LYME disease SURVEILLANCE SUMMARY

Bacterial Zoonoses Branch
Division of Vector-Borne
Infectious Diseases
National Center for Infectious Diseases
Centers for Disease Control

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RESULTS OF CDC ATTEMPTS TO ISOLATE *B. burgdorferi* FROM SUSPECTED ERYTHEMA MIGRANS LESIONS, UNITED STATES, 1990-1992

Culture of *Borrelia burgdorferi* from patients is currently the only unequivocal means of confirming a diagnosis of Lyme disease. Positive cultures from patients have been reported from Connecticut [1], New York [2, 3], and Wisconsin [4]; in addition, CDC has isolated the organisms from patients in California and Maryland (unpublished data). These states all have high incidence rates of Lyme disease and well-documented, established enzootic cycles of *B. burgdorferi* transmission. Although isolation of *B. burgdorferi* has also been reported from patients in Texas [5], an established enzootic cycle in that state has not been documented.

The highest culture yields of *B. burgdorferi* from clinical samples (ca. 70%) have been obtained from punch biopsies of erythema migrans (EM) lesions [1-3], the characteristic dermatologic sign of acute Lyme disease. Additionally, *B. burgdorferi* has been cultured from cerebrospinal fluid (CSF), blood, joint fluid, and cardiac muscle, but yields have been low or attempts few [5-7].

Beginning in 1990, CDC has collaborated with clinicians to culture *B. burgdorferi* from patients with clinically suspected Lyme disease. Emphasis has been on states where enzootic transmission of *B. burgdorferi* has not been proven, or in which cases of Lyme disease have been diagnosed clinically, but never confirmed by culture. Specialized culture medium (BSK) has been shipped to interested clinicians, and samples have been obtained and placed in the culture medium, and then returned to the Diagnostic and Reference Section, Bacterial Zoonoses Branch, CDC, Fort Collins, Colorado for incubation and examination. Cultures are examined periodically for 2-3 months before considered to be negative.

As of August 10, 1992 a total of 72 punch biopsy samples from suspected EM lesions from 69 patients of 42 clinicians have been submitted for culture (Tables 1 and 2). None of 60 samples was culture-positive from states where the isolation of *B. burgdorferi* has not been reported from humans, animals or ticks (Arkansas, Florida, Kansas, Missouri, North Carolina, and Tennessee), or where low enzooticity has been detected, but no isolates from humans have been documented (Virginia). In contrast, 5 of 12 (42%) samples were culture-positive from states where the endemicity of *B. burgdorferi* is proven, and where substantial areas of enzooticity have been documented (California, Maryland, New Jersey, New York, and Wisconsin). This difference is statistically significant (0/60 vs. 5/12, Fisher's exact test, 2-tailed $p < 0.001$).

CDC will continue these efforts to culture biopsies of EM lesions, particularly in states where the isolation of *B. burgdorferi* has not been documented, but where cases of Lyme disease are being diagnosed clinically. Ongoing problems with false positive results from serologic tests underscore the importance of establishing the presence of Lyme disease in these states by isolating *B. burgdorferi* from suspected EM lesions.

REFERENCES

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Table 1. Results of CDC attempts to culture *Borrelia burgdorferi* from suspected erythema migrans lesions, 1990-1992, in states where isolation of *B. burgdorferi* has not been reported*, or where limited areas of enzooticity have been documented+.

State	No. clinicians	No. Patients	No. skin biopsies cultured	No. cultures positive
Arkansas	1	2	2	0
Florida	2	2	4	0
Kansas	1	4	4	0
Missouri	14	25	28	0
North Carolina	3	6	6	0
Tennessee	2	6	5	0
Virginia	8	12	11	0
Total	31	57	60	0

* Arkansas, Florida, Kansas, Missouri, North Carolina, Tennessee

\+ Virginia

Table 2. Results of culture of *Borrelia burgdorferi* from suspected erythema migrans lesions, 1990-1992, in states where isolation of *B. burgdorferi* has previously been reported from humans, animals or ticks, and where substantial areas of enzooticity of *B. burgdorferi* have been documented.

State	No. clinicians	No. patients	No. skin biopsies cultured	No. cultures positive
California	6	7	7	3
Maryland	2	2	2	1
New Jersey	1	1	1	0
New York	1	1	1	0
Wisconsin	1	1	1	1
Total	11	12	12	5

NEW SPECIES OF LYME *BORRELIA* DESCRIBED

Researchers at the Pasteur Institute in Paris have described a new species named *Borrelia garinii* associated with Lyme borreliosis (1). They also report on a number of isolates in Group VS461, named after the type strain, that preliminary evidence suggests will be included in a 3rd Lyme borreliosis-associated species of *Borrelia*. *Borrelia burgdorferi* sensu stricto have been isolated from Europe and the United States. *Borrelia garinii* and Group VS461 isolates are from Asia and Europe only; none has been described from the United States. DNA homology and ribotyping were used to delineate these new genospecies. DNA relatedness is summarized below:

Percent homology when probed with (N=strains) *

Strains of	**B31 DNA**	**20047 DNA**	**VS461 DNA**
B. burgdorferi s.s.	80-100 (12)	49-67 (4)	48-50 (2)
B. garinii	51-55 (4)	75-100 (13)	53-74 (9)
Group VS461	51 (1)	54-73 (7)	87-100 (7)

*limited ranges may be due to small number of strains tested; B31 and 20047 are the type strains for *Borrelia burgdorferi* sensu stricto and *Borrelia garinii*.

Although these findings make the diagnosis, epidemiology, immunology, pathogenesis, etc. of Lyme borreliosis more complicated, they may help explain some of the quandaries about Lyme disease. For example, it is thought that Lyme arthritis is less common in patients in Europe than the United States (4). We can speculate that this may be because *B. garinii* and/or Group VS461 strains have less arthritogenic potential. Western blotting patterns of patient sera from Europe and the U. S. have different reactivities (2).

Comparisons of the *ospA* genes of strain B31 [which is *Borrelia burgdorferi* sensu stricto] and strain Ip90 [which is *Borrelia garinii*] show their nucleotide sequences are 86% identical and predicted amino acid sequences are 79% identical (3). The greater similarity of *ospA* genes compared to total DNA may be because the *osp* genes are located on the 49 kbp linear plasmid which could have been recently introduced into *Borrelia*.

Although all 3 genospecies are detected by current diagnostic tests, there is no simple assay at this time to differentiate *Borrelia burgdorferi* sensu stricto from *Borrelia garinii* or Group VS461. Ribotyping or DNA hybridization are the only methods which currently can be used to speciate Lyme disease spirochetes.

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1. Baranton G, Postic D, Saint Girons I, Boerlin P, Piffaretti JC, Assous M, and Grimont PAD. Delineation of *Borrelia burgdorferi* sensu stricto, *Borrelia garinii* sp. nov., and group VS461 associated with Lyme borreliosis. *Int J Syst Bacteriol* 1992;42:378-83.

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COMPARISON OF REPORTED CASES OF LYME DISEASE FROM 1990 TO 1991 BY STATE/ TERRITORY AND REGION

Final data from 1991 have been received from nearly all states and territories (Table 3). Directions of change listed are not expected to differ when final minor data adjustments are made. Reporting of Lyme disease cases increased in all regions except the Pacific states where a 28% decrease was registered in 1991 compared to 1990. For the entire United States, reported cases increased 19% in 1991.

KNOWN DISTRIBUTION OF *Ixodes dammini* AND *Ixodes pacificus* IN THE UNITED STATES

In previous editions of LDSS, we have requested the assistance of our readers in a project to collect data on the distribution of known vectors of Lyme disease in the nation. These contributions along with surveys by public health officials and investigators and a review of the published literature have been collated to provide the accompanying map (Figure 1) and tabular data by counties (Table 4). In the Northeast and upper Midwest, 18 states appear to have established populations of *I. dammini* ticks; and an additional 3 states have reported identifying them as present, but have not yet shown that they are established. *I. pacificus* ticks appear to be established in 5 western states and have been reported in 2 others.

While these data are valuable, they should be interpreted cautiously. Most areas not listed as infested in this compilation have not yet been evaluated. Two other considerations are that 1) although an entire county is listed as infested, the infestation is often quite focal, and 2) the data only refer to the presence of tick populations--they do not distinguish infected from uninfected populations. Some areas listed as harboring these vector ticks may be remote and present a small risk of disease transmission to humans. In many counties, *Ixodes* spp. tick populations may be very focal and may or may not be infected.

Ixodes scapularis, another member of the *Ixodes ricinus* complex, is found throughout the southern United States. It is a competent vector of *B. burgdorferi* in the laboratory, but has a low rate of *B. burgdorferi* infection in nature and does not frequently bite humans. Further studies are needed in the southern United States to map the

distribution of *B. burgdorferi* in ticks and vertebrate hosts, and to confirm cases of suspected human infection with *B. burgdorferi* by isolating the organism from patient specimens.

REPORTING OF LYME DISEASE CASES IN 1991 AND 1992 BY NETSS

The numbers of Lyme disease cases reported through National Electronic Telecommunication Surveillance System (NETSS) in the period January through September 3, 1992 are shown in Figure 2. Of the total 4,999 cases reported through Week 36, 3,999 (80%) were reported from the mid-Atlantic and New England regions. The negative data shown in Week 30 correct an erroneous transmission of data from one state in a previous reporting period. Figure 3 shows the numbers of cases reported through NETSS during 1991 for comparison. The total number for 1991 (N=9,469) is still provisional and is expected to be revised slightly in the next few weeks. This number already differs from the final surveillance total which is being published in the 1991 MMWR Annual Summary. The deadline for submitting final data for that publication has passed although a few states are still receiving data requiring modifications of their final 1991 numbers.

ERRATA

In the previous issue of **LDSS (1992;3(2):2-4)**, two points require clarification. The statement that *Borrelia burgdorferi* grows best in "anaerobic conditions" should read in "microaerophilic conditions". That article also contains some apparently conflicting recommendations on optimal growth temperatures (32-33 degrees C and 33-34 degrees C). *B. burgdorferi* grows well throughout the range from 32-35 degrees C and shows marked decrease in growth at 38 degrees C (Barbour AG. *Yale J Biol Med* 1984;57:521-25, 1984).

Lyme Disease Surveillance Summary (LDSS) is edited by Drs. Robert Craven and David Dennis. If you have information to contribute or wish to receive a LDSS, please contact them at:

CDC/DVBID
Lyme Disease Surveillance Summary
P.O. Box 2087
Fort Collins, CO 80522

Table 3.
Totals of reported cases of Lyme disease by state/territory and region, 1990-1991.

STATE/TERRITORY OR REGION	REPORTED CASES		
	1990	1991	% AND/OR DIRECTION OF CHANGE
MAINE	9	15	+
NEW HAMPSHIRE	4	38	+
VERMONT	11	7	-
MASSACHUSETTS	117	265	+
RHODE ISLAND	101	142	+
CONNECTICUT	704	1192	+
NEW ENGLAND REGION	946	1,659	+75.4%
NEW YORK *	3244	3944	+
NEW JERSEY	1074	915	-
PENNSYLVANIA	553	718	+
MID. ATLANTIC REGION	4,871	5,577	+14.5%
OHIO	36	112	+
INDIANA	15	16	+
ILLINOIS	30	51	+
MICHIGAN	134	46	-
WISCONSIN	337	424	+
E.N. CENTRAL REGION	552	649	+17.6%
MINNESOTA	70	84	+
IOWA	16	22	+
MISSOURI	205	207	+
NORTH DAKOTA	3	2	-
SOUTH DAKOTA	2	1	-
NEBRASKA	0	25	+
KANSAS	14	22	+
W.N. CENTRAL REGION	310	363	+17.1%
DELAWARE	54	73	+
MARYLAND	238	282	+
DC	5	5	EVEN
VIRGINIA	129	151	+
WEST VIRGINIA	11	43	+
NORTH CAROLINA	87	73	-
SOUTH CAROLINA	7	10	+
GEORGIA	161	25	-
FLORIDA	7	35	+

STATE/TERRITORY OR REGION	REPORTED CASES		
	1990	1991	% AND/OR DIRECTION OF CHANGE
S. ATLANTIC REGION	699	697	-0.3%
KENTUCKY	18	44	+
TENNESSEE	28	35	+
ALABAMA	33	13	-
MISSISSIPPI	7	8	+
E.S. CENTRAL REGION	86	100	+16.3%
ARKANSAS	22	31	+
LOUISIANA	3	6	+
OKLAHOMA	13	29	+
TEXAS	44	57	+
W.S. CENTRAL REGION	82	123	+50.0%
MONTANA	0	0	EVEN
IDAHO	1	2	+
WYOMING	5	11	+
COLORADO	0	1	+
NEW MEXICO	0	3	+
ARIZONA	0	1	+
UTAH	1	2	+
NEVADA	2	5	+
MOUNTAIN REGION	9	25	+177.8%
WASHINGTON	30	7	-
OREGON +	11	5	-
CALIFORNIA +	345	265	-
ALASKA	0	0	EVEN
HAWAII	2	0	-
PACIFIC REGION	388	277	-28.6%
GUAM	0	0	EVEN
PUERTO RICO	0	0	EVEN
VIRGIN ISLANDS	0	0	EVEN
AMERICAN SAMOA	0	0	EVEN
C.N.M.I.	0	0	EVEN
TERRITORIES	0	0	EVEN
UNITED STATES TOTAL	7943	9469	+19.2%

* Including New York City.

\+ Included in this table, but not in the 1991 totals in MMWR (Lyme disease not reportable in Oregon).

of the Distribution of *Ixodes dammini* and *Ixodes pacificus*
in the United States

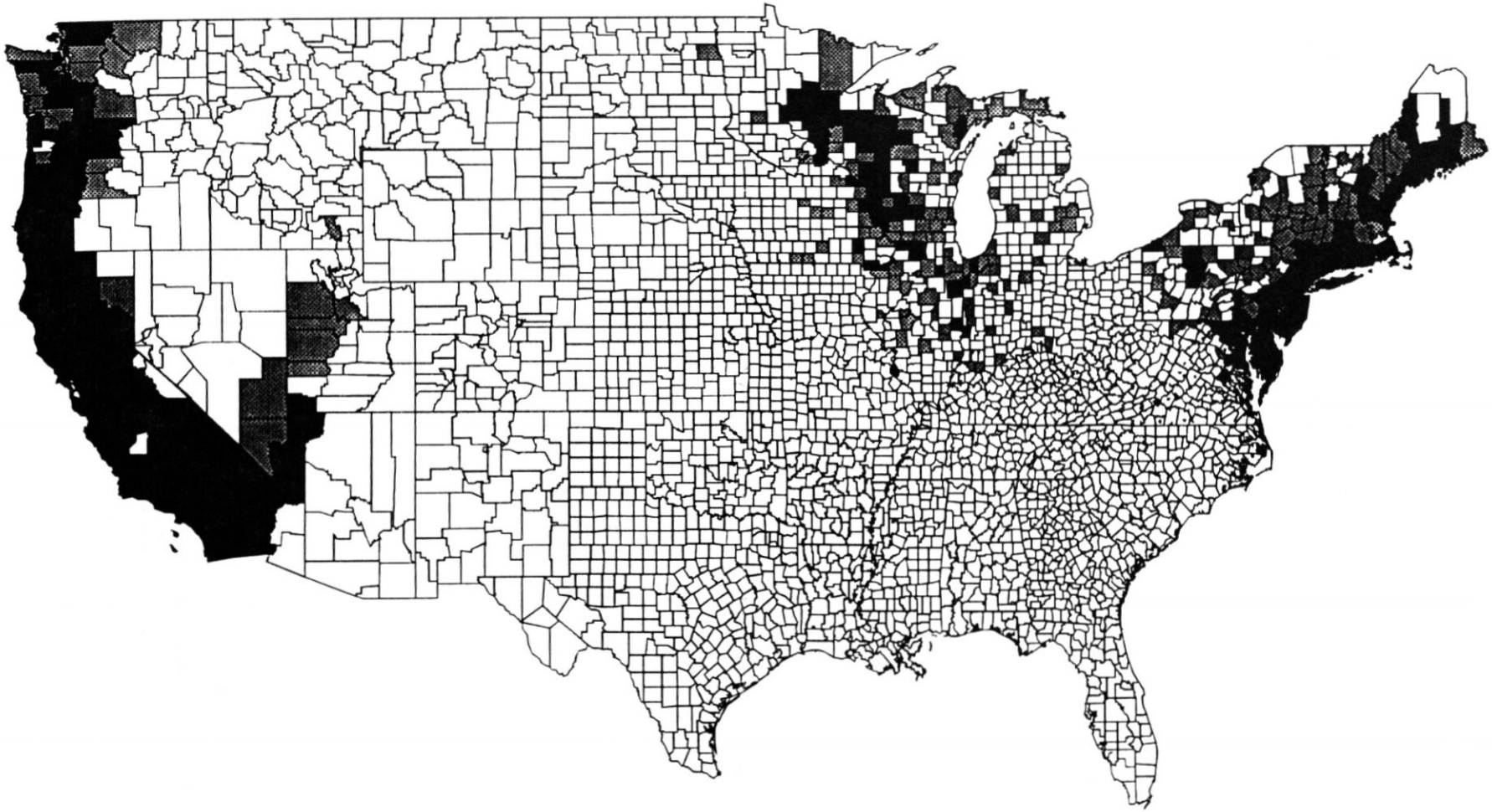

Table 4 (Page 1)

Tick Populations by State and County

ARIZONA:
mojave

CALIFORNIA:
alameda
amador
butte
calaveras
colusa
contra costa
del norte
el dorado
fresno
glenn
humboldt
imperial
inyo
kern
lake
lassen
los angeles
madera
marin
mariposa
mendocino
merced
monterey
napa
nevada
orange
placer
plumas
riverside
sacramento
san benito
s.bernadino
san diego
s.francisco
san joaquin
s.l.obispo
san mateo
santa barbara
santa clara
santa cruz
shasta
sierra
siskiyou
solano
sononma
stanislaus
sutter
tehema
trinity
tulare
toulumne
ventura
yolo
yuba

CONN:
fairfield
hartford
litchfield
middlesex
new haven
new london
tolland
windam

DELAWARE:
kent
new castle
sussex

IDAHO:
bannock

ILLINOIS:
boone
brown
carroll
coles
cumberland
du page
edgar
fayette
grundy
henry
iroquois
jo daviess
kankakee
knox
la salle
lawrence
lee
mchenry
mclean
macoupin
menard
mercer
monroe
ogle
peoria
piatt
putnam
rock island
sangamon
stephenson
will
winnebago

INDIANA:
allen
cass
dubois
fountain
jasper
lake
la porte
madison
marshall
morgan
newton
parke
pike
porter
st joseph
starke
vigo
wabash
warren
washington

IOWA:
allamakee
cerro gordo
clayton
dallas
deleware
dubuque
floyd
jackson
johnson
linn
marshall
muscatine
polk
winnebago
winneshiek

MAINE:
androscoggin
cumberland
franklin
hancock
kennebec
knox
lincoln
oxford
penobscot
sagadahoc
somerset
waldo
washington
york

MARYLAND:
allegeny
anne arundel
baltimore
calvert
caroline
cecil
charles
dorchester
frederick
garrett
harford
howard
kent
montgomery
p. georges
queen annes
st marys
somerset
talbot
washington
wicomioo
worcester

MASS:
barnstable
berkshire
bristol
dukes
essex
franklin
hampden
hampshire
middlesex
nantucket
plymouth
worcester

MICHIGAN:
baraga
berrien
chippewa
clinton
delta
dickinson
genesee
gogebic
iosco
jackson
kent
lappeer
leelanau
livingston
mackinac
manistee
marquette
menominee
oakland
oceana
ontonagon
schoolcraft

MINNESOTA:
aitkin
anoka
carlton
carver
chisago
crown wing
dakota
douglas
houston
isanti
kanabec
mille lacs
morrison
olmstead
pine
ramsey
st louis
scott
washington
winona

N. DAKOTA:
grand forks

N.HAMPSHIRE
belknap
carroll
cheshire
coos
grafton
hillsborough
merrimack
rockingham
strafford
sullivan

NEW JERSEY:
atlantic
bergen

erie
franklin
fulton
juniata
lackawanna
lancaster
lebanon
lehigh
luzerne
lycoming
mckean
mercer
monroe
montgomery
n.hampten
philadelphia
potter
sullivan
warren
wayne
westmorland
york

R.ISLAND:
bristol
kent
newport
providence
washington

UTAH:
beaver
juab
millard
tooele
utah
washington

VERMONT:
addison
bennington
caledonia
lamoille
windham
windsor

VIRGINIA:
accomack
caroline
p.william
york

W.VIRGINIA:
jefferson

WASHINGTON
chelan
clallam
clark
cowlitz
graysharbor
island
jefferson
king
kitsap
klickitat
lewis
mason
okanogon
pacific
pierce
s.juan
skagit
skamania
snohomish
thurston
wahkiakum
whatcom
yakima

WISCONSIN:
adams
ashland
barron
buffalo
burnett
chippewa
clark
columbia
crawford
dane
eau claire
grant
iowa
jackson
jefferson
la crosse
lafayette
lincoln
manitowoc
marathon
marinette
milwaukee
monroe
oneida
outagamie
polk
portage
price
racine
richland
rock
rusk
st croix
sauk
sawyer
taylor
trempealeau
vernon
walworth
washburn
waukesha
winnebago

NOTE: Counties that are in **bold type** are counties considered to have established populations, on the basis of surveys of public health officials and investigators and a review of the published literature. Counties in normal type have reported ticks but do not meet criteria for established populations.

Figure 2.
Reported Lyme Disease Cases by Week of Report, U.S., 1992

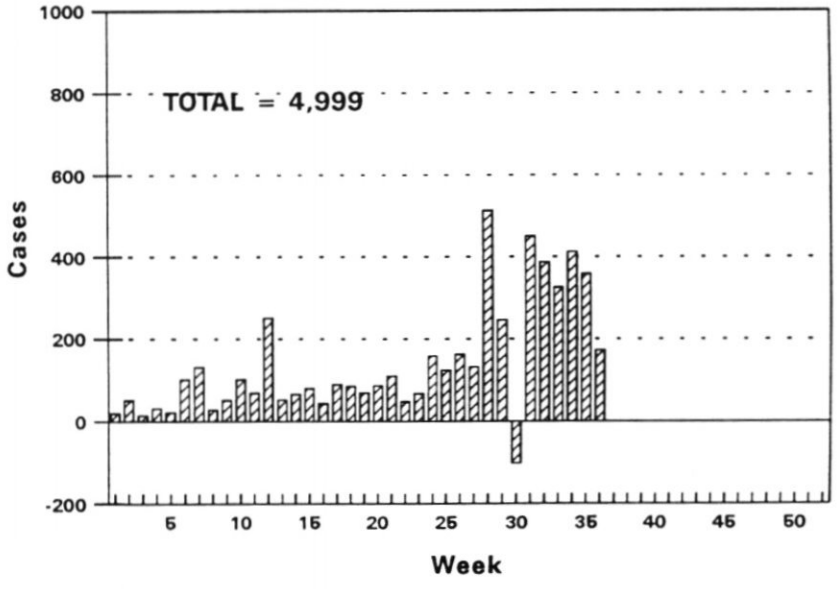

Figure 3.
Reported Cases of Lyme Disease by Week of Report, U.S., 1991