 1,000-fold within 5 min after transfer. The authors concluded that transmitting infection from the surfaces tested would require a high titre of virus (105.0 TCID50/mL) on the surface; but such titres can be found in nasal secretions at an early stage of illness. Thus, under conditions of heavy environmental contamination, the transmission of influenza virus via fomites may be possible.<br><br>The persistence of avian influenza virus in faeces and respiratory secretions is of major importance. Their stickiness facilitates spread over a wide geographical area on footwear, clothing, equipment and other fomites. This is the main way infection is transmitted between premises. |
| **Does hand hygiene practice require specific attention in and outside health care settings?**<br>**Yes!**<br><br>Hand hygiene remains a pre-requisite requirement to prevent from the transmission of diseases. In H5N1 environment, hand hygiene, which includes hand washing and the use of alcohol-based hand rubs is critical to prevent possible inoculation of the nose, mouth, and conjunctivae by contaminated hands. But, one must bear in mind that hand hygiene is also necessary to prevent from the transmission of other nosocomial infections. | When visibly dirty, wash hands with plain soap and water and rub hands together vigorously for at least 40 seconds, covering all surfaces of the hands and fingers. Rinse hands with water and dry thoroughly with a clean towel at domestic level or single use towel in settings gathering groups of people to reduce self-contamination. Use towel to turn off the faucet.<br>In order for the chlorine bleach to have a bactericide and virucidal effect, it must contain a concentration of **5 mg** active chlorine/per liter of water.<br><br>Alcohol-based hand rubs on soiled hands require washing with water first. Many studies have demonstrated that influenza, an enveloped virus, is susceptible to alcohols when tested *in vitro* and *in vivo* testing with a 95% ethyl alcohol hand disinfectant reduced influenza virus on hands by a $\log_{10}$ reduction > 2.5.<br>Ethyl alcohol has greater activity against viruses than isopropyl alcohol, therefore, ethyl alcohol-based hand disinfection products may be preferred over isopropyl alcohol products in settings where transmission of influenza H5N1 is likely.<br>When decontaminating hands with an alcohol-based hand rub, apply product to palm of one hand and rub hands together, covering all surfaces of hands and fingers, until hands are dry. Follow the manufacturer's recommendations regarding the volume of product to use..<br><br>The use of alcohol-based hand preparations should be done very parsimoniously, if ever done, at least due to safety reasons at household level. |

**Precautions for domestic settings**

Basic good health habits that will help reduce the spread of influenza virus in the home include:

**Personal hygiene**

- Cover your mouth and nose with a tissue when coughing or sneezing.
- Wash your hands often, especially:
  - Before, during, and after you prepare food
  - Before you eat
  - After you use the bathroom
  - After handling animals or animal waste
  - Before feeding babies
  - When your hands are dirty, and
  - More frequently when someone in your home is sick.
- Avoid touching your eyes, nose or mouth. Infections are often spread when a person touches something that is contaminated with germs and then touches his or her eyes, nose, or mouth.

Contact with sick or dead animals.

Disinfection of clothing, shoes and utensils used with soapy water or disinfectant solutions (0.5%). Hang them in the sun to dry.
Leaves shoes or boots outside the house until they have been cleaned. When cleaning shoes, be careful that you do not flick any particular in your face or clothes.
Protect yourself: mask, goggles, rubber boots and gloves. If these are not available, cover the mouth with a piece of cloth, wear glasses, use plastic bags to cover hands and shoes fixing them tightly with rubber bands or strings.
Wash hands before and after putting or removing protection clothing and shoes.

**Domestic hygiene**

Cleaning and disinfection of household surfaces likely to be contaminated by infectious secretions appears worthwhile, but no evidence supports the efficacy of widespread disinfection of the environment or air, though good community health can reinforce personal hygiene behaviour.

Do not prepare poultry from affected areas as food (including eggs).
Do not eat poultry raw meat or raw eggs. Special attention on the shells (the eggs should be washed before preparation). The food should be cooked to an internal temperature of 70°C.
Kitchen utensils should be washed after use.
Cleaning of surfaces that can be contaminated with detergent

People should avoid contact with poultry and wild birds (including feathers, faeces and other waste). Do not keep birds as pets and do not sleep near poultry. Special attention on children!

For linen and laundry of an H5N1 infected person, see recommendations under health care settings.

| | |
|---|---|
| **Precautions for schools**<br><br>As part of pandemic influenza planning, special attention should be given to teaching staff, children, and their parents on how to limit the spread of infection. | Programs should already be teaching these things (for example, use good hand washing; cover the mouth when coughing or sneezing; clean toys frequently) to build good hygiene habits that protect children from disease in general.<br><br>Handwashing and respiratory hygiene/cough behaviours should be routine for all and strongly encouraged in public health messages. Such practices should be facilitated by making hand-hygiene facilities available in schools. Keep a good supply of supplies you will need to help control the spread of infection. (soap, paper towels, and tissues). Store the supplies in easy-to-find places. |
| | |
| **Waste water** | |
| **What is the role of wastewater management in preventing the spread of HPAI?** | Although there is no specific information available on the response of H5N1 virus to wastewater treatment processes, virus concentrations are generally reduced at various rates and to various extents in both human and animal waste treatment processes, but they are not completely eliminated. Furthermore, virus concentrations may be enriched in certain treated or separated waste fractions (such as waste solids) by sedimentation and solid–liquid separation processes.<br>More information is needed about the inactivation of HPAI viruses in wastewater treatment processes. Specifically, information on changes in H5N1 concentrations at different stages of treatment and the virus's resistance to treatment will help to refine risk management strategies. |
| | |
| **Sanitation** | |
| **Do we know how long avian influenza viruses can persist in sewage, excreta and animal wastes?** | Studies on the survival of viruses in human faecal wastes and agricultural animal wastes indicate that persistence is dependent on several factors, including the virus type, waste type, temperature and other environmental conditions and processes. The period of avian influenza infectivity in bird faeces and secretions depends primarily on pH and temperature conditions, but generally four weeks after infection, avian influenza virus can no longer be detected. In studies of ducks inoculated with an H3N6 strain of avian influenza, faeces stored at 20°C were infective for 7 days and faeces stored at 4°C were infective for 30 days.<br>Given the small number of human cases to date, it is not surprising that information specific to H5N1 persistence in sewage is lacking. Regarding persistence in animal faeces, ducks infected with the H5N1 virus have been found to shed the virus at high titres from the cloacae, with peak levels of virus shedding after three days. The virus was undetectable in faeces that were dried overnight at room temperature (20°C). H5N1 appears to persist in faeces at colder temperatures and produces outbreaks in birds during the colder months of the year. However, current H5N1 strains survive longer in wet faeces at warmer temperatures than previously circulating viruses, which may explain how the virus has re-surfaced in summer months in Asia. Given these observations, we can assume that freshly deposited faeces are highly infective (at any temperature), that H5N1 in faecal deposits on land may be more rapidly inactivated (by drying) than H5N1 in water and that the virus's survival decreases at higher temperatures. |

| | |
|---|---|
| **How might avian influenza virus be transmitted to humans from sewage, excreta and animal wastes?** | The H5N1 virus could potentially enter into sewage in urine or faeces excreted by infected humans or in animal waste that is combined with human sewage. Human and animal excreta are most often managed separately. However, there are settings and scenarios where animal waste may be combined with human waste. If the sewage from poultry houses was mixed with human sewage, for example, there could be a risk of transmitting influenza through interconnected sewage pipes and non-sealed venting with the transmission cycle being completed should contaminated water be consumed or sewage is handled.<br><br>There is some evidence to show that H5N1 is excreted in human faeces, but information on the excretion of H5N1 viruses in urine or faeces by mammalian species, including humans, is exceedingly limited and unlikely to be representative of a potential future human pandemic strain. The isolation of the H5N1 virus from the faeces of a child presenting with diarrhoea followed by seizures, coma and death suggests that the virus may be excreted by infected humans and can enter sewage in this manner. No virus was detected in the urine of this patient.<br><br>Other means of excreta disposal such as latrines are likely to represent an extremely low risk of virus transmission because of the reduced likelihood of aerosol formation. The widespread use of untreated poultry faeces as fertilizer is another possible risk factor.<br><br>Overcrowding, close cohabitation with livestock, high rates of malnutrition, and poor access to health care and public health services are likely to impact the vulnerability of refugees and displaced populations to the H5N1 pandemic. |
| **Should any precautions be taken?** | Providing that poultry house discharge is not mixed with human sewage, there is currently little risk to sewage treatment workers. In the event that human infection with highly pathogenic avian influenza (HPAI) becomes significant, human excreta could contain HPAI viruses shed by humans and the exposure risks to sewage workers would need to be reconsidered. In situations where exposure to potentially infected poultry waste currently exists, there need to be prevention and control measures to reduce airborne droplet and aerosol transmission. |
| **Solid waste** | Appropriate refuse pits or sanitary landfill are necessary.<br>When burying to avoid generating dust, spray the area with water first.<br>Do not handle sick of dead animals. Experienced personal should deal with them, if available. If you have to do it:<br>• Burial is the preferred method for dead poultry disposal, including feeds, eggs and litter. These should be buried at a depth of at least 1 meter and at least 2 meters above ground water table. Covering the buried carcasses with lime is recommended.<br>• Open-air burning of carcasses and contaminated materials is not recommended<br>Infected waste should receive the same attention as medical infectious waste. |

| | |
|---|---|
| **Communication** | Staff from organizations<br><br>The threat of a pandemic will create a high demand for information both within your respective organization and from external partners. It will be vital to coordinate the information that is circulated. A country communication plan should be prepared to rapidly provide proper information to all staff. This should identify who is responsible for coordinating the information and communications at a field and HQ level. Clear internal and external communication will be essential to rapidly deal with rumours and prevent staff anxiety.<br>In the likely event of staff being asked to stay away from the office either to prevent them from being exposed to infection due to their journey or to prevent them infecting their colleagues if they themselves are ill, it is important to have tested communication systems in place. E.g. all staff needed for carrying out essential functions should have a VHF (Very High Frequency) radio as this may become the main and most reliable means of communications.<br>Source: UNHCR |

## Health care settings

| | Emergency level 3<br>(also for emergency phase 6) |
|---|---|
| **Water supply** | |
| See above | |
| | |
| **Hygiene** | |
| **Are soiled surfaces a potential risk?<br>Yes!** | • Cleaning MUST precede disinfection. Items and surfaces cannot be disinfected if they are not first cleaned of any kind of organic matter (patients' excretions, secretions, dirt, soil, etc). Disinfection is a process of killing microorganisms without complete sterilization. Avian influenza virus is inactivated by a range of disinfectants, including:<br>▪ phenolic disinfectants<br>▪ quaternary ammonia compounds<br>▪ peroxygen compounds<br>▪ sodium hypochlorite (household bleach) or calcium hypochlorite, see below<br>▪ alcohol (see below)<br>▪ germicides with a tuberculocidal claim on the label<br>▪ other registered/licensed disinfectants<br><br>• Use manufacturer's recommendations for use/dilution, contact time, and handling.<br><br>• Because mycobacteria have the highest intrinsic level of resistance among the vegetative bacteria, viruses, and fungi, any germicide with a tuberculocidal claim on the label (i.e., an intermediate-level disinfectant) is considered capable of inactivating influenza.<br><br>• Patient rooms/areas should be cleaned at least daily and cleaned thoroughly when the patient has just been discharged. In addition to daily cleaning of floors and other horizontal surfaces, clean frequently touched surfaces (e.g., medical equipment, bed rails, bedside and over-bed tables, TV controls, call buttons, telephones, bathroom surfaces including safety/pull-up bars, doorknobs, commodes, ventilator surfaces and plastic curtains) e.g., bed rails, phones, bathroom surfaces, toilet) twice daily, if possible.<br><br>• Keep areas around the patient free of unnecessary supplies and equipment to facilitate daily cleaning.<br><br>• Bed curtains should be laundered if visibly soiled and/or at hospital discharge.<br><br>• Paper sheeting that is changed between patients is appropriate for patient examination tables in outpatient areas.<br>• Do not spray (i.e., fog) occupied or unoccupied rooms with disinfectant. This is a potentially dangerous practice that has no proven disease control benefit. |

| Is there any risk of transmission through aerosol or dust while cleaning? | |
|---|---|
| **Yes!**<br>A potential risk exists through possible direct inoculation (e.g., via contaminated hands) into the respiratory mucosa (e.g., nose). | To avoid possible re-aerosolisation of influenza virus, avoid dusting methods that disperse dust (e.g., feather dusting) and wet-dust horizontal surfaces by moistening a cloth with a water.<br><br>The optimal combination of Personal Protective Equipment (PPE) for preventing H5N1 transmission during aerosol-generating procedures has not been determined, but PPE should cover the torso, arms, and hands as well as the eyes, nose, and mouth.<br><br>• **Respiratory protection for aerosol-generating procedures**<br>During aerosol-generating procedures, there must be minimal leakage of the respirator's face-seal to fully protect health care workers from exposure to small-particle aerosols. The following respiratory protection options should be considered:<br>– Disposable particulate respirators (particulate masks e.g., N-95 or equivalent) are the minimum level of respiratory protection required for health care workers performing aerosol-generating procedures.<br>– To ensure adequate protection, health care workers should be fit-tested to the disposable respirator (particulate mask) model that they will wear and know how to perform a user seal check. A user seal check should be performed each time a respirator is put on, before entering the patient room.<br>– Some factors to consider when choosing respirators in this setting include availability, impact on mobility, impact on patient care, potential for exposure to higher levels of aerosolized respiratory secretions, and potential for reusable respirators (particulate masks) to serve as fomites for transmission.<br><br>• **Engineering controls for aerosol-generating procedures**<br>Perform the procedure in a negative pressure room (if available); if a negative pressure room/area cannot be created:<br>– Perform the procedure in a private room, away from other patients.<br>– If possible, increase air exchanges, create a negative pressure relative to the hallway, and avoid recirculation of the room air.<br>– If recirculation of air from such rooms is unavoidable, pass the air through a HEPA filter before recirculation.<br>– Cleaning devices, such as portable HEPA filtration units, may be used to further reduce the concentration of contaminants in the air.<br>– Keep doors closed except when entering or leaving the room, and minimize entry and exit during the procedure. |

| | |
|---|---|
| **Linen and laundry of an H5N1 infected person** | **Standard precautions** are recommended for linen and laundry that might be contaminated with respiratory secretions from suspected or confirmed H5N1 infected patients:<br>• Place soiled linen directly into a laundry bag in the patient's room. Contain linen in a manner that prevents the linen bag from opening or bursting during transport and while in the soiled linen holding area.<br>• Wear gloves and gown and mask when directly handling soiled linen and laundry (e.g., bedding, towels, personal clothing) as per standard precautions.<br>• Do not shake or otherwise handle soiled linen and laundry in a manner that might create an opportunity for disease transmission or contamination of the environment.<br>• Wear gloves for transporting bagged linen and laundry.<br>• Practice good hand hygiene after removing gloves that have been in contact with soiled linen and laundry.<br>• Wash with soap, rinse then soak in 0.5% chlorine and dry linen according to routine standards and procedures. |
| **Waste water** | |
| | See above |
| | |
| **Sanitation** | |
| | See above |
| | |
| **Waste** | |
| **Does waste management requires specific attention?**<br>**Yes!**<br>Standard precautions when working with solid waste (clinical* and non-clinical) that may be contaminated with avian influenza H5N1 virus are required and plan for increased waste volumes with increased patient numbers | • All waste generated in the isolation room/area should be disposed of in suitable containers or bags.<br>• Used patient care supplies that are not likely to be contaminated (e.g., paper wrappers) may be discarded as non-clinical (routine) waste.<br>• All waste from an isolation room/area that may be contaminated with influenza A (H5N1) should be treated as clinical (infectious) waste and "red or yellow-bagged" or labelled as "biohazard" and should be treated and disposed of as per facility policy and in accordance with national regulations pertaining to such waste.<br>• One waste disposal bag is usually adequate, providing waste can be placed in the bag without contaminating the outside of the bag. If that is not possible, two bags are needed (double bagging).<br>• Liquid waste such as urine or faeces can be safely flushed into the sewer system if there is an adequate sewage system including treatment in place.<br>• Outside of the isolation room/area, gloves should be worn when handling waste and hand hygiene should be performed after glove removal. |

* Clinical waste, includes waste directly associated with blood, body fluids secretions and excretions; laboratory waste that is directly associated with specimen processing, human tissues, including material or solutions containing free-flowing blood, and animal tissue or carcasses used for research; and also includes discarded sharps.

| | |
|---|---|
| | **Dishes and eating utensils**<br>Use **standard precautions** for handling dishes and eating utensils used by patients with suspected or confirmed influenza A (H5N1) infection:<br>• Wear gloves when handling patient trays, dishes, and utensils.<br>• Wash reusable items in a dishwasher with recommended water temperature, when possible then soak into chlorine for disinfection.<br>• Disposable items or left over from food should be discarded with other infectious waste.<br><br>**Appropriate corpse management**<br>• Body should be wrapped and leaking of body fluids should be avoided<br>• Assess/identify site for burial<br>• Identify body handlers and burial team<br>• Use of PPE and heavy-duty equipment for the burial team<br>• Knowledge of standard precautions |

## Public Buildings

| | **Emergency level 3<br>(also for emergency phase 6)** |
|---|---|
| **For those responsible for the management of a building or large public facility: what preparations should be put in place to pre-empt H5N1 influenza spreading by human-to-human contact?** | Minimizing the exposure of humans to the virus is a key way to reduce the risk of human infection. The focus of prevention measures by building owners/managers should be (1) encouraging frequent hand washing, (2) ensuring that occupants and visitors have access to facilities for proper personal hygiene and (3) ensuring that surfaces in frequently populated areas are cleaned regularly.<br><br>Hand hygiene, which includes hand washing with soap and water, is critical to prevent possible self-inoculation and the transfer of microorganisms to the environment or others by contaminated hands. Hands should be washed several times each day depending on the frequency of contact and exposure to public facilities. When washing hands with soap and water, first wet hands with water, then apply an amount of product recommended by the manufacturer to hands and rub hands together vigorously for at least 40 seconds, covering all surfaces of the hands and fingers. Rinse hands under running water and dry thoroughly with a disposable towel. Use towel to turn off the faucet. Although antimicrobial soap may be used, there is no evidence that it provides additional protection from viral infection. It is the mechanical action of abrading the skin through rubbing that makes hand washing an effective method for the removal of virus particles.<br><br>In educating building occupants about hand hygiene, it is important to note that alcohol-based hand rubs are only effective when hands are not visibly soiled and are free of proteinaceous material. If hands are visibly soiled or contaminated with proteinaceous material, hand washing with water and soap must be performed. When decontaminating hands with an alcohol-based hand rub, apply product to palm of one hand and rub hands together, covering all surfaces of hands and fingers, until hands are dry. Follow the manufacturer's recommendations regarding the volume of product to use. Ethyl alcohol has greater activity against viruses than isopropyl alcohol, and therefore, may be preferable.<br><br>Environmental cleaning and disinfection is intended to remove pathogens from contaminated surfaces and items, thus breaking the chain of transmission. Disinfection is a process of killing microorganisms without complete sterilization. Cleaning MUST precede disinfection. Items and surfaces cannot be disinfected if they are not first cleaned.<br><br>Apart from healthcare settings, the priority for most buildings and public facilities is cleaning rather than disinfection. Cleaning should focus on *high traffic* areas including entry/exit ways, bathrooms, public eating areas and food dispensaries (cafeteria tables, vending machines), lobby facilities (information counters, kiosks, public telephones), elevators panels, stairway rails and other common-area surfaces (tables and door handles of frequently used meeting rooms and libraries).<br><br>Commercial cleaning products, when used properly according to the manufacturer's specifications, are sufficient to remove pathogens including influenza virus. Cleaning of frequently touched surfaces should be performed twice daily, if possible. |

## References:


Ali J, Dolan M, Fendler E, Larson E. Alcohols. In: Block S, ed. *Disinfection, sterilization and preservation*. 5 ed. Philadelphia: Lippincott, Williams, and Wilkins; 2000:229-253.

*Buxton Bridges CB, Kuehnert MJ, Hall CB. Transmission of influenza: implications for control in health care settings.* Clin Infect Dis. *2003;37(8):1094-1101*

CDC. Guideline for Hand Hygiene in Health-Care Settings. *MMWR.* 2002;51(RR16):1-44.

Department of Population Health College of Veterinary Medicine, The University of Georgia. Highly Pathogenic Avian Influenza Virus H5N1 and Wild Birds, 2005.

Rosenbaum R, Benyo J, O'Connor R, et al. Use of a portable forced air system to convert existing hospital space into a mass casualty isolation area. Ann Emerg Med. 2004;44(6):628-634.

Schurmann W, Eggers H. Antiviral activity of an alcoholic hand disinfectant: comparison of the in vitro suspension test with in vivo experiments on hands, and on individual fingertips. *Antiviral Res.* 1983;3:25-41.

WHO. Guidelines to be used for producing minimum standards for water, sanitation, hygiene and waste management in health-care settings, with specific reference to developing countries, draft under progress.

WHO. Guidelines for Drinking-water Quality, third edition, 2004.

WHO. Consensus document on the epidemiology of severe acute respiratory syndrome (SARS)

WHO/CDS/CSR/GAR/2003. Available at: http://www.who.int/csr/sars/en/WHOconsensus.pdf. Accessed 14 November 2005.


## Additional Reading:


Bean B, Moore B, Sterner B, Peterson L, Gerding D, Balfour HJ. Survival of influenza viruses on environmental surfaces. *J Infect Dis.* 1982;46(1):47-51.

Buxton Bridges C, Katz JM, Seto WH, et al. Risk of influenza A (H5N1) infection among health care workers exposed to patients with influenza A (H5N1), Hong Kong. *J Infect Dis.* 2000;181(1):344-348.

CDC. Guidelines for Environmental Infection Control in Health-Care Facilities. MMWR. 2003;52(RR10):1-42.

Fowler R, Guest C, Lapinsky SE, et al. Transmission of Severe Acute Respiratory Syndrome during Intubation and Mechanical Ventilation. *Am J Respir Crit Care Med.* 2004;169:1198-1202.

Goldmann D. Transmission of viral respiratory infections in the home. *Pediatr Infect Dis J.* 2000;19(10 Suppl):S97-102.

Healing TD, Hoffman PN, Young SEJ. The infection hazards of human cadavers. Commun Dis Rep CDR Rev. 1995;5(5):R61-68.

Katz JM, Lim W, Bridges CB, et al. Antibody response in individuals infected with avian influenza A (H5N1) viruses and detection of anti-H5 antibody among household and social contacts. *J Infect Dis.* 1999;180(6):1763-1770.

Klein M, Deforest A. Principles of Viral Inactivation. *Disinfectants, Sterilization, and Preservation*. 3 ed. Philadelphia: Lea and Febiger; 1991:222-434.

Lidwell OM. Aerial dispersal of micro-organisms from the human respiratory tract. *Soc Appl Bacteriol Symp Ser.* 1974;3(135-154).

Loosli D, Lemon H, Robertson O, Appel E. Experimental airborne influenza infection. I. Influence of humidity on survival of virus in air. *Proc Soc Exp Biol Med.* 1943;53:205-206.

Sehulster L, Chinn R. Guidelines for environmental infection control in health-care facilities. Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). *MMWR.* 2003;52(RR-10):1-42.

WHO. Infection control recommendations for avian influenza in health-care facilities, Aide-Memoire, April 2006.

WHO. Avian Influenza A (H5N1) in Humans - Interim Infection Control Guideline for Health Care Facilities, revised February 2006.

WHO. Guidelines on Hand Hygiene in Health Care (Advanced Draft), May 2005.

WHO. Inter-country-consultation: influenza A/H5N1 in humans in Asia: Manila, Philippines, 6-7 May. 2005.

WHO/UNHCR Pandemic influenza preparedness and mitigation in refugee and displaced populations, May 2006.

Zhong N, Zeng G. Our strategies for fighting severe acute respiratory syndrome (SARS). *Am J Respir Crit Care Med.* 2003;168:7-9.