

Plague and Plague Prevention in the U.S.

The term 'plague' has been very confusing to the laity as a whole because the term has been applied to almost every epidemic of any serious consequence. Specifically, plague is an infection primary in rats and other rodents, secondary in man, caused by *Bacillus Pestis*. In regions where it is found, it is endemic amongst rodents, and its spread to the human population is usually by way of fleas or by direct contact.

Types.

Three clinical types of plague are recognized: (1) Bubonic, (2) Pneumonic, and (3) Septicemic. The bubonic type is the most common, and is characterized chiefly by the glandular swellings or buboes. The pneumonic form may be primary by direct infection of the respiratory tract, or secondary as a complication of the bubonic type. The sputum in this case contains numerous bacilli and is a direct source of infection. The septicemic form is not so common but is the most rapid in its course.

Distribution.

The main geographic source of bubonic plague is southern Asia particularly India, though the disease is quite widespread throughout the tropical countries. As one author states it "...plague may be found encircling the globe in a rather broad band, bounded roughly, by the 35° parallel north and south of the equator". It is found outside of this zone but it is then much more limited in its extent. It has a predisposition for the warmer climates, and where it is found under less favorable climatic conditions, its tendency to

kind

spread is very much lessened.

The pneumonic type of plague, on the other hand, is usually found in the colder or more northern climates as in Northern Asia, and in the northern higher regions of India. A limited outbreak was reported in 1919 from California, which started from an infected squirrel. As far as I can find in the literature, there have been no other cases of pneumonic plague in the United States.

Distribution(U.S.).

Plague probably entered the United States about 1899, because the first recorded case on this continent was discovered in Chinatown, San Francisco, in March 1900. The disease had already appeared at the Hawaiian Islands so that the appearance in San Francisco is ascribed to either the Hawaiian Islands or to the Orient. For the first year(1900), it is stated, there were 22 human cases.

There are now(1923), four endemic foci of plague in the United States:-one on the Pacific Coast, and three in the Gulf states. The focus on the Pacific coast is San Francisco and vicinity, particularly the counties Alameda, Contra Costa, San Mateo, San Francisco. The foci in the Gulf states are New Orleans, Texas, and Florida. Cases have occurred elsewhere in the United States, especially in seaports, but these are regarded as sporadic cases having been transmitted thru means of travel. As to the extent of the disease amongst rodents, figures are very inadequate. Human cases, as given by Rosenau, in the United States for the period from the first appearance of plague to and including the year 1920, are 389. These are distributed;

California.....	298
New Orleans.....	50
Texas.....	31
Florida.....	10

The first appearance of plague on the N. American continent, as above-mentioned, was in 1900 in San Francisco, when the body of a Chinese, dead of this disease, was discovered in the Chinese quarter. The case was proven bacteriologically to be plague, and the Board of Health of San Francisco, on receipt of the preliminary findings, placed the entire district known as Chinatown in quarantine. Judging from literature of the time, there was much dissension on the subject of plague as regarded the local epidemic. A total of 121 cases and 113 deaths were recorded for the four years of the epidemic. In May, 1907, a year after the great fire and earthquake, plague was again discovered in San Francisco. This time the outbreak lasted only six months, but had a total of 160 cases and 77 deaths. It was not limited to one quarter but was scattered all thru the city.

Between 1908 and 1915, there were only sporadic cases in California. For the next three years (1916, 1917, 1918), no cases of plague are known to have occurred anywhere in the United States. In 1919, however, a series of 13 pneumonic cases (according to Kellogg) occurred in Oakland, Calif., the first of the series having its origin in exposure to plague-infected ground squirrels. Since then, only sporadic cases have occurred in California.

Seattle, Washington, suffered an attack of plague in 1907 when seven deaths from this disease were reported. Measures were adopted, not only in Seattle, but also in several Pacific Coast cities for prevention of spread, rat eradication, etc. Since then, there has been one death there ascribed to plague, and the diagnosis on this case is doubted.

Up until 1914, the Pacific coast was apparently the only source in the United States, but in that year a serious epidemic broke out in New Orleans. Nine human cases were reported for the first month, thirty for the first four months. The history of the first case could

not be obtained so that the origin remains unknown. In 1920 ,human bubonic plague was recognized,almost simultaneously,in three previous ly uninfected ports:-Galveston,Beaumont,and Pensacola. This simult- aneous outbreak in three widely separated areas along the Gulf coast is strongly suggestive of some common source,although corroborative evidence was never secured. There were 18 cases attributable to infection acquired in Galveston,and none that could be attributed to infection acquired outside the city. Two of these cases left Galvest- on either in the incubation period or in early stages of the disease and were diagnosed as plague at Port Arthur and Houston, respectively.

Transmission.

Bubonic plague is an insect-borne disease and has an entirely different epidemiology from pneumonic plague,which is a contact in- fection. In the former type,the infection is spraed from rodent to rodent or from rodent to man principally by means of fleas,but may occur by direct contact. The India Plague Commission (1908) came to certain conclusions regarding this disease;

1. Contagion occurs in less than 3% of the cases,playing a very small part in the general spread of the disease.
2. Bubonic plague in man is entirely dependent on the disease in the rat.
3. The infection is conveyed from rat to rat and from rat to man solely by means of fleas.(Experience in other places,however, show direct contact to be a no small factor).
4. A case i man is not in itself infectious.
5. A large majority of cases occur singly in houses.
6. Plague is usually conveyed from place to place by imported fleas,which are carried by people on their persons or in their baggage. The human agent may himself escape infection.
7. Insanitary conditions have no relation to the occurrence

of plague, except in so far as they favor infestation of rats.

8. The non-epidemic season is bridged over by acute plague in the rat, accompanied by a few cases among human beings.

In the pneumonic form personal infection from one person to another is the common form, as the bacilli are sprayed into the air by coughing. The possibility of the flea as a carrier must be considered. Thus hospitalization of the cases of this type usually results in stamping of the disease.

Diagnoses.

At the early stage of an outbreak plague cases are easily overlooked, but if the suspicious cases are carefully studied by a competent bacteriologist, the disease can be readily identified. In at least two-thirds of all cases of human bubonic plague, there are glandular swellings or buboes. Acute, rapidly fatal, pneumonia should arouse suspicion of the pneumonic form.

Plague rats, like human cases, may be divided into two classes, according as to whether or not a bubo is present. The bubo, if present is the most important diagnostic sign of plague. Of the other appearances, those in the liver are of prime importance. An abundant, clear pleural effusion is of great value in diagnoses. From microscopical examination, the bubo gives the best chance of recognizing the bacilli in large numbers. The naked eye is of greater value than the microscope in recognition of the disease. There is always a slight margin of error in basing conclusions on gross lesions so that the first case in a community must be completely confirmed by the isolation of the causative organism and the study of its characteristics, including practically the carrying out of Koch's postulates. Having confirmed the presence of *B. pestis* in the first rodent case many of the subsequent ones may be safely diagnosed from gross

lesions, the percentage of error being too small to be of practical importance. Towards the end of an epidemic when infected rats become few in numbers, and the prospects of seeing the last one appears, it becomes important that full confirmation be secured in each case so that the continued presence of the infection can be indisputedly proven. It is also noted that towards the end of a campaign, the organisms are of low virulence. In but two inoculations of the last eight infected rats of the Galveston epidemic, were the lesions of plague well defined in the first guinea pig.

Plague in the human being must be differentiated from other conditions. The bubonic and septicemic form is frequently mistaken for typhoid fever, pyogenic infections, etc. All cases with acute enlargement and tenderness of the lymphatic glands must be looked on with suspicion, and a bacterial examination be made wherever possible. The pneumonic form is particularly hard to identify except by bacterial tests.

Plague Control.

In California, plague is confined to small endemic focus among the ground squirrels. The flea found infecting these animals and their burrows is usually present in great numbers, and the ground squirrel appears to be its selective host. It readily bites man.

Systematic trapping reduces the rat population and furnishes information as to its extent. It permits the collection of ^{rats and} fleas, and it is the only reliable means we possess for the early detection and delimitation of rodent plague foci, and thru this information it permits the application of intensive destructive measures at the point of infection.

For plague eradication, the method proposed by R.H. Creel, of the U.S. Public Health Service is:-

A. General Measures;

- 1. Survey {
 - Plague laboratory diagnoses
 - Demarcation of infection
 - 2. Eradication {
 - Rodent destruction
 - Rat proofing
 - 3. Restrictive {
 - Fumigation by SO₂ or HCN
 - Rat proofing and supervision
- { Human plague
 - { Rodent "
 - { Rodent examination
 - { Epidemiology of human cases
 - { "Sentinel" guinea pigs or rats
 - { Trapping
 - { Poisoning
 - { Miscellaneous
 - { Food supplies
 - { Elimination of harborage
 - { Ships
 - { Freight
 - { Baggage
 - { Railroad cars
 - { Stations

B. Special Measures; (applied to plague foci)

- 1. Evacuation
- 2. Intensive rodent destruction {
 - Summary destruction of harborage
 - Fumigation--HCN, SO₂, CS₂, CaC₂
- 3. Flea destruction {
 - Kerosene
 - " emulsion
 - Fumigants--HCN, SO₂
 - Gen'l cleanliness
 - Attention to household pets, cats, and dogs

C. Procedures of minor value or doubtful effectiveness;

- 1. Gen'l destructive measures
- 2. Hospitalization of human cases
- 3. Quarantine of personnel
- 4. Vaccination
- 5. Disinfection
- 6. Stoppage of rat holes

When plague-infected rats were discovered in Beaumont, suppressive measures adopted were;

- 1. Fumigation of all buildings and premises where plague-infected rodents were captured or human cases occurred.
- 2. Trapping operations over the entire city, wharves, and ships
- 3. Examination of rodents for plague infection and such other work as required in the service laboratory.

4. Removal of all wood floors and rat harborages in and above each focus where human plague cases occurred or infected rodents were found.

5. Inspection of all buildings and premises in the city in regard to rat proofing same.

CONCLUSIONS.

Plague is an infection primary in rats and other rodents, and so the ultimate object in plague eradication is the destruction of the LAST plague rodent with its infected parasites. The elimination of human plague incidence is, from an eradivative viewpoint, merely incidental. Subsidence of human cases cannot be taken as the criterion of a successful campaign, for the infection may still be quite marked amongst the rodents. The reduction of rodent population, the extent of rat proofing, and the improvement in general sanitary conditions all enter into the question. When a community may be considered free from plague infection is a very difficult question, for the disease is very difficult to eradicate after having gained a foothold in a favorable environment. The chief methods of combat are, apparently, destruction of the animal by any means, or by a rat-proofing or "shutting-out" process. In considering means and methods of rat control, we must take cognizance of other reasons for this work, and so we must consider the subject of the relation of the rat to public health in general.

Biography:-

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Extracts from several articles.

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