An Epidemic of 3,000 Cases of Bacillary Dysentery Involving a War Industry and Members of the Armed Forces*

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ON Saturday, September 12, 1942, a telephone message was received from a practising physician of Newton, Kans., that a severe outbreak of intestinal disorder was occurring in that city. Arrangements were immediately made to send Board of Health personnel to that city and they arrived Sunday morning, September 13.

Newton is the county seat of Harvey County, located in the southeastern section of Kansas, approximately 26 miles north of the City of Wichita. The population was 11,048 in 1940, and apparently there has been little change in the last two years. The population is predominately white, with approximately 1,200 Mexicans and 1,400 Negroes. The topography is gently rolling, sandy loam draining to Sand Creek, a tributary of the Arkansas River, which flows in a southerly direction through the western section of the town.

The main war industries in Newton are the railroad shops, yards, and division offices of the Atchison, Topeka and Santa Fe Railroad, the Ponca Tent Company, and flour mills. Approximately 700 persons living in Newton at the time of the epidemic were employed by airplane factories in Wichita. The local public health personnel included a part-time county health officer and a full-time veterinarian milk inspector.

The source of the public water supply is derived from eight drilled wells having an average depth of 125 feet, located 8½ miles southwest of the city, and is used by more than 95 per cent of the population. The wells are pumped to a surface reservoir and the water is re-pumped from this reservoir into two high service mains. These mains are 12″ and 14″ in size and approximately 8 miles in length before they connect to the distribution system of the city.

The milk shed includes 24 dairies, 4 delivery companies, 2 local pasteurization plants, 1 pasteurizing plant operated by the Santa Fe, and numerous smaller dealers. The known daily milk consumption is 1,300 gal., of which 900 gal. are raw milk and 400 gal. pasteurized. The city operates under the Standard Milk Ordinance, which requires the services of a milk inspector and laboratory for supervision and enforcement of the ordinance.

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There are approximately 30 public eating establishments served by 200 food handlers. The city maintains no supervision or control over these establishments or employees.

The city sewage system is modern in every respect and more than 80 per cent of the houses in Newton are connected to the system.

Upon arrival in Newton, immediate contact was made with physicians of the city and information received indicated that the outbreak was explosive in nature and the geographical distribution was uniform over the entire city.

Samples of water from the city wells and distribution system were taken at once. On Monday, September 14, samples taken from the deep wells showed no contamination; however, those from various points on the distribution system were heavily contaminated. City officials were notified and chlorination of the city water supply by means of an emergency chlorinator at the pumping station, installed by State Board of Health engineers, was started.

Hand-bills were printed, advising citizens to boil all water used for drinking purposes, and prohibiting the sale of milk that had not been pasteurized. Air raid wardens distributed these hand-bills to every home in the city.

As the water department of the Santa Fe Railroad has orders to empty the water tanks on all passenger coaches and fill with the "99.9 per cent pure" Newton water, as advertised by city officials, the division superintendent of the A. T. & S. F. Railroad, was immediately ordered to discontinue the use of Newton city water on passenger trains until such time as it was proved safe for drinking purposes. The City Water Superintendent was given instructions to shut off all public drinking fountains and immediately open fire-hydrants and flush out the water mains.

On Tuesday, September 15, additional personnel of the State Board of Health arrived with laboratory equipment. Headquarters were established and an epidemiological case study of the city was started by health workers. Fifteen nurses, registered with the Civilian Defense organization, volunteered, and were used to block canvass the city to obtain case histories of sick persons.

Laboratory workers obtained stool specimens from hospital cases and a general sample at large.

Early studies of the case reports revealed a massive, generalized, sudden and severe epidemic of dysentery. The average case persisted for approximately 3 to 6 days, and listed as symptoms were weakness, nausea, vomiting, cramps in stomach, persistent diarrhea, and occasional bloody diarrhea. The only possible vehicle was the water supply.

Sanitary engineers checking systematically the distribution system discovered the following defects:

1. Seven cross-connections between the public water supply and private sources of water
2. Seven cross-connections between the public water supply and sewerage system, plus 13 flush tanks in the sewerage system in which the water inlet was below the discharge level of the tank, and a large number of basement ejector pumps located in private residences

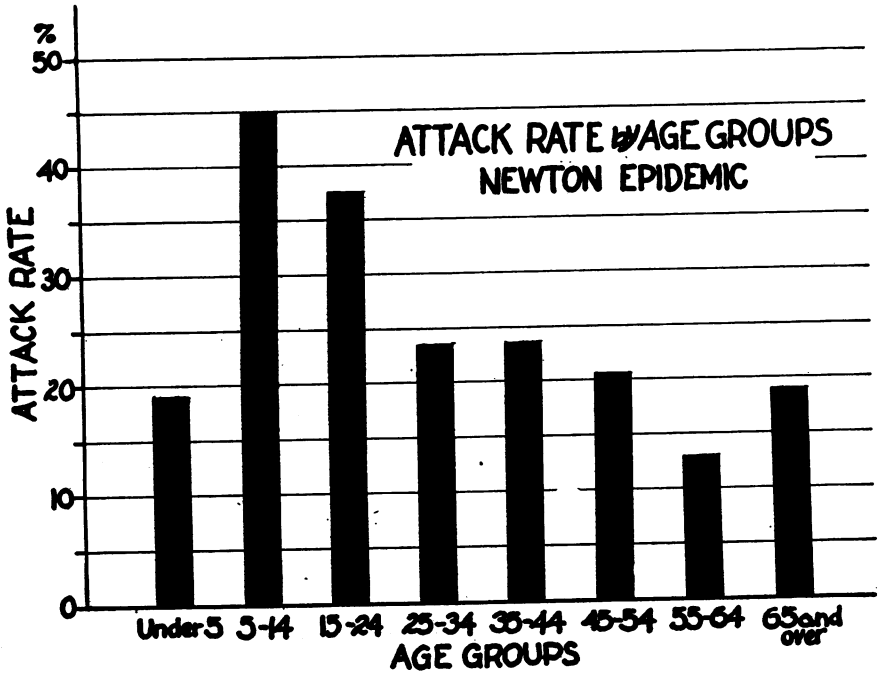
After carefully checking all of the above cross-connections, it was apparent that the source of the contamination had not been discovered.

Epidemiological factors indicated that a large amount of contamination was introduced into the water system at a point from which it could be rapidly circulated through the entire distribution system.

This conclusion was based upon the following factors uncovered in the epidemiological and laboratory studies:

1. Generalized distribution of cases
2. Massive infection of the population

CHART 1—Showing attack rate by age groups



3. Explosive nature of the epidemic
4. Bacteriological analysis of water samples obtained over the distribution system

Upon receiving additional engineering assistance from the District Office of the U. S. Public Health Service, there was a review and discussion of the survey on the distribution system, and efforts to locate the source of contamination were intensified.

On September 18, 4 days after emergency chlorination had been started, the tests showed that a satisfactory chlorine residual was being maintained in all parts of the city. Repeated satisfactory bacteriological analyses having been obtained, the water was released as safe, Saturday, September 19.

A bit of information, which proved of extreme importance, was received from a Santa Fe Railway water department employee who said that a sewer block had occurred at a Mexican village on the southwest outskirts of the city about the time that dysentery cases developed in the city. On Sunday, September 20, an inspection of the water supply, plumbing and sewage disposal of the Mexican village was made by our sanitary engineers.

Contrary to previous statements by city officials, that no change had been made to the distribution system, further information uncovered the fact that changes had been made on the two main supply lines entering the city at a point close to this Mexican village. It developed that on September 7, an 8″ stub and valve were removed and replaced with a 20″ stub and valve. The water pressure was off 9 hours while these changes were made. The next morning, September 8, it was found that the 20″ gate valve had slipped and the section of the 14″ supply line was again taken out of service for more than 3 hours, during

which time the 20″ gate valve was straightened and permanently anchored.

This work was performed by a private contractor, under the supervision of the City Water Superintendent. Our investigation showed that a service connection came from this 14″ main to the Mexican village and supplied three frost-proof hydrants and two water closets equipped with twelve frost-proof toilets. The frost-proof hydrant pits and each of the pits under the water-closets had a drain connection to the sanitary sewer, which had previously been blocked.

Evidence that these pits had been filled with sewage so that it had covered the drain openings in the valves of the frost-proof hydrants, and also the drain connection in the frost-proof toilets, still remained at the time of our inspection.

The hydrants were the only source of water for the Mexican families and the water-closets were used by approximately 112 persons living in the village.

In reconstruction of the situation, when the water pressure was off on September 7 and 8, persons in the village, attempting to get water, apparently opened the valves and, not obtaining water, left them open; this, in turn allowed the sewage backed up in the box to flow through the drain opening into the water main. It is not unreasonable to assume that a person attempting to get water and finding it shut off, would leave the valve open, allowing a continuous flow of sewage through the drain opening. That these valves were open was brought out in later testimony by one of the workers on the mains, who turned them off when the main was put into service. Persons using the water-closets would automatically operate the valves controlled by the seat and thus allow sewage to flow into the water main.

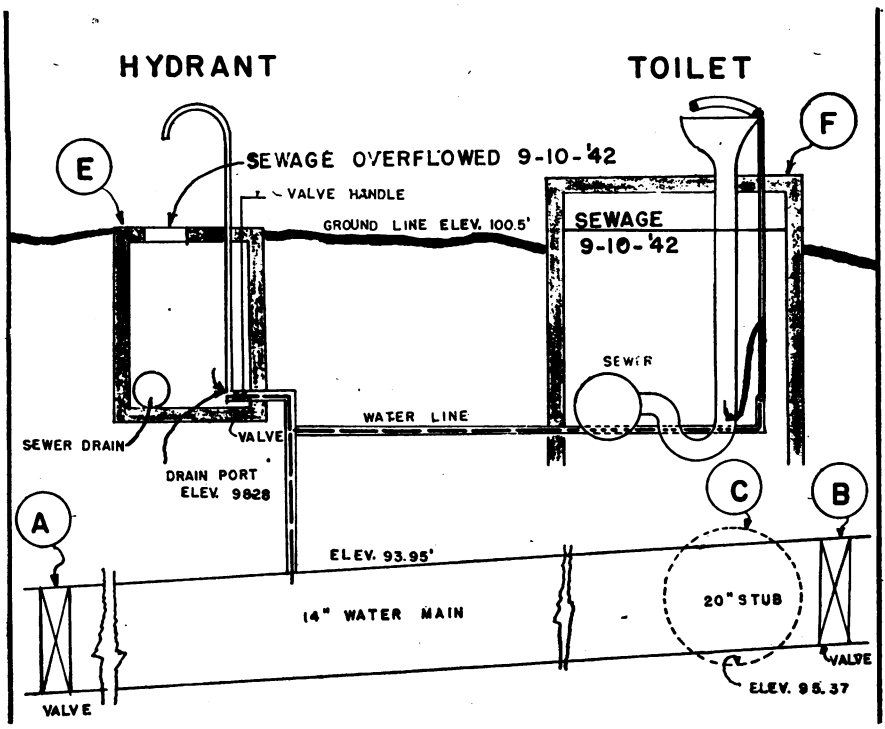
Each time the water main was out of service, only a small amount of water was flushed out of the line before it was placed back in service, and no attempt was made to sterilize it.

Levels were run on the mains and the water take-off to the Mexican village. Since the elevation of the water main was lower at the point of this connection than where the stub was changed, a considerable amount of sewage would remain in the water main after the line was again in service.

In order to prove to city officials that this was possible, conditions equivalent to those at the time the mains were being worked on were reconstructed. Drainage to a hydrant pit was blocked and water placed in the pit, covering the drain port of the frost-proof valve. The hydrant was left partially open, the water line was disconnected at the main and, within a few minutes, dye placed in the hydrant pit was flowing from the disconnected line at the main. Certainly sewage covering those same ports, under similar conditions, would flow into the water main supplying the distribution system of the city. Additional evidence showed that the first 7 cases reported occurred among the Mexican families living in the bunk-houses, and that persons who did not drink water in the city, but did drink from taps on the two supply mains taken off before the water reached the Mexican village, were not infected.

A study of the case histories indicates that slight contamination of the city water supply evidently began about August 1. One hydrant valve in the Mexican village was in bad condition and would not close. Inhabitants of the village were in the habit of emptying sewage through the screen trap in the floor covering the hydrant pit. There were 82 persons who reported they became ill during the month of August, and 124 persons reported the

CHART 2—Schematic charts showing evident flow of sewage entering main



date of onset of their illness to be during the first 6 days of September.

We do know, from a study of the recording manometer on the distribution system, that uniform water pressure was being maintained under great difficulties. In fact, this led to the changes which were made in the distribution lines to include an additional storage tank near the Mexican village. Other cross-connections previously listed may also have been responsible as sources of contamination of the city water supply at times of low pressure.

The epidemiological investigation revealed that the peak onset occurred on September 10, with 743 persons giving this date as the beginning of their sickness. As a result of the epidemic, business in the city was practically at a standstill on Thursday, September 10, when it is estimated about 2,000 persons were ill.

TABLE 1

Onset of Cases by Days

August

Date	Cases	Date	Cases
Aug. 1	7	Aug. 21	2
3	1	23	2
6	1	24	4
10	2	25	7
12	1	26	4
13	1	27	1
14	3	28	4
15	10	29	8
16	1	30	9
19	1	31	4
20	9		
		Total	82

September

Sept. 1	19	Sept. 13	115
2	21	14	109
3	14	15	75
4	17	16	38
5	24	17	16
6	29	18	15
7	60	19	5
8	128	20	7
9	410	21	7
10	743	22	0
11	494	23	1
12	256		
		Total	2,603

In the face of such massive infection of the population, local newspapers carried stories on September 11, quoting city water officials regarding the city water, as saying, "a constant check-up by analysis is made, and reports this week are, that the water is absolutely pure and healthful; there are no open mains, no seepage into the distribution system and no chances of contamination." On September 12, the papers carried a story, stating that the part-time county health officer, residing at a small rural village, was in the city and had made all possible investigations into the numerous cases of illness, which, for want of a better diagnosis, were referred to as "intestinal influenza." The newspaper quoted him further as saying that he was unable to find any evidence whatever that the prevalence of the illness was in any way due to trouble with the city water supply or the supply of milk and other dairy products from the regularly inspected dairies; that the same illness had been prevalent in the country, all neighboring towns, and, in fact, all over the Middle West. He also stated that "during damp season, when excessive rains have continued for extended periods, there is much illness of this nature affecting the stomach and bowels." It was his expressed opinion that "a period of a week or so of sunshine would practicaly clear up the illness."

Because of these stories in the daily newspaper and statements made by various local authorities, our investigation was seriously handicapped for several days before satisfactory cooperation was established with city water officials. Because of inadequate health service and lack of supervision by city officials of the municipal water system, the citizens of Newton were misinformed regarding the cause of the epidemic. If adequate investigations had been made as soon as cases first began to occur in August, it is possible that this epidemic might have been prevented.

Laboratory examination showed the predominating organism recovered from the stools of sick persons and from the intestinal mucosa in fatal cases, to have been *Shigella paradysenteriae,* Flexner group (Hiss.).

From scattered cases traceable to Newton, it is assumed there were many cases other than those occurring in the city, since a large number of trains were supplied with water at this station.

There were 2,871 regular passenger cars (Pullman and coaches) supplied with water between the dates of September 3 and the afternoon of September 14, at which time the water was prohibited for use by interstate carriers; also, a large number of troop trains were serviced during this same period.

Histories were obtained from 150 trainmen, who were off duty on account of illness and undoubtedly there were many other railroad employees, who could not be interviewed because of their absence from the city.

Eighty-one employees of the Ponca Tent Company, working on war materials, were also off duty because of illness caused by drinking city water. Two hundred and fifty employees of airplane factories working in Wichita, who lived in Newton, were off duty because of dysentery during the epidemic.

As a result of the Newton epidemic:

1. The State Legislature passed new laws giving additional authority to the State Board of Health to supervise public water distribution systems.
2. Local funds were made available for a health unit.
3. The city plumbing code was revised and put in force, eliminating all cross-connections.
4. Water specimens are being taken at weekly intervals at designated places in the distribution system.
5. Emergency chlorination of the city water supply became a permanent procedure.

SUMMARY

1. An outbreak of more than 3,000 cases of dysentery, with several deaths at Newton, Kans., was evidently caused by sewage entering the water distribution system of the city through frost-proof hydrants and water-closet valves.

2. Failure of the Water Department to sterilize or flush that portion of the distribution system where changes had been made, led directly to heavy infection of the public.

3. Hazardous cross connections, found in the distribution system at times of low pressure, without chlorination, may have been responsible for previous sporadic cases of intestinal disturbance.

4. A great number of war workers were absent from their jobs for several days; an unknown number of soldiers and civilians were infected; the ordinary business of the city was disrupted for a period of 3 days; and important transcontinental trains, many of them troop trains, were delayed an average of 1 hour while taking water at a nearby safe supply.

5. With institution of proper public health protection measures, the epidemic quickly subsided with no further outbreak of cases reported from the city.