

## Vaxart and H1N1 Flu (Swine Flu)

Vaxart has developed what we believe is the best technology to vaccinate the public against a pandemic:

- Vaxart can supply the first doses of an influenza vaccine about two months sooner than any approach that relies on growing the flu virus.
- Our vaccine is delivered by swallowing a capsule, so we do not require needles or trained medical personnel to administer. This is critical in helping avoid crowds that could further spread disease (social distancing). In an emergency, the vaccine could be delivered by mail carriers, for example.
- Vaxart vaccine manufacturing does not involve growing the dangerous virus that causes the pandemic disease. Vaxart uses just a small, inactive piece of the pandemic virus.
- Our products are stable for weeks at room temperature and could be distributed without refrigeration.
- In animal tests, a Vaxart avian flu vaccine demonstrated strong immune responses against a virus strain that had “drifted” so that it was different from the strain used to make the vaccine. If this holds true with H1N1 flu as well, a Vaxart vaccine could help protect against successive waves of pandemic caused by variants of H1N1 flu.
- We expect that the same manufacturing plant will produce about 20 times as many vaccine doses of the Vaxart vaccine as with conventional approaches. This has obvious advantages for protecting the population as quickly as possible.

Q. Can Vaxart do anything to address the current H1N1 flu (swine flu) crisis?

A. Vaxart has tested an experimental, orally delivered vaccine against avian flu. We were able to protect against lethal virus exposure in the standard animal models for flu infection (mice and ferrets). This suggests that a Vaxart vaccine against H1N1 flu could also be effective. The company has obtained the gene sequence coding for H1N1 flu from CDC and is currently constructing a candidate H1N1 flu vaccine that should be ready for animal testing by late May or early June.

Q. What about a vaccine for humans?

A. The company is working as quickly as possible to prepare its vaccine and is developing plans to supply a H1N1 flu vaccine that could be used in humans, if shown to be safe. Clinical testing of the Vaxart H1N1 vaccine will help regulatory agencies assess the benefits and risks of wider use.

Q. What if a H1N1 flu pandemic becomes a dire emergency and there is a shortage of vaccine?

A. The Food and Drug Administration (FDA) and the U.S. Department of Health and Human Services (HHS) have established systems for accelerated development, regulatory approval and acquisition of emergency vaccines and other countermeasures against pandemic illness, in the event that approved vaccines are not available or adequate. Vaxart will work closely with FDA and HHS to determine whether accelerated development and supply of a H1N1 flu vaccine based on Vaxart technology could play a

role in the government's response to the H1N1 flu outbreak. Vaxart may also explore international use under emergency authorization if supported by clinical trial results.

### H1N1 Flu (Swine Flu) Basics

Q. What is H1N1 flu (swine flu)?

A. A swine influenza virus is very much like a human flu virus, but normally swine flu viruses are only able to cause illness in pigs. All influenza viruses mutate easily, so occasionally a variant arises in animals that has some capability to cause illness in humans. A similar mutation led to the current outbreak of H5N1 avian flu. At this point the new H1N1 virus is spreading among humans so we can consider it as a type of human influenza.

Q. Why is the latest swine flu outbreak considered to be a crisis?

A. The current outbreak has been defined as an emergency and a potential pandemic, based on the facts that it has demonstrated significant and sustained transmission among humans, together with the potential for severe illness and death. Flu experts continually monitor for the emergence of virus strains that are completely different from strains that have circulated in the past, because humans will have no protective immunity against these new strains. If such a strain can cause severe illness or death, and is also able to transmit easily between humans, a catastrophic pandemic can occur. This was demonstrated in the 1918 Spanish Flu outbreak that killed tens of millions.

Q. Isn't the H1N1 outbreak turning out to be fairly mild? Are we overreacting?

A. It's too early to tell; it's possible that H1N1 will be no worse than a typical human flu strain. Flu season is usually ending in the United States at this time of year, so the H1N1 outbreak could decline now and reappear in the fall, or a pandemic could occur in the Southern Hemisphere during our summer. In 1918 the first pandemic flu wave spread in the spring, followed by much more lethal second and third waves in the fall and winter.

Q. How can I learn more about the current outbreak?

A. The most authoritative resources for information on disease outbreaks are the Center for Disease Control (CDC) and the World Health Organization (WHO). Their web sites have a great deal of useful information including measures for preventing spread of disease. For the most recent information on the outbreak, check the updates and investigation reports at these links:

<http://www.cdc.gov/h1n1flu/>

<http://www.who.int/csr/don/en/>

Q. Can I get a vaccine that will help protect me against a swine flu outbreak?

A. No vaccines are available that are believed to offer significant protection against the current outbreak of swine flu.

Q. When will a vaccine be available that can protect against H1N1 flu?

A. Using standard, FDA-approved technology for vaccine manufacture and testing, it takes five to six months from the start of an outbreak to begin to supply vaccine. CDC and WHO are working with vaccine manufacturers to determine whether part of their vaccine capacity should be diverted to H1N1 flu. 'Regular' flu is responsible for over 35,000 deaths in the US and 250,000 worldwide every year, so it's a tough decision.

Q. Why does it take so long?

A. Currently, flu vaccines are made by growing the flu virus itself, either in eggs (the FDA-approved method) or in a newer, experimental process that uses mammalian cells growing in bioreactors. In either case, it is dangerous to grow the wild type pandemic flu virus, so CDC and producers take 2-3 months to create and test a vaccine strain that is safe for manufacturing and grows well. Swine flu strains often do not grow well in eggs, so this effort can be challenging. Once a vaccine is in production, manufacturing capacity will limit the availability of vaccine for additional months.

Q. What does strain-matched mean?

A. Every year the circulating flu strains change their surface proteins, so that the immune system may not recognize and protect against the virus. Unlike most vaccines, manufacturers need to update the flu vaccine every year so that it closely matches the latest circulating strains. For a new virus that causes a pandemic, it takes time to create a new vaccine that will be a match.

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