Q Fever Studies in Maryland

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Q FEVER outbreaks have occurred in people exposed to infected cattle in the Western States (*1, 2*), but even though bovine Q fever has spread into the Eastern States (*3–5*), accompanying human illness has not been generally recognized (*6*). Maryland, with a high concentration of dairy cattle, was chosen as a study area in which to document further the eastward spread of the bovine disease and assess its impact on public health.

As early as 1948, Shepard (*7*) investigated the occurrence of Q fever in Maryland dairy cattle. An unstated number of serums tested by the complement fixation (CF) method were uniformly negative. R. J. Huebner, Laboratory of Infectious Diseases, National Institutes of Health, stated in personal communication that in 1952 he had been unsuccessful in isolating the causative organism from any of 300 Maryland bovine milk samples. In the same year in tests he found less than 1 percent of 1,000 dairy cattle blood samples to be CF positive. The only reported case of Q fever in a human being in Maryland occurred in a Baltimore butcher in 1958 (*8*). Since Maryland is a meat-importing State, it was impossible to determine the source of infection for this case.

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In 1959 a survey by the Maryland State Department of Health revealed 75.2 percent of 1,116 herd milk samples positive for Q fever by the capillary agglutination (CA) test. Isolation of the organism from Maryland bovine milk was accomplished during the same study. In a 1960 Q fever serologic survey, 2 of 25 blood samples of Maryland veterinarians were CF positive (*9*).

Our study was designed to investigate a possible change in the bovine Q fever reactor rate since 1959, and occurrence of the disease among farm residents exposed to infected herds and among the general population of the State.

Methods and Materials

Herd milk samples and dairy cattle blood specimens were selected from among those collected for brucellosis testing. Blood samples from persons exposed to Q fever-infected dairy cattle were drawn on the farm and taken immediately to the laboratory. Blood samples from the general population of the State were drawn from two sources: (*a*) blood samples submitted to the State laboratory for routine syphilis or Rh serology and (*b*) blood samples from the laboratories in two rural county hospitals (Frederick Memorial Hospital and Washington County Hospital) and a bloodmobile from the city of Frederick. In one instance, human placental material was collected at delivery and subsequently tested for the presence of *Coxiella burnetii*.

Bovine blood and milk specimens were tested by the CA method developed by Luoto (*10, 11*). Human blood samples from the general population also were CA tested (*12*). The CA positive

specimens were then tested by the CF technique described by Lennette and associates (*13*). Blood specimens collected from persons exposed to infected dairy cattle were tested only by CF procedure.

The blood samples and milk specimens were screen tested by the CA technique at the undiluted level; visual agglutination was accepted as a positive result. The CF test was performed by the central laboratory of the Maryland State Department of Health with Lederle antigen (9-mile strain); a CF titer of 1:8 or greater was accepted as a positive result. Isolation procedures on bovine milk samples and human placental material were conducted by the Rocky Mountain Laboratory of the Public Health Service by standard hamster and egg inoculation techniques.

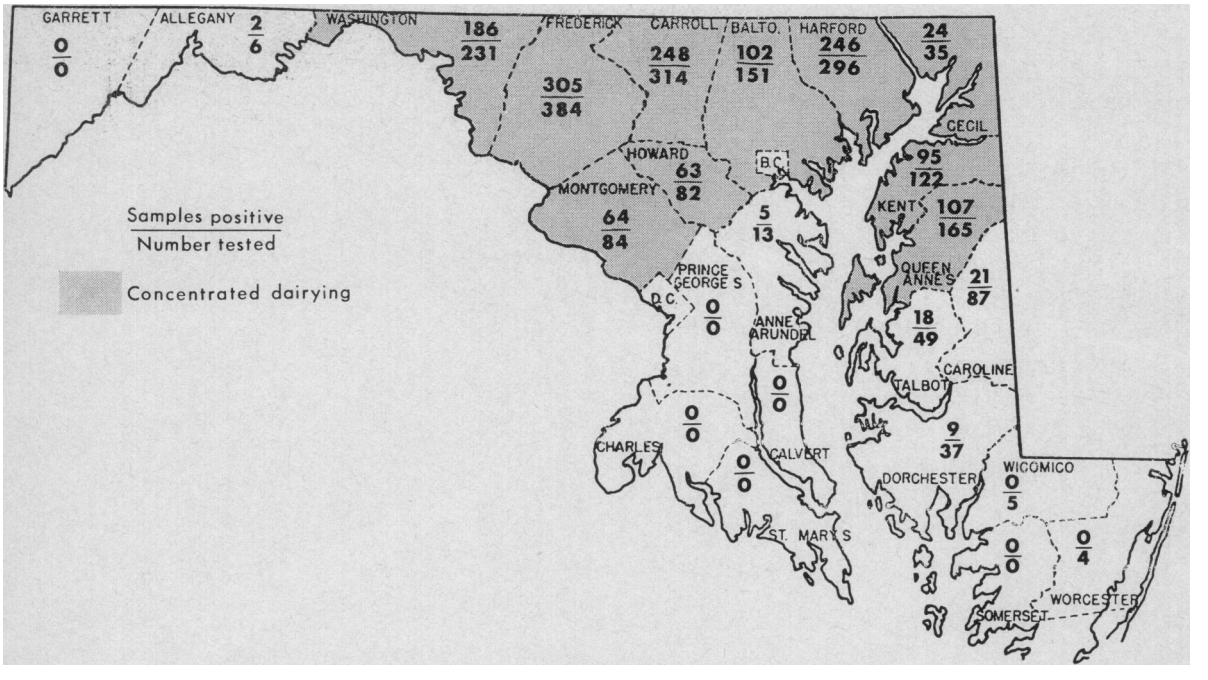
Residents of farms known to maintain Q fever-infected dairy cattle were questioned about illness in the previous 18 months, consumption of raw milk, and animal contacts. An effort was made to collect a blood sample from each person over 5 years of age. Pertinent information such as the number and species of animals on the farm, age of cows, health of the herd, and additions to the herd was recorded.

Persons found to be CF positive in the general population study were interviewed. The interviewees were selected on the basis of proximity and convenience. Pertinent information on recent illness, occupation, and animal contacts was collected.

Results

In a statewide survey of 2,065 dairy cattle herd milk samples, 72.4 percent were positive. Of 10,483 bovine serums tested, 32.9 percent were positive. Results of the herd milk survey were tabulated by county of origin (see map). The highest reactor rates were for herds in the north-central and northeastern counties of Maryland, the area of concentrated dairying in the State. In the present study the geographic distribution of high reactor rates for herds was nearly identical with that of the 1959 herd milk survey.

Frederick County, located in the area of concentrated dairying, was chosen for a study of farm residents exposed to Q fever-infected dairy cattle. Forty-five farms were selected for study on the basis of the cooperativeness of the farm managers and serologic evidence of infection in



Area of concentrated dairying, based on 1959 Census of Agriculture, and results of capillary agglutination test survey of herd milk samples, Maryland, 1963

Table 1. Results of capillary agglutination and complement fixation tests for Q fever in the general population of Maryland, 1963

Source of samples	Number CA tested	Number CA positive	Number CF positive	Percent CF positive
State laboratory [1]	21, 234	153	31	0. 15
County of residence in area of concentrated dairying	8, 916	106	21	. 24
County of residence in remainder of State	[2] 12, 318	47	10	. 08
Hospitals and bloodmobile in area of concentrated dairying	[3] 2, 049	138	50	2. 44
Total	23, 283	291	81	. 35

[1] Samples submitted for routine syphilis or Rh serology.
[2] Includes 4,152 serums tested and 4 CF positive serums unidentified as to county of residence.
[3] Composed of 1,265 from Washington County Hospital, 656 from Frederick Memorial Hospital, and 128 from a bloodmobile in the city of Frederick.

the cattle. Dairy herds on these 45 farms varied in size from 8 to 115 cows. Herd milk samples from three of the smaller herds were CA negative, but one to three individual cows in each of these herds were serologically positive.

Herd milk samples from 10 of the 45 farms were submitted for isolation studies. *C. burnetii* was isolated from seven CA positive milk samples; however, no isolations were made from the three negative milk samples.

Blood samples were collected from 124 interviewed farm residents. Serums of 19 residents (15.3 percent), residing on 17 farms, were CF positive. The reactor rate for 66 men (15.2 percent) was nearly identical with that for 58 women (15.5 percent). The reactor rate increased with age. For 33 residents under 20 years of age the rate was 6.1 percent, for 85 residents 20 to 59 years of age it was 17.8 percent, and for 6 residents 60 or more years of age it was 33.3 percent.

High reactor rates did not appear to be associated with size of the herd, infection rates of cows within herds, or isolation of herds (no known contacts with outside cattle for the previous 10-year period). Neither were high reactor rates associated with increased animal contact or consumption of raw milk. Illness suggestive of recent Q fever was not reported by any of the 124 interviewed farm residents.

In the general population study 21,234 human serums provided by the State laboratory were examined; 31 (0.15 percent) were CF positive. Reactor rates were higher in the area of concentrated dairying than in the remainder of the State (table 1). This geographic distribution was obtained despite assigning all serums of patients for which county of residence was unknown to the remainder of the State group.

Serums from the laboratories of the two rural county hospitals and the bloodmobile in the area of concentrated dairying showed a much higher reactor rate than serums from the State laboratory. The results of serologic tests for patients at Frederick Memorial Hospital are presented in table 2. Men, persons over 20 years of age, and persons who worked or lived in rural areas had higher reactor rates than women, persons

Table 2. Results of complement fixation tests for Q fever in serums of 430 patients at Frederick Memorial Hospital, by sex, age group, residence, and occupation, 1963

Patient characteristics	Number tested [1]	Number CF positive [2]	Percent CF positive [2]
Sex:			
Male	193	9	4. 7
Female	237	6	2. 5
Age group:			
10–19	27	0	0
20–59	246	13	5. 3
60 and over	157	2	1. 3
Residence:			
Rural	250	11	4. 4
Urban	180	4	2. 2
Occupation:			
Farmworkers	17	2	11. 8
Outdoor workers	85	6	7. 1
Town workers	91	2	2. 2
Others [3]	237	5	2. 1

[1] Number screened by CA test. Only CA positives were subjected to CF test.
[2] 3.5 percent of the 430 were positive.
[3] Mainly housewives and retired persons.

under 20 years of age, and persons who lived or worked in urban areas.

Nineteen of the general population study group whose serums were CF positive were interviewed. Eighteen people gave a history of visiting, working, or residing within one-quarter mile of a dairy barn within the previous 18 months. The husband of the only person who did not report such contact had been employed in a facility that conducted experiments with the organism. No illness suggestive of Q fever was reported by any of the 19 people.

A blood sample from a pregnant woman residing in the area of concentrated dairying was found to be CF positive for Q fever at a titer of 1:256. Because of the relatively high titer, a repeat blood specimen was drawn 50 days later at the time of delivery. The second sample proved to be CF positive at a titer of 1:512. Placental material was collected and sent to the Rocky Mountain Laboratory, which reported the isolation of *C. burnetii*. The isolate was reported to have caused reactions in the injected animals similar to those caused by isolates from Maryland bovine milk.

The woman could recall no symptoms suggestive of Q fever in the previous 18 months. She had moved to a dairy farm, where her husband was an employee, a few months before the first blood sample was drawn. She consumed raw milk but did not enter the dairy barn. It was not possible to ascertain the infection status of the dairy cattle on the farm.

Discussion

Before 1959 serologic and isolation surveys provided evidence of few bovine Q fever cases in Maryland. However, surveys conducted in 1959 and 1963 presented both serologic and isolation evidence of widespread dairy cattle infection. Although the survey and test methods used varied in the two periods (before and after 1959), the general results indicate a significant rise in the dairy herd reactor rates in Maryland in the late 1950's. An increase in dairy cattle infection rates during the 1950's also was observed in other Eastern States (*3*).

The distribution of serologically positive people in all the study groups appeared to be related to residence or employment in the vicinity of infected dairy cattle. These results were similar to findings in southern California (*2*), which strongly suggested airborne transmission of the organism from infected cattle to man.

Despite serologic evidence of exposure to Q fever among Maryland people, clinical illness has been reported on only one occasion. If other acute Q fever illnesses have occurred, they have been mild, undiagnosed, or unreported. The isolation of *C. burnetii* from a person with no reported history of acute illness suggests the possibility that asymptomatic infections have occurred.

It is concluded that Q fever as an acute disease is not presently a threat to public health in Maryland. Further studies are indicated to ascertain the virulence of the causative organism and its potential for widespread human infection.

Summary

Q fever studies in Maryland in 1963 revealed that a major source of possible human infection was infected dairy cattle. Of 2,065 herd milk samples tested, 72.4 percent were CA positive. Seven isolations of *Coxiella burnetii* were made from these samples. Serologic evidence of exposure was obtained from: (*a*) a survey of farm residents exposed to infected cattle, in which 15.3 percent of 124 people tested were CF positive; and (*b*) a survey of the general population of the State, which showed that of 23,283 serums tested, 0.35 percent were CF positive.

Serologic reaction appeared to be related to residence or employment in the vicinity of infected dairy cattle. No acute illness attributable to Q fever was reported by any of the serologically positive people who were interviewed. An isolation of *C. burnetii* was made from a person with no reported acute illness, suggesting that asymptomatic infections may have occurred.

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