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THE RETURN OF THE BEAST: MODERN BLACK DEATH?

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SCIENCE 100, 2013-2014

Introduction

- One of the most devastating epidemics known in the history of mankind has been the Black Death. The Black Death swept across Europe in the year of 1347 claiming the lives of approximately 23.5 million Europeans within the first three years of its occurrence (1).
- Studies discovered that there were two other epidemics, Justinian Plague in the year of 565AD and the Indo-Chinese Plague in the year of 1855AD which are related to the Black Death in terms of symptoms, devastating life losses and most importantly the causative agent; *Yersinia pestis*.
- The horrific experience which Europeans had with the 1300's Black Death posed the question of whether there is a possibility that the Black Death may return again or not.
- Understanding symptoms, transmission conditions and types of the plague along with investigating the evolution of *Y.pestis* over time is vital in answering this question.
- Currently, all evidence are pointing towards the huge possibility of the of the resurrection of the Black Death in the modern world.

Transmission of the Plague

- The plague can be transmitted through three pathways: flea bites, handling infected tissue and inhaling infected droplets (2).
- During the plagues the rodent population diminishes rapidly causing the hungry fleas to look for other sources of blood. These fleas are often carrying the bacteria.
- Another method of contraction is handling infected tissue of sick rodents or infected humans.
- The last and most dangerous pathway is the inhalation of infected droplets from a patient with the pneumonic plague. This is the only method by which the plague can be transmitted between humans.
- Transmission factors affect the survival of *Y.pestis* by limiting the pathways by which *Y.pestis* can be acquired; and as a result allowing the plague to go undetected for long periods of time unless there is an endemic or epidemic.
- The life cycles *Y.pestis* and ecology of the plague are both very important in understanding *Y.pestis*' behaviour prior to and during any plague.

Modern Plague

- According to the World Health Organization; in 2003, 2100 cases of the plague out of which 180 deaths were reported (6).
- The latest serious endemic caused by the plague was in the Democratic Republic of Congo where 50 citizens died out of 1174 cases (6).
- In the twenty-first century, approximately seven countries (mainly in Africa and the United States- see figure 3) reported multiple cases of the bubonic and pneumonic plagues (6).
- Almost all cases reported recently are of people living in small towns or villages or agricultural areas(6)
- World Health Organization suggests a mortality rate of 8-10% but some studies suggest that the mortality rates may be much higher (6).

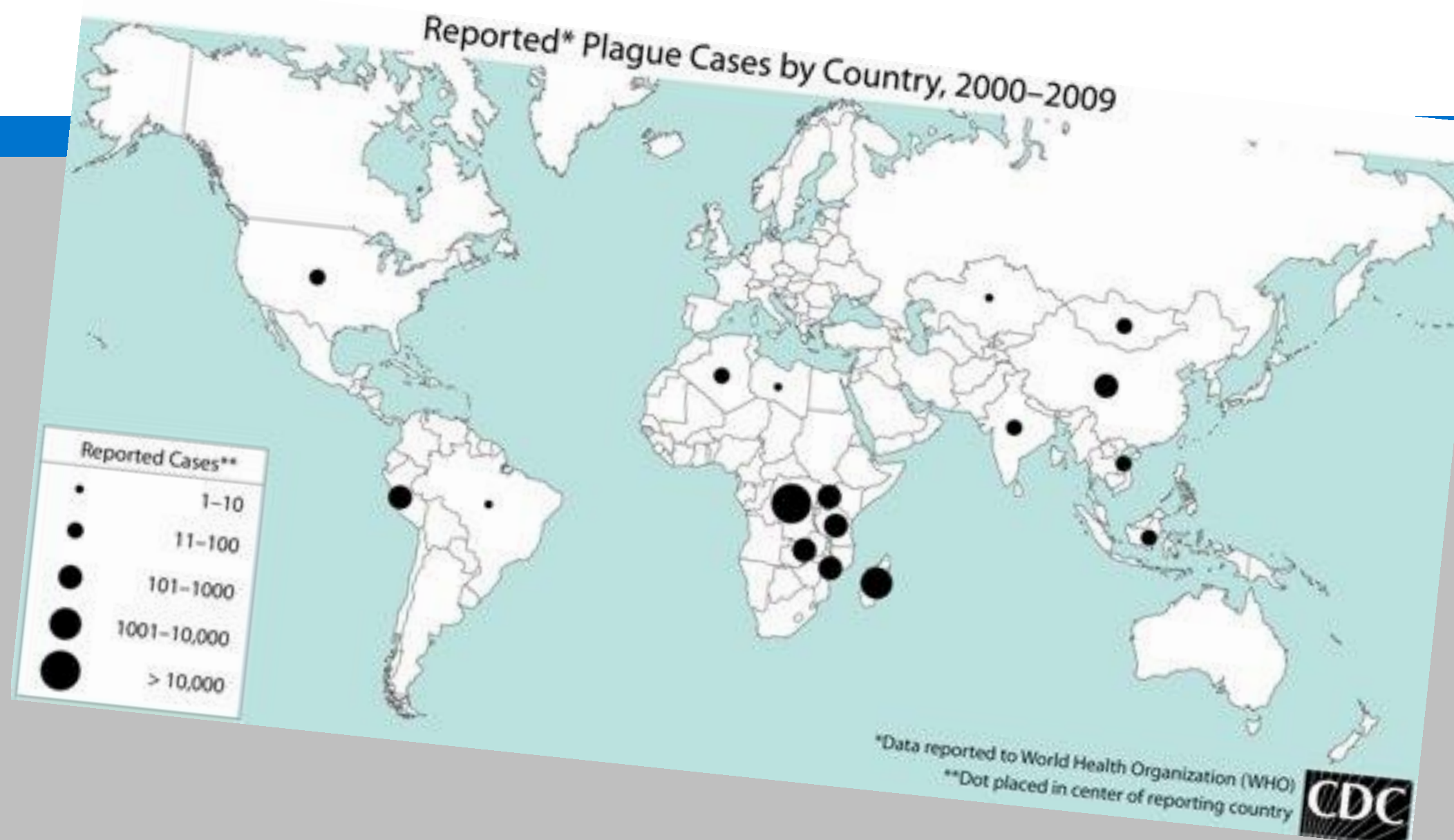


FIGURE3- World Plague map of reported cases in 2010
<http://www.cdc.gov/plague/maps/>

Types and Symptoms of the Plague¹

- There are three types of the plague: the bubonic plague (which was prominent during the Black Death), the septicemic plague and the pneumonic plague.
- Symptoms of the Bubonic plague include fever, chills and painful tender lymph nodes called buboes (See figure 1). *Y.pestis* multiplies in the lymph nodes closest to where it entered the body through the flea bites carrying the disease and form the buboes. If it left untreated the bacteria will spread throughout the rest of the body.
- Septicemic Plague is caused by handling infected tissue or by flea bites. Its symptoms include fever, abdominal pain, internal bleeding or shock. The skin and tissue may also turn black and dies (See figure 2). If the Bubonic and Septicemic Plagues are left untreated, the plague will progress to become the pneumonic version.
- When *Y.pestis* reaches the lungs, the Pneumonic Plague develops. The Pneumonic Plague is considered to be the most dangerous of all. This type is transmitted by inhaling infected droplets. The disease has now progressed to be transmitted between humans. Its symptoms may include fever, chills, development of pneumonia with shortness of breath with coughing bloody mucous and it will result in death.

Ecology of the Plague

- *Yersinia pestis* is known to have maintained its existence through two life cycles involving fleas and their hosts.
- The two life cycles for *Y.pestis* are the enzootic and epizootic cycles.
- Enzootic Cycle: the plague is circulating lightly between rodents without causing too many sudden deaths. The rodents are serving as long time reservoirs for *Y.pestis*(2).
- Epizootic Cycle: when the plague becomes endemic amongst rodents. Humans usually contract the disease only during this cycle(2).
- The plague is found more in semi-arid forests and grasslands where there is a diverse amount of rodents(2).
- Scientists are suggesting that pandemics are most likely to occur during wet winters following cool summers(2).
- Discovering the survival behaviour/life cycles of *Y.pestis* and the ecology of the plague gave scientists a good idea about the survival behaviour of *Y.pestis* and how it was able to survive and evolve till this day.

Conclusion

- The Black Death was one of the most devastating events in the European History and as a result scientists fear another modern Black Death sweeping across the world and causing yet another vicious genocide.
- Studies and researches have been conducted to investigate the possibility of another plague.
- Through research studies and DNA coding, it was found that *Y.pestis* was able to evolve from *Y.pseudotuberculosis* (a totally different pathogen). The importance of this discovery is that *Y.pestis* had the ability to evolve and accommodate to completely different habitats and living conditions.
- It was later discovered that the Plague of Justinian was caused by a different strain than the Black Death's one, which means that *Y.pestis* was able to evolve to different strains, which have the same devastating results and symptoms.
- Understanding the life cycles of *Y.pestis*, scientists could infer that the disease is rapidly spread and it may stay undetected for long periods of time among the rodent population.
- Given global warming, the world is experiencing wetter winters providing the best environment for the resurrection of a new plague.
- Therefore combining the rapid unexpected evolution of *Y.pestis* to completely different strains and the stability of its existence along with the abundance of all the conditions needed for its survival; we can safely claim that there is a huge possibility in the reoccurrence of a modern plague. The Beast may simply Return!

Evolution of *Yersinia pestis*

- *Y.pestis* is known to be a gram negative rod shaped facultative bacterium. It is also known to have evolved from *Y.pseudotuberculosis*; a gastrointestinal pathogen around 15000 to 20000 years ago (3).
- It was found that before an emergence of any epidemic, there happens a "Big Bang" event in the evolution of *Y.pestis*; resulting in the emergence of multiple extant lineages of *Y.pestis* in a short period of time. This phenomena is due to the fact that replication cycles are faster during the epizootic cycle of the disease (when the disease becomes epidemic) (4)
- Latest studies have uncovered that the *Y.pestis* strain which caused the plague of Justinian is completely independent from the strain which caused the Black Death and any other plague onwards. This discovery lead to the conclusion that during the years between the Plague of Justinian and the Black Death one strain completely disappeared and another strain of the same bacteria caused yet another devastating plague (5).
- As listed above, *Y.pestis* appears to be constantly evolving and at a very high rate. The fascinating fact about *Y.pestis* is that its evolution goes undetected till an endemic hit.
- This behaviour in evolution, sudden bursts of diversification, allowed *Y.pestis* to survive till current day.



Figure 1- swollen lymph node (bubo) as a result of the bubonic plague
<http://bashapedia.pbworks.com/w/page/13960223/Bubonic%20Plague>



Figure 2- Necrosis of finger tips resulted from septicemic plague-
<http://people.uwec.edu/piercech/bio/Pneumonic%20Plague.htm>

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