

# Plague in the Continental United States, 1900–76

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BUBONIC PLAGUE, like cancer today, was probably one of the most dreaded and feared diseases a century ago, and even today it is of interest (1–3). Is interest today merely of historic note? The following review of the history of plague in the continental United States provides a context for our current knowledge, points out that the threat of human plague still exists, and alerts public health workers in certain areas to this potential danger.

Even before the first case of plague was documented in the United States, Surgeon General Walter Wyman noted in a pamphlet published for the use of his medical officers (4a):

The appearance of the plague in Santos, Brazil, in October 1899 marks an important epoch in plague literature as furnishing the very first recorded instances of the occurrence of the disease in the Western Hemisphere.

Shortly thereafter, plague was discovered in San Francisco. On March 6, 1900, the body of a Chinese worker was found in the basement of the Globe Hotel and transferred to an undertaker. An autopsy revealed large inguinal nodes suggestive of plague, and the city physician notified the city health officer and bacteriologist Wilfred H. Kellogg of this find-

ing. Organisms with characteristics of the plague bacillus were discovered by Kellogg in smears of lymph fluid (5). The Chief Quarantine Officer at the U.S. Marine Hospital Service at Angel Island, Dr. Joseph Kinyoun, was notified of Kellogg's discovery. Kinyoun recommended that exposed Chinese of San Francisco be inoculated with antipest serum and that the entire area be fumigated. Twelve blocks of Chinatown were surrounded by police in search of persons who might have the disease.

However, what might have been a routine investigation of a potentially major epidemic became a major concern, not only for the health of the citizens but also for commercial interests. A bitter attack was launched against Kinyoun and the board of health. Pressure became so intense that the initial quarantine was lifted after only 60 hours. But, by March 11—although the bodies of the Chinese dead were hidden—two more cases of plague were detected in Chinatown (5).

The newspapers, which had heretofore refused to print the news, could no longer ignore it. Soon the nation knew that plague existed in California. The Governor of California nevertheless con-

ducted an investigation supported by large businesses, the board of trade, the chamber of commerce, and the railroad industry. It was concluded from this investigation that plague "Did not nor ever did exist in California" (5). The political battle waged over the need to quarantine part of San Francisco and to fumigate the Chinese community has been called "One of the sorriest episodes in American medical history" (5a).

By 1904, 118 of 121 persons reported to have had plague had died. Kinyoun had resigned from Federal service. An order from President McKinley to limit travel of orientals was refused. And the new Governor of California recognized the existence of plague and cooperated fully toward its eradication. Rat proofing of buildings had begun, and the outbreak had ended (6).

Although the exact method by which plague entered San Francisco is not known, the data available indicate that the population

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was at risk of an outbreak. Urban plague—plague that is transmitted in a rat-flea-rat cycle with man as an incidental host—depends on a dense rat population which harbors a high flea population, optimally the oriental rat flea, *Xenopsylla cheopsis* (7). The dense rat population must have existed in Chinatown because the poor sanitation there has been well documented. The plague bacillus most likely was introduced by ships from the Orient.

Bubonic plague was pronounced “eradicated” in 1904 primarily because of three factors: (a) bitter opposition to continuing eradication efforts that hurt business and trade, (b) an absence of new cases in man, and (c) inadequate epidemiologic information (8). If the rat population had been surveyed at the time, however, it would have been evident that the disease had not been eradicated. After the 1906 earthquake followed by fire in San Francisco, “Rubbish, garbage, and human and animal wastes piled high. Rats multiplied and fattened in the filth, and passed their fleas on to the ground squirrels in the rural areas” (4b). From May 30, 1907 to June 30, 1908, 159 cases of plague and 77 deaths were reported (4c).

Between 1900 and 1908 it was discovered that the ground squirrel population of California, as well as the rat population, was infected with the plague bacillus. Two theories concerning the infection of wild rodents, referred to as sylvatic plague, prevail: (a) that they became infected through importation from the urban rats and (b) that plague had existed in the wild rodents but had not been identified previously (9–11). An entry by Dr. Rupert Blue in the San Francisco plague Journal in 1904 attests to the possibility that

sylvatic plague was probably quite widespread (4b):

June 18. Two boys died. Had been shooting squirrels in Contra Costa County, May 29, 30, 31, . . . This marks the 3d or 4th death in the past year to be apparently associated with ground squirrel infection, and that the squirrels of Contra Costa County are already infected seem to be foregone conclusions. These animals infest the whole state, their burrows being a continuous chain from one end to the other.

Sporadic cases of human plague of sylvatic origin were reported from Seattle to southern California, giving some hint of the extent of infection in the rodent population during the early 1900s. Annual reports of the Surgeon General reflected concern over this newly discovered locus of plague. Regular notations were made of numbers of rodents (rats, squirrels, and others) found and inspected, as well as the numbers infected.

This concern was well founded. On August 15, 1919, after hunting in the Berkeley Hills and bringing home a squirrel, a man contracted plague and subsequently died. This case is of particular note for several reasons: (a) the man developed secondary plague pneumonia (the major form in which plague can be transmitted from man to man), (b) this was the “first instance of an epidemic of pneumonic plague on the Western Hemisphere” (12), (c) the plague was of sylvatic origin, (d) of the 13 persons who later contracted plague, 12 died, and (e) the manner in which the epidemic was contained by hospitalization and isolation is a somewhat classic example of containment (12).

On the heels of the outbreak just described, plague was reported from yet another area of the country. The Surgeon General’s 1914 report stated that there was continued world prevalence of plague with “no unusual out-

breaks of importance.” However, it went on (13a):

During the last 20 years [plague] has been traveling to all corners of the earth, following the commercial routes, especially water routes. Ships carry rats and rats carry plague, so that in the absence of special precautions to prevent the introduction of the disease in this way it would be surprising and quite accidental if ports of any size have escaped the infection.

How prophetic these words might have seemed to the people of the Gulf Coast had they seen them 5 years later when human plague was recognized nearly simultaneously in Galveston, Beaumont, and Pensacola (14). Closely following these outbreaks, cases were also reported from New Orleans and Port Arthur; a total of 71 cases with 31 deaths resulted from these outbreaks.

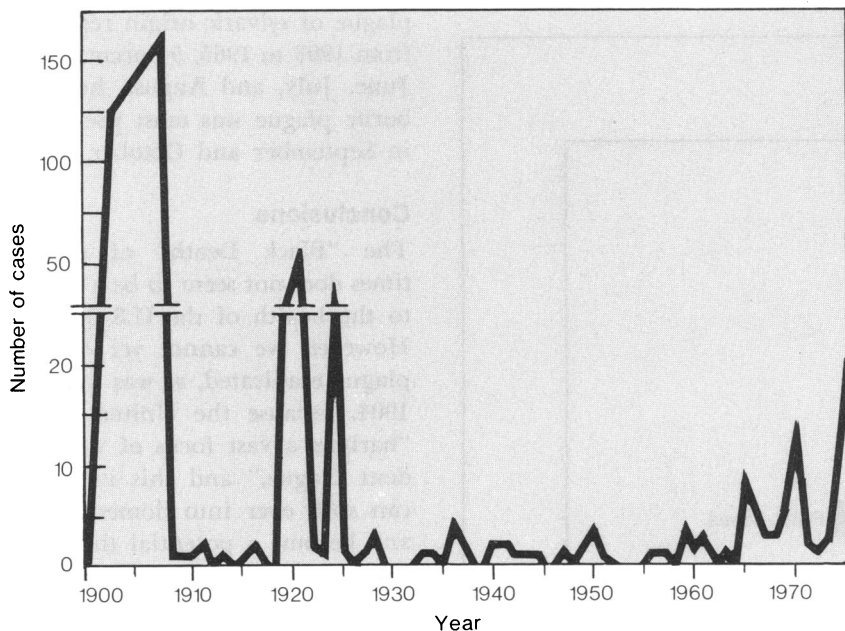
Shortly thereafter, yet another epidemic was in progress. Again, plague pneumonia was the major killer. A 2-week outbreak in October and November 1924 occurred in the primarily Mexican section of Los Angeles. Of 39 human cases reported, 28 were in Mexicans; a total of 33 persons died. The epidemic was contained, according to Wayson (15) who compared it with the earlier epidemic in San Francisco’s Chinatown, because the Mexicans were “easier to deal with” and did not hide their dead.

Rat proofing of buildings in a number of port cities seemed to be paying off in more than a diminution of plague cases. The Surgeon General’s 1917 report from New Orleans pointed out some of the “fringe benefits” (13b):

The average number of fleas per rat had lessened; the general health of the community was improved; and it is also estimated by the fire marshall that as a result of rat-proofing the number of fires had been reduced.

Additionally, Oakland, Calif., was declared “free from plague infection” in 1925, and restrictions

Figure 1. Reported cases of human plague, United States, 1900-75



were removed from vessels moving in and out of the area (13c).

It seemed that urban plague was waning after the Gulf Coast outbreak and that plague might be approaching elimination in the United States. Yet, reports of infected wild rodents became more frequent in the 1930s. Following few cases and few reports of infected rodents (although the death of one person was attributed to infected ground squirrels in 1928), the Surgeon General's reports contained increasingly frequent notations about plague infections in wild rodents and their fleas. Infected ground squirrels in California were first mentioned in 1914 (13a) and then from 1935 to 1937 they were reported to be in Oregon, Montana, Idaho, Nevada, and Utah (13d, e, f). The list of infected animals continued to expand—prairie dogs, chipmunks, and even some birds were implicated in the spread of plague (16). Also, most wild rodents have been implicated, and in 1972 the first confirmed direct association of an

infected wild carnivore (bobcat) with plague in man was reported (17).

### Summary of Epidemiology

From 1900 to 1975, a total of 617 cases of human plague were reported (fig. 1). The majority of persons were affected during the decade 1900-10 by ratborne bubonic plague. Although this form of plague has diminished to the point of being of historical inter-

est, it has been supplanted by an increasing prevalence of sylvatic plague in the United States.

Of the 100 cases of human plague reported since 1950, 22 percent of the 54 males and 13 percent of the 46 females died (fig. 2). Eighty-one percent of the cases occurred in the age group under 30, reflecting the younger persons' greater exposure to infected animals (fig. 3).

No particular race seems to be inherently more susceptible to plague infection. Although some racial or ethnic groups, such as the Chinese in San Francisco, the Mexicans in Los Angeles, and recently the Navajos in New Mexico (18), have been affected by outbreaks, the first two groups were living in unsanitary conditions that undoubtedly contributed to a large population of rats. Moreover, the Navajos not only live in areas in which plague is enzootic to the wild animal populations but they also include prairie dog in their diet.

In the first two decades of this century, sailors and dock workers were at greater risk than others of contracting plague. As sylvatic plague became of increasing concern, however, the risk became greater for others who work out

Figure 2. Reported cases of human plague, United States, 1950-75, by age and sex

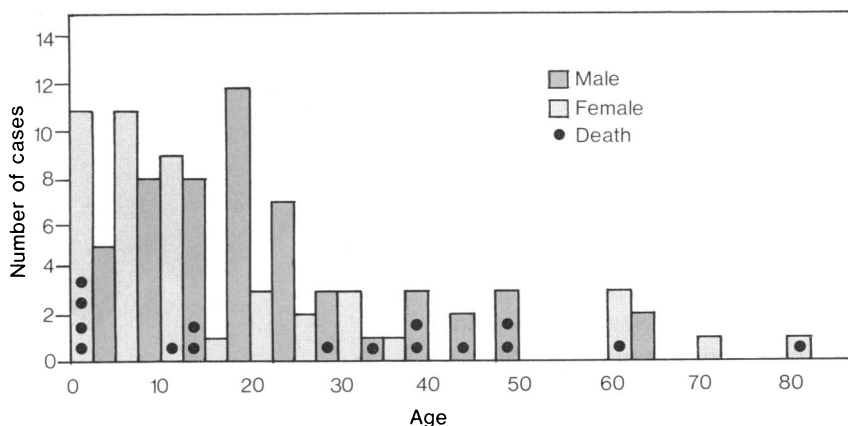
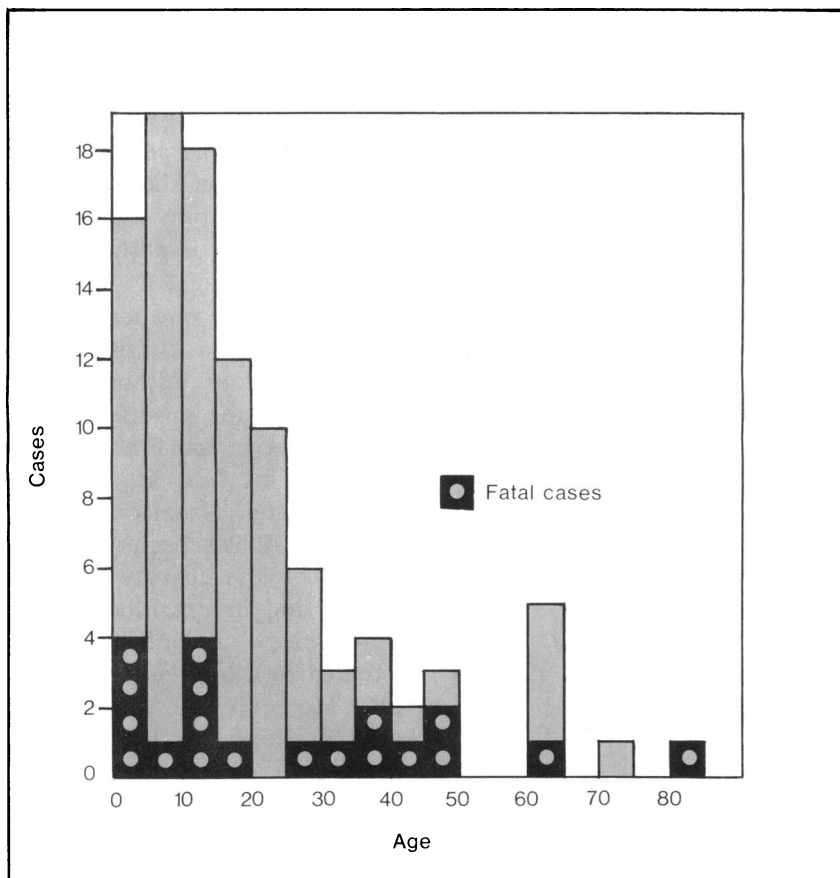


Figure 3. Reported cases and deaths from human plague, United States, 1950-76, by age groups



of doors. Several occupations of persons who were infected were shepherd, geologist, farmer, telephone lineman, and hunter.

Rat-borne plague in the United States was first reported in San Francisco and later in Galveston, New Orleans, and Pensacola (fig. 4). No human cases of sylvatic plague origin have originated east of the 100th meridian (18a). The reason for this is unclear, but Kartmen (18) suggested that dense populations of ground squirrels and prairie dogs do not extend beyond the 100th meridian. Cases in man are being reported more frequently from New Mexico and Arizona and less so from States further west. The numbers of human cases reported in the af-

ected States are shown in figure 5.

Of the 80 human cases of plague of sylvatic origin reported from 1903 to 1966, 54 occurred in June, July, and August, but rat-borne plague was most prevalent in September and October (18b).

### Conclusions

The "Black Death" of earlier times does not seem to be a threat to the health of the U.S. public. However, we cannot yet declare plague eradicated, as was done in 1904, because the United States "harbors a vast focus of wild rodent plague," and this infection can spill over into domestic rats and become a potential threat to people. Thus, the possibility of secondary plague pneumonia exists with a great risk of spread from person to person (18c).

Although the absolute numbers of cases of human plague are small, they have been increasing in recent years. As shown in the table, the case fatality rates are alarmingly high despite the treatment capabilities we now possess. A major factor in the continuing

Figure 4. First reported case<sup>1</sup> and last reported case of human plague (in white type), United States, 1900-76, by State and year

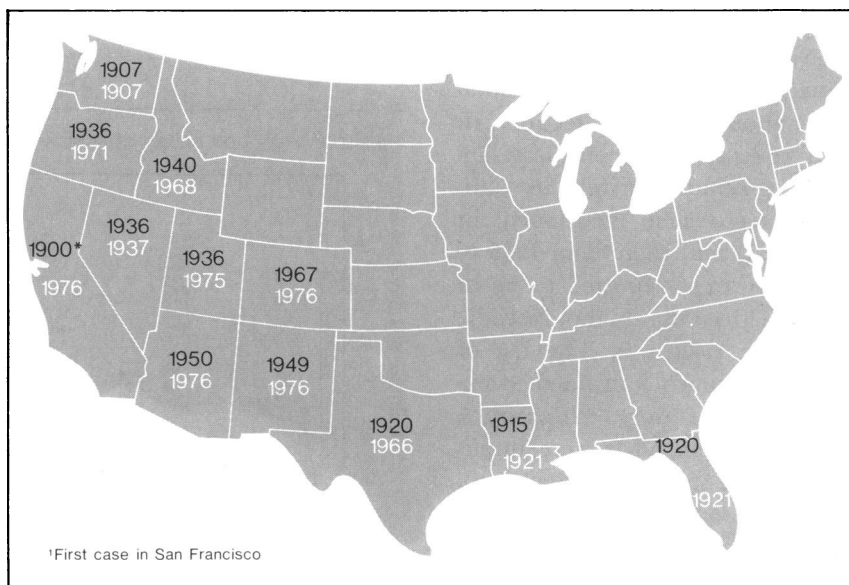
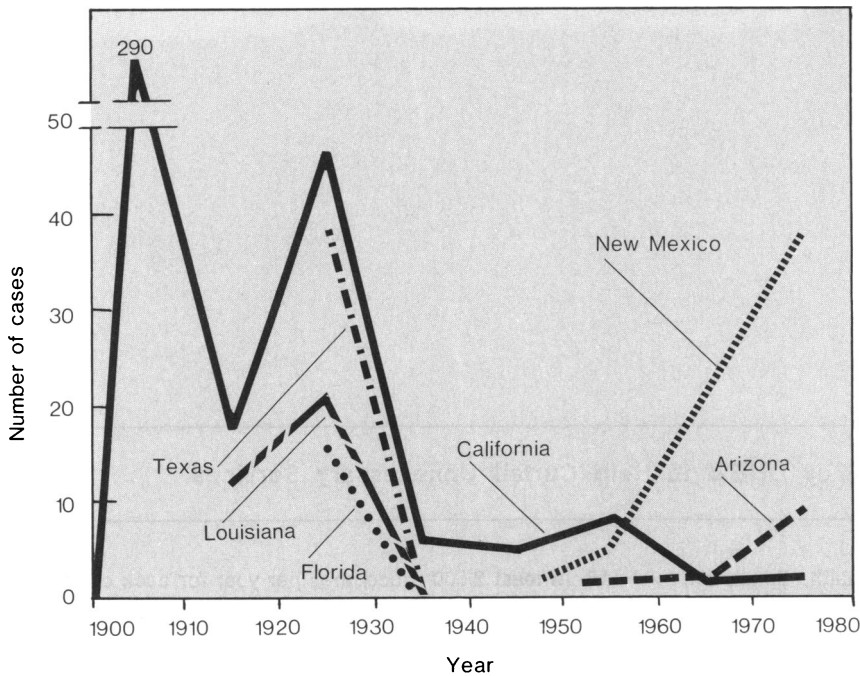


Figure 5. Reported cases of human plague, 1900-76, by State



high case fatality rates may be that medical personnel do not suspect and diagnose plague early enough. It is particularly important for public health workers in the Western States to be alert to the possibility of plague infection.

Plague is a disease of rodents that is spread by fleas. Man is incidental to the cycle of this infection. Yet, as man invades the natural habitats of wild rodents—camping, hunting, and exploring the wilderness—he becomes more and more at risk of acquiring the

disease that some public health workers once believed had been eradicated.

**References**

1. Camus, A.: The plague. Translated from the French by Stuart Gilbert. Vintage Books, New York, 1972.
2. McNeil, W. H.: Plagues and peoples. Anchor Press, New York, 1976.
3. DeFoe, D.: A journal of the plague year. Penguin Books, Baltimore, 1966.
4. Furman, B.: A profile of the United States Public Health Service, 1798-1948. DHEW Publication No. (NIH) 73-369. U.S. Government Printing

- Office, Washington, D.C., 1973, (a) p. 217; (b) p. 254; (c) p. 255.
5. Lipson, L. G.: Plague in San Francisco in 1900: The United States Marine Hospital Commission to Study the Existence of Plague in San Francisco. *Ann Int Med* 77: 304 (1972); (a) p. 310.
6. Kellogg, W. H.: Present status of plague, with historical review. *Am J Public Health* 10: 835-844 (1920).
7. Reed, W. P., Palmer, D. L., Williams, R. C., and Kisch, A. L.: Bubonic plague in the Southwestern United States. *Medicine* 49: 467 (1970).
8. Creel, R. H.: Plague situation in the Western United States. *Am J Public Health* 31: 1156 (1941).
9. Meyer, K. F.: The prevention of plague in the light of newer knowledge. *Ann NY Acad Sci* 48: 429 (1947).
10. Beasley, P.: Human plague in the United States. *JAMA* 208: 1024, May 12, 1969.
11. Pollitzer, R.: Plague. World Health Organization, Geneva, 1954, p. 51.
12. Kellogg, W. H.: An epidemic of pneumonic plague. *Am J Public Health* 10: 599 (1920).
13. U.S. Treasury Department: Annual reports of the Surgeon General of the Public Health Service of the United States. U.S. Government Printing Office, Washington, D.C., (a) fiscal year 1914, p. 292; (b) fiscal year 1917, p. 214; (c) fiscal year 1925, p. 1849; (d) fiscal year 1935, pp. 824, 1081; (e) fiscal year 1936, p. 1019; (f) fiscal year 1937, p. 1048.
14. Boyd, M. F., and Kemmerer, T. W.: Experience with bubonic plague (human and rodent) in Galveston, 1920. *Public Health Rep* 36: 1754-1764 (1921).
15. Wayson, N. E.: Plague: A discussion of its trend in the United States. *Clinics* 2: 868-874 (1943).
16. Jellison, W. L.: Sylvatic plague: Studies of predatory and scavenger birds in relation to its epidemiology. *In Annual report of the Surgeon General of the United States for the fiscal year 1939.* U.S. Treasury Department, pp. 792-798.
17. Poland, J. D.: Human bubonic plague from naturally infected carnivore. *Am J Epidemiol* 97: 332-337 (1973).
18. Kartmen, L.: Historical and oecological observations on plague in the United States. *Trop Geogr Med* 22: 268 (1970); (a) p. 261; (b) pp. 264, 265; (c) p. 274.

Human plague cases and fatalities, United States, 1900-76

Years	Cases	Fatalities	Case fatality rate
1900-09	332	228	68.7
1910-19	69	34	49.3
1920-29	99	69	69.7
1930-39	10	4	40.0
1940-49	10	6	60.0
1950-59	10	4	40.0
1960-69	28	7	25.0
1970-76	59	8	13.5

SOURCES: Reference 10 and Morbidity and Mortality Weekly Reports, Center for Disease Control, vols. 18-25, 1970-76.