

Note: this edition of Biotech101 represents a departure from our traditional article style. Instead, we'll be exploring details about the H1N1 virus in a "question and answer" format.

2009 H1N1 Flu Outbreak: separating myth from fact

An image of the H1N1 virus taken by the CDC Influenza Laboratory

What is H1N1?

H1N1 is an influenza virus. More specifically, it is a RNA virus, which means it uses RNA, rather than DNA, as the genetic material.

The H and N letters represent the type of two different proteins on the surface of all influenza viruses – hemagglutinin (H) and neuraminidase (N). The different subtypes of influenza A are classified on the basis of small changes in the structure of these proteins. The different protein forms are assigned an H number and N number. Changes in these proteins allow the virus to evade the immune system or infect new hosts.

Why is it often called "swine flu"?

Initial studies showed many of the genes in this virus were similar to influenza viruses that normally were found in pigs in North America. More detailed studies have shown this particular virus is much more complex – it also contains two genes from flu viruses that normally are found in European and Asian pigs as well as genes from flu viruses that were originally found in birds (thus called avian flu) and humans.

How can this virus infect humans, if it normally infects pigs?

Pigs are capable of contracting both bird and human viruses – to reproduce, the virus infects host cells and copies its genetic material. There are eight segments of the virus genome and each must be copied and assembled into new viruses. Think of them as a hand of playing cards: survival requires that all eight "cards" be incorporated into the next generation of virus. Genetic mutations in the virus lead to slightly different version of each card (analogous to the difference between the king of hearts and the king

of diamonds). To evade attack by the host or a drug treatment, the virus continually changes the eight cards in its hand. In addition, if any host is simultaneously infected by two different viruses, the viruses can swap genetic cards and create new hands, or combinations of the eight genes in their genome. This is a process known as "reassortment," and it occurs continually among viruses (see FIGURE 1 for details).

Reassortment can lead to novel combinations of the virus, with the combinations having different rates of infection or clinical symptoms. Since there are many parts of the world where humans have close contact with pigs and birds every day, the viruses can jump from one host species to the next. The various combinations of this novel H1N1 influenza virus are thought to have been introduced into pigs over an 80-year window.

We do know that H1N1 viruses are not spread through food, so eating properly cooked pork (or chicken) is safe. As far as human-to-human transmission, most of this can be prevented by standard measures of frequent handwashing and covering your mouth when coughing or sneezing. Now that summer is here, the CDC has shown that the amount of chlorine used in swimming pools and even tap water is adequate to inactivate other types of flu virus, so spread of the 2009 H1N1 through water is not likely.

Are the clinical symptoms of the 2009 H1N1 outbreak different from seasonal influenza?

Patients have clinical symptoms that are similar to or even less severe than "regular" seasonal influenza, with one exceptional area: gastrointestinal symptoms including

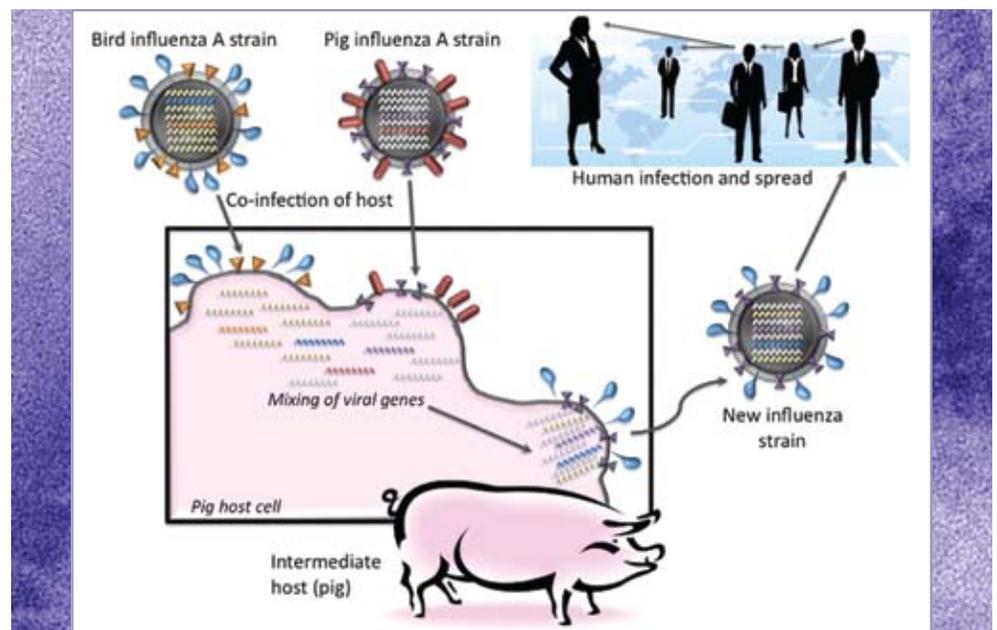


FIGURE 1 – Genetic mixing of viruses: The genetic material inside the virus, directs, among other things, the production of proteins found on the outside of the virus shell, shown here as colored shapes on the circular virus coating. If two viruses simultaneously infect the same host (in this case, a pig cell in pink), the viruses' genetic information may mix, leading to a new strain with characteristics of both original viruses. In this way, genetic material from pig, bird and human viruses has combined to form the 2009 H1N1 strain.

FIGURE 2 – This World Health Organization graphic documents the spread of H1N1 worldwide as of June 11, 2009. Red circles indicate countries reporting 2009 H1N1 infection. The size of the circle corresponds to the relative number of confirmed cases.



nausea, abdominal pain and diarrhea, which are not commonly associated with seasonal flu, have been associated in over 1/3 of the 2009 H1N1 outbreak cases in the US.

Almost ½ of the US cases requiring hospitalization had some underlying condition (pregnancy, lung disease, diabetes, cardiovascular disease etc.), and most or all of the deaths did as well. The death rate for the 2009 H1N1 flu is less than that of other known strains, and nowhere near the mortality in the 1918 pandemic, also caused by an H1N1 virus.

Since a virus causes this type of flu, antibiotics cannot be used to treat it. Antiviral drugs like Tamiflu can still be used to treat this specific 2009 H1N1 strain, but other viral strains have developed resistance to these drugs.

Is the H1N1 outbreak a pandemic?

Many experts say that the flu virus is always teaching us to expect the unexpected. The 2009 H1N1 outbreak has forced scientists and epidemiologists to redefine the very word “pandemic.” Many officials agree with Dr. Michael T. Osterholm of the University of Minnesota: “a pandemic is basically a new or novel agent emerging with worldwide transmission.” Not until June 11th did the World Health Organization (WHO) activate Phase 6 of their “pandemic alert scale,” meaning that they officially recognize the virus is at the pandemic phase; for months before then, the internet was filled with debate over what should be done and when. What we do know for sure is that by early June in the USA, all 50 states and the District of Columbia were reporting cases of novel H1N1 infection. As figure two from the WHO shows, 2009 H1N1 cases had been reported in many countries on almost all continents (these data are also updated each day at <http://flutracker.rhizalabs.com/>).

How does the 2009 H1N1 influenza outbreak so far compare to

seasonal influenza and previous influenza pandemics?

Seasonal influenza: 3-5 million severe cases each year; 250,000 to 500,000 fatalities annually.

- 1918 pandemic influenza (a member of the H1N1 influenza A family): 500 million cases; 50-100 million fatalities.
- 1957 pandemic influenza (a reassortment of avian influenza A and human influenza A virus): 1-1.5 million fatalities.
- 1968 pandemic influenza (a reassortment of avian influenza A and human influenza A virus): 1 million fatalities.
- 2009 H1N1 influenza (as of June 8): ~29,000 confirmed cases, less than 150 fatalities.

Even though the 2009 H1N1 influenza has relatively low infection and fatality rates, experts are concerned about what the future may hold. Many of the deadly pandemics had multiple waves of illness that spread around the globe, and the 2009 pattern bears similarities to that from 1918. With the 1918 virus, there was a wave of mild illness in the spring in the Northern Hemisphere, followed that fall by the emergence of the extremely deadly form of the virus. Luckily, we have many more infection control measures, diagnostics, and new therapies than in 1918.

Is this the same as the bird flu?

No. In fact public health officials have been expecting that virus, which is an H5N1

influenza primarily circulating in Southeast Asia, to represent the next pandemic. So they were surprised to learn an H1N1 virus apparently with swine origins and starting in Mexico was causing some fatalities and spreading fast – reinforcing the need to expect the unexpected. Scientists are still closely monitoring the avian flu, using new tools like Google Earth mashups (which gathers data from multiple sources) to pinpoint cases.

How is the 2009 H1N1 influenza virus diagnosed?

Most laboratories around the country have “rapid influenza antigen tests,” which take about 30 minutes and detect proteins from the virus’s outer coat only. The molecular method is similar to a pregnancy test, but is used on throat or nose swabs. However, these tests will only identify there is a positive result for a virus of the influenza A family, and will not specify the 2009 H1N1 virus.

More involved tests include utilize a molecular technique known as reverse-transcriptase PCR. Again, the kits in widest use are not specific for the 2009 H1N1 virus, but the US Centers for Disease Control (CDC) has worked quickly to release 2009 H1N1 flu virus sequences on their website, so laboratories could modify this test and single out 2009 H1N1.

One of the best tests was developed by Dr. Jian Han, now a Faculty Investigator at HudsonAlpha and the Chief Scientific Officer for Diatherix, a HudsonAlpha associate company. This test is run on a

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nose or throat swab, but can detect up to 14 pathogenic organisms from the same sample, including 2009 H1N1.

Will a vaccine be developed for novel H1N1 influenza?

Yes. Even though the traditional flu season is still several months away, vaccine production and distribution takes four to six months, meaning work must begin immediately. The US Department of Health and Human Services (HHS) has already awarded several contracts to pharmaceutical companies to begin producing vaccine against H1N1. As the first step in vaccine production, the CDC and WHO are developing initial stocks of the virus that will be distributed to the pharmaceutical companies by mid July.

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If you want to know more:

U.S. Centers for Disease Control H1N1 overview: <http://www.cdc.gov/h1n1flu/>

World Health Organization updates: <http://www.who.int/csr/disease/swineflu/updates/en/index.html>

Using Google Earth mashup to identify H1N1 cases: <http://www.nature.com/nature/multimedia/googleearth/>