

A Milkborne Outbreak of Shigellosis In Madison County, Tenn.

By CECIL B. TUCKER, M.D., M.P.H., GLENN C. FULKERSON, M.P.H.,
and R. M. NEUDECKER, M.D.

AS A RULE, reports of milkborne outbreaks of shigellosis which have appeared in the literature traced the infection to known raw milk supplies. Milk contaminated after pasteurization or improperly pasteurized may also carry infections to the consumer. Without adequate milk sanitation and the enforcement of laws and ordinances dealing with milk sanitation, the danger of the transmission of pathogenic organisms through milk is always present.

An outbreak of shigellosis traceable to milk occurred in Madison County, Tenn., in October 1952. It was the first milkborne outbreak of shigellosis reported in the State.

Features of the Outbreak

On the evening of October 14, 1952, a sudden outbreak of an illness occurred among school children and teachers in 3 Jackson grammar schools and in 1 Madison County school located approximately 5 miles from Jackson. In addition, there were a few scattered cases occurring

Dr. Tucker is the director of the division of preventable diseases, and Mr. Fulkerson is sanitation consultant in charge of milk sanitation, both with the Tennessee Department of Public Health. Dr. Neudecker is director of the Jackson-Madison County Health Department.

in members of families in Jackson in age groups other than the grammar school age group.

The illness was characterized by sudden onset with nausea, vomiting, abdominal cramps, headache, fever, and diarrhea. Nausea and vomiting were such prominent symptoms in a large number of cases that other pathogenic organisms were at first suspected. Blood and mucus were present only in the stools of the more severe cases.

Most cases were mild and lasted from 2 to 24 hours. A few cases were severe with durations from 7 to 21 days with 1 or more relapses. No deaths occurred.

Stool specimens were obtained from 30 patients within 36 hours of the onset of their illness. Specimens collected were from patients from the four schools involved. Since a branch of the division of laboratories is located in Jackson, bottles for the collection of fecal specimens without preservative were provided and transported to the laboratory within 3 hours of collection. *Shigella sonnei*, type 1, was readily isolated from the stool specimens obtained from patients. A summary of the outbreak in the four schools is given in table 1.

Epidemiological Observations

Obviously there was a common source of infection in the four schools. It was also obvious that the infection was peculiar to these schools

Table 1. Shigellosis cases and attack rate per 100 students in 4 schools in Madison County, Tenn., October 1952

School	Registration	Number of cases	Percent
Total	1, 923	784	40. 8
Alexander	670	314	46. 9
Malesus	305	148	48. 5
Parkview	650	230	35. 4
Whitehall	298	92	30. 9

as infections were not occurring in the other schools and throughout the population of the city and county.

Since it was thought that the contaminated vehicle was eaten or drunk in the school cafeteria at lunch on October 14, 1952, detailed information on the food was obtained from a sample of children at the Alexander school. These data suggested that milk was the probable source of the infection.

A detailed investigation was made at each school. The schools did not have a common water supply. The three schools in Jackson used the city supply whereas the county school (Malesus) had a different source of water. Since the three Jackson schools were widely separated, a general epidemic would have been expected if the water had been the source of the infection.

Menus were obtained from each school for the 7 days prior to the onset of the illness. Only one of the schools served ice cream during the period. Surplus commodity dried milk and eggs were used but on no single day were these foods served in all four schools. Samples of dried milk and eggs were obtained from each school for bacteriological examination. No pathogenic enteric organisms were found.

Three of the schools purchased fresh vegetables from the same source; however, so extensive an outbreak of shigellosis would not be expected to occur from contaminated fresh vegetables. Nevertheless, samples were examined bacteriologically, and no pathogenic enteric organisms were found.

A careful study of the menus showed that the only food served by the 4 schools in common on any 1 day during the 7-day period was milk.

One milk plant had a contract to supply standard pasteurized milk in half-pint bottles. In addition to the schools where the outbreak of shigellosis occurred, the plant supplied milk to nine other schools in Madison and adjacent counties. No outbreak of shigellosis occurred in the nine schools.

The milk plant delivered approximately 100 gallons of milk to the 4 schools daily. One bottle of milk which presumably had been delivered on October 14, 1952, was obtained at 1 of the 4 schools. This was the only available bottle which had been delivered on that day and none which had been delivered on the previous day was available. This sample showed a negative phosphatase test. The bacterial count greatly exceeded the allowable limits for grade A pasteurized milk. Cultures were negative for pathogenic organisms.

Additional evidence that the milk was contaminated was deemed necessary before presenting the evidence to the milk plant officials and before investigating to determine, if possible, the method by which the milk was contaminated.

Histories were obtained from 1,309 of the 1,923 students registered in the 4 schools. In order that the total sample would be similar to the sample obtained at the Alexander school, histories of the food eaten at lunch on October 14 were obtained.

The attack rates among students who drank milk and among those who did not drink milk at lunch on October 14, 1952, are given in table 2. Six hundred and thirty-nine, or 48.8 percent of the 1,309 students, became ill; 625, or 57.4 percent of the 1,088 students who drank milk, became ill, whereas only 14, or 6.3 percent of

Table 2. Shigellosis cases and attack rate per 100 students in 4 schools in Madison County, Tenn., according to milk consumption at school, Oct. 14, 1952

Milk consumption	Number of children	Number of cases	Percent
Total	1, 309	639	48. 8
Drank milk at school	1, 088	625	57. 4
Drank no milk at school	221	14	6. 3

the 221 students who drank no milk on that date became ill. The attack rate among those drinking milk was nine times the attack rate among those not drinking milk.

Investigation of the Milk Plant

The investigation of the milk plant was made on the basis of the 1939 recommended Public Health Service Standard Milk Ordinance and Code. Only the most important findings are included here. The plant processed approximately 800 gallons of milk per day. Recording thermometer charts for the plant for a period of several weeks during and prior to the outbreak were studied.

On October 12, 1952, 3 of the 4 pasteurization vats in the plant were used (vats 2, 3, and 4). Only 2 recording thermometers were in operation on that day, and these were permanently mounted on vats 3 and 4. Figure 1 is a reproduction of the recording thermometer chart for vats 2 and 3 covering 200 and 150 gallons of cream line or standard milk. The record for vat 2 indicates that the holding time at the most was 18 minutes. Figure 2 is a reproduction of another original chart for vats 2 and 3 for October 12, 1952. Obviously one is a duplicate chart for the vats, since only one chart would have been used for this thermometer on this date. It appears that a "faked" chart was substituted.

Close examination of figure 2 indicates that there was no relationship between the recordings at room temperature and the recordings made for the milk pasteurized in vats 2 and 3. Furthermore, these recordings of pasteurization temperatures do not show the required emptying time when cooling is done outside the pasteurization vat. The outlet valves to the vats could have been opened at any time during the 30-minute holding period since no cooling time is indicated on the chart. It would have been impossible to have bottled the milk in the time indicated by the chart.

The chart for vat 4 was similar to the chart indicated in figure 2. It, too, appeared to have been a substitute.

There were also substituted charts for October 8, 13, and 15, 1952. Several of the charts showed multiple mountings as indicated by the

enlarged and many pinholes in the axis of the charts.

The water supply source for the milk plant was investigated. It showed satisfactory sanitary protection. Samples of the water revealed no bacterial contamination.

Stool specimens were collected from the milk plant personnel. No pathogenic enteric organisms were found. The milk handlers had no history of recent enteric disease. Records at the milk plant indicated that milk was obtained from 32 producing farms. All of the producers were visited. No histories of enteric disease could be obtained. It was not deemed practical to obtain stool specimens from the milk handlers on the farms.

The investigation disclosed that just prior to the outbreak one of the owners of the plant and the plant superintendent had had a heated argument concerning the operation of the plant. The plant superintendent had submitted his resignation to become effective at the end of the month. The plant superintendent, although having 25 years experience in plant operation, showed little understanding of the significance of the pasteurization process.

Discussion

After the investigation of the plant had been made, it appeared that in all probability milk contaminated with *Shigella sonnei* was delivered to the plant on October 12, 1952, by some producer and improperly pasteurized. Apparently the contaminated milk was delivered to the schools on October 13 rather than on October 14 and served for lunch the same day. This conclusion is based on the fact that a bottle of milk, presumably delivered on October 14, was found to have been properly pasteurized, and that more evidence showing lack of pasteurization of the milk delivered on October 13 was found.

Although the histories of students who drank milk for lunch on October 14 were tabulated, rather than that for October 13, certain children routinely eat lunch in the cafeterias and drink milk; others routinely eat lunch in the cafeterias and do not drink milk; some children bring lunch to school and drink milk in the

Figure 1. Reproduction of recording thermometer chart for milk pasteurization at the milk plant on October 12, 1952, Madison County, Tenn.

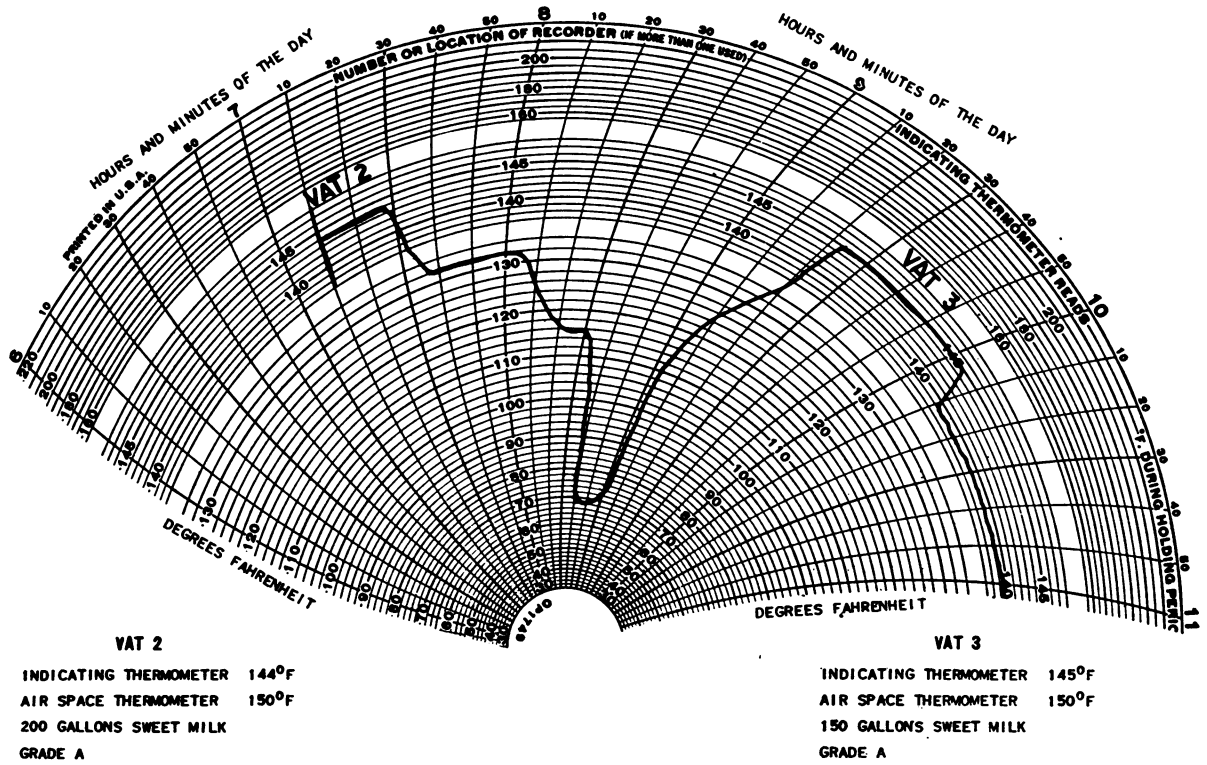


Figure 2. Reproduction of recording thermometer chart for milk pasteurization at the milk plant on October 12, 1952, Madison County, Tenn.

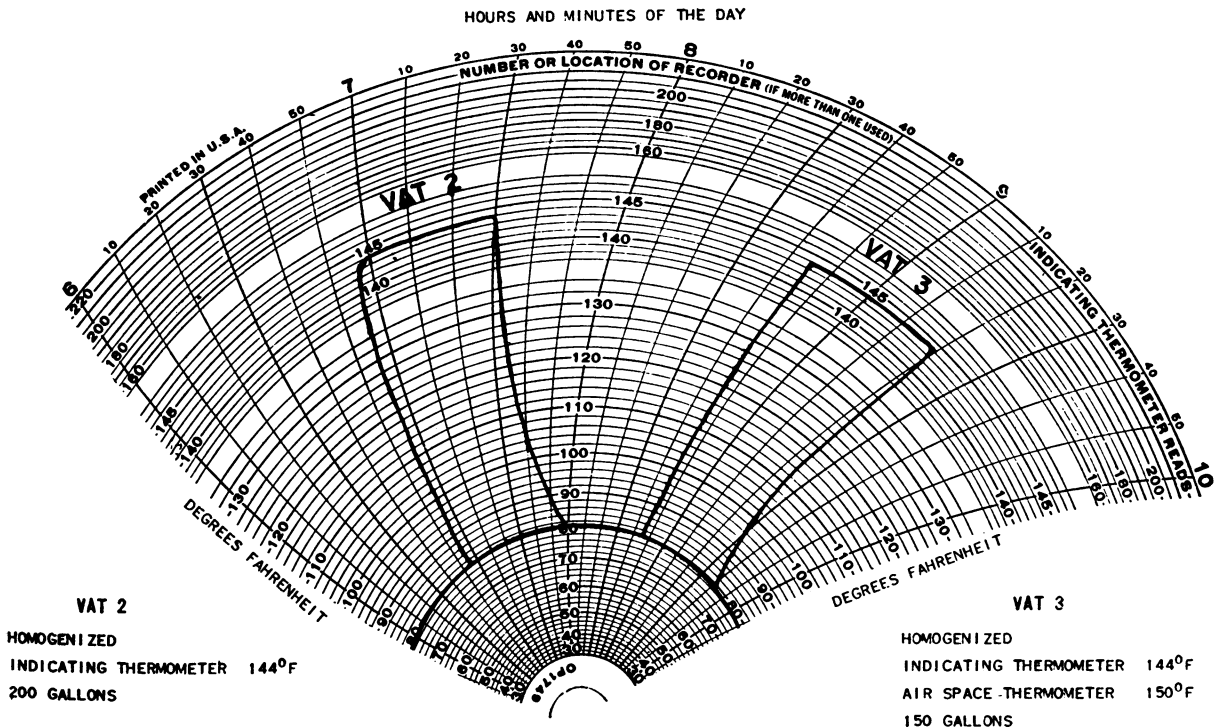


Table 3. Shigellosis cases and percentages according to date of onset among students at Parkview School, Madison County, Tenn., October 1952

Date of onset	Number of cases	Percent
Total.....	155	100. 0
13.....	1	0. 6
14.....	17	11. 0
15.....	26	16. 8
16.....	37	23. 9
17.....	32	20. 6
18.....	20	12. 9
19.....	10	6. 5
20.....	9	5. 8
21.....	3	1. 9

cafeterias; others bring lunch to school and do not drink milk; and some go home for lunch.

Under these circumstances, it would not be expected that the histories of students drinking milk on October 13 would differ significantly from the histories obtained on October 14. In all probability, the evidence of milk being the source would have been stronger if histories of milk drunk on October 13 had been obtained. Where possible, histories of food eaten should cover two or more meals in such investigations.

Although every effort was made to obtain information from the superintendent and others at the plant as to what occurred on October 12, none could be obtained. Since it appears that the charts were faked, most anything could have happened.

In this plant, milk is usually processed each day as it is received from the producer. It is weighed and dumped into conventional receiving equipment. It is then pumped to the vats.

The amount of milk produced on any 1 farm ranged from 20 to 100 gallons. It is reasonable to assume that the milk from only one farm was contaminated. Therefore, not more than 100 gallons of contaminated milk reached the plant. Since the capacity of the vats was 150 and 200 gallons, it is possible that not more than 50 to

100 gallons of uncontaminated milk were mixed with the contaminated milk. Certainly this would have been true if the contaminated milk was the last batch processed on that day. In fact, the contaminated milk may have been processed without having been mixed with other milk.

This investigation presented an opportunity to study the incubation periods of *S. sonnei* infections. The dates of onset for cases occurring in the Parkview School were tabulated (table 3). Although 1 case had an onset approximately 10 hours after lunch was served on October 13, 17 cases had onsets 36 to 48 hours after the probable infection time. The maximum incubation period was 8 days and the median was 3 days.

This outbreak of shigellosis traceable to milk is an example of poor milk sanitation. It illustrates the importance and need for legal authority by the State health department in the operation of milk sanitation programs. In Tennessee, legal responsibility is not vested in the State health department but is a responsibility of an agency primarily interested in milk production. The best milk sanitation program is one where the State health agency has the legal authority for the program with power of delegation of authority to local health agencies. Power of delegation of authority is needed because of the detailed enforcement measures that are required in carrying on a good, uniform milk sanitation program.

ACKNOWLEDGMENTS

Alexander D. Langmuir, M.D., and William H. Clark, M.D., Communicable Disease Center, Public Health Service, visited Jackson after the initial proof had been obtained that milk was the source of the outbreak. They offered suggestions for obtaining additional verification of the source of the infection. The division of laboratories of the Tennessee Department of Public Health isolated and typed the organisms. Staff members of the department and the Madison County Health Department assisted in the collection of data.

