Danger of major swine flu outbreak continues

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Just over two weeks since the swine flu (H1N1) outbreak emerged in Mexico, it has spread to 21 countries on 5 continents. As of May 10, the World Health Organisation (WHO) had confirmed 4,379 cases of swine flu and 49 deaths—45 in Mexico, two in the United States and one each in Canada and Costa Rica.

According to WHO, the risk of a pandemic remains at phase 5, based on swine flu's geographical spread. Most confirmed cases, however, have so far been mild, with relatively few deaths compared to the number of cases. But in the international media, there has been little to illuminate the causes of the outbreak or explain the potential threats of a global pandemic.

The initial media response verged on hysteria, creating an atmosphere of alarm, with saturation coverage of the widening spread of the virus. Such sentiments were manipulated in various countries for definite political purposes (see "Politics and economics dominate response to swine flu epidemic"). Now the story has dropped off the front pages, shutting down public discussion and preventing any critical examination of the initial responses and preparedness for further outbreaks.

A definite threat remains. Last week, WHO assistant director-general for health Keiji Fukuda warned that significant infection transmission was continuing. While the US had confirmed just two deaths, there were 896 confirmed infections and another 927 probable cases. Few cases have been confirmed in the southern hemisphere, but winter is beginning and a viral outbreak could have a major impact, particularly among the impoverished populations of Africa and South America.

To make estimates of a potential pandemic, WHO mainly observes the geographical spread of an infection. Two other measures used by scientists—basic reproductive rate (Ro) and generation time—are used to model the spread. Ro refers to the number of new cases caused by exposure to one infected individual. In the current swine flu outbreak, the Ro rate is about 1.4, compared to around 4 for the deadly 1918 pandemic. Generation time refers to the length of time before infected individuals begin to infect others. The higher the Ro and the shorter the generation time, the more difficult it is to control an infection's spread.

The overall mortality rate for the swine flu outbreak has been low, but virologists warn that the virus could mutate into a more deadly disease as it infects people across the globe. While major viral outbreaks have varied enormously in history, the last time this particular family of flu viruses (subtype H1N1) created a pandemic was in 1918. A four-month mild wave of the illness preceded a major disaster killing more than 50 million after the virus mutated into a deadlier form.

Avian influenza expert Professor Kennedy Shortridge, from the University of Hong Kong, raised concerns in the April 29 edition of the journal *Science*, about complacency over the mildness of the initial outbreak. He explained that the further the virus spread, the greater the chance of it mixing, or reassorting, with other flu viruses in circulation and turning into something more lethal.

"The prospects for change [in the virus] are considerable and worrying," he said. Shortridge was among the first scientists to suggest that pigs might act as "mixing vessels" for new combinations of viruses. The swine flu, now spreading from Mexico, "fits into the mixing vessel hypothesis," he added.

An analysis of flu specimens by Canada's National Microbiology Laboratory in Winnipeg and at the US Centres for Disease Control and Prevention in Atlanta, Georgia, have found that the swine flu virus was made up of pieces of genetic material from human, swine, and avian viruses from three continents—North America, Europe, and Asia. This mixture "gives an order of complexity we really don't understand at this point," Shortridge explained.

How a virus is able to mutate and evolve is one of the most intriguing and complex phenomena that confront scientists in the field of microbiology, virology and epidemiology. Influenza A is the most common type of infection in humans and is known to have 11 subtypes, four of which have caused worldwide pandemics since the late 1880s. Pandemics occur when small changes in the virus over a long period of time eventually "shift" the virus into a whole new subtype, leaving the human population with no time to develop a new immunity.

Unlike bacteria, viruses are sub-microscopic and do not have a cellular structure. Their essential component is genetic material—either DNA (Deoxyribonucleic Acid) or RNA (Ribonucleic Acid)—that allows them to take control of a host cell. Viruses reproduce by invading a host cell and directing it to produce more viruses that eventually burst out of the cell, killing it in the process.

The influenza virus is about one-hundredth of the size of a bacteria and extremely adept at infecting its hosts. Its genetic material is safely enclosed in a protein/fat capsule with surface antigens or "markers" that can change after each infection. The ability of surface antigens to rapidly alter make the disease especially hard to control, as it can side-step the immunity the host may have developed against a previous form of influenza. This is why annual flu immunisations are limited in their effect.

Influenza's genetic material—RNA—is made up of eight tiny strands. The RNA is similar to the DNA found in a cell's chromosomes but much smaller. Influenza has only 30 or so genes compared with around 25,000 found in each human cell. These flu genes provide the instructions for making the virus's simple inner and outer components, including the capsule and surface markers. The surface markers are what give the influenza its particular subtype label. The subtype for swine flu is H1N1—H stands for Haemagglutinin and N for Neuraminidase—the same subtype as the deadly Spanish flu of 1918. The bird flu's subtype was H5N1.

The small size of the RNA strands also enable influenza to mix and match with other strands found in humans, pigs and birds. The spread of an infection enables the virus to change or “recombine” its genetic material over time with other strains, which is how scientists believe the current swine flu developed.

Prior to the current outbreak, swine flu was only known to have infected 50 people—all of these cases were through direct contact with pigs. The 2009 swine flu is a new variation that can cause infection from human to human. The fact that swine flu has not circulated widely among the human population is also causing concern among scientists. As people have not been exposed to any variant of the virus, they will not have developed any immunity.

Pigs have receptors for both human and bird flu viruses, which makes them ideal “mixing vessels” for new viral combinations. Bird flu is easily transmitted to pigs via their droppings. If a pig catches two kinds of flu at once, a new hybrid can emerge with genes from both viruses.

A 2003 paper in the journal *Science* acknowledged that scientists knew as far back as 1998 that a new flu strain had begun to infect pigs. Prior to that, only one subtype was known. Author Bernice Wuethrich explained: “In the past decade, big swine producers have gotten bigger, and many small producers have gone out of business. The percentage of farms with 5,000 or more animals surged from 18 percent in 1993 to 53 percent in 2002.” With larger numbers of pigs being farmed together, there is also a greater chance of viruses spreading and rogue strains developing.

In the same paper, US National Veterinary Services Laboratories expert Sabrina Swenson warned: “We don’t have any official surveillance system for swine influenza. We have to bring the human health people together with the vet-health people because of the concern that the viruses can move to people ... but it’s dependent on funding.”

The swine flu outbreak in Mexico started near the Smithfield Foods farm, which produces nearly a million pigs a year. The company denied responsibility, pointing out that their pigs had shown no signs of illness. But that is largely due to the administration of flu vaccinations, which prevent the pigs from getting ill, but does not stop infection from spreading to humans.

While the danger of a swine flu emerging in human populations was known, little appears to have been done. The response to the current outbreak has been characterised by delays, a lack of medical equipment and staff, and inadequate international collaboration. These conditions were compounded in Mexico by economic backwardness and widespread poverty.

If the swine flu does mutate into a more potent strain, the consequences could be devastating. Health authorities do not have an effective vaccine. The current regular vaccine is effective only against three viral strains. A new vaccine would not be available for at least six months. Its production would be limited to several large corporations as well as two government laboratories in the US and others in Europe.

An editorial in *New Scientist* this month explained: “The extent of global vaccine R&D and manufacturing capacity has been largely dictated by companies’ commercial interests. No more or less can be expected of companies, of course, but with few exceptions we’ve left everything to them.... To divert all resources to tackling this virus ... means a huge leap of faith and... [they] may only do it if governments pick up the tab.”

Antiviral agents such as Tamiflu can assist if the virus is caught early, as they act to reduce the virus’ effectiveness in replicating inside a host cell. If the infection is already advanced, however, there is not much an antiviral agent can do to reduce symptoms.

The SARS virus outbreak in 2003 exposed the inadequacies of health systems around the world. According to experts, hospital systems require trained infection control staff and an infection control committee in every hospital; additional beds and a dedicated wing in major hospitals; a system to exchange information with neighbouring countries; and an expansion of flu research labs. A 2007 survey of 30 European nations found that only about half met WHO standards. In poorer countries, the situation is undoubtedly much worse.

The crisis in Mexico exposed some of these problems. The country has only one laboratory, the Instituto de Diagnóstico y Referencia Epidemiológicos (InDRE) in Mexico City, that can carry out the necessary PCR (polymerase chain reaction) tests to determine the strain of influenza involved. Scientists were forced to borrow equipment from a pharmaceutical company, and purchase 10 machines to keep up with the thousands of cases needing diagnosis.

International collaboration is obviously required to contain a major pandemic, but many governments responded to the latest outbreak by turning their countries into “fortresses” while offering little to help Mexico deal with the crisis.

It is quite possible that the current swine flu virus may not mutate into a more dangerous form and the danger will subside. Scientists, however, are concerned that the virus is poorly understood, and could prove to be unstable and thus susceptible to mutation. As demonstrated by the chaotic response to the first outbreak, the real danger lies in the anarchic character of capitalism, which puts the private profits of a wealthy few ahead of even the most basic necessities of life for the vast majority of humanity.