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## I. Introduction

The ability of containment strategies to substantially slow the spread of pandemic influenza may be limited by the short incubation period for influenza, the large proportion of asymptomatic infections, and the non-specific nature of clinical illness from influenza infection. These challenges may lead to difficulty in identifying infected persons, in quarantining contacts of infected person prior to onset of illness, and in marshalling the substantial resources that would be needed to initiate and monitor the use of containment measures. Nonetheless, during early stages of a pandemic, particularly if the novel influenza virus is not efficiently transmitted, use of containment measures may help to slow the spread of a pandemic influenza A virus and allow additional time for the development and use of a vaccine and the production and use of antiviral medications.

This document is intended to provide guidance to public health officials on the use of influenza containment strategies in response to an influenza pandemic

## II. Background

Influenza can be highly contagious, particularly among persons without pre-existing antibodies against influenza, such as young children during the inter-pandemic phase influenza and anyone during a pandemic. *(See the Pandemic Influenza core plan for a brief discussion of the WHO pandemic phases and Website Resources for more detailed references.)* The typical incubation period of influenza is two days (range one to four days). Viral shedding, and the period during which a person may be infectious to others, generally peaks on the second day of symptoms, but may begin the day before symptoms start, and typically lasts five to seven days in adults. Young children and immunocompromised persons may shed virus and be infectious for three weeks or longer. The amount of virus shed and the length of time of viral shedding may be prolonged during initial infection with a new influenza subtype.

### A. Symptoms

Clinical symptoms of influenza can range from mild upper respiratory tract illness with no elevation in temperature to illness characterized by high fever, constitutional symptoms, and cough. Young children may present with sepsis-like syndrome (high fevers, low blood pressure and rapid heart rate) or febrile seizures, and one-third may have diarrhea. Thus, the symptoms of influenza are often non-specific and wide-ranging, making influenza difficult to differentiate from other causes of respiratory illness based on the clinical presentation alone. Complications of influenza include viral and/or bacterial pneumonia, heart failure, muscle aches and inflammation ("myositis"), Reye syndrome, and inflammation of the brain ("encephalopathy"), among others.

### B. Transmission and Infection Control Strategies in Healthcare Settings

The ability of one person to infect another relates, in part, to the amount of virus shed by the infected person during their acute infection. Studies in healthy persons have shown that the

amount of virus shed correlates with the height of an infected person's temperature. However, approximately 50 percent of persons infected with influenza do not develop symptoms, but still may shed virus. The relative importance of asymptomatically or mildly asymptomatically infected persons in the spread of influenza is unknown, but may allow for unrecognized transmission.

**Routes of influenza transmission**

*Direct and indirect contact transmission*

Direct transmission involves direct body-to-body surface contact. Indirect transmission occurs via contact with contaminated intermediate objects such as contaminated hands or inanimate objects such as needles or countertops.

*Droplet transmission*

Droplet transmission occurs when contagious droplets produced by the infected host are propelled a short distance through coughing or sneezing and can come into contact with another person's conjunctiva, mouth or nasal mucosa. Since these droplets generally are large (greater than10 micrograms and do not stay suspended in the air, this mode of transmission is not affected by special air handling or control of room pressures.

*Droplet nuclei (airborne) transmission*

This entails the production of infectious droplet nuclei, generally 5 micrograms or less in diameter. In contrast with larger droplets, these droplets can remain suspended in the air and be disseminated by air currents in a room or through a facility to be inhaled by a susceptible host. Preventing the spread of droplet nuclei requires the use of special air handling and ventilation procedures.

Evidence supporting the relative contribution of each route of transmission for influenza is limited; however, droplet transmission is thought to be the predominant form of spread in a setting with an appropriate number of air exchanges and standard ventilation. In the absence of appropriate ventilation and air exchange, airborne transmission may play a greater role, such as in a crowded space where air exchange is limited. Experimental studies on the transmission of influenza are restricted mostly to animal studies. However, observations in hospitals and nursing homes indicate that influenza outbreaks in these settings are more likely explained by droplet transmission or by contact with health care workers rather than by airborne transmission through the ventilation systems. Outbreaks of inter-pandemic influenza in these settings can be controlled through the use of a combination of control measures, including influenza vaccine, antiviral medications, and the use of standard and droplet precautions. Further, such outbreaks have been controlled without the use of negative pressure rooms and isolation precautions specific for airborne diseases.

**Recommended influenza isolation precautions in health care settings**

- The patient should be placed in a private room or a room with other influenza-infected patients.
- Although airborne spread is not believed to play a major role in influenza transmission, if feasible early in a pandemic, the patient should be placed in a negative air pressure room or placed together with other patients with suspected

or proven influenza in an area of the hospital with an independent air supply and exhaust system.

- Health care personnel should wear a surgical mask when entering the room of a patient with known or suspected influenza.
- Health care personnel should use standard plus droplet and contact precautions, including hand washing, use of gloves, and gown and eye protection if they are apt to come into contact with body fluids or contaminated surfaces.

**C. Community Transmission Control Strategies Used in Past Pandemics**

During prior pandemics, use of masks, closing of schools, and restrictions on large public gatherings and meetings were recommended to prevent community spread. These strategies, however, generally were not found to be effective, possibly because they tended to be instituted late in the outbreak and were not strictly adhered to, or because the control measures were not appropriate to the principle modes of transmission of influenza virus. Successful quarantines were rare. One notable exception was the successful prevention of the introduction of Spanish Flu into American Samoa. In this instance, strict quarantine and isolation were initiated and maintained from 1918 to 1920, including stoppage of mail service and restriction of travel to and from other Samoan Islands. In Western Samoa where influenza was introduced, death tolls were high. Knowledge of the severe health consequences seen in Western Samoa were a substantial motivating factor for persons living on American Samoa and solidified public support for the extreme isolation measures.

In Alaska, quarantine and isolation measures may have delayed introduction of Spanish Flu into the Alaskan Interior for several months, and some very isolated villages were completely spared. Quarantining ships' passengers and crew for five days was not always successful as influenza appears to have been introduced to more than one Alaskan coastal village by healthy, presumably asymptomatically infected persons.

## III. Containment in Healthcare Settings and the Community

**Goal of Containment Measures**

To slow the spread of pandemic influenza as much as possible in order to provide additional time for the development, manufacture, distribution and administration of influenza vaccine and the manufacture and the distribution of influenza antiviral medications



Strategies to achieve this goal must take into consideration the modes of transmission of influenza, the short incubation period, the non-specific clinical presentation, the likelihood of asymptomatically infected persons who may be involved in transmitting infection, and past experience in the use of containment measures during influenza pandemics. Because of the uncertainty of the benefits of containment measures for pandemic influenza, the effectiveness and compliance with such measures and the resources necessary to initiate and enforce compliance should be continually evaluated.

The two main strategies for prevention of transmission involve 1) decreasing contact between infected and uninfected persons; and 2) decreasing the probability that contact will results in infection if contact occurs (*see Table*). Interventions to achieve these objectives can be implemented in healthcare settings and in the community.

**Table**. Possible influenza transmission prevention strategies for healthcare settings and the community.

| | **Healthcare setting** | **Community** |
|---|---|---|
| **Decrease potential for contact** | • Private room or cohorting with other influenza patients<br>• Negative pressure room, if feasible<br>• Designate specific wards or hospitals for admission of case patients<br>• Minimize transportation of patient outside of room<br>• Limit the number of healthcare workers caring for influenza patients<br>• Limit number of visitors to influenza patients | • Provide advisories or limit travel to areas where a novel influenza strain is causing disease<br>• Screen travelers for febrile and respiratory illness on exit from an area where a novel influenza strain is causing disease or on entrance to the U.S.<br>• Cancel large group gatherings<br>• Close schools<br>• Encourage telecommuting<br>• Limit availability of public transportation |

| | | |
|---|---|---|
| | • Environmental decontamination for influenza following existing guidelines | • Avoid unnecessary visits to hospitals<br>• Discourage hand shaking<br>• Identify cases early through public education and self-assessment for symptoms, including fever, leading to early isolation at home or in healthcare settings<br>• Early quarantine of contacts of suspected cases |
| **Decrease potential for infection if contact occurs** | • Antiviral chemoprophylaxis for health care workers<br>• Vaccination of health care workers<br>• Hand hygiene<br>• Respiratory hygiene/cough etiquette<br>• Standard and droplet precautions including use of gowns, gloves and masks by healthcare workers or visitors to influenza patients | • Hand hygiene<br>• Respiratory hygiene/cough etiquette<br>• Wear masks in public<br>• Antiviral chemoprophylaxis or vaccination if available |

The meeting was titled: WHO consultation on priority public health interventions before and during an influenza pandemic http://www.who.int/csr/disease/avian_influenza/en/Public_health_interventions.pdf (this is the section on public health interventions…

Prioritizing the importance of any or all of these recommended procedures for influenza prevention is hindered by the lack of data demonstrating their relative efficacy in various settings, particularly outside of a health care setting. Biological characteristics of the influenza virus, experience with infection control in healthcare settings, and experience from investigating influenza outbreaks in hospitals and long-term care facilities provide support for specific interventions to decrease contact with influenza viruses. Influenza viruses are known to survive on non-porous surfaces such as steel and plastic, for up to 24 to 48 hours after inoculation and from cloth, paper, and tissues for up to 8 to 12 hours. Viable virus can be transferred from non-porous surfaces to hands for 24 hours and from tissues to hands for 15 minutes. A clinical study on hand washing has shown a reduction in total respiratory illnesses although the study subjects were not tested specifically for influenza. A separate study demonstrated that hand sanitation using a commercially available ethanol-based hand rub had viricidal activity against influenza viruses. Although the effectiveness of hand washing or the use of other forms of hand hygiene on influenza transmission have not been studied, this measure is prudent the available data and the relative ease of instituting hand hygiene measures.

Observational studies and observations in hospitals indicate that transmission from one patient to others occurs most often in persons nearest the infected patient and that health care workers are important spreaders to patients on the same or different wards. These observations suggest that

infection control measures to limit droplet as well as contact spread may be helpful. There is less data to support the clinical importance of isolation procedures (such as negative pressure rooms) to limit airborne transmission in the setting of normal air exchange. Further, the number of such rooms is limited and likely would be insufficient to handle the number of hospitalized patients expected in a pandemic. However, early in a pandemic when few cases have been identified, this strategy may be helpful in limiting spread to other patients, health care workers, or hospital visitors. Extrapolating from the available data, frequent hand washing or other hand hygiene practices, increasing ventilation, and possibly use of masks and gloves may prevent some transmission in households where infections have occurred.

New antigenic variants of influenza and new influenza subtypes can rapidly spread throughout the globe. This rapid spread is facilitated by the globally mobile nature of our society, although even during previous influenza pandemics, new subtypes spread around the world in less than 1 year after their initial recognition. Whether such spread could be slowed with earlier detection of new viruses and travel advisories, screening travelers or restrictions on travel is not known.

Isolation and quarantine can be very effective in preventing the spread of infectious conditions but several substantial challenges may limit their usefulness during an influenza pandemic.

- The short incubation period for influenza makes it difficult to identify and quarantine contacts of pandemic influenza-infected persons before they become ill and have spread infection to others. By contrast, the longer incubation periods for smallpox (about 14 days) and SARS (up to 10 days) make this a more effective control strategy for those infections;
- A high rate of asymptomatic influenza illness means that many potential spreaders of influenza will not be identified and their contacts not quarantined.
- The wide range of clinical symptoms that may be expressed by influenza infected persons are common to many different pathogens and would necessitate isolation and quarantine of large numbers of persons, many of whom will not be infected with influenza. Consequently, it would require an extraordinary level of resources to implement and enforce the containment measures during a pandemic.

Whether to consider the use of isolation and quarantine in an influenza pandemic may depend, in part, on the transmission rate of the pandemic virus, the susceptibility of the population, the geographic distribution of influenza-infected persons, and the severity of illness associated with infection. All of these parameters may change in the course of a pandemic and would require frequent re-evaluation as a pandemic progressed.

## IV. Influenza Containment Strategies by Pandemic Stage

*(See the core plan for a brief discussion of the WHO pandemic phases and Website Resources for more detailed references.)*

### A. Phase 0, Level 0 *(Inter-pandemic period with no identified novel influenza virus strain in humans)*

No use of community or individual containment measures outside of the health care setting is recommended at this phase and level. Continue to encourage the use of influenza vaccine for persons at increased risk of influenza complications, their household contacts, and health care workers. Encourage the use and application of current recommended strategies to prevent health care-acquired influenza. Familiarity with these recommended strategies will help to minimize start-up time for implementing pandemic-level influenza containment strategies in the health care setting when a pandemic virus emerges.

**B. Phase 0, Levels 1 and *2 (Novel virus alert)***

This phase indicates laboratory confirmation of infection of humans with a novel influenza A virus, initiating a "novel virus alert". Several novel virus alerts have been issued since 1977, none of which progressed to a pandemic. These include isolated cases and limited clusters of swine H1N1 influenza virus infections, avian H5N1 infections in 1997 (18 persons hospitalized) and 2003 (two persons hospitalized), avian H9N2 in 1999 (2 persons hospitalized), avian H7N7 in 2003 (83 human illnesses, including one death), and avian H5N1 in 2004 (34 human illnesses, including 23 deaths as of May 2004). Control measures have included culling of poultry and protection of those who may have been exposed to the avian influenza virus, particularly those with high-level exposure (e.g., those doing the culling). Protective measures include the use of personnel protective equipment (PPE) and receipt of influenza antiviral medication for chemoprophylaxis. PPE used may reflect healthcare resources available in the affected area. In addition, exposed persons received influenza vaccine directed against human circulating strains to decrease the likelihood of reassortment occurring between the avian virus and a human strain. Strict infection control in healthcare settings, including the use of droplet nuclei precautions among hospitalized cases in Hong Kong in 1997, also was implemented. In each outbreak, the novel influenza virus contained only avian influenza genes and person-to-person transmission was limited. The relative roles of vaccine, antiviral medication, PPE, culling of infected bird flocks, and hospital infection control measures in the preventing spread of these avian viruses is not known. However, reducing the amount and source of the avian viruses through culling of affected flocks was associated with an end to new human cases.

When a novel virus alert occurs, epidemiological investigations should be conducted and containment measures of persons in the affected area should be implemented. If the novel virus is a human/animal virus reassortant, the possibility of person-to-person transmission is elevated and containment measures may be more important to limit spread of the novel virus. Nonreassorted viruses may be less efficiently spread, but spread should still be contained aggressively to prevent further cases and increase the possibility of co-infection with circulating human influenza viruses and reassortment.

1. **Possible containment measures if cases are first detected in the U.S.**
    a. Initial actions
        - Increase collection of respiratory specimens from persons with acute febrile and respiratory illnesses with subtyping of all influenza A isolates, particularly in the affected region.

- Persons who are positive for influenza A should be placed in isolation until subtyping of their isolate can be accomplished. Isolation may be at home or, if medically necessary, in a hospital. Isolation should continue for at least seven days or until viral shedding is no longer detected, whichever is longer, or until the isolate is laboratory-confirmed not to be a novel influenza A virus.

b. If an animal source is identified with ongoing transmission within the animal population
   - Coordinate with agricultural authorities to eliminate the source of the novel virus from domestic animals as much as possible.
   - Advise persons who may be in contact with potentially infected animals to
     - wear PPE
     - receive influenza vaccine to reduce the possibility of a co-infection with novel influenza virus and circulating human influenza virus and their reassortment
     - use antiviral chemoprophylaxis
   - Monitor for febrile, respiratory and conjunctival illness among persons exposed to infected animals or the animals' contaminated environment
   - If persons exposed to the animal source of influenza become ill
     - Isolate at home or, if medically necessary, in a hospital for seven days or viral shedding is no longer detected, whichever is longer, or until the viral isolate is laboratory-confirmed not to be a novel influenza A virus.
     - Coordinate with local public health officials to conduct rapid testing for influenza and arrange for viral culture of respiratory specimens at designated facilities.
     - Provide antiviral medication for treatment, although its use would not affect isolation instructions since infected persons taking antiviral medication still may shed influenza virus (and possibly antiviral drug-resistant viruses).

c. If no animal source is identified
   - Initiate studies to determine epidemiologic links between infected persons.
   - Isolate persons with known or suspected influenza at home or, if medically necessary, in a hospital for seven days or until viral shedding is no longer detected, whichever is longer, or the viral isolate is laboratory-confirmed not to be a novel influenza A virus.
   - Quarantine contacts of infected persons at home for seven days or until influenza is ruled out in their contact. (Contacts are defined as persons residing in the same home and persons working within six feet of a suspected person.)

**2. Possible containment measures if cases are first detected outside of the U.S.**

a. Increase surveillance for influenza with subtyping of a higher proportion of influenza A isolates.

b. Increase surveillance for influenza-like illness among recent travelers to the affected region and subtype all influenza A isolates obtained.
c. If a person is a recent (within seven days) traveler to the implicated region, consider isolation if they have influenza-like-illness and perform testing for influenza A. If influenza is suspected or confirmed, isolate at home or, if medically necessary, in a hospital for seven days or until viral shedding is no longer detected, whichever is longer, or until the viral isolate is laboratory-confirmed not to be a novel influenza A virus.

### C. Phase 0, Level 3 *(Human-to-human transmission of a novel influenza virus is confirmed)*

Very limited person-to-person transmission occurred during the 1976 Swine influenza outbreak in the U.S., the 1997 H5N1 avian influenza outbreak in Hong Kong, and may also have occurred during the 2003 H7N7 avian influenza outbreak in the Netherlands. None of these outbreaks progressed, however, to the next pandemic level possibly because none of these viruses were animal/human reassortants and, in case of the avian influenza outbreaks, aggressive efforts to eliminate the domestic animal reservoir were carried out. For interpandemic influenza, person-to-person transmission occurs efficiently with each case infecting an average of three to four susceptible persons; secondary household illness rates greater than 20 percent have been reported. A threshold rate of secondary transmission has not been established for declaration of a *Phase 0, level 3* "pandemic alert". This outline assumes laboratory-confirmed person-to-person transmission is documented in more than the rare instance and that public health officials have concluded, based on available data, that sustained community transmission is possible. The short incubation period of influenza, the severity of illness caused by the novel virus, and support of the community must be taken into account when considering containment measures at this stage.

**1. Possible containment measures if cases are detected in the U.S.**

a. Isolate confirmed or suspected influenza cases at home, or if medically necessary, in a hospital for seven days or until viral shedding has stopped, whichever is longer; or until the infection is confirmed by laboratory testing not to be caused by the novel influenza A virus.
b. Quarantine contacts of cases and their contacts. Such quarantine may be lifted after seven days given the short incubation period for influenza.
c. Discourage or cancel large gatherings in the affected region depending on the level of person-to-person transmission.
   - If some cases are children, consider school closures in the affected region.
   - Closures of specific office buildings, colleges/universities or other groups should be considered based on the epidemiology of known infected case patients.

**2. Possible containment measures if cases are occurring outside of the U.S.**

a. Issuance of a travel advisory recommending limiting travel to the affected region and screening travelers from the affected region for illness compatible with influenza.
b. Notification of persons arriving in the U.S. from the affected region that they should isolate themselves in their home or other lodging and notify public health officials if they become ill.
c. Same as per instructions in Phase 0, Level 2

**D. Phase 1** ***(outbreaks occur in one or more countries and a pandemic is declared)***

Containment measures are less likely to be effective at this stage as the efficiency of person-to-person transmission is likely to be greater, although such measures may help to slow the spread of influenza and allow time for vaccine and antiviral drug production and distribution.

1. **Possible containment measures if spread within the U.S.**
   a. Discourage or ban large indoor gatherings (such as meetings and conferences)
   b. School closures, including universities vs. limiting class size and holding meetings outside when possible
   c. Isolation of persons with confirmed or suspected influenza A as in phase 0 and quarantine of persons exposed to suspected or confirmed cases

2. **Spread outside of the U.S.**
   See recommendations for *Phase 0, level 3*.

**E. Phases 2-5** ***(from regional disease or U.S. outbreaks, through the end of first and subsequent pandemic waves)***

Containment measures in *Phases 2 to 4* may be similar to those in *Phase 1*, although involving multiple regions and at increased cost and logistical difficulty. Use of such measures should be considered in the context of available vaccine and antiviral medication, the level of cooperation on the part of the public, resources available to implement and monitor compliance with containment measures, and the severity of illness. Assessment of compliance with containment measures and their effectiveness should be conducted on an ongoing basis during *Phases 2 to 5* and changes made based on these factors and on emerging epidemiologic information. In the case of a pandemic with the severity of the 1918 Spanish Flu, all available prevention tools should be used. However, for less severe disease, such as the 1968 Hong Kong Flu, continuation of containment measures at this stage may not be acceptable.

**Definitions of terms**

**Containment measures:** Isolation, surveillance, and quarantine used together. When these tools are applied to an individual or individuals not defined by geographic area (including population-specific measures), the term refers to *individual containment measures***.** When these tools are applied to a group of persons in a specific geographic area, the term refers to *community containment measures*.

**Isolation:** Restriction of movement or activities or separation of an ill person(s) with contagious disease

- Usually in hospital, but can be in home or dedicated isolation facility
- Typically applied on an individual level

**Quarantine:** Restriction of movement and activities or separation of well person(s) believed to have been exposed to a contagious disease

- Usually at home, but can be in a dedicated facility or hospital
- Can be applied to individuals, populations, or geographic areas
- Can be applied to restriction of movement into or out of buildings, other structures, and large conveyances, such as a plane or ship.

**Surveillance:** Close observation of a well person(s) exposed to a contagious disease for signs and symptoms of disease

- Usually at home, but can be in dedicated facility or hospital–can be passive relying on spontaneous reporting from the person(s) or active where information is systematically and periodically obtained for all persons under surveillance
- Can be applied to an individual or a population