

1. The following information was posted on the WHO web site.

[http://www.who.int/csr/don/2005\\_08\\_03/en/](http://www.who.int/csr/don/2005_08_03/en/)

## Outbreak associated with *Streptococcus suis* in pigs in China

3 August 2005

To date, the Ministry of Health in China has reported 206 cases of human disease associated with an outbreak of *Streptococcus suis* in pigs. Of these human cases, 38 have been fatal. As reported by China, 18 patients are critically ill.

Virtually all cases have occurred in Sichuan Province, where infections with *Streptococcus suis* have been detected in pigs in a concurrent outbreak. The province has one of the largest pig populations in China.

Investigation and containment of the outbreak have been given high priority by Chinese authorities. The country's ministries of health and agriculture are working in close collaboration, and WHO and FAO are being promptly informed of new developments.

Investigations conducted by Chinese epidemiologists indicate that the first human cases occurred at the end of June in Ziyang City, Sichuan Province. From 24 June through 21 July, the authorities reported 20 cases of illness, of unknown cause, admitted to three hospitals in that city. WHO was officially informed of the outbreak on 22 July, at which time 20 cases and 9 deaths had been reported.

Cases have since been reported in 11 prefectures in Sichuan Province. Most cases reported have occurred in adult male farmers. Information reported to WHO suggests that close contact with diseased or dead pigs is the principal source of human infection.

Symptoms reported by local clinicians include high fever, malaise, nausea, and vomiting, followed by meningitis, subcutaneous haemorrhage, toxic shock, and coma in severe cases. The incubation period is short and disease progression is rapid.

Local experts are conducting active searches for further cases. To date, Chinese authorities say they have found no evidence of human-to-human transmission.

The outbreak in humans has some unusual features and is being closely followed by WHO. Diagnostic testing to further characterize the causative agent is recommended as an essential part of ongoing efforts to understand this outbreak, ensure its rapid containment, and prevent further deaths.

- a. It appears that the strain of *Streptococcus suis* has involved in this outbreak has acquired some new properties which make it a more significant pathogen. What mechanisms can you suggest which might lead to the rapid acquisition of such new pathogenic properties.
- b. What information might be obtained from sequencing the genome of this pathogenic strain of *Streptococcus suis* which might give insight into the pathogenic properties of the bacteria.
- c. Explain what type of gene the bacteria might have acquired which leads to toxic shock. Explain the mechanism by which toxic shock is induced by this gene

2. An infection is sweeping the MIT community which causes an upper respiratory infection, general malaise and specifically attacks the math centers in the brain causing a precipitous drop in test scores in all course 18 classes. A group of UROP students are determined to identify the cause of this infection. They determine that the infection can be transferred to mice, rabbits, cats and hamsters by swabbing a Q-TIP from the nasal secretions of a student who has just failed an 18.01 exam on the tip of the nose of an experimental animal. The same procedure fails to transfer any pathological condition to dogs and guinea pigs.

- a. Explain how the procedures students could use to determine what type of infectious agent is responsible for the infection. Be specific about what types of results would suggest the agents was a virus.
- b. The infectious agent does turn out to be a virus. Explain how the students might determine what type of virus they had isolated.
- c. The students isolate three distinct proteins from the virus A, B and C. The students divide themselves into 3 groups and attempt to make antibody against these proteins. The first group has only enough of protein A to inject a rabbit once, so they harvest serum after a single injection. The second group has enough of protein B to inject a rabbit twice and then they harvest the serum. The third group has enough serum to inject a rabbit a total of times and then harvest the serum. What differences would you expect to observe for the antiserum harvested by each group of students. Explain the reasons for these differences in terms of the molecular and cellular mechanisms for generating antibody.
- d. Explain three different strategies the UROP students might use to attempt to develop a vaccine against the virus. Explain which cell types of the immune system would be involved in each approach to vaccination.
- e. A similar outbreak has occurred at Harvard, but the symptoms differ slightly. Although the math performance of the students appears undiminished (measurements turn out to be statistically significant on this point despite the relatively low baseline) the Harvard students uniformly exhibit an inability to bs effortlessly as they had been able to do prior to infection. These two pathological functions turn out to be encoded by different viral genes. A meeting held at a bar in Central Square between infected Harvard and MIT students leads to students becoming infected with both types of viruses. What outcome would you expect if the virus

turns out to be an influenza virus. How would you expect this virus to behave if it were to infect BU students. Would your view of the outcome of this meeting differ if the virus turns out to be a picorna virus.

- f. If the virus was an influenza virus, what chemical treatments might be effective in treating the disease. Explain the molecular basis for these treatments.
- g. What reasons could you suggest for the inability of the virus to infect dogs and hamsters.

3. The term epitope refers to the part of an antigen which is specifically active in eliciting an immune response. A virus encoding a single coat protein is capable of eliciting both an antibody response and a cytotoxic T cell response. Would you expect these responses to be directed towards the same epitopes on the virus coat protein? If not, why not? Be specific in your answer referring to the components of the immune system active in each case and explain why the portion of the polypeptide chain against which the response was directed would differ in each case.