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International Notes

Earthquake Disaster – Luzon, Philippines

At 4:30 p.m. on July 16, 1990, an earthquake measuring 7.7 on the Richter scale struck northern and central Luzon Island in the Philippines, resulting in substantial morbidity and mortality and widespread damage. Among the areas severely affected were the mountain city of Baguio; the coastal areas in La Union; Dagupan city in Pangasinan; and the central plain area—primarily Cabanatuan city in Nueva Ecija and mountainous Nueva Viscaya. Buildings in Baguio and Cabanatuan suffered extensive structural failure, and buildings in the coastal areas in La Union and in Dagupan suffered foundation failure or the effects of liquefaction*. This report summarizes preliminary data gathered by Philippine Field Epidemiology Training Program (FETP) teams on the damage, deaths, and injuries sustained in the four areas.

Baguio

The city of Baguio (1989 population: 154,000) covers 49 square kilometers (30 square miles) in the Cordillera mountains. Baguio is a major tourist destination and the principal trade and educational center in the Cordillera region. Twenty-eight buildings and 132 residences in the city were damaged or destroyed. Three hotels were totally destroyed. Two schools were severely damaged, trapping students and faculty members. A factory building collapsed and burned with workers trapped inside.

For the first 48 hours after the earthquake, the city was isolated from the rest of the country. Electric, water, and communication lines were destroyed. The city was inaccessible by land because of landslides and inaccessible by air, except to helicopters, because of damage at the airport. Food and fuel were scarce. Because hospital buildings were damaged, patients were relocated under tents set up in open spaces in front of hospitals. Damage to homes and the occurrence of many aftershocks caused most residents to set up camps in open spaces in the city. Three days after the earthquake, a main road leading to the city was cleared to enable delivery of supplies.

During the first 48 hours, rescue teams consisted of local volunteers, mainly miners and cadets from a military school in the city, who worked with their hands and

*A change in the soil from a firm material into a viscous semiliquid material that resembles quicksand.

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with picks and shovels. Foreign rescue teams with sophisticated equipment and dogs trained for rescue were able to reach the area after 48 hours.

The FETP team estimated that 1084 earthquake-related casualties occurred: 695 injured survivors and 389 fatalities (case-fatality rate: 36%). The estimated injury rate was 703 per 100,000 population; the estimated death rate was 252 per 100,000.

The FETP team conducted a case-control study to identify risk factors for earthquake-related injuries. The study included 150 cases (surviving and deceased casualties) and 305 controls.[†] Casualties ranged in age from 3 months to 70 years (mean: 25 years); 51% were male. Eighty-four (56%) casualties were at home when the earthquake struck; 19 (13%), in school; 11 (7%), in a street; and 36 (24%), in other places. The majority (74%) of casualties were inside a building during the earthquake.

The 150 casualties sustained a total of 235 injuries (average: 1.6 injuries per person). The three most common injuries were contusion (35%), fracture (14%), and laceration (12%). The most common causes of injury were being hit by falling objects (37%), being crushed or pinned by heavy objects (29%), and falling (7%).

Based on preliminary analysis, cases and controls were similar in age and sex distribution. Similar proportions of cases and controls were inside (74% and 80%, respectively) and outside (26% and 20%, respectively) buildings during the earthquake. For persons who were inside a building, risk factors included building height, type of building material, and the floor level the person was on. Persons inside buildings with seven or more floors were 35 times more likely to be injured (odds ratio [OR]=34.7; 95% confidence interval [CI]=8.1–306.9). Persons inside buildings constructed of concrete or mixed materials were three times more likely to sustain injuries (OR=3.4; 95% CI=1.1–13.5) than were those inside wooden buildings. Persons at middle levels of multistory buildings were twice as likely to be injured as those at the top or bottom levels (OR=2.3; 95% CI=1.3–4.2).

Cabanatuan

Cabanatuan (population: 176,053) is a major city in the central plain of Luzon. The city has many concrete buildings, mostly three stories high. The highest structure, a six-floor school, was the only building in Cabanatuan that collapsed during the earthquake. A total of 363 casualties (including 274 [75%] persons, primarily students, trapped in the collapsed school) were reported in Cabanatuan; 154 (42%) died. The death and injury rates were 87 and 206 per 100,000 population, respectively.

Dagupan

Dagupan (population: 112,850) is a commercial city located along the coast of Lingayen Gulf. Approximately 150 concrete buildings were located in the commercial hub; most of these were less than five stories high. Approximately 90 (60%) buildings in the city were damaged, and approximately 20 collapsed. Some structures sustained damage because liquefaction caused buildings to sink as much as 1 meter (39 inches). Because the earthquake caused a decrease in the elevation of the city, several areas were flooded.

Of 64 casualties, 47 survived and 17 died. The injury and death rates were 57 and 15 per 100,000 population, respectively. Most injuries were sustained during stam-

[†]A case was any casualty (injured or dead) resulting directly from the earthquake or aftershocks. For injured persons, information was obtained from the patients, when possible, or from other survivors; for infants and young children, from their parents or guardians; and for decedents, from survivors or from rescuers. Controls were noninjured family members or noninjured persons in refugee centers.

Earthquake Disaster — Continued

pedes at a university building and a theater. Fourteen (82%) of the deaths occurred among women.

La Union

In La Union, a coastal province located in the northwestern part of Luzon, five municipalities (combined population: 132,208) were affected: Agoo, Aringay, Caba, Santo Tomas, and Tubao. Principal occupations are farming and fishing. The houses are constructed of wood, concrete, or light materials; most buildings are concrete and are less than four stories high. A total of 2387 families were dislocated when two coastal barangays (i.e., a large neighborhood or barrio) sank. Many buildings collapsed or were otherwise severely damaged. Of 493 casualties, 32 died. The injury and death rates were 349 and 24 per 100,000 population, respectively.

Patterns of Damage

The earthquake caused different patterns of damage in different parts of Luzon Island. The mountain resort of Baguio was most severely affected, probably because it had the highest population density and many tall concrete buildings, which were more susceptible to seismic damage. Because all routes of communication, roads, and airport access were severed for several days, relief efforts were also the most difficult there. Relief efforts were further hampered by daily drenching, cold rains. Because Baguio is home to a large mining company and a military academy, experienced miners and other disciplined volunteers played a crucial role in early rescue efforts. Rescue teams arriving from Manila and elsewhere in Luzon were able to decrease mortality from major injuries. Surgeons, anesthesiologists, and specialized equipment and supplies were brought to the area, and victims were promptly treated. Patients requiring specialized care (e.g., hemodialysis) not available in the disaster area were airlifted to tertiary hospitals in metropolitan Manila. Outside of Baguio, destruction tended to be more diffuse. Damage was caused by landslides in the mountains and settling in coastal areas. Relief efforts in these areas were prompt and successful, partly because the areas remained accessible.

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Editorial Note: As in previous earthquake disasters, the most important relief work in the Philippines was done by survivors during the first 48 hours after the shock (*1,2*). Because earthquake relief efforts may be hampered by a lack of accurate data (*3,4*), the Department of Health (DOH) deployed teams of FETP epidemiologists within 24 hours to each site to provide accurate estimates of casualties, damage, and needs.

Because Baguio was accessible only by air, setting priorities for relief shipments was vital. Daily reports were provided for local disaster coordinators and to headquarters in Manila. Information gathering was possible but was constrained by the lack of telephones, power, and transportation and by general confusion.

On July 19, 3 days after the earthquake, the priority of relief efforts shifted from treatment of injuries to public health concerns. For example, numerous broken pipes completely disrupted water systems, limiting the availability of potable water, and refugees who camped in open areas had no adequate toilet facilities. Early efforts at providing potable water by giving refugees chlorine granules were unsuccessful.

Earthquake Disaster — Continued

Most potable water was distributed from fire engines, and DOH sanitarians chlorinated the water before it was distributed. Surveys of refugee areas showed few latrines; these had to be dug by the DOH.

Although national disaster plans had worked well in typhoons and floods, their effectiveness was undermined by the unprecedented demands caused by the earthquake. High-level government officials, such as cabinet secretaries and agency heads, were quickly assigned to manage emergency relief in different areas.

Important factors contributing to the risk for death after the collapse of buildings include entrapment, the severity of injuries, length of time victims can survive without medical attention, and time to rescue and medical treatment (*5–7*). Earthquake drills are important, particularly in relation to appropriate occupant behavior at the time of an earthquake (*8*). Deaths and injuries caused by stampedes in schools underlined the need for earthquake drills.

A widespread public expectation was that epidemics of communicable diseases would follow the earthquake. However, sentinel surveillance sites established in each of the earthquake areas did not detect increases in diarrhea, measles, or other diseases, confirming experiences after previous earthquakes (*9*). This information was released to the press frequently and helped to quell rumors, a major concern in the second and third weeks following the earthquake. In addition, reliable epidemiologic data permitted relief managers to avoid displacing important relief goods with unnecessary medicines (sorting and storing large quantities of inappropriate medicines has been a problem after other recent earthquakes [*10*]).

Many nations contributed effectively to the successful relief effort. The most useful international relief was low-technology assistance, such as tents, blankets, and food. Teams equipped with high-technology equipment to detect survivors arrived after most of the survivors had already been extricated. A team from Singapore remained for several weeks to provide a range of services, including medical care and cooking; these services were particularly useful. In addition, in response to a request from the Philippine FETP, the government of Mexico provided information based on its experience with the recent earthquake in Mexico; this information aided the Philippines in its public health response.

Future international relief efforts should focus more on problems that arise in the days after earthquakes. In Baguio, these needs were 1) engineers to establish whether buildings are habitable and to help reestablish water and communication lines, 2) volunteers to help remove corpses from the wreckage, 3) psychologists and psychiatrists to attend to the psychological problems of helplessness, depression, and anger in survivors and rescuers, and 4) tents and food.

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Epidemiologic Notes and Reports

Nursing Home Outbreaks of Invasive Group A Streptococcal Infections — Illinois, Kansas, North Carolina, and Texas

During the winter of 1989-90, outbreaks of invasive group A streptococcal infections in one nursing home each in Illinois, Kansas, North Carolina, and Texas were reported to CDC. This report summarizes the clinical, laboratory, and epidemiologic features of these outbreaks.

A total of 18 residents had invasive disease, and 10 (56%) died. Clinical features of infection included fever, altered mental status, and symptoms referable to the specific focus of infection. Eight patients had pneumonia with cough and respiratory distress; seven had cutaneous infections (usually at the site of a pre-existing skin lesion); two had sinusitis; and three had no apparent focus for infection. Serious complications included necrotizing fasciitis requiring debridement or amputation, renal failure, and adult respiratory distress syndrome (ARDS). Several patients had illnesses consistent with streptococcal toxic shock-like syndrome (*1*). Documented group A streptococcal infection in nursing home staff was rare; two nurses had culture-confirmed pharyngitis, and one, pneumonia.

Isolates from patients from each of the outbreaks were typed at CDC. Two outbreaks were caused by M-nontypeable, T-11/12 strains; one, by M-1, T-1; and one, by M-29, T-nontypeable strains. In all four nursing homes, culture surveys of all residents and staff were performed to evaluate throat and wound carriage of group A streptococci. Eleven (4%) of 312 residents and four (1%) of 297 staff had asymptomatic pharyngeal carriage. At each nursing home, the pharyngeal and invasive isolates were the same serotype. No wound swab cultures were positive.

In one nursing home, a case-control investigation was conducted to determine risk factors for infection. This study suggested person-to-person spread of infection between close contacts, with statistically significant clustering of case-patients by room. No other risk factors were identified.

In three nursing homes, prophylactic antimicrobial therapy was instituted after the survey of residents and staff was completed. In two, full courses of therapy were given to all residents and staff; in the third, therapy was discontinued when all surveillance cultures were reported as negative. In the fourth nursing home, antimicrobial therapy was given only to those who were culture positive. No further cases of infection occurred after these interventions.

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Editorial Note: Residents of nursing homes are at increased risk for many infectious diseases. Outbreaks of infection in this setting are facilitated by the close contact of persons who are highly susceptible to infection because of their ages and underlying illnesses. In addition, knowledge of infection-control practices by nursing home personnel and the ability to isolate or cohort patients in a nursing home are often limited (*2*).

In recent years, invasive group A streptococcal infections have occurred more commonly throughout the United States (*1,3*). Recent population-based studies have established an incidence of 4–5 cases per 100,000 persons (CDC, unpublished data). The risk for streptococcal bacteremia and the case-fatality rate are highest in the elderly (*4,5*). Additional outbreaks in nursing homes are possible because of the increasing rate of severe group A streptococcal infections, the propensity of this organism to cause disease in the elderly, and the ability of this organism to spread by the person-to-person route.

These four nursing home outbreaks shared several features: 1) a cutaneous or respiratory focus of infection in most patients, 2) high case-fatality rates, 3) uncommon pharyngeal carriage among residents and staff, 4) lack of documentation of carriage in skin lesions not showing evidence of an acute cellulitis, and 5) apparent person-to-person spread between close contacts. Two other reported nursing home outbreaks were characterized by similar features (*6,7*).

Although specific guidelines for controlling group A streptococcal infections in nursing homes have not been published, the CDC guidelines for isolation precautions in hospitals should be applied to these settings (*8*). Isolation of patients until 24 hours of effective antimicrobial therapy has been completed is important. The role of culture surveys and antimicrobial prophylaxis is unclear; because the streptococcal carriage rate is low, treatment of all patients and staff probably is unnecessary. However, throat cultures could be obtained from all nursing home residents and staff followed by institution of antimicrobial therapy; when culture results are available, a course of therapy could be completed only by those who are culture positive or who have symptoms consistent with streptococcal infection. Penicillin is the recommended antimicrobial for treating group A streptococcal infections; erythromycin is recommended for penicillin-allergic persons.

The development of more effective approaches to the control of invasive group A streptococcal infections in nursing home residents and in other settings requires additional information about clusters of this disease. Descriptions of clusters of two or more cases of invasive group A streptococcal infections may be reported to CDC's Respiratory Diseases Branch, Division of Bacterial and Mycotic Diseases, Center for Infectious Diseases, through state health departments. Serotyping of isolates from clusters and case report forms are available from CDC.

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Common Source Outbreak of Relapsing Fever — California

In August and September 1989, six persons who had each at different times spent the night in the same cabin at Big Bear Lake, San Bernardino County, California, developed sudden onset of high fever with severe headache, prostration, nausea, and vomiting. Four patients were initially considered to have viral gastroenteritis and received no antibiotic therapy. When fevers recurred, relapsing fever was suspected and confirmed serologically in two of these patients. Two of the four patients were treated with tetracycline and recovered. Two recovered without treatment after three relapses.

The fifth patient, an elderly woman, was admitted to intensive care with septic shock. Laboratory findings included spirochetes visible in a Giemsa-stained smear of peripheral blood, neutrophilic pleocytosis of the cerebrospinal fluid, peripheral leukocytosis, thrombocytopenia, and hypophosphatemia. She was treated with intravenous doxycycline and developed a probable Jarisch-Herxheimer reaction before recovering fully.

For the sixth patient, the suspected diagnosis of relapsing fever was confirmed by the identification of spirochetes in a thick blood smear. This patient was treated promptly with tetracycline and recovered rapidly.

The Santa Barbara and San Bernardino county health departments were advised of the outbreak and conducted an epidemiologic and environmental investigation of the Big Bear Lake area and the cabin used by each of the six patients. The investigators noted a large population of California ground squirrels and chipmunks and the widespread practice by visitors of feeding these animals. Inhabited ground-squirrel burrows were found under the cabin. The cabin was fumigated to kill vectors (ticks). No other cabins were known to be associated with illness. In the spring of 1990, educational literature about relapsing fever and prevention of the disease was distributed to cabin owners in the Big Bear Lake area.

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Editorial Note: In the United States, relapsing fever results from infection by the spirochetes *Borrelia hermsii* and *B. turicatae*. The disease, which occurs in the western United States, is transmitted to humans principally by the bites of the infected ticks *Ornithodoros hermsi* and *O. turicata* but possibly also by *O. parkeri*

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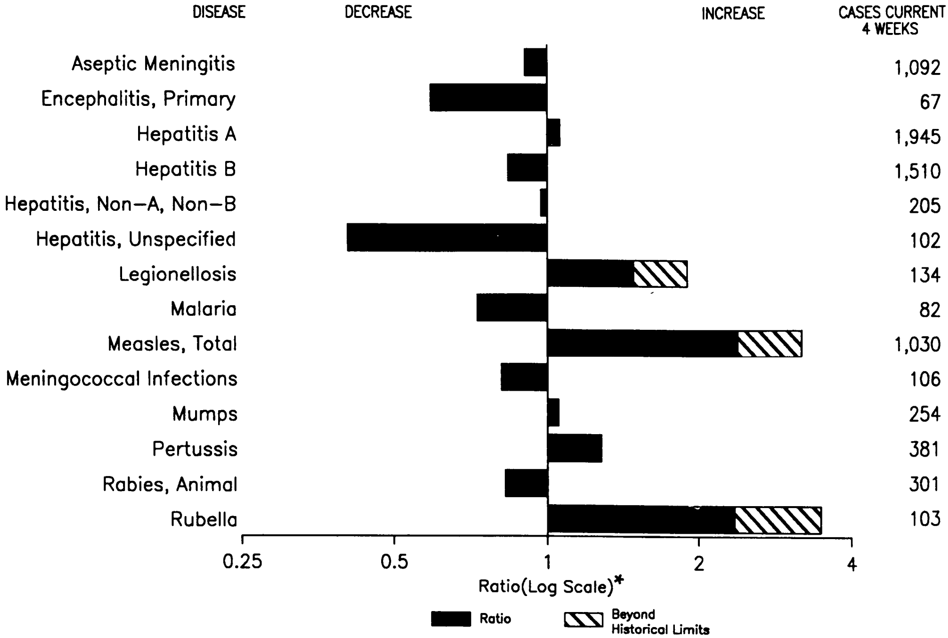
FIGURE I. Notifiable disease reports, comparison of 4-week totals ending August 25, 1990, with historical data — United States



*Ratio of current 4-week total to mean of 15 4-week totals (from comparable, previous, and subsequent 4-week periods for past 5 years).

TABLE I. Summary — cases of specified notifiable diseases, United States, cumulative, week ending August 25, 1990 (34th Week)

	Cum. 1990		Cum. 1990
AIDS	27,283	Plague	1
Anthrax	-	Poliomyelitis, Paralytic*	-
Botulism: Foodborne	9	Psittacosis	77
Infant	39	Rabies, human	1
Other	6	Syphilis: civilian	31,180
Brucellosis	47	military	166
Cholera	3	Syphilis, congenital, age < 1 year	685
Congenital rubella syndrome	3	Tetanus	35
Diphtheria	2	Toxic shock syndrome	214
Encephalitis, post-infectious	65	Trichinosis	19
Gonorrhea: civilian	430,230	Tuberculosis	13,926
military	5,921	Tularemia	81
Leprosy	139	Typhoid fever	263
Leptospirosis	29	Typhus fever, tickborne (RMSF)	383
Measles: imported	969		
indigenous	18,016		

*Three cases of suspected poliomyelitis have been reported in 1990; five of 13 suspected cases in 1989 were confirmed and all were vaccine-associated.

TABLE II. Cases of specified notifiable diseases, United States, weeks ending August 25, 1990, and August 26, 1989 (34th Week)

Reporting Area	AIDS	Aseptic Meningitis	Encephalitis: Primary	Encephalitis: Post-infectious	Gonorrhea (Civilian)	Gonorrhea (Civilian)	Hepatitis (Viral), by type: A	Hepatitis (Viral), by type: B	Hepatitis (Viral), by type: NA,NB	Hepatitis (Viral), by type: Unspecified	Legionellosis	Leprosy
	Cum. 1990	Cum. 1990	Cum. 1990	Cum. 1990	Cum. 1990	Cum. 1989	Cum. 1990	Cum. 1990	Cum. 1990	Cum. 1990	Cum. 1990	Cum. 1990
UNITED STATES	27,283	4,659	469	65	430,230	446,733	18,650	13,161	1,422	1,091	759	139
NEW ENGLAND	1,013	174	17	-	12,107	12,809	381	704	46	44	33	9
Maine	40	6	3	-	129	177	6	25	4	1	3	-
N.H.	53	16	-	-	119	115	6	29	4	2	4	-
Vt.	10	17	2	-	38	44	4	37	4	-	5	-
Mass.	566	56	6	-	5,021	4,968	263	442	24	39	15	8
R.I.	53	55	1	-	755	939	39	31	-	2	6	1
Conn.	291	24	5	-	6,045	6,566	63	140	10	-	-	-
MID. ATLANTIC	8,462	459	35	4	58,889	66,547	2,652	1,844	156	79	240	17
Upstate N.Y.	1,035	241	29	1	8,894	10,165	736	480	44	20	90	1
N.Y. City	5,002	98	3	1	25,160	26,923	347	494	23	42	50	12
N.J.	1,618	-	1	-	9,736	9,781	251	428	33	-	43	3
Pa.	807	120	2	2	15,099	19,678	1,318	442	56	17	57	1
E.N. CENTRAL	1,881	846	117	11	82,041	79,954	1,433	1,566	114	68	171	2
Ohio	440	187	34	3	24,973	20,511	141	284	44	10	61	-
Ind.	176	123	2	6	7,240	5,638	85	286	5	14	30	-
Ill.	747	150	38	2	26,099	26,124	706	300	31	15	8	1
Mich.	368	356	38	-	18,781	20,796	259	449	24	29	52	1
Wis.	150	30	5	-	4,948	6,885	242	247	10	-	20	-
W.N. CENTRAL	633	212	38	1	22,202	19,785	1,076	594	95	25	38	1
Minn.	120	12	11	1	2,759	2,178	156	76	21	-	-	-
Iowa	25	25	5	-	1,638	1,653	210	46	8	2	4	-
Mo.	360	119	5	-	13,420	12,023	336	366	42	19	23	-
N. Dak.	2	9	-	-	55	93	10	4	2	1	-	-
S. Dak.	2	5	2	-	144	167	144	5	3	-	-	-
Nebr.	29	16	7	-	1,156	890	64	23	4	-	6	1
Kans.	95	26	8	-	3,030	2,781	156	74	15	3	5	-
S. ATLANTIC	5,650	982	105	19	123,506	121,105	2,245	2,524	217	169	121	5
Del.	65	28	3	-	2,013	2,005	89	68	6	1	6	-
Md.	560	119	14	1	13,988	13,661	784	363	31	9	49	3
D.C.	484	2	-	-	8,657	8,117	12	28	4	-	-	-
Va.	501	157	35	2	11,412	9,990	186	163	32	124	9	-
W. Va.	39	33	19	-	751	926	15	59	4	4	3	-
N.C.	408	88	23	-	18,964	18,374	501	704	82	-	15	1
S.C.	233	12	1	-	9,672	11,019	29	401	13	8	15	-
Ga.	772	194	4	1	27,206	23,272	243	295	7	7	14	-
Fla.	2,588	349	6	15	30,843	33,741	386	443	38	16	10	1
E.S. CENTRAL	665	418	39	1	37,510	35,043	257	1,004	105	4	46	-
Ky.	113	101	15	-	3,930	3,365	65	346	36	3	18	-
Tenn.	211	66	18	1	11,274	11,610	122	544	53	-	16	-
Ala.	144	174	6	-	13,166	11,194	69	109	14	-	12	-
Miss.	197	77	-	-	9,140	8,874	1	5	2	1	-	-
W.S. CENTRAL	2,975	446	23	6	43,598	46,784	1,924	1,341	62	175	38	30
Ark.	140	8	1	-	5,725	5,465	348	55	6	13	7	-
La.	457	62	6	-	8,071	9,905	131	206	3	7	12	-
Okla.	148	40	2	5	3,994	4,067	375	107	19	17	13	-
Tex.	2,230	336	14	1	25,808	27,347	1,070	973	34	138	6	30
MOUNTAIN	737	231	17	2	8,274	9,374	3,053	1,003	139	85	29	-
Mont.	10	3	-	-	116	129	88	49	5	4	2	-
Idaho	19	7	-	-	88	125	59	60	8	-	3	-
Wyo.	2	1	1	-	101	62	44	12	5	1	-	-
Colo.	219	52	3	-	1,634	2,090	199	107	31	30	5	-
N. Mex.	70	10	-	-	810	910	605	131	9	5	2	-
Ariz.	232	113	7	-	3,521	3,664	1,496	354	53	31	9	-
Utah	68	24	2	-	272	293	326	73	18	5	3	-
Nev.	117	21	4	2	1,732	2,101	236	217	10	9	5	-
PACIFIC	5,267	891	78	21	42,103	55,332	5,629	2,581	488	442	43	75
Wash.	437	-	6	1	3,448	4,325	938	396	83	20	11	4
Oreg.	192	-	-	-	1,683	2,033	579	278	37	7	-	-
Calif.	4,524	745	67	19	35,948	48,019	3,913	1,815	356	409	31	60
Alaska	22	84	4	-	691	626	137	42	3	1	-	-
Hawaii	92	62	1	1	333	329	62	50	9	5	1	11
Guam	1	2	-	-	149	111	9	1	-	8	-	-
P.R.	1,004	45	6	-	460	725	113	192	2	19	-	-
V.I.	10	-	-	-	249	454	1	8	-	-	-	-
Amer. Samoa	-	1	-	-	49	32	26	-	-	-	-	10
C.N.M.I.	-	-	-	-	148	68	10	9	-	15	-	4

N: Not notifiable U: Unavailable C.N.M.I.: Commonwealth of the Northern Mariana Islands

TABLE II. (Cont'd.) Cases of specified notifiable diseases, United States, weeks ending August 25, 1990, and August 26, 1989 (34th Week)

Reporting Area	Malaria	Measles (Rubeola)					Menin-gococcal Infections	Mumps		Pertussis			Rubella		
		Indigenous		Imported*		Total									
	Cum. 1990	1990	Cum. 1990	1990	Cum. 1990	Cum. 1989	Cum. 1990	1990	Cum. 1990	1990	Cum. 1990	Cum. 1989	1990	Cum. 1990	Cum. 1989
UNITED STATES	740	104	18,016	101	969	11,258	1,704	53	3,791	98	2,175	2,194	6	776	288
NEW ENGLAND	61	-	236	-	24	312	128	-	36	9	266	258	-	8	6
Maine	1	-	27	-	2	-	10	-	-	-	10	9	-	1	-
N.H.	4	-	-	-	8	11	6	-	8	5	36	5	-	1	4
Vt.	5	-	-	-	1	3	10	-	1	-	6	6	-	-	1
Mass.	32	-	17	-	7	45	60	-	11	4	197	214	-	2	1
R.I.	5	-	27	-	3	41	12	-	5	-	2	11	-	1	-
Conn.	14	-	165	-	3	212	30	-	11	-	15	13	-	3	-
MID. ATLANTIC	157	-	976	1	150	906	251	2	247	46	395	110	6	11	29
Upstate N.Y.	31	-	200	1§	110	138	93	-	105	8	276	43	6	10	12
N.Y. City	51	-	226	-	21	89	36	-	-	-	-	3	-	-	15
N.J.	54	-	188	-	10	422	58	-	62	-	21	25	-	-	2
Pa.	21	-	362	-	9	257	64	2	80	38	98	39	-	1	-
E.N. CENTRAL	44	1	3,201	-	143	3,629	233	1	386	11	445	303	-	31	24
Ohio	5	-	549	-	3	743	73	-	89	-	128	45	-	1	3
Ind.	2	1	319	-	1	78	23	-	16	7	83	18	-	-	-
Ill.	19	-	1,242	-	10	2,288	62	-	116	-	97	100	-	18	19
Mich.	14	-	348	-	125	307	54	1	126	4	60	30	-	9	1
Wis.	4	-	743	-	4	213	21	-	39	-	77	110	-	3	1
W.N. CENTRAL	10	-	770	-	13	638	58	2	111	3	108	157	-	14	6
Minn.	1	-	314	-	3	16	11	-	7	-	17	36	-	9	-
Iowa	2	-	25	-	1	9	1	-	16	-	15	13	-	4	1
Mo.	6	-	96	-	-	367	23	-	50	-	60	97	-	-	4
N. Dak.	-	-	-	-	-	-	1	-	-	-	2	2	-	1	-
S. Dak.	-	-	15	-	8	-	2	-	-	-	1	1	-	-	-
Nebr.	-	-	97	-	1	113	5	-	3	1	4	5	-	-	-
Kans.	1	-	223	-	-	133	15	2	35	2	9	3	-	-	1
S. ATLANTIC	154	2	834	99	307	541	308	26	1,573	4	180	197	-	18	9
Del.	3	-	8	-	3	39	3	-	4	-	5	1	-	-	-
Md.	43	-	193	-	18	76	35	12	908	-	47	26	-	2	2
D.C.	10	-	15	-	7	35	11	-	32	-	14	-	-	1	-
Va.	39	2	72	-	2	21	40	-	90	-	15	24	-	1	-
W. Va.	2	-	6	-	-	51	13	-	40	-	14	20	-	-	-
N.C.	10	-	9	-	15	168	44	-	220	-	39	40	-	-	1
S.C.	-	-	4	-	-	3	21	12	45	-	5	-	-	-	-
Ga.	15	-	81	98§	201	2	54	2	82	-	24	26	-	-	-
Fla.	32	-	446	1§	61	146	87	-	152	4	17	60	-	14	6
E.S. CENTRAL	15	-	147	-	2	210	99	2	84	-	110	152	-	3	2
Ky.	2	-	31	-	-	32	32	-	-	-	-	1	-	-	-
Tenn.	8	-	70	-	-	132	36	1	47	-	45	93	-	3	2
Ala.	5	-	20	-	2	46	29	1	13	-	59	49	-	-	-
Miss.	-	-	26	-	-	-	2	-	24	-	6	9	-	-	-
W.S. CENTRAL	37	52	3,975	1	87	3,109	114	6	589	7	87	219	-	66	36
Ark.	2	-	12	-	28	5	16	2	133	5	8	18	-	3	-
La.	2	-	10	-	-	9	26	3	101	-	19	13	-	-	5
Okla.	8	-	175	-	-	106	15	-	105	2	32	41	-	1	1
Tex.	25	52	3,778	1§	59	2,989	57	1	250	-	28	147	-	62	30
MOUNTAIN	18	49	796	-	91	372	53	5	299	2	188	498	-	105	35
Mont.	1	-	-	-	1	13	10	-	1	-	26	29	-	13	1
Idaho	3	-	16	-	10	2	5	1	142	-	36	65	-	49	32
Wyo.	-	-	-	-	11	-	-	-	2	-	-	-	-	-	1
Colo.	2	-	89	-	42	73	17	-	21	1	63	43	-	4	-
N. Mex.	3	-	81	-	12	31	6	N	N	1	15	21	-	-	-
Ariz.	8	-	274	-	12	137	4	4	110	-	34	326	-	30	-
Utah	-	48	126	-	-	113	5	-	8	-	10	13	-	1	-
Nev.	1	1	210	-	3	3	6	-	15	-	4	1	-	8	1
PACIFIC	244	-	7,081	-	152	1,541	460	9	466	16	396	300	-	520	141
Wash.	17	-	202	-	69	51	59	-	41	13	101	120	-	-	-
Oreg.	12	-	168	-	44	28	53	N	N	3	44	7	-	10	2
Calif.	210	-	6,625	-	33	1,435	336	7	407	-	217	166	-	500	118
Alaska	2	-	78	-	2	1	8	-	4	-	4	-	-	-	-
Hawaii	3	-	8	-	4	29	4	2	14	-	30	7	-	10	21
Guam	3	U	-	U	1	2	-	U	3	U	-	1	U	-	-
P.R.	2	-	808	-	-	466	9	-	7	-	6	4	-	-	7
V.I.	-	-	21	-	3	4	-	-	7	-	-	-	-	-	-
Amer. Samoa	35	U	190	U	-	-	-	U	19	U	-	-	U	-	-
C.N.M.I.	-	U	-	U	-	-	-	U	8	U	4	-	U	-	-

*For measles only, imported cases includes both out-of-state and international importations.

N: Not notifiable U: Unavailable †International §Out-of-state

TABLE II. (Cont'd.) Cases of specified notifiable diseases, United States, weeks ending August 25, 1990, and August 26, 1989 (34th Week)

Reporting Area	Syphilis (Civilian) (Primary & Secondary)		Toxic-shock Syndrome	Tuberculosis		Tula-remia	Typhoid Fever	Typhus Fever (Tick-borne) (RMSF)	Rabies, Animal
	Cum. 1990	Cum. 1989	Cum. 1990	Cum. 1990	Cum. 1989	Cum. 1990	Cum. 1990	Cum. 1990	Cum. 1990
UNITED STATES	31,180	27,931	214	13,926	13,699	81	263	383	2,747
NEW ENGLAND	1,158	1,101	16	340	363	2	21	16	4
Maine	5	8	5	-	12	-	-	-	-
N.H.	40	10	1	3	17	-	-	-	2
Vt.	1	-	-	7	7	-	-	-	-
Mass.	453	337	8	185	183	2	20	15	-
R.I.	12	21	1	43	42	-	-	-	-
Conn.	647	725	1	102	102	-	1	1	2
MID. ATLANTIC	6,375	5,735	22	3,547	2,635	1	66	17	638
Upstate N.Y.	569	590	8	281	212	-	13	8	79
N.Y. City	2,966	2,536	5	2,231	1,443	-	36	-	-
N.J.	1,039	882	-	579	522	1	14	6	194
Pa.	1,801	1,727	9	456	458	-	3	3	365
E.N. CENTRAL	2,145	1,131	49	1,417	1,441	1	22	36	109
Ohio	362	88	17	236	257	1	5	28	5
Ind.	56	43	1	120	133	-	1	1	4
Ill.	866	519	7	725	655	-	11	-	21
Mich.	645	380	24	276	311	-	4	7	31
Wis.	216	101	-	60	85	-	1	-	48
W.N. CENTRAL	322	215	23	364	355	30	3	42	435
Minn.	61	32	1	66	70	-	-	-	159
Iowa	42	22	5	40	28	-	-	-	17
Mo.	166	112	8	175	167	22	3	27	19
N. Dak.	1	3	-	14	11	-	-	-	61
S. Dak.	1	1	-	9	18	3	-	2	139
Nebr.	9	17	3	14	16	3	-	1	4
Kans.	42	28	6	46	45	2	-	12	36
S. ATLANTIC	10,236	10,225	20	2,796	2,916	3	31	146	769
Del.	123	110	1	24	30	-	-	1	16
Md.	759	509	1	214	233	-	8	14	283
D.C.	690	608	1	98	132	-	-	-	-
Va.	563	347	2	246	232	1	2	15	132
W. Va.	57	11	-	49	52	-	-	-	29
N.C.	1,161	671	10	361	350	1	2	73	4
S.C.	664	560	2	311	338	1	1	34	94
Ga.	2,635	2,590	1	468	458	-	1	9	148
Fla.	3,584	4,819	2	1,025	1,091	-	17	-	63
E.S. CENTRAL	2,882	1,852	12	1,064	1,106	7	2	53	122
Ky.	57	39	2	268	267	1	1	6	34
Tenn.	1,209	821	7	277	315	6	-	40	27
Ala.	865	565	3	336	320	-	1	7	61
Miss.	751	427	-	183	204	-	-	-	-
W.S. CENTRAL	4,752	3,767	11	1,798	1,614	24	8	55	333
Ark.	356	242	-	229	165	17	-	12	37
La.	1,150	885	1	150	212	-	-	1	18
Okla.	159	63	7	125	145	7	2	39	97
Tex.	3,087	2,577	3	1,294	1,092	-	6	3	181
MOUNTAIN	557	408	24	329	300	10	18	10	139
Mont.	-	1	-	22	11	-	-	4	34
Idaho	6	1	2	9	20	-	-	-	2
Wyo.	-	3	2	3	-	3	-	-	43
Colo.	26	55	7	14	21	2	-	1	9
N. Mex.	29	21	3	78	54	3	-	1	6
Ariz.	403	162	7	146	138	-	16	1	25
Utah	8	12	3	18	26	2	-	3	6
Nev.	85	153	-	39	30	-	2	-	14
PACIFIC	2,753	3,497	37	2,271	2,969	3	92	8	198
Wash.	229	292	4	182	158	1	3	-	-
Oreg.	95	161	-	86	95	-	4	1	1
Calif.	2,411	3,032	32	1,848	2,557	-	81	2	175
Alaska	10	3	-	29	43	2	-	-	22
Hawaii	8	9	1	126	116	-	4	5	-
Guam	2	4	-	29	54	-	-	-	-
P.R.	204	376	-	66	200	-	-	-	33
V.I.	3	8	-	4	4	-	-	-	-
Amer. Samoa	-	-	-	11	4	-	1	-	-
C.N.M.I.	3	7	-	40	17	-	4	-	-

U: Unavailable

TABLE III. Deaths in 121 U.S. cities,* week ending August 25, 1990 (34th Week)

Reporting Area	All Causes, By Age (Years)						P&I**
	All Ages	≥65	45-64	25-44	1-24	<1	Total
NEW ENGLAND	544	385	89	42	18	10	55
Boston, Mass.	164	93	39	22	6	4	14
Bridgeport, Conn.	36	23	9	3	1	-	3
Cambridge, Mass.	18	16	2	-	-	-	1
Fall River, Mass.	24	20	4	-	-	-	2
Hartford, Conn.	50	31	8	6	5	-	8
Lowell, Mass.	20	16	3	-	1	-	1
Lynn, Mass.	15	13	2	-	-	-	3
New Bedford, Mass.	27	25	1	1	-	-	3
New Haven, Conn.	31	23	3	2	1	2	2
Providence, R.I.	33	23	5	3	2	-	4
Somerville, Mass.	8	6	1	-	-	1	-
Springfield, Mass.	35	27	4	2	1	1	2
Waterbury, Conn.	33	28	3	1	-	1	6
Worcester, Mass.	50	41	5	2	1	1	6
MID. ATLANTIC	2,685	1,734	538	294	71	47	131
Albany, N.Y.	49	35	10	3	-	1	2
Allentown, Pa.	19	15	3	1	-	-	-
Buffalo, N.Y.	110	69	29	4	6	2	2
Camden, N.J.	41	22	10	4	1	4	3
Elizabeth, N.J.	19	14	2	2	1	-	-
Erie, Pa.†	40	34	3	2	1	-	1
Jersey City, N.J.§	46	31	8	6	-	1	1
N.Y. City, N.Y.	1,340	837	265	181	34	23	50
Newark, N.J.	76	35	11	18	8	4	6
Paterson, N.J.	33	21	8	4	-	-	2
Philadelphia, Pa.	484	303	116	41	12	11	33
Pittsburgh, Pa.†	68	43	18	7	-	-	2
Reading, Pa.	32	29	2	-	1	-	3
Rochester, N.Y.	126	91	25	6	3	1	13
Schenectady, N.Y.	25	21	1	2	1	-	-
Scranton, Pa.†	30	24	5	1	-	-	3
Syracuse, N.Y.	62	48	10	4	-	-	2
Trenton, N.J.	34	22	8	4	-	-	2
Utica, N.Y.	23	19	1	1	2	-	2
Yonkers, N.Y.	28	21	3	3	1	-	4
E.N. CENTRAL	2,264	1,466	451	190	67	90	112
Akron, Ohio	57	41	9	2	4	1	4
Canton, Ohio	46	35	10	-	1	-	4
Chicago, Ill.§	564	362	125	45	10	22	16
Cincinnati, Ohio	138	83	24	12	11	8	13
Cleveland, Ohio	132	82	28	12	4	6	7
Columbus, Ohio	185	122	32	11	4	16	13
Dayton, Ohio	117	75	20	14	4	4	3
Detroit, Mich.	238	124	63	28	8	15	6
Evansville, Ind.	26	20	4	2	-	-	2
Fort Wayne, Ind.	70	45	16	6	3	-	5
Gary, Ind.	27	12	9	2	4	-	1
Grand Rapids, Mich.	66	41	11	6	5	3	12
Indianapolis, Ind.	161	110	27	16	4	4	6
Madison, Wis.§	37	26	7	4	-	-	2
Milwaukee, Wis.	129	97	20	9	-	3	1
Peoria, Ill.	40	32	4	-	1	3	5
Rockford, Ill.	44	34	4	4	1	1	3
South Bend, Ind.	31	20	9	2	-	-	1
Toledo, Ohio	102	70	17	11	3	1	7
Youngstown, Ohio	54	35	12	4	-	3	1
W.N. CENTRAL	690	488	112	51	25	14	26
Des Moines, Iowa	65	46	11	6	1	1	2
Duluth, Minn.	27	17	6	1	2	1	4
Kansas City, Kans.	29	23	3	2	1	-	1
Kansas City, Mo.	119	76	18	18	5	2	7
Lincoln, Nebr.	32	22	8	1	1	-	1
Minneapolis, Minn.	134	94	25	10	3	2	7
Omaha, Nebr.	74	56	10	3	1	4	3
St. Louis, Mo.	122	84	18	9	7	4	1
St. Paul, Minn.	46	36	9	-	1	-	-
Wichita, Kans.	42	34	4	1	3	-	-
S. ATLANTIC	1,279	757	248	162	54	53	57
Atlanta, Ga.	151	90	26	27	7	1	10
Baltimore, Md.	170	97	35	28	8	2	5
Charlotte, N.C.	81	49	23	6	-	3	5
Jacksonville, Fla.	91	61	11	11	6	2	4
Miami, Fla.	169	97	27	27	7	11	4
Norfolk, Va.	70	39	12	4	3	12	1
Richmond, Va.	78	53	18	5	2	-	7
Savannah, Ga.	55	34	10	5	2	4	5
St. Petersburg, Fla.§	61	49	7	2	1	2	6
Tampa, Fla.	72	46	14	6	4	2	4
Washington, D.C.§	251	119	61	39	14	14	6
Wilmington, Del.	30	23	4	2	-	-	-
E.S. CENTRAL	798	481	174	70	42	30	27
Birmingham, Ala.	104	60	22	14	3	5	1
Chattanooga, Tenn.	66	48	13	3	2	-	4
Knoxville, Tenn.	94	52	25	8	7	2	2
Louisville, Ky.	99	59	27	4	5	4	5
Memphis, Tenn.	137	76	29	13	8	10	7
Mobile, Ala.	137	75	28	19	11	4	2
Montgomery, Ala.	39	27	4	3	5	-	1
Nashville, Tenn.	122	84	26	6	1	5	5
W.S. CENTRAL	1,764	1,112	359	188	64	39	75
Austin, Tex.	53	36	12	5	-	-	3
Baton Rouge, La.	55	37	8	5	2	3	1
Corpus Christi, Tex.	41	30	7	2	1	1	2
Dallas, Tex.	215	128	38	30	13	6	8
El Paso, Tex.	43	26	9	5	3	-	3
Fort Worth, Tex	93	59	14	9	5	6	4
Houston, Tex.§	734	436	169	89	24	16	18
Little Rock, Ark.	80	58	17	2	1	2	7
New Orleans, La.	107	68	23	13	1	1	-
San Antonio, Tex.	185	125	35	17	7	1	14
Shreveport, La.	53	36	10	4	2	1	6
Tulsa, Okla.	105	73	17	7	5	2	9
MOUNTAIN	609	384	119	71	17	18	26
Albuquerque, N. Mex.	66	38	13	9	2	4	5
Colo. Springs, Colo.	37	23	9	2	2	1	3
Denver, Colo.	82	51	9	13	4	5	2
Las Vegas, Nev.	92	55	27	8	1	1	1
Ogden, Utah	20	15	-	3	2	-	2
Phoenix, Ariz.	139	82	31	20	4	2	3
Pueblo, Colo.	19	11	4	4	-	-	4
Salt Lake City, Utah	47	29	6	9	-	3	-
Tucson, Ariz.	107	80	20	3	2	2	6
PACIFIC	1,977	1,289	340	208	87	47	124
Berkeley, Calif.	18	14	3	-	1	-	-
Fresno, Calif.	58	35	8	7	6	2	9
Glendale, Calif.§	26	21	4	1	-	-	1
Honolulu, Hawaii	95	69	15	7	3	1	18
Long Beach, Calif.	92	53	21	3	4	11	13
Los Angeles Calif.§	499	312	86	66	26	6	19
Oakland, Calif.	46	28	5	7	4	1	3
Pasadena, Calif.	18	11	3	3	1	-	2
Portland, Oreg.	141	95	24	14	6	2	5
Sacramento, Calif.	154	107	26	14	4	3	9
San Diego, Calif.	296	199	52	27	11	5	21
San Francisco, Calif.	150	84	31	27	5	3	4
San Jose, Calif.	119	85	22	6	4	2	8
Seattle, Wash.	168	109	24	20	7	8	6
Spokane, Wash.	50	35	10	2	2	1	2
Tacoma, Wash.	47	32	6	4	3	2	4
TOTAL	12,610††	8,096	2,430	1,276	445	348	633

*Mortality data in this table are voluntarily reported from 121 cities in the United States, most of which have populations of 100,000 or more. A death is reported by the place of its occurrence and by the week that the death certificate was filed. Fetal deaths are not included.

**Pneumonia and influenza.

†Because of changes in reporting methods in these 3 Pennsylvania cities, these numbers are partial counts for the current week. Complete counts will be available in 4 to 6 weeks.

††Total includes unknown ages.

§Data not available. Figures are estimates based on average of past available 4 weeks.

Relapsing Fever — Continued

and *O. rudis* (*1–6*). These ticks normally inhabit the burrows and nests of rodents in which the natural infection cycle proceeds without apparent disease in the rodents.

Humans are incidental hosts when bitten by an infected tick. *Ornithodoros* vectors are reclusive night feeders and bites often go unnoticed. Cabins in wilderness areas are attractive nesting sites for potentially infected rodents, particularly when food is made available by cabin users. *Ornithodoros* spp. infestations of rodent nests in cabins have been associated with outbreaks reported in Spokane County, Washington, in 1968 (*7*) and in the Grand Canyon National Park in 1973 (*8*).

The clinical features in the patients in this report are unusual in the prominence of gastrointestinal symptoms and severity of illness. The evidence of meningeal inflammation in the fifth patient is of interest, given the known predilection for the nervous system of the related spirochete, *B. burgdorferi*, the causative agent of Lyme disease. The severe headaches associated with relapsing fever may reflect meningeal involvement as a relatively frequent event (*9,10*).

The relapsing nature of this illness is thought to be associated with the presence of antigenic variants. As an immune response develops to the predominant antigenic strain, variant strains multiply and cause a recrudescent infection. The most rapid diagnostic test is identification of spirochetes on a Giemsa- or Wright-stained thick or thin smear of peripheral blood obtained during a febrile episode. As suggested by the clinical histories in this report, tetracyclines are effective in terminating this infection (*9*).

Prevention of relapsing fever consists of avoiding likely tick habitats or, when this is not possible, reducing the risk of tick bites by the use of repellents or acaricides. Additional measures include fumigating nesting sites in human habitations, "rodent-proofing" buildings in endemic areas, and eliminating rodent access to unnatural food sources.

Cases of relapsing fever should be reported to local and/or state health departments. The frequency with which relapsing fever cases occur in clusters related to a single location makes an environmental evaluation of an individual case a mandatory public health preventive measure. CDC's Bacterial Zoonoses Branch, Division of Vector-Borne Infectious Diseases, Center for Infectious Diseases, requests that *B. hermsii*- and *B. turicatae*-infected ticks, *B. hermsii* and *B. turicatae* isolates, and serum samples from patients with documented infections from *B. hermsii* and *B. turicatae* be submitted for its International Borreliosis Reference Collection. These items should be sent to the Bacterial Zoonoses Branch, CDC, P.O. Box 2087, Ft. Collins, CO 80522; telephone (303) 221-6400.

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Relapsing Fever — Continued

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Current Trends

Football-Related Spinal Cord Injuries Among High School Players — Louisiana, 1989

During the 1989 high school football season in Louisiana, four high school players sustained cervical spinal cord injuries (SCIs) while playing football. From 1978 through 1988, only three such injuries are known to have occurred in this state (National Center for Catastrophic Sports Injury Research, unpublished data).* Louisiana law requires reporting of all SCIs to the Office of Public Health, Louisiana Department of Health and Hospitals.

Three of the injured players were defensive backs, and one was an outside linebacker/tight end. All injuries resulted in quadriplegia; three of the injuries were complete (i.e., motor and/or sensory function below the zone of injury was not preserved). The injuries occurred during evening games when the players were tackling or blocking with the head as a point of contact but not in the typical head-down or spearing position. The circumstances suggested that the mechanism of injury was an axial load on a partially-flexed neck and that the vertical force was transmitted down the length of the spine. Previous studies have shown axial loading to be the mechanism most likely to lead to permanent quadriplegia in injured athletes (*1–3*).

The Louisiana Safety and Sports Medicine Advisory Committee, a group formed to address the problem of SCIs among high school football players, is developing an educational program to instruct coaches and trainers on safer methods of tackling. This program may be implemented during the 1990 football season.

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Editorial Note: Based on data collected by the National Football Head and Neck Injury Registry for 1971–1975 and compared with data for 1959–1963, the incidence of football-associated cervical SCIs increased from 0.7 per 100,000 participants to 1.6 per 100,000 participants, respectively (*3*). More than half the injuries identified were attributed to use of the top of the helmet as the initial point of contact. This mechanism of first contact became more common because the modern helmet and face mask, developed in the 1960s and 1970s, offers greater protection in general (*3*). Because of the increased occurrence of these injuries, in 1976 the National Collegiate Athletic Association (NCAA) and the National Federation of High School Athletic Associations adopted rules prohibiting the deliberate use of the top of the helmet to

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Spinal Cord Injuries — Continued

strike a runner or use of the helmet to butt or ram an opponent (*3,4*). The overall decrease in the incidence of quadriplegia in high school football players, from 2.2 per 100,000 participants in 1976 to 0.4 per 100,000 in 1984, was attributed to the successful implementation of these rules (*3*).

The expected number of football-associated SCIs in Louisiana during 1989 can be estimated in two ways. Based on the 1984 national rate of 0.4 SCIs per 100,000 participants (*3*) and the 1989 population of Louisiana high school football players, only one such injury would be expected during a 14.5-year period. Alternatively, based on the experience in Louisiana from 1978 through 1988, one SCI would be expected during a 3.7-year period. Reasons for the occurrence of the four SCIs during the 1989 high school football season in Louisiana are unknown.

At greatest risk for football-related SCIs are players who tackle by flexing their necks and using the tops of their helmets to strike opponents (*1–3*). Suggested strategies to prevent football-related cervical SCIs include educating coaches and participants about proper tackling techniques, enforcing existing tackling rules (*1–6*), educating officials about the mechanisms of injury, strengthening the neck with proper conditioning exercises (*1,6*), requiring medical examinations before participation in football and before resumption of participation after injury (*1,5*), and increasing awareness among school administrators and coaches about the proper handling of any player injured during practice or competition (*1,5,6*).

In 1987, the Council of State and Territorial Epidemiologists recommended that traumatic SCIs be designated as reportable (*7*). Strengthening state-based surveillance of SCIs will aid in identifying these catastrophic injuries and assist in the planning, implementation, and evaluation of prevention programs. SCI is a targeted condition in CDC's Disabilities Prevention Program, which supports SCI surveillance and prevention activities in Louisiana.

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Update: Eosinophilia-Myalgia Syndrome Associated with Ingestion of L-Tryptophan — United States, through August 24, 1990

As of August 24, 1990, 1536 cases of eosinophilia-myalgia syndrome (EMS) had been reported to CDC from all 50 states, the District of Columbia, and Puerto Rico (Figure 1) (*1–5*). Twenty-seven deaths have been reported in patients who met the surveillance case definition and who used L-tryptophan–containing products (LTCPs).

EMS – Continued

As of August 24, CDC had received 1117 completed report forms from state and territorial health departments. Ages of patients ranged from 4 years to 85 years (median: 48 years); 1046 (94%) of the patients were non-Hispanic white, 19 (2%) were Hispanic, 12 (1%) were black, and 40 (4%) were from other or unknown racial/ethnic groups; and 930 (83%) were female. One thousand sixty-eight (96%) patients had histories of LTCP ingestion preceeding onset of symptoms. Symptom onset during or after July 1989 was reported in 946 (85%). Eight (0.7%) patients had onset on or after February 1, 1990. Three hundred sixty (32%) patients had been hospitalized for their illnesses by the time the cases were reported.

Reported by: State and territorial health departments. Div of Environmental Hazards and Health Effects, Center for Environmental Health and Injury Control, CDC.

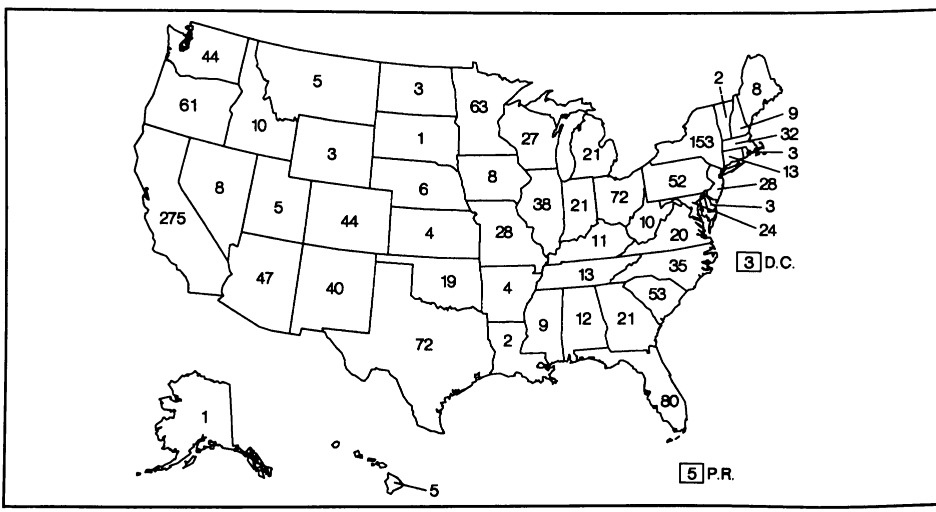
Editorial Note: On November 17, 1989, the Food and Drug Administration (FDA) recalled all dietary supplements that provided a daily dose of L-tryptophan (LT) ≥100 mg. By March 22, 1990, this recall had been expanded to include all LTCPs at any dosage except some protein supplements, infant formulas and special dietary foods, and intravenous and oral solutions in which small amounts of LT are needed for nutrient fortification.

The eight EMS cases reported with onset after February 1 appear to have resulted principally from continued use of LT by some persons after the FDA recall rather than from long disease latency following cessation of LTCP exposure. One patient began use of LTCPs on March 20, 1990, and became ill 1 month later, indicating that some persons may be unaware of, or choose to ignore, the FDA recall.

National surveillance figures do not fully reflect the proportion of patients ultimately hospitalized as a result of EMS. Because each case is reported only once, information regarding hospitalization of patients requiring admission after their cases are reported is not available.

The surveillance definition for reporting EMS cases to CDC requires the presence of severe, debilitating myalgias and eosinophilia ≥1000 eosinophils per mm^3. Recent

FIGURE 1. Reported cases of eosinophilia-myalgia syndrome, by state – United States, through August 24, 1990



EMS — Continued

unpublished reports indicate that this case definition may be overly restrictive for clinical purposes. Many persons may have forms of EMS that are either less severe or in which the constellation of clinical findings does not include the intense eosinophilia or severe myalgias initially identified as the hallmarks of epidemic EMS. Thus far, such cases have not been the object of national surveillance.

The failure of a case to meet criteria specified in the surveillance definition does not preclude a clinical diagnosis of EMS in a person who manifests other features of EMS or who has either a lower eosinophil count or milder myalgias. As in other diseases with multiple connective tissue manifestations, a set of clear-cut diagnostic criteria with both high sensitivity and specificity may be difficult or impossible to establish. The physician's judgment and appropriate weighing of all available information are important in the clinical diagnosis of EMS.

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Analysis of L-Tryptophan for the Etiology of Eosinophilia-Myalgia Syndrome

Eosinophilia-myalgia syndrome (EMS) has been associated with consumption of L-tryptophan–containing products (LTCPs) (*1,2*) and most strongly associated with consumption of LTCPs produced by one manufacturer (*3–5*). Epidemiologic and laboratory investigations have suggested that the implicated LTCPs were contaminated (*3–5*). To further examine this hypothesis, CDC and the Food and Drug Administration (FDA) conducted additional laboratory studies. This report summarizes preliminary data that indicate that implicated LTCPs were contaminated with the di-tryptophan aminal of acetaldehyde (DTAA).

The laboratory investigation determined that case-associated L-tryptophan (LT) cultures were negative for bacteria and viruses and that endotoxin levels were not elevated in case-associated LT (*6*). Analysis of case-associated LT for 37 elements identified none at toxicologically significant concentrations.

Fifty lots of LT produced between March 1985 and June 1989 by the implicated manufacturer were analyzed by high-performance liquid chromatography (HPLC). Thirteen lots were linked to EMS cases; other lots were considered as controls because no link with cases could be identified. Several HPLC peaks (called peaks 97, 100, and 200) were identified that were predictive of case-associated LT lots. Amounts of peak 97 in LT lots from the implicated manufacturer increased dramatically between March and June 1989. Based on a Wilcoxon rank-sum test, peak 97 was the single most predictive peak ($p<0.0001$) of case-associated LT lots. A bivariate plot of peaks 100 and 200 was as predictive as peak 97. HPLC analysis of samples exchanged between CDC and the Mayo Clinic revealed that peak 97 is likely the same as peak E (*5*).

L-Tryptophan — Continued

HPLC was used to isolate peak 97 from case-associated LT lots. Proton nuclear magnetic resonance indicated that peak 97 was a tryptophan derivative with its characteristic aromatic indole protons and aliphatic protons but with an unusual doublet at a chemical shift of 2.2 ppm. HPLC combined with atmospheric pressure ionization/mass spectrometry/mass spectrometry determined that peak 97 had a molecular weight of 434. High-resolution fast-atom bombardment mass spectrometry determined the exact mass of peak 97 to be 434.2020 corresponding to a molecular formula of $C_{24}H_{26}N_4O_4$, indicating that peak 97 contained two tryptophan molecules and an additional C_2H_2. These data suggested that peak 97 was the DTAA (Figure 1A).

With LT as a standard, the concentration of peak 97 was estimated at 0.01% in a typical case-associated LT lot. Scientists at the implicated manufacturer independently arrived at the same proposed structure (R. Hinds, personal communication). Confirmation of this structure by synthesizing DTAA is in progress. In addition to peaks 97, 100, and 200, ongoing investigation is directed at 1-methyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid (MTCA) (Figure 1B) and bacitracin, detected in LT lots from the implicated manufacturer (*6*). MTCA could be produced from the breakdown of DTAA or independently formed.

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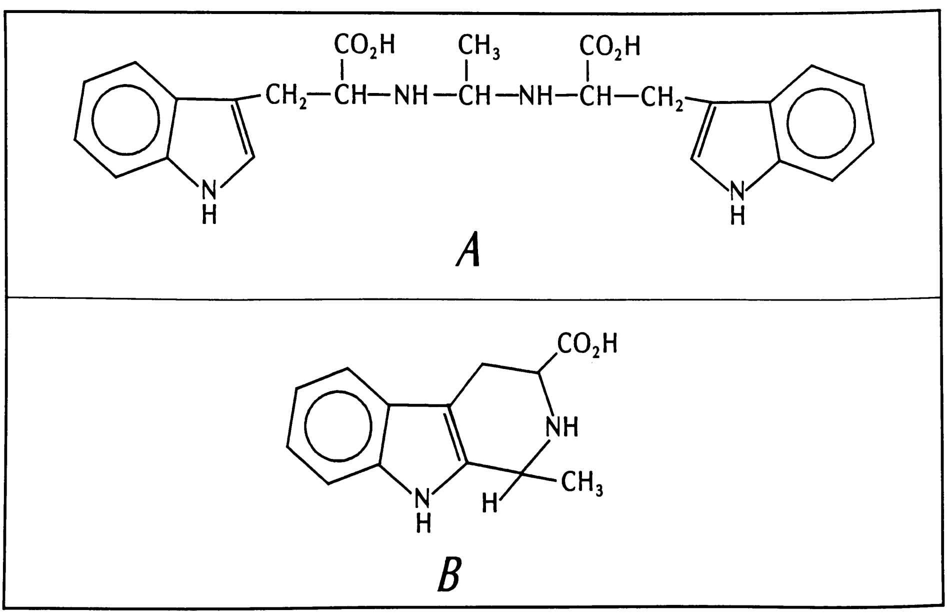
Editorial Note: The epidemiologic association of peak 97 and any other particular compound with EMS indicates that these compounds may either be the causative agent(s) or marker(s) for a different, as yet unidentified, causative agent in case-associated LT lots. Based on an average daily dose of 2 g of LT for a 70-kg person and

FIGURE 1. A: Di-L-tryptophan aminal of acetaldehyde (proposed structure for Peak 97). B: 1-Methyl-1, 2, 3, 4-tetrahydro-β-carboline-3-carboxylic acid.



L-Tryptophan — Continued

a 30-day delay before onset of EMS, the total dose of peak 97 is approximately 90 µg/kg. The toxic properties of the aminals are not well defined; however, the suspected decomposition products, the β-carbolines, exhibit a variety of biologic properties (*7*).

The full definition of biologic and toxic effects of the contaminants can be determined only in an animal model for EMS. A joint National Institute of Mental Health/National Institutes of Health/FDA/CDC study has recently reproduced EMS-like changes in rats (E.M. Sternberg, personal communication). Synthesizing these contaminants and testing them in the new rat model may help to clarify their relationship to the etiology and pathogenesis of EMS. Continuing studies include analyzing additional LT lots, identifying and synthesizing contaminants, and attempting to associate changes in the manufacturing process with these contaminants.

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