Pandemic Influenza Planning Assumptions[1]

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This document contains assumptions for SC preparedness planning. These planning assumptions were originally developed in 2006 to address the avian influenza H5N1 pandemic threat. We believe that much of the information here is likely relevant more generally, to pandemic threats from novel viruses involving person-to-person respiratory transmission. Please send comments, suggestions for improvement, and questions to estarbuck@savechildren.org.

Influenza pandemics are global epidemics caused by new flu viruses which evolve from birds or animals to allow sustained person-to-person respiratory transmission. Since the 16th century, there has been an average of about three flu pandemics per century. While the 1918 pandemic is estimated to have killed 50 to 100 million people,[2,3,4] the most recent pandemic, the 2009 "swine flu," was very much milder.

The concern today is that another virus, such as the H5N1 or the H7N9 avian flu viruses, or the MERS coronavirus, could evolve to cause a severe pandemic. In such an event, vaccine and antiviral treatment would likely be unavailable for much or all of the world's population during at least the first several months. Although risk of onset in the next year, or in the next decade, of a severe pandemic involving respiratory transmission of a novel virus cannot be quantified, such an event is considered to be an important global threat by leading organizations.

I. Pandemic Influenza Threat & General Planning Assumptions

While many characteristics of the next influenza pandemic can be predicted based on experience from the last four influenza pandemics (1918, 1957, 1968, 2009) and the inter-pandemic periods, some of the specific characteristics of a new pandemic virus will remain uncertain until after specific information becomes available following pandemic onset. Thus, some characteristics of the pandemic (including those related to the severity of illness in general, and by demographic / risk group, the relative importance of different modes of transmission, the effectiveness of preventive measures, antiviral drug effectiveness, & immunity following recovery) must be monitored during the pandemic and related interventions modified after pandemic onset.

1. Pandemic influenza is different from avian influenza. Influenza pandemics are caused by influenza viruses in birds or animals that adapt to allow efficient & sustained person-to-person transmission. The main direct threat to human health is from pandemic influenza, not from avian influenza.

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[1] These assumptions, originally drafted in 2006, & revised in 2007, were based on WHO http://www.who.int/csr/disease/influenza/pandemic10things/en/index.html & the US plan, http://www.hhs.gov/pandemicflu/plan/part1.html. Revisions in this update reflect Pandemic Influenza Risk Management: WHO Interim Guidance, 2013, Annex 2: http://www.who.int/influenza/preparedness/pandemic/GIP_PandemicInfluenzaRiskManagementInterimGuidance_Jun2013.pdf?ua=1 & the UK Influenza Pandemic Preparedness Strategy, Scientific Evidence Base Review, March 2011, last updated, June 2014: https://www.gov.uk/government/publications/review-of-the-evidence-base-underpinning-the-uk-influenza-pandemic-preparedness-strategy

[2] Taubenberger JK, Morens DM. 1918 Influenza: The Mother of All Pandemics. Emerg Infect Dis 2006;12:20: http://wwwnc.cdc.gov/eid/article/12/1/pdfs/05-0979.pdf

[3] Johnson NPAS, Mueller J. Updating the Accounts: Global Mortality of the 1918–1920 "Spanish" Influenza Pandemic, Bull. Hist. Med., 2002, 76: 105–115: www.birdflubook.org/resources/NIALL105.pdf

[4] The world population was about 1.8 billion in 1918, about ¼ of the 2014 population of about 7.2 billion.

2. Influenza pandemics are global epidemics. Measures such as border closures, & travel restrictions, may delay arrival of the virus, but are unlikely to stop it (because of substantial transmission from those with mild non-specific symptoms, peak transmission around the time of symptom onset, and flu's short serial interval / generation time of about 3 days – all very different from SARS, and because of respiratory modes of transmission – see below. These factors also make "containment" infeasible, except perhaps at the very start of a pandemic at the site of onset). Geographical spread will be rapid, and virtually all communities on earth will experience outbreaks.

3. Influenza pandemics are recurring events, with 11 recorded since 1732, with no recognizable pattern in timing. There is widespread expert agreement that another pandemic will occur, though when this will happen remains very uncertain.

4. Once the pandemic starts, 25% - 45% of all people on earth will likely become ill during 1 – 3 waves (outbreaks) over a period of time which may last up to approximately 1½ years. Clinical symptoms of uncomplicated pandemic influenza are expected to be similar to those of seasonal influenza: respiratory symptoms, fever, and abrupt onset of muscle ache and headache or backache.

5. Susceptibility to the pandemic influenza subtype will be universal. (Anyone can get it.) Because a pandemic virus is new to humans, there is little pre-existing immunity, & disease may be more serious than that caused by seasonal influenza. Risk groups for severe and fatal infection cannot be predicted with certainty but are likely to include infants, the elderly, pregnant women, and persons with chronic or immunosuppressive medical conditions. One characteristic of flu pandemics is the younger age-distributions of cases involving severe illness and death, compared with the older age distributions of severe illness and death associated with seasonal influenza. In 1918, most deaths occurred among young, previously healthy adults, while case-fatality was highest among pregnant women.

6. The number deaths will largely depend on the virulence of the pandemic virus. The 1918 – 1919 pandemic caused 50 – 100 million deaths worldwide (when global population was a quarter of what it is now), & nearly 675,000 deaths in the US. In 1957-58 there were approximately 2 million deaths worldwide and 70,000 deaths in the US, & in 1968-69, 1 million worldwide and 34,000 in the US. The US CDC estimates that between 8,870 and 18,300 H1N1 related deaths occurred in the US between April 2009 and April 2010 (fewer than the 24,000 average number of deaths from seasonal influenza, though the age distribution of deaths in 2009 was strikingly younger than that seen with seasonal flu). Mortality in the next pandemic is unpredictable, but could be very high if caused by mutation of H5N1,[5] H7N9, or MERS-CoV.

7. The first pandemic wave (rather benign in 1918) does not predict mortality in subsequent waves.

8. Illness resulting from the pandemic strain is likely to confer at least partial immunity to subsequent illness or severe illness due to the pandemic wave. (This will need to be monitored and findings communicated.)

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[5] "One especially important question that was discussed is whether the H5N1 virus is likely to retain its present high lethality should it acquire an ability to spread easily from person to person, and thus start a pandemic. Should the virus improve its transmissibility by acquiring, through a reassortment event, internal human genes, then the lethality of the virus would most likely be reduced. However, should the virus improve its transmissibility through adaptation as a wholly avian virus, then the present high lethality could be maintained during a pandemic." ….. "Concerning the potential high lethality of a wholly avian pandemic virus, some modelling studies have suggested that pandemic spread could not be fully sustained in the presence of very high mortality. All such matters remain difficult to predict." Influenza research at the human and animal interface: Report of a WHO working group, Geneva, Switzerland, 21–22 September 2006 (www.who.int/csr/resources/publications/influenza/WHO_CDS_EPR_GIP_2006_3C.pdf, pages 15 & 16).

9. Social & economic disruptions may be temporary, but amplified in today's closely interrelated & interdependent systems of global commerce, involving just-in-time delivery of goods. Disruption of key services, such as airline travel (perhaps including power supplies and communications services, including the internet[6]), and reduced availability of important goods, including food, fuel, medications (even those unrelated to influenza), and office supplies, are likely if the pandemic involves high mortality.

II. Planning Assumptions Related to Transmission of the Virus[7]

10. In each community, each pandemic wave (outbreak) will last between 6 and 16 weeks.[8]
11. The seasonality of the pandemic & pandemic waves cannot be predicted. (One characteristic of influenza pandemics is the occurrence of pandemic waves during months of the year other than those during which seasonal influenza occurs.)
12. The typical incubation period (the time between acquiring the infection until becoming ill), for influenza averages 2 days. (We assume this would be the same for a pandemic strain that is transmitted between people by respiratory secretions, though current H5N1 incubation periods may be longer). Persons who become ill may shed virus and can transmit infection for one-half to one day before the onset of illness, with viral shedding and the risk for transmission from adults greatest during the first 2 days of illness (yielding an average of about 3 days between each generation of cases, very different from SARS which had peak transmission during the second week of illness). The duration of infectiousness is about 5 days in adults, and possibly longer in children. Each ill person will cause illness in an average of about 1.5 to 2 other persons. Some transmission by asymptomatic carriers is also expected.
13. Despite the prevalence of influenza year after year, the amount of direct scientific information on modes of transmission is very limited. However, the epidemiologic pattern observed is generally consistent with spread through close exposure (up to 6 feet or 2 meters, i.e., exposure to large respiratory droplets, direct contact, or near-range exposure to aerosols). The relative contributions and clinical importance of the different modes of influenza transmission are currently unknown. However, one implication of person-to-person respiratory transmission, substantial transmission from those with mild non-specific symptoms, and peak transmission around the time of symptom onset, is that those in close proximity, including colleagues, friends, and relatives at home, work, and school, etc., pose a potential threat.
14. Droplet transmission: Large droplets are expelled by coughing, sneezing, and talking, and generally travel through the air no more than 3 feet (one meter) from the infected person.

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[6] Increased telecommuting and millions of homebound children could put heavy pressure on the system. Rajeev Venkayya, MD, senior director for biodefense on the White House Homeland Security Council, said, "What I'm hearing is that there continues to be concerns about the last mile and also about the backbone," referring to the capillaries and main arteries of the Internet. He added that the Department of Homeland Security (DHS) is looking into the question. Alfonso Martinez-Fonts, assistant secretary for the Private Sector Office at DHS, had a somewhat different message. "The backbone of the Internet is pretty sturdy," he said. "It's the last mile that's a concern." (Business Preparedness for Pandemic Influenza, Center for Infectious Disease Research & Policy, Feb. 5 – 6, 2007 meeting.)

[7] These assumptions, drafted in 2006 & 2007, were originally based on CIDRAP, the Center for Infectious Disease Research & Policy, University of Minnesota, http://www.cidrap.umn.edu/cidrap/content/influenza/panflu/biofacts/panflu.html, and the US HHS plan, supplement 4, http://www.hhs.gov/pandemicflu/plan/pdf/S04.pdf

[8] In early 2007, both WHO & CDC started referring to local outbreaks / waves lasting as long as 12 weeks. Some more recent sources have referred to durations of up to 16 weeks. Recent CDC documents have noted that waves may last from weeks to months.

Transmission via large droplets requires close contact between the source and recipient persons, permitting droplets, which do not remain suspended in the air, to come into direct contact with oral, nasal, or ocular mucosa of the recipient. Special air handling and ventilation systems are not required to prevent droplet transmission.

15. Direct and indirect contact transmission: Direct contact transmission involves skin-to-skin contact (such as hand-to-hand) between an infected person and a susceptible person. Influenza viruses can live for 24 to 48 hours on nonporous environmental surfaces and less than 12 hours on porous surfaces, indicating that transmission can occur when hands that touch contaminated surfaces subsequently come into contact with oral, ocular, or nasal mucosa of a susceptible person (indirect contact or "fomite" transmission).
16. Airborne transmission (via small-particle aerosols / droplet nuclei): The relative contribution of airborne transmission to influenza outbreaks is uncertain, but is an important issue, because droplet nuclei are smaller in size than large droplets (with implications for the type of masks most likely to be effective), can travel farther than 3 feet (1 meter), and can remain suspended in air. As it is likely that some aerosol-generating medical procedures (e.g., endotracheal intubation, suctioning, nebulizer treatment, bronchoscopy) could increase the potential for dissemination of droplet nuclei in the immediate vicinity of the patient, additional precautions for healthcare personnel who perform aerosol-generating procedures on influenza patients may be warranted (such as fit-tested N-95 masks or equivalent, instead of surgical or procedure masks, for example). Airborne transmission may also occur at short distances in other settings, particularly in shared air spaces with poor air circulation. (This implies that good air circulation / ventilation may reduce transmission in indoor areas and in other enclosed spaces, such as in vehicles, planes, trains, etc.) There is little evidence of airborne transmission over long distances or prolonged periods of time (as is seen with *M. tuberculosis*), and no evidence that influenza transmission can occur through ventilation systems.
17. Animal-to-Person: As animal-to-person (including bird-to-person) transmission is expected to remain a comparatively rare event, the information above all refers to person-to-person transmission. (Types of H5N1 bird-to-person exposures that have been identified to date include: Plucking and preparing diseased birds; Handling fighting cocks; Playing with poultry, particularly asymptomatic ducks; Consumption of duck blood, and possibly undercooked poultry products. Visiting markets which sell live birds has been implicated in bird-to-person transmission of H7N9.)

III. Planning Assumptions Related to Prevention & Treatment

18. Annual / seasonal influenza immunization will likely not be protective against the pandemic strain.
19. Currently available antiviral drugs will likely be helpful in treating viral illness due to the next pandemic strain, though there is risk of the pandemic virus developing resistance to available antiviral drugs. Antibiotics will likely play an important role in treating secondary bacterial infections, including bacterial pneumonia.
20. If a severe pandemic happens anytime in the near future, supplies of pandemic vaccines & antiviral drugs – the two most important medical interventions for reducing illness & deaths – will be inadequate in all countries at the start & for several months thereafter.
21. "Few" countries have the staff, facilities, equipment, & hospital beds needed to cope with the large numbers of people who will suddenly fall seriously ill in a severe pandemic. Most ill people will need to be cared for in their own homes/ communities.

22. Even in a severe pandemic, appropriate care for most of those ill with influenza can likely be provided in the home, if families receive appropriate guidance. Home-based care can address hydration, fever, nutrition, safe use of available medications, and when to seek outside help.

23. Non-Pharmaceutical Interventions (NPIs) related to "social distancing" & hygiene, if implemented well, will somewhat reduce transmission risk among individuals and slow down the spread / flatten the epidemic curve (meaning that in communities, persons get ill over a somewhat longer period of time, with fewer illnesses & fatalities during the peak of the wave, which is very desirable.) At family or household level, these interventions include: Keep your distance; Wash your hands; Cover your coughs & sneezes; & Isolate your ill (including cleaning, masks, & household members minimizing interaction with others if pandemic is severe). NPIs at the community level may include dismissal of students from schools and colleges, along with social distancing to reduce out-of-school mixing of children, closure of childcare programs, cancelation of large public gatherings, measures to reduce crowding on public transportation, and alteration of workplace environments and schedules to decrease social density without disrupting essential services. Implementing a combination of these family and community-level interventions is likely to be more effective than focusing on any single intervention.

24. In a severe pandemic scenario, when all countries around the world and all responding organizations are themselves struck or preparing to be struck, most low-resource communities will fail to receive adequate medical supplies, at least during the first several months, and their health services will be more stressed than they are today. However, these communities, and families can, by following well-directed and scientifically based measures, play an important role in slowing transmission and caring for those not severely ill, thereby reducing the burden on health services. Furthermore, most people in these communities have access to local volunteers, community health workers, radio, or mobile phones, from which they could receive guidance about such measures.

25. In a severe pandemic scenario, the imperative to respond may lead many communities to attempt mitigation measures without prior planning or expert guidance on the best choice of interventions, how and when to implement them, and how to limit any negative consequences. The effectiveness of these efforts will likely be less – and negative effects greater – than if plans had been made in advance. In a severe pandemic, many communities may also be challenged by contradictory guidance (as in Connecticut in October 1918, when communities received precisely the opposite recommendations from federal and state health officials on closing schools, theaters, and other places of public gathering). Planning for public health measures before pandemic onset may reduce the risk of such contradictory guidance.

IV. Workforce Planning Assumptions[9]

26. If the wave is severe: 15% of the workforce is absent for 6 to 16 weeks because school closures oblige working parents to stay home and look after children. Note that this proportion will vary according the particular workforce.

27. 25% to 45% of those remaining at work become ill at some time during one of the pandemic waves. The workplace attack pattern follows a pattern similar to that in the general population. Every person who becomes ill has 7 shifts off work.

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[9] Based on the Government of New Zealand Influenza Pandemic Business Continuity Planning Guide, December 2009, pages 59-60. This document no longer appears to be available on the web pages of the New Zealand government. These assumptions "model the potential impact of a large severe pandemic influenza wave on the workforce. The basic scenario is that of November 1918. This differs from earlier published New Zealand scenarios that were based on lower infection and death rates as observed in the 1968 pandemic."

28. If the wave is severe: There is a 100% additional absence rate – that is, for every person in the remaining workforce who gets ill, another does not come to work because of the need to look after a spouse or children, or a disinclination to commute or work. The additional absences follow the workplace attack pattern.

29. Individual employers must consider their workforces and their particular circumstances. However, in general, employers should make contingency plans to operate during severe pandemic waves with at most 85% of their normal staff available (on site), and between 50% and 65% available for the peak three weeks of each wave.

Planning Assumptions Related to Children and Adolescents

30. As infected school age children are likely to shed more virus, for a longer period of time than adults, and are less likely to follow respiratory and hand-washing etiquette, they play an important role in flu transmission within communities. This, along with the desire to protect children from infection in crowded school and transportation environments, is the rationale for school closing during severe outbreaks.

31. School closure or dismissal of classes, & closure of daycare centers, is likely during a severe pandemic wave. In an optimistic scenario, closure of schools during a pandemic might have some effect on the total number of cases (maybe a 15% reduction), but cause larger reductions (around 40%) in peak attack rates. However, this reduction will be substantially undermined if there is substantial mixing of out-of-school children in the community or if the policy is not well implemented.[10]

32. Potential negative consequences of closing schools include the impact on children's education and development, and nutrition (if food is provided in school), along with the economic and social consequences of many parents having to stay home with their children. (ie. How many more health workers will stay away from their jobs because they need to be home with their children while schools are closed?)

33. Illness among parents and other family caregivers will have direct consequences for the health and care of children and youth. As was the case during the 1918 pandemic, children in families in which all potential caretakers are ill at the same time will be at particularly high risk.

[10] Simon Cauchemez, Neil M Ferguson, Claude Wachtel, Anders Tegnell, Guillaume Saour, Ben Duncan, Angus Nicoll. Closure of schools during an influenza pandemic. Lancet Infect Dis 2009; 9: 473–81. (http://www.team-bhp.com/forum/attachments/shifting-gears/173297d1250059229-swine-flu-information-important-information-post-102-page-7-closure-schools-augs2009.pdf)

Preparing for which Pandemic?
Humanitarian Pandemic Preparedness (H2P) Initiative
Updated Friday, March 13, 2015

Introduction

The number and importance of the uncertainties concerning the next influenza pandemic are such that the development of credible, detailed scenarios is practically impossible. Among such uncertainties, the following five are particularly worth mentioning:

a) The date of onset of the next influenza pandemic is unpredictable (any time from sometime next week to sometime in a few decades).

b) The virulence of the virus subtype responsible for the pandemic is unpredictable, with possible case fatality rates ranging from what is typical of seasonal flu, to the hopefully unlikely "end of civilization" levels of the current H5N1 cases.

c) Risk groups for severe and fatal infections cannot be predicted with certainty.

d) The effectiveness and timely availability of pharmaceutical interventions (primarily antiviral drugs, vaccines, and antibiotics) is uncertain.

e) The level of social, economic, and possibly even political, disruption is unpredictable, and will vary from country to country. It will only partly depend on the severity of the pandemic.

Therefore, the scenario outlined below is in no way a "predictive" one. It is presented here only as a framework to inform planning.

A Severe Pandemic Scenario

1. Once the pandemic starts, geographical spread will be rapid: time for final planning and preparations will be limited to several weeks at most.
2. Virtually all communities on earth will experience outbreaks: roughly 1 person in three in the world will become ill during a period of up to approximately 1 ½ years.
3. Communities will experience one to three outbreaks ("pandemic waves") of a duration of 6 to 16 weeks each. The characteristics of the first wave (in terms of fatalities) may not be predictive of what will happen in the following waves.
4. Although some groups within the population will be markedly more at risk for contracting the disease and others will be more at risk of dying from it, it is difficult to predict risk groups in advance.
5. Supplies of vaccines and antiviral drugs will be inadequate in developing countries. Even in developed countries, vaccines are unlikely to substantially reduce mortality and morbidity for at least the first four months of the pandemic.
6. Healthcare systems will be overwhelmed and incapable of coping with the large number of people who will suddenly fall ill: care will have to be provided at the community and household levels. Many routine, non-flu-related health services will also be unavailable during the pandemic waves.
7. More in general, a variable but generally severe level of disruption is to be expected in the delivery of the services provided by the State. Governmental contingency plans for response to a pandemic will encounter substantial difficulties and will only be partially effective in limiting adverse consequences.

8. Even more generally, severe social and economic disruption is to be expected. More developed countries are particularly vulnerable because of the highly interdependent nature of more advanced societies, whilst developing countries are particularly vulnerable because of the pre-existing vulnerability of large sectors of the population.
9. In many countries, localized and even generalized security problems (from erosion of law and order to open conflict triggered by the pandemic) cannot be ruled out.
10. For several reasons, international assistance on a large scale, and substantial national domestic assistance to districts and communities, will not be feasible.
11. Substantial absenteeism of staff (possibly above 50%, because of illness, need to care for family members, school closures, fear, etc.) and logistical difficulties (movement, communications, basic services) will substantially limit the capacity of peripheral governmental structures and civil society organizations to respond.

A Severe Pandemic at the Household Level

At the household level, the above 11 assumptions will translate into the following picture:

12. There will be many families in which all potential caregivers are ill at the same time and unable to care for their families.
13. Because of illness, the need to care for the ill, fear, or as a consequence of mitigation measures and/or of the difficulties in movement/transportation, many family members will be mostly confined at home during the peak intervals of the pandemic waves.
14. Children will be out of school for extended periods of time.
15. In the vast majority of severe cases, families will not be able to count on hospital-level health care. Some families will be able to count on at least some community-level health care services, but many won't.
16. Regardless of affluence (and of the development level of the country), the food security of many families may be challenged.
17. Families will experience variable levels of difficulty in accessing key essential services (water, energy, telecommunications, transport, education, energy, finance) during the peak intervals of the pandemic waves. Some of these services may be interrupted altogether.
18. Regardless of affluence (and of the development level of the country), family capacity to produce an income and to protect their assets may be challenged.
19. Families may experience security problems (lawlessness, conflict).