

Epidemiology of Human Brucellosis in Iowa

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An increasing proportion of cases of brucellosis now comes from close contact with infected cows and pigs and fewer are caused by the consumption of unpasteurized dairy products. What Iowa is doing about this serious public health problem is recounted here.

✠ Of the diseases of animals transmissible to man, the one that is reported most frequently in man in Iowa is brucellosis. Iowa's first human case was recognized in 1926.¹ From then until the end of 1953, 8,642 human cases and 71 deaths due to brucellosis have been reported to the Iowa State Department of Health. A large number of these cases have been exhaustively investigated. The reports¹⁻⁴ of these studies have been published and will not be reviewed here. Highly significant among the many facts described were reports of the importance of the skin as a portal of entry for *Brucella* organisms,² the milk-borne epidemics of human brucellosis due to *B. suis* emphasizing the danger of allowing hogs to mingle with dairy cows,³ and the occurrence of *B. melitensis* in man and hogs in Iowa.⁴

While it is recognized that not all brucellosis cases are reported, 2,047 were recorded during the 1951-1953 period. Of these, 1,201 came from practicing physicians and 846 were based on reports from the State Hygienic Laboratory of an agglutination titer of 1:160 or higher.* A case reg-

istry of patients by name is maintained to avoid duplications. The following discussion deals with the 1,201 cases. Geographically they were scattered throughout the state with the counties having the larger packing houses reporting the higher incidences.

Occupation and Sex—The occupation and sex of 720 cases reported during 1952 and 1953 on which this information is available are shown in Table 1. Fifty per cent of the cases were male farm workers and 22 per cent were packing house employees. The number

Table 1—Human Brucellosis in Iowa 1952-1953, Distribution of Cases by Occupation and Sex

Occupation	Male	Female	Total
Male farm workers	363		363
Packing house employees	142	16	158
Housewives		74	74
Miscellaneous occupations *	29	3	32
Students	15	9	24
Veterinarians	20		20
Livestock dealers	12		12
Rendering plant employees	8		8
Truckers	8		8
Merchants	6		6
Retail butchers	5	1	6
No data	6	3	9
Total	614 (85%)	106 (15%)	720

* Includes a teacher, bar tender, mason, café operator, beautician, auto salesman, auto mechanic, plumber, Armed Forces personnel, junk dealer, and a turkey processing plant field man.

* The antigen used is standardized with the U. S. Department of Agriculture, Agricultural Research Service antigen.

of housewives reported with brucellosis during this period may seem unusually large. However, 76 per cent of the 74 were rural housewives. Not infrequently farm women help their husbands with the farm work and in the care of livestock. They thereby are exposed to the same reservoirs of infection in much the same manner as male farm workers. For example, a rural housewife developed a *B. suis* bacteremia after caring for baby pigs.

Of the cases reported during the 1952-1953 period, 85 per cent were male and 15 per cent were female, as compared with 79 per cent and 21 per cent, respectively, reported by Jordan⁵ for a series of Iowa cases from 1940-1946.

Age—The percentages of the Iowa 1951-1953 cases in each 10-year age group and over 50 are 1.6, 5.7, 26.7, 34.5, 20.0, and 11.5, respectively. This age distribution differs somewhat when compared with other reports. For the Iowa 1951-1953 group there is a lower percentage of cases in the first and second decades of life and over 50 and a higher percentage among persons in the third and fourth decades of life as compared with a Wisconsin⁶ 1948-1951 group and an Iowa⁵ 1940-1946 series.

Seasonal Distribution—Feig,⁶ Hart, et al.,⁷ and Magoffin, et al.,⁸ observed no marked variation in the seasonal incidence of human brucellosis in Wisconsin, Connecticut, and Minnesota. Jordan and Borts⁹ reported more patients with initial symptoms during June (10.9 per cent), July (11.2 per cent), and August (10.8 per cent) than in other months in a series of Iowa cases from 1933 to 1946. Of the Iowa 1951-1953 cases, information on the month of onset is available for 989 and is shown graphically by occupation in Figure 1. The seasonal variation is most marked among male farm workers with about two and one-half times as

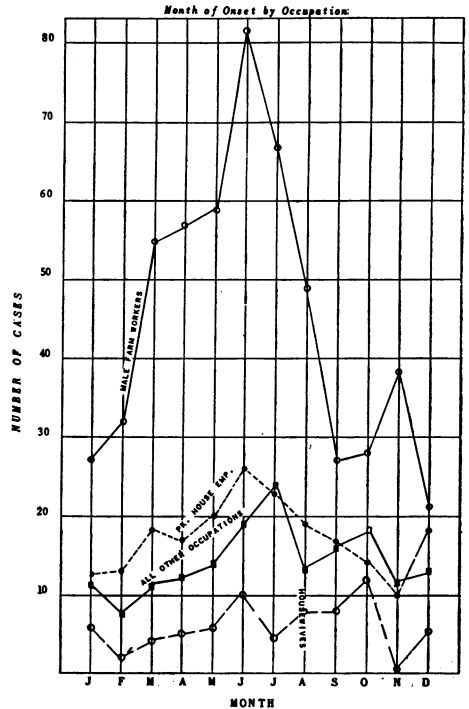


Figure 1—Human Brucellosis in Iowa—1951-1953, Month of Onset by Occupation

many cases with beginning symptoms in June as in January. For all occupational groups the seasonal distribution of onset varied from 5.5 per cent having initial symptoms in February to 13.8 per cent in June.

Since a large majority of male farm workers in Iowa have contact with animals it is interesting to compare the month of onset of brucellosis in this occupational group with the number of pigs born each month. Table 2 lists the numbers of sows farrowed by month and the number of brucellosis cases among male farm workers by month of

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This paper was presented before the Conference of Public Health Veterinarians at the Eighty-Second Annual Meeting of the American Public Health Association in Buffalo, N. Y., October 11, 1954.

Table 2—Number of Sows Farrowed by Month * and Brucellosis Cases Among Male Farm Workers by Month of Onset Iowa 1951–1953

Month	1951		1952		1953	
	Sows Farrowed	Human Cases	Sows Farrowed	Human Cases	Sows Farrowed	Human Cases
January	31,000	8	25,000	10	39,000	9
February	159,000	12	144,000	12	170,000	8
March	630,000	22	513,000	15	509,000	18
April	921,000	22	779,000	17	688,000	18
May	453,000	28	428,000	15	366,000	16
June	197,000	42	230,000	20	196,000	21
July	81,000	32	103,000	15	100,000	20
August	217,000	22	206,000	13	241,000	14
September	343,000	8	299,000	12	255,000	7
October	147,000	13	118,000	9	96,000	6
November	25,000	15	24,000	12	23,000	11
December	15,000	5	14,000	9	19,000	7
Total	3,219,000	229	2,883,000	159	2,702,000	155

* From the Iowa Crop and Livestock Reporting Service. Crop & Livestock News 11:1 (Dec.), 1951, 12:1 (June), 1952, 12:1 (Dec.), 1952, 13:1 (June), 1953, 14:1 (June), 1954.

onset for the period 1951–1953 for the cases for which this information is available. These data are presented graphically in Figure 2 and clearly show the seasonal nature of farrowings. The spring high point is reached in April and the much lower fall peak occurs in September. The seasonal nature of the onset of brucellosis among

male farm workers follows a similar pattern. The spring peak of human cases among this occupational group is reached in June and the lower fall peak occurs in November. In both spring and fall the high points in human cases occur two months after the peak farrowing seasons.

Thus it would seem that persons

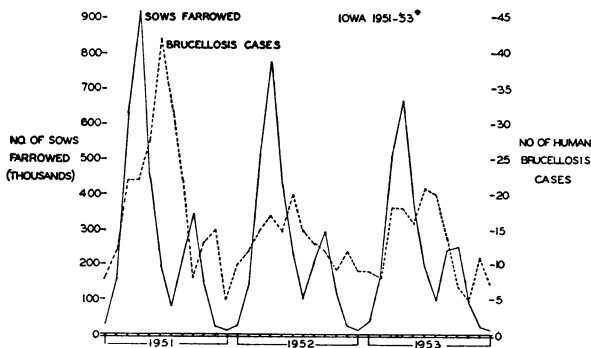


Figure 2—Number of Sows Farrowed by Month and Reported Brucellosis Cases Among Male Farm Workers by Month of Onset

* Data from Table 2

caring for livestock are more likely to become infected with brucellosis during farrowing season than at any other time of the year. Knowing that persons caring for sows during parturition frequently do have contact with newborn pigs, uterine fluids, and fetal membranes it is not difficult to understand that this might occur. The fact that the seasonal variation of the human cases is not as extreme as the farrowings perhaps can be explained at least in part. Some of the male farm workers no doubt become infected from other sources, such as contact with infected cattle, drinking raw milk from infected cows, or contact with infected hogs at other times. Also, the insidious nature of the onset of human brucellosis and its variable incubation period would tend to prevent sharp seasonal variations.

Animal Contact—Of the 1951–1953 group of patients, 80 per cent were engaged in occupations that resulted in animal contact or worked at other occupations, but reported having had contact with animals or animal excretions in the weeks before onset of illness. This may be compared with 75 per cent for the Iowa cases for the period 1940–1946.⁵ The stated occupation of a person may be misleading at times in locating the possible source

of infection. For example, in 1953, two machinists working in a plant in which no animals were involved and who consumed pasteurized milk developed brucellosis. Investigation revealed that they had a part-time job on Saturdays loading and hauling manure from a rendering plant.

At times, apparently, rather indirect contact results in human *Brucella* infection. For example, on two occasions carpenters who had been engaged in building construction on hog farms during previous weeks developed brucellosis. In another instance an 11-year-old urban boy who spent quite a lot of time playing around a hog buying station at the edge of town became ill with the disease. Since epidemiologic investigations indicated that the more common sources, such as direct animal contact and raw dairy products were not involved in these cases, it seems likely that the infections resulted from contaminated environment.

Species of *Brucella*—Sixty-one per cent of the *Brucella* cultures isolated from human patients in Iowa during the period 1927–1953 were *B. suis*. This is in contrast to Minnesota,⁸ Wisconsin,⁶ and Connecticut,⁷ where 85.8 per cent, 96 per cent, and 93.2 per cent, respectively, were *B. abortus* (see Table 3). This fact, no doubt, is related to

Table 3—Distribution of Species of *Brucella* Isolated from Human Patients in Iowa, Minnesota, Wisconsin, and Connecticut

	Total Number of Isolations	Per cent <i>Brucella</i> <i>abortus</i>	Per cent <i>Brucella</i> <i>suis</i>	Per cent <i>Brucella</i> <i>melitensis</i>	Source of Data
Iowa 1927–1953	539	26.0	61.0	13.0	
Minnesota 1945–1948	268	85.8	6.0	8.2	Ref. 8
Wisconsin 1946–1948	238	96.0	3.0	1.0	Ref. 6
Connecticut 1934–1952	176	93.2	6.2	0.6	Ref. 7

the difference in seasonal incidence as discussed previously when Iowa is compared with these states. With a higher percentage of cases being due to *B. suis* they would be more likely to occur during the season in which persons have the most contact with contaminated animals, uterine fluids, and fetal membranes.

Reservoir of Infection—Data presented above would indicate that hogs constitute a major reservoir of *Brucella* infection in Iowa. However, information pertaining to the exact incidence of the disease in hogs in the state is not available. In 1935 McNutt¹⁰ reported that 2.3 per cent of the 1,547 hogs tested reacted positively to the agglutination test in a dilution of 1:50 or higher. The Iowa Veterinary Medical Diagnostic Laboratory tested 9,545 and 13,570 hog blood specimens in 1951 and 1952, respectively.¹¹ Of these 4.1 per cent reacted positively to the *Brucella* agglutination test in a dilution of 1:100 or higher in 1951 and 3.6 per cent of the 1952 group were positive. Since the specimens tested were not a random sample, the results may or may not indicate the incidence of infection among Iowa hogs. Specimens are submitted to the laboratory for one or more of several reasons. Some hogs undoubtedly were tested more than once. Regardless of the exact incidence of the disease among swine, the hog crop of approximately 20 million animals per year in Iowa provides a large potential reservoir of infection.

There is also a reservoir of the disease among cattle in the state. During 1951, 5.9 per cent of 89,412 bovine blood specimens reacted positively to the agglutination test. In 1952, 3.8 per cent of 129,538 samples were positive.¹¹ As with the swine specimens the bovine specimens were selected and do not constitute a random sample.

An example will illustrate the public health seriousness of the reservoir of

bovine brucellosis. While the mortality rate among human brucellosis cases is low, deaths do occur. In January of this year the death of a four-year-old girl due to brucellosis was reported to the State Department of Health. Diagnosis had been confirmed by isolation of *B. abortus* from the patient. Investigation revealed that the girl had lived on a dairy and hog farm with her parents and one sister. The family drank raw milk from their dairy herd. One cow had aborted in November, 1953. Blood specimens for brucellosis agglutination tests were drawn from the cattle on February 10, 1954, and on this day one more cow aborted. Eight of 20 cows tested * reacted positively to the blood agglutination test in a dilution of 1:100 or higher and were classified as reactors. One cow reacted positively in a dilution of 1:50 and was classed as a suspect. On February 17 a milk sample was taken from each quarter of the udder of each positive reacting cow and from the suspect. *B. abortus* was isolated from the milk from three of the reactor cows by direct culture of gravity cream and from the milk from six of the eight reactor cows by guinea pig inoculation and culture by the director of the State Hygienic Laboratory. One cow was shedding the organism from three quarters. Other members of the family were not ill and were negative to the agglutination test in January. While many farm families in recent years have purchased home pasteurizing units it would appear that the percentage of rural families using pasteurized milk still is low. This study revealed that 70 per cent of the patients who drank milk from their own cows prior to illness did so without the benefits of pasteurization.

Blood testing of animals for brucel-

* Tests done at the Iowa Veterinary Medical Diagnostic Laboratory.

losis on farms from which human cases of the disease have been reported has been carried on in Iowa for a number of years through the cooperation of the practicing veterinarians with the U. S. Department of Agriculture Animal Disease Eradication Branch (formerly BAI), the Iowa State Department of Agriculture, and the Iowa State Department of Health. Of 3,332 cattle tested in 260 herds under this arrangement, 16 per cent reacted. Sixty-one per cent of the herds tested contained reactors. Of 833 hogs tested in 78 herds, 19 per cent reacted. Thirty-five per cent of the swine herds tested contained reactors.

Prevention—It is recognized that prevention of human brucellosis is dependent upon eradication of the disease in animals.⁸ In Iowa progress is being made in this direction. For example, under the cooperative program of the federal and State Departments of Agriculture 19,190 cattle were tested for brucellosis in June, 1954, as compared with 9,829 in June of the previous year.¹³ This is more significant than the number alone would indicate. The agencies named above along with the Iowa State College Extension Service have established a milk ring (ABR) testing program that has been carried out on a county-wide basis in many counties. It is used as a screening test and herds that are positive on the ring test are then blood tested. The result is that the blood testing is being concentrated on those herds in which *Brucella* infected animals are most likely to be found. There has been a marked increase in calfhood vaccination against brucellosis. In June, 1954, 19,297 calves were officially vaccinated as compared with 8,544 in June of the preceding year.¹³

It is generally agreed that the herd sire is the most important factor in the spread of swine brucellosis.¹² Control of the sire then should lower the inci-

dence of the disease among hogs. With this in mind a swine brucellosis control program was initiated in 1949 by the state veterinarian in cooperation with the U. S. Bureau of Animal Industry and the Iowa State College Veterinary Medical Research Institute.¹² The immediate objective of the plan is to develop brucellosis-free breeding herds from which the commercial hog raiser can obtain disease-free breeding stock. The Iowa Certified Brucellosis Controlled Swine Herd Program lists three plans for ridding infected herds of the disease, of which the hog breeder may select the one best suited to his herd operation. It provides for a method of certifying herds free from brucellosis and gives official recognition to herds that are free of the disease. In 1950 only eight herds were certified. The program has progressed so that for the first eight months of this year 78 herds were on the certified list.

Summary

Human brucellosis continues to occur throughout Iowa each year. The reported cases in man for the period 1951–1953 covered by this summary differ from earlier findings. For the later group the percentage incidence was higher in males; the seasonal variation in onset was greater; a higher percentage of cases had contact with animals; and a higher proportion occurred in the 20- to 39-year-age group. Thus, it would appear that an increasingly larger proportion of the cases result from animal contact and a smaller number from consuming contaminated unpasteurized dairy products. There is indication that male farm workers in Iowa are more likely to become infected during the sow farrowing season than at other times of the year. A reservoir of brucellosis exists in both cattle and hogs in the state and programs to eliminate it are under way.

Although the pasteurization of dairy products plays an important role in human infection, contact with infected animals is the major source in Iowa. Only by complete eradication of the disease in animals will human brucellosis be prevented.

ACKNOWLEDGMENT—The writer wishes to express appreciation to Ralph H. Heeren, M.D., and I. H. Borts, M.D., for valuable suggestions and assistance in collection and preparation of data in this paper.

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