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Figure 1 | Illustration of the five stages through which pathogens of process, ranging from rabies (still acquired only from animals) to HIV-1 animals evolve to cause diseases confined to humans. (See Box 1 for (now acquired only from humans).

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Basic elements which affect the transmission of infectious diseases

- Host condition: population (size, density, agestructure), gene (resistant, susceptible), nutritional status, socio-cultural factors (network, behavior)
- Environmental condition: temperature, humidity and vector animals (in the case of vector-borne infection)
- Parasite condition: host-specificity, lifespan, transmission type, etc.
- Interaction: route of infection, evolution to optimal virulence based on the interaction between infectiousness and virulence (Ebert and Herre, 1996), virulence decrease in direct transmission (like JC virus) vs no change in vector-borne transmission (Ewald, 1994)

Different frequency distributions between the diseases with vector-borne and direct transmission by virulence (case fatality ratios)



Source: Ewald (1994) [pp.38, Figure 3.1]



International cooperation – origins

- · Traditional control measures quarantine, sanitation and immunization - became inadequate.
- International cooperation needed to control the spread of infectious diseases.
- · International conventions on sanitation and health of the 1850s evolved into the International Health Regulations (1969).
- · Revised IHR (2005) came into force in June 2007.

World Health Organization August 07

Source: www.who.int/whr/2007/media centre/slides en.pdf



Source: www.who.int/whr/2007/media centre/slides en.pdf

TABLE 2-3 Means of Transmission of Infectious Diseases and Their **Characteristic Features**

Transmission	Characteristics
Contact	Requires direct or indirect contact (indirect = infected fomite, blood, or body fluid; direct = skin or sexual contact)
Food- or water-borne	Ingestion of contaminated food (outbreaks may be large and dispersed, depending on distribution of food)
Airborne	Inhalation of contaminated air
Vector-borne	Dependent on biology of the vector (mosquito, tick, snail, etc), as well as the infectivity of the organism
Perinatal	Similar to contact infection; however, the contact may occur in utero during pregnancy or at the time of delivery

Route of infection

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World Health Organization

August 07

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WHO

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Evolution of public health security

Outbreaks of infectious diseases and health emergencies have threatened public health security throughout history. • Plague: In 1348, plague killed up to two-thirds of the population in Europe. · Cholera: In 1855, cholera killed an estimated 500 people in a 10-day period in London. • Smallpox: Smallpox ravaged populations until it was finally eradicated in 1979. World Health Organization ugust 0 WHO Source: www.who.int/whr/2007/media_centre/slides_en.pdf Significant events in public health





Selected emerging and re-emerging infectious diseases: 1996-2004 World Health Organization August 07

Source: www.who.int/whr/2007/media_centre/slides_en.pdf





Public Health Crisis during 1980-2013 http://www.who.int/kobe_centre/mediacentre/forum/WHO_presentation_final_rev1.pdf

Coordinating Between Emergency Reform and HSS Building on Health System and on an Intersectoral Approach



(IHR Art.44 on Assistance and Cooperation)

Framework from WHO Kobe Centre, at Ise-Shima summit 2016

Both *minimize undesirable health effects and *maintain trade and transport (as possible as we can) are needed http://www.who.int/kobe_centre/mediacentre/forum/WHO_presentation_final_rev1.pdf

International Health Regulations (IHR) 2005



- Japanese Government decided that all the school within a prefecture should be closed just after the initial case detection
- Cauchemez S, Valleron AJ, Boëlle PY, Flahault A, Ferguson NM. Estimating the impact of school closure on influenza transmission from Sentinel data. Nature. 452:750-754, 2008.
- The number of patients projected by CDC FluAid2.0 (Meltzer, Cox, Fukuda 2000)



Public Health Crisis during 1980-2013 http://www.who.int/kobe_centre/mediacentre/forum/WHO_presentation_final_rev1.pdf

International Health Regulations (IHR) 2005

- Major changes in 2005
 - · Widened scope: to report all major events, that may constitute Public Health Emergency of International Concern (PHEIC)
 - Notification by designated National IHR Focal Points ٠
 - National core capacities for detection and response
 - Real time event management system
- Definition of PHEIC
 - · means an extraordinary event which is determined, as provided in these Regulations:
 - (i) to constitute a public health risk to other States through the international spread of disease and
 - (ii) to potentially require a coordinated international response"
- Core capacities
 - · National level: assess within 48hr, notify WHO within 24hr
 - Local and Intermediate level capacities are also needed 20

Flu pandemic: focusing on the social response

- Background
 - Several pandemics ever occurred
 - Spanish flu 1918 (H1N1): 20-40 million deaths
 - Asian flu 1957 (H2N2)
 - Hong Kong flu 1968 (H3N2)
 - · Russian flu 1977 (H1N1)
 - Newly introduced strains generally had high virulence.
 - Avian flu (H5N1) since 1997 had high virulence for birds, and some human patients also suffered from it Case Fatality Rate for human was more than 60%
 - No human to human infection
 - WHO and CDC noticed the possibility of coming pandemic by H5N1 when it would acquire infectivity from human to human
 - "International Health Regulations" were updated in 2005 (activated since 15 June 2007) http://www.who.int/ihr/en/

Flu researchers

- **Theoretical Epidemiologists**
 - Imperial College Group (UK) followers of Anderson RM Niel M Ferguson (who also suggested the necessity of behavioral followup) [http://www1.imperial.ac.uk/medicine/geople/neil.fergus blications]
 - Several Groups in USA
 - Verial Cloups III COA Ira M. Lorgini, University of Washington [http://www.biostat.washington.edu/sites/www/content/files/misc/longin Intra_4906/2028.pdf] Marc Lipstch, Harvard University [http://www.hsph.harvard.edu/faculty/marc-lipsitch/] Carlos Castillo-Chavez, Arizona State Univ. [https://webap4.asu.edu/directory/person/566521]
 - Germany (Klaus Dietz), Netherlands (Odo Diekmann, J.A.P. Heesterbeek), Japan (Hiroshi Nishiura, Yasushi Ohkusa, etc.)
- Virologists / Medical zoologists
- Yoshihiro Kawaoka's group (Univ. Tokyo, Japan) shi Noda et al. Nature 15 June 2009 Tak
- Hiroshi Kida's group (Hokkaido Univ., Japan)
- Elodie Ghedin (Univ. Pittsburgh)



Human H1N1 Outbreak H11



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Preparation by several countries

- USA (http://www.pandemicflu.gov/index.html)
 - "Monitering Outbreaks" have undergone
 - 100 million dollars were invested to vaccine study
 FluAid2.0, FluSurge2.0, FluWorkLoss1.0 (CDC)
- UK
 - A national framework for responding to an influenza pandemic Canada
- The Caradian Pandemic Influenza Plan for the Health Sector
 Australia
- Australian Health Management Plan for PANDEMIC INFLUENZA
- NZ
 - New Zealand Influenza Pandemic Action Plan 2006
- EU
 - EWRS; Early Warning and Response System
 - HEDIS; Health Emergency and Disease Information System
 MedISys; Medical Intelligence Sytem
- Japan (http://www.cas.go.jp/jp/influenza/index.html)
 - Cabinet Secretariat and Ministry of Health, Labor and Welfare
 Team acting against novel influenza was made in MHLW since 2008
 - Team acting against novel influenza was made in MHLV since 200
 Law to prevent infectious diseases changed in 2007
 - Guideline for novel influenza was made on 17 Feb 2009

Tracking Swine Flu (April 27, 2009 NYTimes)

- United States officials declared a public health emergency on Sunday (26 April) over increasing cases of swine flu, but continued to urge Americans not to panic on Monday, as most of the cases have been mild
- Americans not to panic on Monday most of the cases have been mild. Confirmed cases
 - firmed cases As of Monday (27 April), officials had confirmed 42 cases of a new A(H1N1) swine flu virus in the United States, including 28 New York City high school students. Six cases were identified in Canada — all linked to travel in Mexico. While the World Health Organization says 20 swine flu cases in Mexico have been confirmed, officials say there are at least 1,600 suspected infections and at least 149 suspected deaths. One infection was confirmed in eastern Spain. *creatitions*
- Precautions
 - The Centers for Disease Control and Prevention recommends washing hands frequently, avoiding touching the face, covering the nose and mouth when sneezing and staying home when sick. People cannot be infected by eating pork.





Global Response to Swine Flu (cont'd)

- Officials confirmed eight cases in New York, seven in California, two in Kansas, and one in Ohio. About 100 students at St. Francis Preparatory School in Fresh Meadows, Queens, became sick in the last few days. New York Mayor Michael R. Bloomberg said that all the cases had been mild.
- Photo: Louis Lanzano/Associated Press



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Global Response to Swine Flu (cont'd)

- Travelers with face masks at Mexico City's international airport. Because of the outbreak, events were canceled, and schools and museums were closed. The swine flu has killed more than 80 people in Mexico and infected 1,300 more, reported the Associated Press.
- Photo: Adriana Zehbrauskas for The New York Times



WHO's response since 26 April 2009

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

Swine flu illness in the United States and Mexico - update 2

26 April 2009 -- As of 26 April 2009, the United States Government has reported 20 laboratory confirmed human cases of swine influenza A/H1N1 (8 in New York, 7 in California, 2 in Texas, 2 in Kansas and 1 in Ohio). All 20 cases have had mild Influenza-Like Illness with only one requiring brief hospitalization. No deaths have been reported. All 20 viruses have the same genetic pattern based on preliminary testing. The virus is being described as a new subtype of A/H1N1 not previously detected in swine or humans.

Also as of 26 April, the Government of Mexico has reported 18 laboratory confirmed cases of swine influenza A/H1N1. Investigation is continuing to clarify the spread and severity of the disease in Mexico. Suspect clinical cases have been reported in 19 of the country's 32 states.

WHO and the Global Outbreak Alert and Response Network (GOARN) are sending experts to Mexico to work with health authorities. WHO and its partners are actively investigating reports of suspect cases in other Member States as they occur, and are supporting field epidemiology activities, laboratory diagnosis and clinical management.

On Saturday, 25 April, upon the advice of the Emergency Committee called under the rules of the International Health Regulations, the Director-General declared this event a Public Health Emergency of International Concern.

WHO is not recommending any travel or trade restrictions.

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Global Response to Swine Flu(NY Times)



- The global spread of swine flu, a contagious respiratory illness, has caused governments to react. Homeland Security Secretary Janet Napolitano declared a public health emergency on Sunday (26 April) after announcing that 20 cases had been confirmed in the United States. By her side was the White House press secretary, Richard Gibbs.
- Photo: Pablo Martinez Monsivais/Associated Press

Global Response to Swine Flu (cont'd)

- A quarantine officer monitored travelers with a thermographic device at the arrival gate at Narita International Airport, which serves Tokyo. The World Health Organization said that the outbreak was considered "a public health emergency of international concern" but would not decide until Tuesday on whether to raise the pandemic alert level.
- Photo: Itsuo Inouye/Associated Press



Global Response to Swine Flu (cont'd)

- A member of the Mexican army handed out face masks to tourists and pedestrians in Mexico City on Sunday.
 Photo: Adriana Zohbrauskas for The New York Times
- Photo: Adriana Zehbrauskas for The New York Times



Global Response to Swine Flu (cont'd)

- A priest talked with a group of nuns wearing masks as a preventive measure in front of the Basilica of Guadalupe in Mexico City.
- Photo: Luis Acosta/Agence France-Presse -- Getty Images



Global Response to Swine Flu (cont'd)

- A couple kissing at the Historic Center in Mexico City on Tuesday. "My government will not delay one minute to take all the necessary measures to deal with this epidemic," Mexico President Felipe Calderón said.
- Photo: Alfredo Estrella/Agence France-Presse -- Getty Images



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From "Swine flu" to "Influenza A(H1N1)"

A/H1N1 influenza like human illness in Mexico and the USA: OIE [World Organization for Animal Health] statement (Paris, April 27 2009)

It would be logical to call this disease "North-American influenza" [http://www.oie.int/eng/press/en_090427.htm]

- WHO stopped using "swine", by pork industry's request In addition, the Egyptian government, where the national religion is Islain, decided to kill al pies raised by minor Christians within the country to prevent publics from "swine flu" on 29 April 2009, and a minute
- Joint FAO/WHO/OIE Statement on influenza A(H1N1) and the safety of pork (May 7 2009; To avoid any misunderstanding FAO, WHO and OIE would like to reissue their joint statement originally issued on 30 April)
- In the ongoing spread of influenza A(HIN1), concerns about the possibility of this virus being found in pigs and the safety of pork and pork products have been raised. As the influenza viruses are not known to be transmissible to people through eating processed pork or other food.
- Products device from tigs. Heat treatments commonly used in cook ng meat (e.g. 70°C/160°F core temperature) will readily
- inactivate any viruses potentially present in raw meat products. Pork and pork products, handled in accordance with good hygienic practices recommended by the WHO, Codex Alimentarius Commission and the OIE, will not be a source of infection Authorities and consumers should ensure that meat from sick pigs or pigs found dead are not processed or
- used for human consumption under any circumstances. [http://www.who.int/mediacentre/news/statements/2009/h1n1_20090430/en/index.html] Enserink M: Swine flu names evolving faster than swine flu itself. Science, 324(5929): 871, 15 May 2009 37

Some social impacts in Japan

Masks sold out

- In mid-May, masks disappeared. Net auction price. was raised up to 10 times higher than original. "One package incl. 50 pcs., usually sold in 1,200 yen, sold in 14,000 yen. (Sankei shimbun)
- School closure
 - Hyogo and Osaka prefectures closed all schools for 1 week (though the closure is decided by the principal, it was requested by the government).
 - Several Universities in Kansai area closed for 5-7 days, Kyoto University didn't (Kyoto prefecture asked to close in May, the Kyoto University held classes as usual, Asahi shimbun).
- Many events suspended or prolonged
- Emergency medicine delayed to make clinics specialized for outpatients with fever -----
- Patients were refused to treat

Global Response to Swine Flu (cont'd)

- Even Sunday Mass was affected. The Roman Catholic Church gave worshipers the option to listen to services on the radio, and priests who decided to hold services were told to be brief. Priests were also encouraged to put Communion wafers in worshipers' hands instead of their mouths. At the Basilica of Guadalupe, only two church workers attended Mass.
- Photo: Luis Acosta/Agence France-Presse -- Getty Images



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A side effect – computer virus

- 29 April 2009: Fake CDC's alert e-mail with the attachment named "Swine influenza frequently asked questions.pdf." It contained a computer virus. https://forums2.symantec.com/t5/blogs/blogarticlepage/blog-id/malicious_code/article-id/268
- In the end of April 2009: "Search Engine Optimization Poisoning" is reported. When a user searched web sites using "swine" as a search word, malware containing sites was listed in top page. IPA [http://www.ipa.go.jp/security/txt/2009/06outline.html
- 30 April 2009: In Japan, virus containing e-mails were found. It is pretended as sent by the National Institute for Infectious Diseases, and the attached file titled "Knowledge about swine flu " (actually in Japanese) included a computer virus. 20090430-OYT1T00396.htm]

Academic responses

- Many scientific journals opened special sites, rushed!
 - Science [http://blogs.sciencemag.org/scienceinsider/swine-flu/] Nature [http://www.nature.com/news/specials/swineflu/index.html]
 - NEJM [http://h1n1.nejm.org/]
 - Lancet [http://www.thelancet.com/H1N1-flu]
- BioMed Central [http://www.biomedcentral.com/gateways/influenza] Cohen J: Flu researchers train sights on novel tricks of novel H1N1. Science, 324(5929): 870. [http://www.sciencemag.org/cgi/content/full/324/5929/870]
- Health Education via Internet
 - Supercourse in the University of Pittsburgh
 - [http://www.pitt.edu/~super1/lecture/lec34601/index.htm] i ealth The latest information is given by the specialists and tranlated into Spanish, Russian, Farsi, Arabic, Vietnamese, Bahasa Melayu (Malay), French, Macedonian, Chinese, Hebrew, Bosnian, and Japanese, which are freely accessed via Internet
 - Peter M. Sandman's article as a risk communication
 - A short version was published as a commentary to Nature. [http://www.nature.com/nature/journal/v459/n7245/full/459322a.html] Origiral long version is given as an online article
 - [http://www.psandman.com/col/swineflu1.htm]
 - The Nature article is translated into French, which is also given online [http://www.zonegrippeaviaire.com/showthread.php?t=973#2] 38

Japanese Newspapers

Yomiuri Shimbun

THE KOBE SHIMBUN (16 May 2009, First Japan's confirmed patients found in Kobe, the newspaper was filled up by Influenza

information, 30 topics given) 症状が出たら… 病院に直接行かず、まず相談窓口(一覧表参照) に電話を。専用の外来(県内に39病院)を紹介 hese (case fatality/severity) we nly based on Mexico/USA info



- In Hyogo prefecture (incl. Kobe city), all schools were closed for 1 week. Many students went to Karaoke, but were denied to enter.
- Initial epidemic among high school students were not reported in detail (ethics).
- Yomiuci Shimbun http://www.yomiuri.co.jp/feature/20090425-436828/index.htm [1] 24 April 2009: US Swine? flu 7 patients, possible human to human infection (only 1 article) [2] 25 April 2009: Suspected 60 deaths by swine origin flu to human in Mexico and other countries [48 articles] [3] 26 April 2009: MHO's alert of public health, but declaration of phase 4 was prolonged [+11 articles] [4] 27 April 2009: MHO's alert of public health, but declaration of phase 4 was prolonged [+11 articles] [5] 28 April 2009: MHO's alert of public health, but declaration [5] 28 April 2009: MHO's declared phase 4 [+33 articles] [6] 28 April 2009: WHO' declared phase 5 [+22 articles] [8] 1 May 14 May [104 articles] [9] 8 May 14 May [104 articles] [9] 15 May 21 May [124 articles] [11] 25 May 21 May [124 articles] [12] 22 May 21 May [242 articles] 3.June "It's ease" by Hyogo [13] 5 June 11 June [26 articles] [14] 12 June 24 June [15 articles] Mainichi Shimbun
- Mainichi Shimbun
- Asahi Shimbun http://www.asahi.com/health/pandemicflu/

Numbers of articles were peaked around the finding 1st patient in Japan

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Flowchart of Novel Influenza (A/H1N1) Diagnosis at Medical Institutes in Japan since 24 May, 2009



Strategy in Japan

1. Basic Framework since 19 June 2009 (MHLW)



Number of patients by country



2 deaths in Australia (age 26 and 37 males with underlying disease)

1 death in Phillipine (age 49 female with CVD) All other deaths in North/South Americas

WHO recommendation for post-pandemic

- http://www.who.int/csr/disease/swineflu/notes/briefing_20100810/en/
- 10 AUGUST 2010 | GENEVA The world is now in the post-pandemic period. Based on knowledge about past pandemics, the H1N1 (2009) virus is expected to continue to circulate as a seasonal virus for some years to come. While the level of concern is now greatly diminished, vigilance on the part of national health authorities remains important. Such vigilance is especially critical in the immediate post-pandemic period, when the behaviour of the H1N1 (2009) virus as a seasonal virus cannot be reliably predicted.
- For example, it is likely that the virus will continue to disproportionately affect a younger age group, at least in the immediate post-pandemic period. Groups identified during the pandemic as at higher risk of severe or fatal illness will probably remain at heightened risk, though the number of such cases could diminish. In addition, a small proportion of people infected during the pandemic developed a severe form of primary viral pneumonia that is not commonly seen during seasonal epidemics and is especially difficult to treat. It is not known whether this pattern will continue during the post-pandemic period, further emphasizing the need for vigilance.
- WHO is today issuing guidance on recommended activities during the postpandemic period, including advice on epidemiological and virological monitoring, vaccination, and the clinical management of cases.
- National health authorities are reminded that cases and local outbreaks of H1N1 (2009) infection will continue to occur, and in some locations, such outbreaks could have a substantial impact on communities.

"Pandemic" (June 12 2009, NY Times) Photo by Mike Clarke/Agence France-Presse — Getty Images TP The government of Hong Kong on Thursday (11 June) ordered all primary schools in the city to be closed for two weeks after the firs cluster of local swine flu cases was found. Above (right), kindergarten students at a local school on Thursday (11 June) The announcement (of phase 6 "pandemic") does not mean that the illness, which has been mild in most people, has become any worse. The term pandemic reflects only the geographic spread of a new disease, not its severity. Pandemics typically infect about a third of the world in a year or two, and sometimes strike in successive waves. Δ2

Patients Distribution in Japan (23 June 2009)



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[Problems] * Confirmed cases truly reflect occurrence? 1-0.2^(1/881)=0.0018 Why does severity differ in American Continents from elsewhere?

Epilogue for pandemic flu (H1N1/2009)

upper limit of p was:

- **CDC** summary page
 - https://www.cdc.gov/h1N1flu/cdcresponse.htm
- WHO summary page
 - http://www.who.int/csr/disease/swineflu/en/
- Final report based on IHR2005
 - apps.who.int/gb/ebwha/pdf_files/WHA64/A64_10-en.pdf Three summary conclusions
 - The IHR helped make the world better prepared to cope with publichealth emergencies. The core national and local capacities called for in the IHR are not yet fully operational and are not now on a path to timely implementation worldwide.
 - WHO performed well in many ways during the pandemic, confronted systemic difficulties and demonstrated some shortcomings. The Committee found no evidence of malfeasance.
 - The world is ill-prepared to respond to a severe influenza pandemic or to any similarly global, sustained and threatening public-health emergency. Beyond implementation of core public-health capacities called for in the IHR, global preparedness can be advanced through research, reliance on a multisectoral approach, strengthened health-care delivery systems, economic development in low and middle-income countries and improved health status. 46

WHO's recommendation (cont'd)

Monitoring of respiratory disease activity

- Vaccination
 - The H1N1 influenza virus, which caused the 2009 pandemic, continues to circulate in some parts of the world, causing variable levels of disease and outbreaks. In some countries, seasonal trivalent vaccines are available that cover the H1N1 (2009) virus. In other countries, however, seasonal influenza vaccines are not available. WHO advises that there is still public health value in using monovalent H1N1 vaccine (where available) to immunize persons at risk of severe disease from H1N1 influenza infection, especially where trivalent seasonal influenza vaccine is not available.

Clinical management