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Could the 'Black Death' become a re-emerging infectious disease?

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Black Death

- Analysis of DNA from victims in northern and southern Europe published in 2010 and 2011 indicates that the pathogen responsible was the *Yersinia pestis* bacterium, probably causing several forms of plague.
- *Yersinia pestis* (formerly *Pasteurella pestis*) is a Gram-negative rod-shaped coccobacillus, a facultative anaerobic bacterium that can infect humans and animals.
- Human *Y. pestis* infection takes three main forms: pneumonic, septicemic, and bubonic plagues. All three forms were responsible for a number of high-mortality epidemics throughout human history



A scanning electron microscope micrograph depicting a mass of *Yersinia pestis* bacteria.



Immunological and physiological effects

- Those infected with the bacteria develop symptoms that can include swollen, tender lymph glands, fever, headache, chills, and weakness. Other symptoms may include muscle pain and seizures. The human body is generally unsuccessful in fighting the disease because cells of *Y. pestis* can resist phagocytosis.



Image from the recently unearthed London Plague Pits.

See:

<http://www.guardian.co.uk/science/2013/mar/15/black-death-victims-city-london>



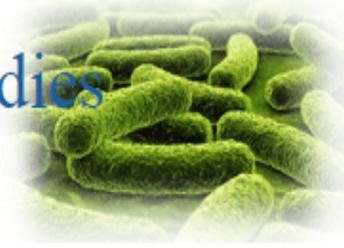
Pathogenic re-emergence?

- Key question:
 - Could the plague ever re-emerge on a similar level in the twenty-first century?
- Due to the potential seriousness of the disease this is a subject worthy of epidemiological consideration and research.



History

- The Black Death is the name given to a deadly plague (often called bubonic plague, but is more likely to be pneumonic plague) which was rampant during the Fourteenth Century.
- In Medieval England, the Black Death was to kill 1.5 million people out of an estimated total of 4 million people between 1348 and 1350.
- It was believed to have arrived from Asia in late 1348 and caused more than one epidemic in that century - though its impact on English society from 1348 to 1350 was terrible.



Historical origins of the bacterium

- The bacterium seemingly evolved several thousand years ago from a far more benign, gut dwelling bug called *Y. pseudotuberculosis* (one of a group of relatively benign intestinal diseases).
- It is unknown if *Y. pestis* caused all causes of plague during this period, although it stands as the main the etiologic agent (many of the skeletons exhumed from 'plague pits') have been tested using a rapid diagnostic test for the detection of *Y. pestis* F1 antigen to confirm the cause of their death.



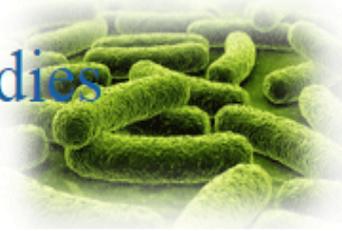
Vectors

- Until recently the Black Death was thought to have been caused by fleas carried by rats that were very common in towns and cities. When the fleas bit into their victims, it was thought they were literally injecting them with the disease.
- New evidence from human remains in the north of the City of London (paleotraumatological evidences) suggests that fleas could not actually have been responsible for an infection that spread so fast - it had to be airborne.
- Once the disease reached the lungs of the malnourished, it was then spread to the wider population through sneezes and coughs.



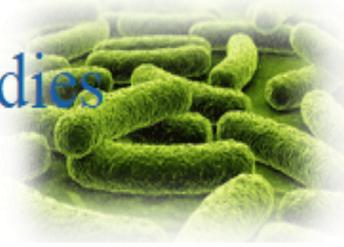
Key research questions

- One debate that has arisen from such finds is whether the major plague pandemics simply stand as historic events or whether they could ever re-occur on a similar scale and with similar virulence?
- Analysis of the **Great Plague of Marseille**, which caused 100,000 deaths between 1720 and 1723.
 - There are issues we are facing with infectious diseases today,
 - The case allows us to identify the best ways to respond to epidemics,
 - The case begs the question whether we are still at risk of the plague re-emerging again?



Consideration of the question

- A number of factors show populations are still at risk of plague today.
- This is due to several reasons including:
 - Transport and trade,
 - Threats in developing countries where multi-drug resistant pathogens are currently emerging and spreading rapidly.
- These global problems would require responses at various intersecting levels of public health and political authority: global, national, and local.



Plague cases remain global

- Cases of plague continue to be reported. In 1994 and 2010 cases were reported in Peru; and in the USA cases were reported in Oregon and Colorado.
- Globally, most human cases since the 1990s have occurred in Africa.
- However, cases are currently small in number. Typically Between 1,000 and 2,000 cases each year are reported to the World Health Organization, although this is likely to be an underestimation.
- But – if certain risk factors combine –an epidemic could potentially occur.



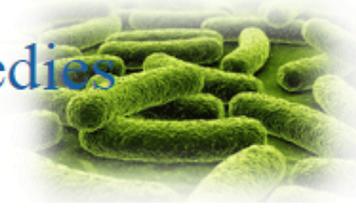
Other considerations

- Concern stems from the genetic analysis of the plague causing bacterium.
 - Studies have found that the *Y. pestis* had a similar genetic structure to the bacterium that causes leprosy.
 - Additionally research suggests that *Y. pestis* continues to evolve; the concern is whether this evolutionary trajectory is towards an even more dangerous pathogen or into one and may one day develop into an microorganism that poses no threat to the cells of its host.
 - Currently the main treatment is with the use of fluoroquinolones drug class. There is no reason why, however, the target bacterium should not develop antibiotic resistance should the drug be over-used.



Summary

- The potential for global spread exists. *Y. pestis* is capable of causing catastrophic human epidemics and was certainly responsible for great epidemics in the past.
- The potential for genetic modification to the bacterium remains a possibility.



Dr. Tim Sandle

- Dr. Sandle is a chartered biologist. He has over twenty-five years experience of microbiological research.
- Dr. Sandle is a tutor with the School of Pharmacy and Pharmaceutical Sciences, University of Manchester for the university's pharmaceutical microbiology MSc course.
- In addition, Dr. Sandle serves on several national and international committees relating to pharmaceutical microbiology and cleanroom contamination control. He is a member of several editorials boards for scientific journals.
- Dr Sandle's website is:
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