

THE DISEASE CARRIER ON TRAIN AND STEAMBOAT.¹

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The traveler runs a greater risk of contracting disease than does the man who stays at home. He enters a large number of communities with varied climates, and is apt to come into contact with acute cases of contagious disease, with chronic disease-carriers, and with disease-bearing insects. In this way he is likely to be exposed to diseases against which he has acquired no specific immunity, as he has had no experience with them at home.

Infections taking place on trains and steamboats, while secondary in number to infections in the communities visited, are nevertheless deserving of special consideration. A part of these infections are traceable to disease-carriers—persons who are healthy but nevertheless harbor and discharge germs capable of producing disease.

In certain respects the disease-carriers on railroads and steamboats are more dangerous than if they were not traveling, altho this increase in danger is to a degree offset by sanitary supervision usually exceeding that exercised by health officers at the carriers' homes. The carriers, when traveling, come into contact, often under conditions of crowding, with people going to many localities. The persons infected by such carriers introduce the disease into their widely separated communities. Moreover the carrier who is traveling is less likely to be discovered and controlled than the one who stays at home, because his victims are widely scattered and have little notion as to the source of their infection. Attention is not called to him by recurring cases of the disease in his neighborhood.

The diphtheria carrier is our best known representative of those carriers who distribute infectious germs in the secretions of their noses and mouths. On both trains and ships the limited space increases contact between passengers. Necessarily, the passengers, one after another, in rapid succession, handle fixtures, such

¹ Read at the 40th Annual Meeting of the American Academy of Medicine, San Francisco, June 28, 1915

as doorknobs and hand-rails, and thus make opportunity for the transfer of infection from hand to hand and then to mouth. They often cough and sneeze in close proximity to each other. Before the common cup was abolished on interstate carriers, it furnished an almost direct method for the transfer of diphtheria, common colds, and the like.

Instances are not infrequent in which people have developed diphtheria at the close of a railway journey in which they did not knowingly come into contact with a sick person. Some of these persons were undoubtedly infected by carriers among their fellow passengers.

That dangerous carriers travel in considerable numbers cannot be doubted. A proved instance of a carrier of virulent diphtheria bacilli traveling by train and boat occurred recently in California. A school-girl who had passed through an attack of diphtheria was released from quarantine after a single negative culture, instead of the two required by the State Board of Health, and was allowed immediately to travel by railroad and boat to her home at the lighthouse on the Farallone Islands, which are situated in the Pacific Ocean about thirty miles west from San Francisco. Within a week her brother contracted a fatal attack of diphtheria and soon afterward examinations showed that two of the thirteen persons on the island had become carriers, and that the girl who brought the disease to this isolated community still had diphtheria bacilli in her throat. If any persons were infected by her during her trip to her home, it is not likely that they would have any idea as to the source of their infection. Had it not been for the fatal case at the end of her journey her carrier state would have gone unrecognized.

Diphtheria carriers played an important part in an epidemic of diphtheria on the United States Steamship Buffalo in 1903.¹ The conditions were favorable for an outbreak because the ship was crowded, and there was, therefore, unusual opportunity for contact infection. The epidemic originated from an unknown source, probably from a carrier among men recently taken on

¹ Harmon, G. E. H.: Report of an Epidemic of Diphtheria on Board of the U. S. S. Buffalo, report of the Surgeon-General, U. S. Navy, 1903, pp. 217-222.

board for training. Among 750 men there were 137 cases, 18 per cent. During the epidemic it was found that 14 per cent. of the well persons were carriers. The outbreak was permanently ended by leaving on shore all persons who persistently gave positive cultures.

In epidemic cerebrospinal meningitis we have a disease which is spread largely by healthy carriers who harbor the germs in their noses and mouths. Such conditions as would favor the spread of diphtheria would also increase the opportunity for outbreaks of cerebrospinal meningitis. We have an example of an epidemic of meningitis on shipboard in the experience of the United States Steamship Minneapolis.¹ In 1903 the disease was in all probability introduced into the ship either by a man in the incubation period or by a chronic carrier. The ship was unusually crowded. There were 1450 men on board while the normal complement was 500 men. Under these conditions an outbreak of 23 cases occurred.

In cholera, in dysentery (bacillary and amebic) and in typhoid fever we have three diseases which may be spread by carriers. In all three the infectious agent is usually given off in the feces and infects other persons through the pollution of food or water.

According to Pannenberg² contact is a common method of infection with dysentery on shipboard. He cites four instances in which outbreaks of dysentery on German war-vessels could be explained only on the supposition that they originated from carriers. In tropical harbors, flies may perform an important part in conveying infectious material to food. If carriers have access to the water supply there is danger that it will become polluted and will cause an outbreak of dysentery.

The danger from cholera in the United States at the present time depends entirely on the carriers who cross the ocean in ships and infect persons en route and after landing. Fortunately we are being successfully protected against this menace by an efficient system whereby immigrants are kept under observation

¹ Stokes, C. F.: Report on Epidemic of Cerebrospinal Meningitis, U. S. S. S. Minneapolis, report of the Surgeon-General, U. S. Navy, 1903, pp. 229-234.

² Pannenberg, A. E.: Die Gefahr der Bazillenträger und Dauerausscheider an Bord. Archiv. für Schiffs- und Tropen-Hygiene, 1915, Vol. 19, Nos. 1 and 2, pp. 7-26 and 33-66.

before they leave cholera-infected ports, and their feces are examined bacteriologically before they are allowed to land in the United States. In June, 1911, prior to the order of the Treasury Department requiring these bacteriologic examinations, a few carriers gained entrance to the United States, but luckily started no epidemics. The danger from cholera carriers on ship-board was shown by the experience of ships arriving at the port of New York between June 13 and August 18, 1911.¹ Sixteen cases of cholera had developed on these ships while they were at sea, fifteen more occurred during detention in quarantine, and three after release. Most of these cases were due to carriers among passengers and crew. The order requiring bacteriologic examination of the feces of immigrants from cholera-infected ports resulted in the discovery of thirty-one carriers on ships arriving in New York from July to November, 1911. Only four gave histories of cholera-like ailments. Two were from ships on which there had been no recognized cases of cholera during the voyage, and at least one of these men must have been a carrier before embarking.

The danger from cholera-carriers is greatly reduced by the short duration of the carrier state—seldom more than two months. The stools of cholera cases are usually free from the spirilla in twelve to fourteen days, and carriers who have not had the disease are in most cases soon rid of their infection.

All the historic epidemics of cholera have spread along the lines of travel, along the caravan routes across the desert, along the trading highways of the ocean, along the lines of march of armies. It seems to be a disease in the spread of which travel is especially involved. Cholera epidemics, when once under control, do not start up again until the disease is brought from another country by travelers. Carriers of long duration are so rare that they, alone, do not keep the disease alive in a community. Nevertheless the carrier state is sometimes of long enough duration to permit the carrier to remain infectious during a voyage across the ocean.

¹ Craster, Chas. V.: Ship-borne Cholera. *Jour. American Medical Assoc.*, Dec. 20 1913, L.XI, 2211. Creel, R. H.: Method Employed at New York Quarantine for the Detection of Cholera Carriers. *Jour. Am. Public Health Assoc.*, Dec., 1911, I, 899.

Within the United States typhoid carriers are common, and some of them are very dangerous. The number of these carriers is being kept up by constant accessions from those communities which fail to apply the well-known principles in the prevention of this disease. Every city which permits conditions to continue which produce a high typhoid rate is responsible for an annual output of typhoid carriers, some of whom will travel to more meritorious communities and help keep up the residual typhoid fever there. As passengers or employees on railroads and ships these carriers will also be sources of danger.

The number of typhoid carriers produced is a fairly definite proportion of the total number of cases and therefore every precaution to reduce the typhoid rate will at the same time cause a diminution in the number of carriers. According to Prigges¹ five per cent. of cases of typhoid fever remain carriers, and there are three carriers who have not passed through a recognized attack of typhoid fever for every seven who have. On this basis we reach the conclusion that approximately seven carriers are produced for every one hundred cases which are allowed to occur. Fortunately some of the carriers clear up and many do not infect other persons.

The typhoid carrier, as a passenger on a train, is not specially dangerous, but a carrier among the waiters or cooks on a dining car might infect the food of many people. Here are found the same conditions for easy transfer of disease which exist in a public restaurant. The danger of the infection of drinking water by carriers is being greatly diminished since the handling of ice and the cleaning of water containers, and the separation of the ice from the drinking water have received so much attention in the regulations of the United States Treasury Department and the rules of the railroads.

On ships the typhoid carrier is more dangerous. The passengers live together, for a more or less extended time, under conditions of close contact similar to those in a crowded house. Carriers among cooks and waiters would have their opportunities for

¹ Prigges, quoted by Müller, P. T.: Vorlesungen über Allgemeine Epidemiologie, 1914, p. 9.

infesting food, and the stewards and stewardesses, if carriers, would be likely to infect the passengers to whom they brought food.

With all these possibilities, the number of outbreaks of typhoid fever traced to carriers on trains, or ships is small and much infection is undoubtedly prevented by the supervision of sanitary arrangements by railroad and steamship companies and health officials. Pannenberg¹ has collected reports of typhoid fever outbreaks, due to carriers, on three war-vessels—one Japanese, and two German.

While sanitary precautions to a degree prevent the spread of disease on interstate passenger steamers, the conditions on some of the intrastate lumber and freight boats are ideal for the spread of typhoid fever from one member of the crew to the others. An example is furnished by a carrier in the crew of a lumber steamer sailing from Humboldt County to San Francisco.² An investigation by the California State Board of Health showed that this carrier, altho he had nothing to do with the preparation or serving of food, had spread the infection to 27 sailors and officers, four of whom had died. Twenty-six of these infections took place during a stay of three years and seven months on one vessel which carried only 22 men. The conditions on board gave opportunity for the transfer of infection in the crowded fore-castle, and in the dirty water closet, but especially by means of a cask for drinking water. This cask was filled with water in port, and during the voyage the men dipt drinking water from it with a common cup, frequently wetting their hands in the process. Under this arrangement pollution of the water was unavoidable.

This carrier was placed under quarantine at the Marine Hospital in San Francisco and was studied and treated by officers of the United States Public Health Service with a view to making it safe for him to return to his trade. At the end of seven months he was released on parole because the typhoid bacillus had not

¹ See second foot-note on p. 133.

² Sawyer, W. A.: A Typhoid Carrier on Shipboard. *Jour. Am. Med. Assoc.*, May 4, 1912, Vol. LVIII, p. 1336.

been found in his feces for four months. He found work on a lumber vessel and shortly afterward infected three sailors, one of whom died. An investigation by the officers of the United States Public Health service showed that this ship, like the other one, had a drinking cask into which the men dipt a common cup, wetting their hands as they did so. Conditions like these would be serious even in the absence of an unusually dangerous carrier like the one reported. The drinking water supply on board a ship should be in a closed container to avoid contamination and should be drawn thru a faucet.

PRECAUTIONS AGAINST INFECTION FROM CARRIERS.

The danger from carriers on railroads and steamboats can be reduced by diminishing the opportunity for transfer of infection from one person to another and by detecting and controlling the more dangerous carriers.

Great advances have already been made in diminishing the opportunity for the transfer of infection to passengers from other passengers or employees. The interstate quarantine regulations promulgated by the United States Treasury Department forbid the providing, by common carriers, of any drinking cup or glass for common use in cars, ships, or depots. The individual paper cup on trains and the bubbling fountain in stations have taken the place of the common drinking glass which used to furnish such an obvious opportunity for transferring germs from the mouths of carriers to those of well people. The interstate quarantine regulations forbid also the furnishing, by common carriers, of any towel for the use of more than one person, thus decreasing the danger from carriers. Drinking water is protected from the danger of contamination by carriers, especially typhoid carriers among employees, by the regulation that ice shall be handled in such manner as to prevent its becoming contaminated with disease organisms. The railroad companies have their own regulations regarding special buckets and carts for ice and the use of ice tongs and rubber gloves, all designed to avoid the touching of ice with hands and to prevent clothing from coming in contact with it.

The danger of the less immediate contacts is diminished by the rules of the railroad companies regarding the cleansing of cars, the changing of the linen covers and head rests, and the cleaning and disinfecting of toilet rooms.

On passenger ships engaged in interstate traffic, precautions similar to those of the railroad companies are being taken. It is in the coastwise steamers which do not carry passengers and are not interstate carriers that we find conditions very favorable to the transfer of infection from carriers to other members of the crew. On these ships, the storage of water in open casks, accessible to the crew, the use of the common drinking cup, the crowding of the fore-castle, and the use of insanitary toilets are sometimes still found and should be corrected.

The best of sanitary arrangements would not entirely prevent the danger from carriers on trains and boats. It is necessary that the more dangerous carriers should not engage in certain occupations. Greatest care must be taken to exclude the typhoid carrier from service in the kitchen or dining room of steamboat or train. The Southern Pacific Company requires that all applicants for appointment to positions on trains or in stations shall be examined physically when admitted to the service and applicants found to be suffering from any disease that would make their employment in that service inadvisable are rejected. With cooks and waiters there is additional provision for re-examination on suspicion that they may be suffering from a disease which would make them dangerous to the traveling public. How far these examinations protect against the employment of carriers depends largely on the ability of the examining physician to get at the facts, in the carrier's past history, which would lead to suspicion of his condition. Laboratory tests could then be made, but even in the absence of laboratory proof no person with a very suspicious history should be employed in a position where a carrier would be dangerous, because many carriers are intermittent in the discharge of their disease germs.

The protection against carriers depends to a large extent on co-operation between health departments in detecting and keeping under surveillance dangerous carriers. All outbreaks of com-

municable disease should be investigated. If carriers are discovered they should at least be kept from engaging in occupations in which they would be specially dangerous. If a carrier moves away from the jurisdiction of the local health officer, the health officer at his point of destination should be officially notified so that he will be responsible. In this way the danger from carriers both on and off boats and trains would be diminished.