

Decreasing Prevalence of Q Fever in Illinois

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THE ORGANISM THAT CAUSES Q FEVER, *Coxiella burnetii*, was first isolated in the United States in 1935 in Montana. It was isolated from a tick, *Dermacentor andersoni* (1). The first time that clinical illness due to the organism was recognized in Illinois residents was during an outbreak in a Chicago packing plant in 1946 (2). Subsequent studies in Illinois revealed that antibodies to *C. burnetii* were present in cattle, sheep, swine, and man (3).

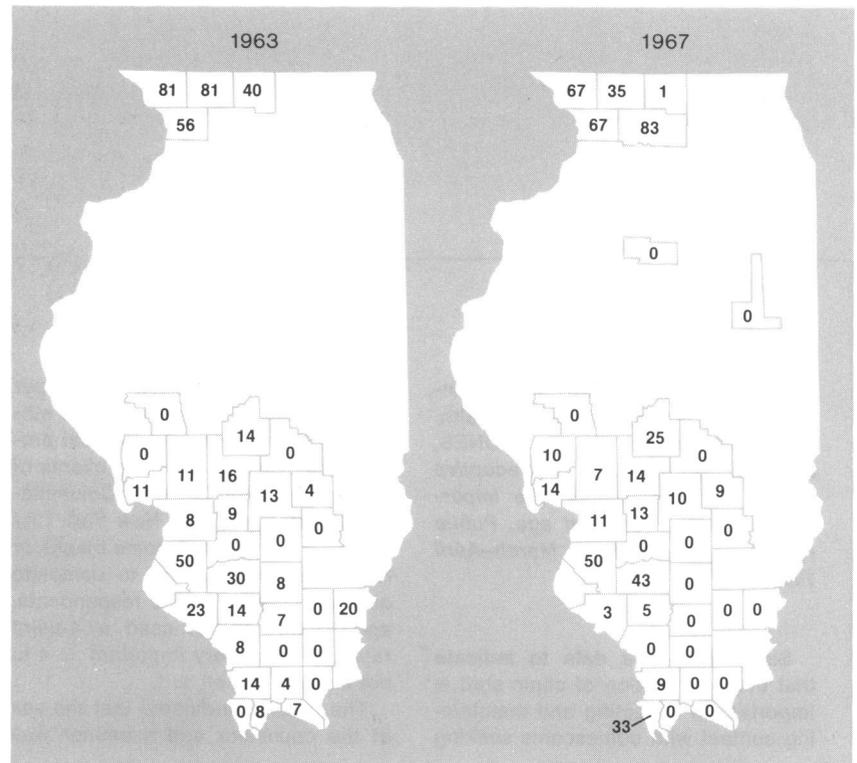
Clinical disease in people in the western United States has occasionally been associated with *C. burnetii* (4). In fact, 67 percent of the 785 cases reported to the Center for Disease Control from 1948 to 1977 were from California (5). Although various studies in the eastern United States have shown a high prevalence of anti-

body to the organism in man and increasing infection rates in cattle, few cases of clinical illness associated with *C. burnetii* have been found in either species (3, 6-9, 10). There is little public concern about, or concentrated surveillance of, this disease, apparently because of its rarity. In this report we describe the results of a multifaceted surveillance program in Illinois.

Methods

Detection in cattle. In the summers of 1963 and 1967, milk samples collected from producers supplying dairies in northern (Freeport), central (Litchfield), and southern (Carbondale) Illinois were examined at the University of Illinois College of Veterinary Medicine for antibody to *C. burnetii* by means of the capillary

Percentage of dairy herds in Illinois counties with milk samples reactive to *Coxiella burnetii* capillary agglutination test



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agglutination test (CAT) of Luoto (11). The antigen was the Ohio strain obtained from the Center for Disease Control, and only complete agglutinations were considered reactive. Standard positive and negative control serum samples were included in each test run. The results of the 1963 and 1967 studies were compared on a milkshed and an individual farm basis.

To explore the possible association of Q fever infection and infertility in cattle, records of the American Breeders' Service and Northern Illinois Breeders' Cooperative Association were searched for herds from which milk samples were tested in 1963. The predominant breed of cattle and the number of visits in 1963 by inseminators were recorded for each herd. Each visit was tabulated according to whether it was the first, second, or third time the specific cow had been inseminated during the current lactation period. This information was compared with the 1963 CAT status of the herd.

Finally, the 1963 mean monthly catalase test results of a major Illinois milk company were calculated for the study herds and compared with the CAT results in an effort to explore the possible association of *Coxiella* infection and mastitis.

Detection in man. Q fever in human beings was a reportable disease in Illinois until 1977. The two cases reported in the period 1963-77 were investigated by the Illinois Department of Public Health.

To determine the prevalence of antibody to *C. burnetti* in persons who had contact with cattle, the health department's division of laboratories tested, with the complement-fixation (CF) technique, serum samples collected from veterinarians attending the 1956, 1964, 1966, 1968, 1970, and 1972

annual meetings of the Illinois State Veterinary Medical Association. A Nine Mile strain commercial antigen was used, and a titer of 1:8 was considered reactive. Serums that had been collected from employees of a Peoria County abattoir during a 1966 brucellosis outbreak, then frozen and stored at -20° centigrade, were also tested for antibodies to *C. burnetii* by the CF technique (12).

Preemployment serum samples were collected from all new employees at a Cass County abattoir starting in 1967 when the plant opened; collection continued for the duration of our study. The samples were tested for *C. burnetii* antibody with the CF test at the Illinois Department of Public Health laboratories and with the CAT test at the College of Veterinary Medicine laboratory. CAT titers of 1:1 were considered reactive.

Results

Antibody in cattle. Milk samples from 37.7 percent of the 2,277 herds tested in 1963 were reactive to the Ohio strain of *C. burnetii* (see map for 1963), varying from 10.6 percent (58 of 545 herds) in the southern portion of the State and 10.5 percent (71 of 673) in the central part to 68.8 percent

(729 of 1,059) in northern Illinois.

In the 1967 retest of these milksheds, milk from 19.2 percent (380 of 1,975) herds was reactive. The reactor rates were 3.6 percent (11 of 303 herds) in the south, 10.8 percent (85 of 784) in the central portion of the State, and 32 percent (284 of 888) in the north (see map for 1967).

Of a total of 2,565 different herds tested in the two surveys, milk samples from 853 (33.3 percent) were reactive. Of all herds, 1,687 (65.8 percent) were tested on both occasions. Milk from 1,050 herds was negative and milk from 175 herds was reactive on both tests. One hundred forty-nine herds converted from negative for antibody in 1963 to positive in 1967; 313 reverted from positive to negative. Converters outnumbered reverts only in the central portion of the State. In Stephenson County, in northern Illinois, the 1963 reactive rate for Holstein herds was 60.2 percent (210 of 349) compared with 45.7 percent (21 of 46) for herds consisting primarily of other breeds.

Insemination records were available on 13,962 cows from 408 herds. Repeat insemination visits were necessary for 2,949 (21.1 percent) of the cows, and at least 3 visits were required to produce

Table 1. *Coxiella burnetii* complement-fixation test results on serum from Illinois veterinarians collected in 6 years

Reactive titer	Number of reactors in 6 selected years					
	1956	1964	1966	1968	1970	1972
1:8	10	3	3	0	0	0
1:16	5	2	1	0	0	0
1:32	0	0	0	0	0	0
1:64	2	0	0	0	0	0
1:128	0	1	0	0	0	0
Total reactive	17	6	4	0	0	0
Number tested	128	152	110	155	138	128
Percent reactive	13.3	3.9	3.6	0	0	0

Table 2. *Coxiella burnetii* complement-fixation test results on serum samples collected from Illinois veterinarians with at least one reactive serum sample

Veterinarian No.	Titer, by year tested						Practice type (1967)
	1956	1964	1966	1968	1970	1972	
1	1:64	NT	NT	NT	NT	NT	Military.
2	1:64	NT	NT	NT	NT	NT	Government.
3	1:16	1:8	NT	NT	NT	NT	Large.
4	1:16	NT	Neg	NT	NT	NT	General.
5	1:16	NT	NT	NT	NT	NT	Large.
6	1:16	NT	NT	NT	NT	NT	General.
7	1:16	NT	NT	NT	NT	NT	Small.
8	1:8	Neg	Neg	NT	Neg	NT	General.
9	1:8	Neg	NT	NT	NT	NT	Large.
10	1:8	NT	NT	NT	NT	NT	Small.
11	1:8	NT	NT	NT	NT	NT	General.
12	1:8	NT	NT	NT	NT	NT	Unknown.
13	1:8	NT	NT	Neg	NT	NT	Teaching.
14	1:8	NT	NT	NT	NT	NT	Large.
15	1:8	NT	NT	NT	NT	NT	Small.
16	1:8	NT	NT	NT	NT	NT	Small.
17	1:8	NT	NT	NT	NT	NT	Government.
18	Neg	1:128	Neg	Neg	NT	NT	Small.
19	Neg	Neg	1:16	Neg	Neg	Neg	Large.
20	NT	1:16	NT	Neg	NT	NT	Large.
21	NT	1:16	NT	NT	NT	NT	Large.
22	NT	1:8	NT	NT	NT	NT	Government.
23	NT	1:8	NT	Neg	NT	NT	Large.
24	NT	Neg	1:8	Neg	Neg	Neg	Government.
25	NT	NT	1:8	Neg	NT	NT	Large.
26	NT	NT	1:8	NT	NT	NT	Unknown.

NOTE: NT = not tested. Neg = negative.

conception in 930 (6.7 percent). Of the cows in herds with CAT reactive milk, 21.4 percent required repeat visits, and 6.8 percent needed at least 3 visits.

Catalase results were available on only 114 herds. The 78 herds with reactive milk had a mean catalase reading of 25.3 percent compared with 27 percent for the 36 herds with nonreactive milk.

Antibody in man. Only two cases of Q fever have been reported in Illinois residents since 1963. One occurred in 1969 in an adult male from St. Clair County who was responsible for moving live cattle in an abattoir, and one occurred in 1970 in a 19-year-old male college student from Cook County.

Reaction rates for serum collected from veterinarians decreased from 13.3 percent in 1956 to 0 percent in 1968, 1970, and 1972 (table

1). The 27 reactive serum samples from the 6 test periods were from 26 veterinarians (table 2). Eleven of the 26 were retested after the reactive sample was collected. Serum from 10 retested after 2 to 12 years had become nonreactive; 2 serums remained reactive. The practices of these 26 veterinarians included regulatory medicine and

teaching as well as large, general, and small animal practices; the lowest reaction rate was for small animal practitioners (table 3).

Serums were tested from 526 (67.2 percent) of the 783 Peoria County abattoir employees in 1966. Serums from 14 (2.7 percent) were reactive—7 had titers of 1:8, 2 of 1:16, and 5 of 1:32. Samples

Table 3. Practice type of Illinois veterinarians with serum tested against *Coxiella burnetii* on one or more occasions, 1967

1967 practice type	Veterinarians in Illinois	Tested (1956-72)		Reactive ¹	
		Number	Percent	Number	Percent
Large animal	334	118	35.5	9	7.6
General	101	42	41.6	4	9.5
Small animal	397	111	28.0	5	4.5
Teaching	47	11	23.4	1	9.1
Government	142	52	36.6	4	7.7
Other and unknown	175	52	29.7	3	5.8
Total	1,196	386	32.3	26	6.7

¹ Complement-fixation test titer \geq 1:8.

Table 4. Length of employment of workers at an Illinois abattoir tested for antibody to *Coxiella burnetii*, 1966

Years employed	Total plant population	Tested		Reactive ¹	
		Number	Percent	Number	Percent
0-5	197	124	62.9	5	4.0
6-25	513	355	69.2	9	2.5
26 or more	71	45	63.4	0	0
Unknown	2	2	100.0	0	0
Total	783	526	67.2	14	2.7

¹ Complement-fixation test titer \geq 1:8.

from 4.5 percent of the 176 persons aged 35-44 were reactive compared with 2.2 percent of the samples from the 134 people who were younger than 34 and 1.4 percent of the samples from the 213 who were 45 or older. However, the rates of reactors decreased as their length of employment increased (table 4).

Although there was no correlation between the percentage of reactors and their degree of exposure to cattle within the plant, the reaction rate was highest for employees who had the greatest exposure to swine (table 5). The distribution of the height of the titers was similar for whites and nonwhites; however, titers of 1:8 or greater were more common in nonwhite employees than in white; 6

of 147 (4.1 percent) nonwhite employees were reactors in contrast to 8 of 379 (2.1 percent) white employees, although the difference was not significant. This difference was more marked (but, again, it was not significant) when examined on a race-sex basis; only 5 of 289 (1.7 percent) white men were reactors in contrast to 6 of 144 (4.2 percent) nonwhite men. Three of 90 (3.3 percent) white women were reactors compared with 5 of 289 (1.7 percent) white men. Since only three nonwhite women were tested, no valid conclusions could be reached concerning that group.

Four of 40 (10 percent) of the employees who wore eyeglasses were reactors in contrast to 2 of 103 (1.9 percent) who did not. This difference was found in both races,

but the difference was not statistically significant.

Only 2 (0.1 percent) persons among the 1,432 tested before employment in the Cass County abattoir had reactive serums—1 each at 1:16 and 1:64 by the CF test. Both of their serums were antibody negative by the CAT.

Discussion

The findings on conception rates and the catalase test results, although inconclusive because of the study design and small numbers, agree with the reports that Q fever does not cause infertility and mastitis (12).

Although the small number of human reactors found must be considered when evaluating the data, the results do suggest that Q fever was not a common occupational infection among Illinois veterinarians or abattoir workers during the study period. Similarly, it is not a commonly reported disease in the State. The low reaction rate in a biased group—persons receiving preemployment examinations at abattoirs—although not representative of the general population, suggests that human infection is infrequent in Illinois.

The decrease in reaction rates among older abattoir employees

Table 5. Relationship between reactive rates of employees in an Illinois abattoir tested against *Coxiella burnetii* and their exposure to cattle and swine, 1966

	Exposure to cattle			Total	Exposure to swine		
	Maximum ¹	Moderate ²	Minimum ³		Maximum ¹	Moderate ²	Minimum ³
Total plant population	77	132	574	783	113	242	428
Number tested	55	89	382	526	73	170	283
Percent tested	71.4	67.4	66.6	67.2	64.6	70.2	66.1
Titers:							
1:8	1	1	5	7	2	2	3
1:16	0	0	2	2	1	0	1
1:32	0	1	4	5	3	0	2
Total	1	2	11	14	6	2	6
Percent reactive	1.8	2.2	2.9	2.7	8.2	1.2	2.1

¹ Contact with warm meat.

² Contact with chilled meat.

³ Contact with cured, smoked, or wrapped meat; or no contact with meat.

could represent an early infection followed by the buildup of a lasting resistance to *C. burnetii* despite a relatively short life of *C. burnetii* CF antibody. This explanation would also apply to the findings related to length of employment. The apparent racial difference in the abattoir employees could be a reflection of the disproportionately large percentage of maximally exposed nonwhites (13). The high reaction rates in abattoir workers who had contact with swine is surprising, since *C. burnetii* has rarely been associated with swine, although it is still prevalent in the cattle population in Illinois.

The decrease in reactors in any single phase of this study could possibly be explained by antigenic shifts or decreased antigen sensitivity in the laboratory, but the use of adequate laboratory controls and the total agreement in all phases of the surveillance program suggest that a true decrease in prevalence occurred. This decrease would not be expected in light of the consolidation of dairy herds in Illinois; increased mobility of dairy animals should increase the probability that a given herd would be exposed. Large herds and the Holstein breed have been associated with higher reaction rates in Ohio (6).

The decreased prevalence of antibody to *C. burnetii* could signal a

markedly lower resistance of Illinois cattle herds, which could leave the way open for an explosive outbreak of Q fever in man and animals if a highly virulent strain should be introduced. The decrease noted in Illinois is not consistent with the 1967 observation that milk from 99 percent of the 268 dairy herds in Los Angeles County were reactive to the CAT (14). Other statements concerning increases in prevalence (5) are based on studies completed in 1962 (8). The discrepancy deserves clarification through studies designed to detect changes in prevalence over a broad section of the nation.

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SYNOPSIS

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There were 858 (37.7 percent) Q fever-infected dairy herds among the 2,277 tested in Illinois in 1963. The

percentage decreased to 19.2 percent (380 of 1,975) in 1967. Reaction rates (complement-fixation test titer of 1:8 or greater) in serum samples from veterinarians decreased from 13.3 percent in 1956 to 3.9 percent in 1964 and from 3.6 percent in 1966 to 0 percent in 1968, 1970, and 1972. There were 14 (2.7 percent) reactive serum samples among 526 abattoir workers tested in 1966; reaction rates were higher among workers

having contact with swine (8.2 percent) than among workers having contact with cattle (1.8 percent). Two (0.1 percent) of 1,432 serum samples collected from 1967 to 1971 during preemployment examinations at another abattoir were reactive. Only two clinical cases of Q fever were reported to the Illinois Department of Public Health in the period 1963-80. All evidence points to a decreasing prevalence of Q fever in Illinois.