PLAGUE AND BIO-TERRORISM

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Abstract

Plague ranks high on the list of biological agents that might be used by terrorists. However, its status as a weapon of mass destruction is based on two assumptions: (a) that it caused the Black Death and (b) that it was responsible for heavy mortality in India in the late 19th and early 20th centuries. As to the former there is no convincing evidence that it was the agent of the medieval pandemic [a] . Plague deaths in India, whilst apparently high when expressed as a total over the 44 years before antibiotics became available, were annually no greater than those of local endemic diseases. Even pneumonic plague, the only form liable to be used by terrorists, has serious limitations as to delivery method and contact rate. Furthermore, evidence from past epidemics of pneumonic plague has shown that one infected person would, on average, infect only 1.3 others, a situation that could be coped with by movement restriction, isolation and antibiotics.

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[a] A pandemic occurs when a single disease spreads across a large area or is world-wide.

When plague bacteria enter lung tissue the third form, pneumonic plague, results. This form of the disease is very dangerous, with a 100% fatality rate unless treated with antibiotics. It may occur in a small number of cases dur

The received wisdom tells us that there have been three plague pandemics: the first was the one which spread across the Mediterranean region during the reign of the Byzantine Emperor Justinian (A.D.527-565) and had its origin in central or eastern Africa. It appeared in a port at the eastern end of the Nile delta in 541 and took about two years to spread over most of the Middle East and the Mediterranean. It may have reached Ireland in 544 or 545 and perhaps Wales in 547. The second was the Black Death which between 1347-50 spread from the toe of Italy to the most northerly parts of Scandinavia. The third, and present, pandemic began in southern China in the 19th century, reached Hong Kong in 1894, and spread over most of the world in the following decade.

Most scholars of the periods in which the first two pandemics occurred consider that there is little doubt concerning the diagnosis of bubonic plague for both. Such questions as have been asked come from modern studies of the Black Death and these turn out to be equally relevant to the earlier pandemic. The questioning arises from the nature of the third pandemic and it is in this comparative approach that some confusion has arisen and become part of the accepted history. What has happened is "that early authoritative accounts of the third pandemic have included not only historical backgrounds but at times the historical record of the Black Death to supplement the data available for the third pandemic. Thes

pandemics, largely due to an emphasis on modern mortality and the use of figures for deaths in India between 1896 and 1917. Since bio-terrorism is all about how many people can be killed in a fairly short period of time let us examine just how effective plague is in this respect.

5 Ancient mortality estimates

Procopius, in his narrative of the Persian Wars, had returned to Constantinople in 540 and describes high mortality of 10,000 a day and higher, with deserted villages and abandoned cattle. John of Ephesus put the figure in the capital at 16,000 per day with as many as 300,000 taken off the streets where they had died. Without any precise knowledge of the population size before and af

weapon would have even greater capability if the original recipient could infect many others before succumbing and if those others could in turn affect yet more. In this respect these two forms of plague have no part to play in spreading the organism. Yet bubonic plague in the late 19th and early 20th centuries is still seen as a scourge that caused heavy mortality more or less world-wide and it is worth examining what really happened.

Bubonic plague had been diffusing throughout south-western China since at least 1772 and eventually reached Hong Kong and other south China ports in the last decade of the 19th century [16]. This was a new disease for the area and, on its supposed performance in earlier centuries, it should have produced a matching mortality since knowledge of its transmission mechanism was still unknown and would remain so for the best part of the next two decades. It did not, however, live up to its record.

In 1894 the population of Hong Kong was approximately 242,365. In that year there were 2679 plague cases, 2552 of which died, a case fatality rate of 92.6%. This was the worst year yet only 1.05% of the population died of plague. Between 1894 and 1923 the only other year in which plague cases exceeded 2000 was 1914, with 2146 cases, of which 2020 died. By that time the population numbered 495,209 so that the percentage dying of plague was only 0.4.

In the period 1893-1907 a total of 95,832 people died in Hong Kong and it is interesting to compare deaths from plague with those from other illnesses:

Plague:	**12,506**
Pulmonary tuberculosis:	9,392
Tetanus:	7,293
Malaria:	6,977
Bronchitis:	6,037

Even more interesting is the situation in Taiwan for the years 1906-15. The total number of deaths was 949,405 and the principal causes of death were:

Malaria:	94,741

these that are cited as examples of the way in which this form of plague might produce a pandemic. However, examination of the logistics and evolution of the two outbreaks shows a less alarming picture and in fact suggests that had one designed the physical features of this situation as an experiment to show how a pandemic could be started it would not have been deemed a success. It is, therefore, important to study the details of the two outbreaks.

The first epidemic in 1910-11 was probably due indirectly to an increase in the price of marmot skins which rose from 0.30 rouble in 1907 to 1.20 roubles in 1910. The exports of these skins increased from 700,000 in 1907 to 2.5 million in 1910, a rise that was due to an increase in the number of hunters: in the summer of 1910 there were 11,000 Chinese hunters at Manchouli and by October there were still 4,600. Rodents dying of plague appear sick and drowsy and are easy prey. The native hunters were skilled: they shot animals and had learned to avoid sick marmots. The influx of get-rich-quick hunters were unskilled Chinese who used snares and, since these are unselective, the hunters had to handle sick animals. Pneumonic plague cases may arise in skinning wild animals when

insufficient to produce infection. Likewise, the number of victims among the persons isolated after having been found in contact with plague patients is, as a rule, very low" [22]. The author of this paper, the Chinese plague expert Lien-Teh Wu, concluded that the sick room by itself, and even when occupied by plague patients, was not particularly dangerous except when standing in the direct line of the spit or droplet. Modern work showing the limited ability of to cross lung epithelium, [23,24], supports this observation made 80 years earlier.

Even the confined space in railway carriages was shown to be less conducive to infection than was thought and Wu quotes cases where patients with fever and cough travelled in railway cars with 47, 37, 47 and 30 other persons for more than nine hours and yet, despite the close proximity of the pneumonic plague-infected person, none of these other passengers became ill.

Recent work has shown that the average number of secondary cases per primary case (R_o) for eight outbreaks of primary pneumonic plague between 1907 (Seattle, USA) and 1997 (Madagascar) was 1.3. This figure means that one infected person would, on average, infect 1.3 others and bearing in mind that when R_o becomes less than 1.0 the epidemic will die out it shows the low infectivity of pneumonic plague. Similar figures for bubonic and septicaemic plague are not available but they will be well below 1.0 and almost certainly close to zero. Despite this low figure the authors maintain that "pneumonic plague poses a potentially increasing risk to humans in plague non-endemic regions either as a consequence of an aerosolized release or through importation of the disease" [25].

Urban populations present the only worthwhile target for bio-terrorism in so far as the aim would be to kill as many as possible in a short time and provide a nucleus of organisms for the infection of others, the material of choice being pneumonic plague. With this in mind the World Health Organisation calculated in 1970 that in the worst-case scenario, " If 50 kg of were released as an aerosol over a city of 5 million, pneumonic plague could occur in as many as 150,000 persons, 36,000 of which would be expected to die. The plague bacilli would remain viable as an aerosol for 1 hour for a distance of up to 10km. Significant numbers of city inhabitants might

involved in such work in the former Soviet Union may have gone elsewhere, taking their expertise and, perhaps, samples with them for sale to the highest bidder, or at any rate someone who would give them work.

The development of plague as a weapon of mass destruction is only feasible under the auspices of national laboratories which could produce the considerable quantity of material needed to produce death on a large scale. Even then, the difficulties of distributing the organisms to a civilian population present many problems and the use of aerosol plague on the battlefield could be a double-edged weapon in addition to such awkward matters as ambient temperature and survival of the plague bacillus, an organism that does not live for long outside the body.

Modern terrorism is carried out by small groups of people or individuals whose strength lies in their ability to move about frequently and to communicate electronically. The production of plague and other organisms would demand a pattern of behaviour that is not easy to reconcile with a cryptic lifestyle: extensive glassware and metal flasks would be necessary, plus cages for animals and the considerable space needed for such laboratory work. All this is too obvious unless carried out in some deserted corner of the world and even then it is difficult to see it being conducted in caves in Afghanistan. Even if enough plague material could be manufactured, there remains the question of transporting it to the target.

Considering the technical difficulties of preparation and distribution, the use of plague by small groups of clandestine terrorists is unlikely. By far the most potent weapon in relation to this organism is fear and outbreaks of plague in various parts of the world in the early 20th century produced a reaction that had overtones of the events that had taken place in the 14th century. For example, when plague reached San Francisco in 1900 the proclaimed 'Black Plague Creeps Into America' [30], yet in the first ten months there were only 23 recorded plague deaths. This slow start is typical of bubonic plague, in contrast to the Black Death, which in the same period of time in 1348 had covered the whole area from the toe of Italy to the south of England.

Given the particular, but unreasonable, fear of plague that would be presented by the media and even those who ought to know better, the spreading of innocuous material thought to be plague might achieve a degree of panic that could be difficult to control. The experience of an epidemic that included a few cases of pneumonic plague in India in 1994 [31], was an illustration of how things can quickly get out of hand when plague is believed to be present and the modern response, it seems, is unlikely to be very different from the medieval one. The most dangerous object today would be the unrestrained use of the single word **Plague.**

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