California Medicine

Meningococcal Infections

Fort Ord and California

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■ *Meningococcal meningitis began to occur in outbreak proportions during 1962 at Fort Ord, Monterey County. This increase in incidence continued until basic training was stopped at that post late in 1964. Most of the cases were among basic trainees in the first eight weeks of training, although other personnel had close contacts with trainees.*

All of the meningococci isolated were serotype B and about 50 per cent of the military patients with meningitis had sulfadiazine resistant strains. At this time, approximately 20 per cent of the civilian male population of military age are carriers of the organism before going into service. By eight weeks of training nearly 90 per cent of the men in some barracks carried the organism. Yet there was no correlation between the carrier rate and the occurrence of cases between barracks.

A feature of this outbreak was that a high proportion of healthy males (20 per cent) were carriers of type B meningococci. This finding reflects the carrier rate in the general civilian population of the same age. The organism is apparently so widely disseminated throughout the population that it is impossible to decide with certainty the source of the organism infecting any particular person. It is unlikely that military groups pose extraordinary hazard to civilians. During 1964, only one case of meningococcal meningitis was found among the civilians of Monterey County while there were 89 in military personnel and 10 among the civilian dependents of military personnel.

At present there is an increasing rate of meningococcal meningitis among the total population of California, suggesting that this area is on the upward swing in the cyclical occurrence of the disease.

THE INCIDENCE of meningococcal meningitis in California has shown a gradual increase since 1959, the most recent low point in the cyclical occurrence of the disease. There were 190 cases reported in 1959 and 553 cases in 1964, the case rate rising from 1.4 per 100,000 in 1959 to 3.0 in 1964.

In recent months considerable attention has been focused on the occurrence of meningococcal meningitis at Ford Ord, a United States Army training center in Monterey County, California. This army post has had cases of meningitis at all seasons dur-

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ing the past three years, the greatest number of cases having occurred during the summer and fall of 1964. The continuous occurrence of new cases of meningitis at this training center over an extended period has created public awareness of the hazard of this disease and led to considerable publicity and consequent anxiety in the public mind.

The purpose of this report is to summarize the situation at Fort Ord with attention to its impact on the civilian population. The public news media have been assiduous in their coverage of the outbreak at Fort Ord. *Epidemiologic Notes* and *California's Health*, both publications of the California State Department of Public Health, have kept local health officers aware of developments.[1,2] This review includes the current reported incidence and recent trends in the occurrence of meningococcal meningitis for the State of California, which is the background against which the Fort Ord outbreak should be considered. The results of laboratory studies are mentioned. Details of these will be reported elsewhere.

TABLE 1.—*Meningococcal Infections at Fort Ord 1960-1964 Through November 18*

Year	Combat Trainees: Meningitis Cases	Combat Trainees: Meningitis Deaths	Combat Trainees: Clinical Meningococcal Infections Without Meningitis Cases	Military Dependents Meningitis Cases*	Military Dependents Meningitis Deaths*	Total Meningococcal Infections
1964†	89	12	4	10	2	103
1963	56	5	3	5	0	64
1962	36	0	0	2	0	38
1961	6	0	0	0	0	6
1960	2	0	0	0	0	2

*Includes 2 civilian cases (one fatal) who had close contact but were not dependents.

†Through November 18, 1964.

Prepared by Bureau of Communicable Diseases.

Fort Ord Cases, Military and Military Dependents

Data in Table 1 suggest that the present cycle of increased incidence of meningococcal meningitis at Fort Ord began between 1961-1962. There were two and six cases in 1960 and 1961 respectively. A significant increase to 38 cases occurred in 1962. There were 64 cases in 1963 and 108 in 1964. Chart 1 shows the number of cases by months. It also indicates illness in basic trainees, other military personnel, civilian military dependents, those cases which were fatal and those with meningococcal infections without meningitis or meningococcemia. Fatalities first occurred in 1963 with a further increase in 1964. Table 2 shows the case rate per 100,000 total population each year in the period 1959-1964 by geographic area within the state of California. Most areas show a moderate or slight increase in case rate. In the central coast area, which includes Monterey and Fort Ord, there was a pronounced increase.

Most of the cases of meningitis at Fort Ord occurred in basic trainees in the first eight weeks of training. During 1963 and 1964 there was an increase in meningitis among those who had recently completed basic training. Only two cases occurred in men of the regular garrison. There was no meningitis in cadremen who were the instructors and otherwise helped in basic training. These men have close daily contact with the trainees and occupy the same barracks. None of the officers, including line commanders, physicians, dentists and nurses had a meningococcal infection. The officers had individual quarters and the cadremen had space separate from the trainees but in the same barracks.

The peak number of cases in a single month occurred in August 1964, but the outbreak continues to the present with nine cases in October and eight

TABLE 2.—*Meningococcic Meningitis Cases and Rates per 100,000 by Area, California, 1959, January 1-November 30, 1964*

Area	1959 Cases	1959 Case Rate	1960 Cases	1960 Case Rate	1961 Cases	1961 Case Rate	1962 Cases	1962 Case Rate	1963 Cases	1963 Case Rate	1964 Cases	1964 Case Rate
Central Coast*	6	1.6	6	1.6	20	5.2	46	11.5	55	13.3	103	23.8
Los Angeles	60	0.9	64	0.9	75	1.1	124	1.7	125	1.7	158	2.0
Mountain	1	0.3	8	2.6	3	1.0	1	0.3	2	0.6	5	1.5
North Coast	7	3.8	8	4.3	9	4.8	6	3.1	3	1.6	12	6.2
Sacramento Valley	9	1.2	12	1.5	8	1.0	17	2.0	12	1.3	14	1.5
San Diego	21	2.1	23	2.1	26	2.4	33	2.9	51	4.4	38	3.3
San Francisco Bay	41	1.2	46	1.3	63	1.7	63	1.6	93	2.3	108	2.6
San Joaquin Valley	19	1.4	24	1.7	21	1.4	26	1.7	23	1.5	36	2.3
South Central	6	1.8	3	0.8	1	0.2	7	1.6	12	2.5	8	1.6
Southeast	20	2.3	15	1.7	10	1.1	11	1.1	11	1.1	14	1.3
Total State	190	1.2	209	1.3	236	1.4	334	2.0	388	2.2	496	2.7

*Includes Monterey County and Fort Ord.

in November. Five of eight cases in trainees during November were among those who had completed basic training. All basic trainees had left Fort Ord by the end of November. In October there were three cases in dependents of military personnel. One of the patients was a civilian military dependent who was cared for on the post. The other two civilians were not near the post but had close contact with a healthy carrier from a basic training brigade at Fort Ord. One died. There are other instances in which individual civilians had meningococcal meningitis and indirect contact with the post could be traced but which are not listed because of the nature of the exposure and the multiple other opportunities for contact with meningococci elsewhere.

Clinical Features

The Fort Ord outbreak has been attended by several fulminating cases of meningococcemia, with shock and a confluent hemorrhagic eruption. The interval between the onset of illness and death has been as short as five hours, beginning with malaise, sore throat, slight headache, one or two petechiae a little later, to the state of collapse with widespread confluent hemorrhages in the skin a few hours after the first petechiae appeared. Most of the deaths were in this group. The measures taken at the post to insure early diagnosis and early treatment no doubt have been important factors in the overall relatively favorable case fatality rate.

The case fatality rate for the three years was: 1962, zero; 1963, 8.2 per cent; and 1964 (to December 1) 13.3 per cent. The fatality rate for California as a whole was 19.1 per cent in 1962 and again in 1963 (Table 3). The Fort Ord case and fatality rates include the occasional recruit who developed meningitis while on furlough after finishing basic training and was put in hospital elsewhere. Often treatment was received at a later stage of the disease in such cases. Some of these were fatal. But every patient connected with trainees at or recently from Fort Ord is listed in the totals.

During 1964 there were 10 patients classified as military dependents. Two of these died. In several instances the contacts had throat cultures and the

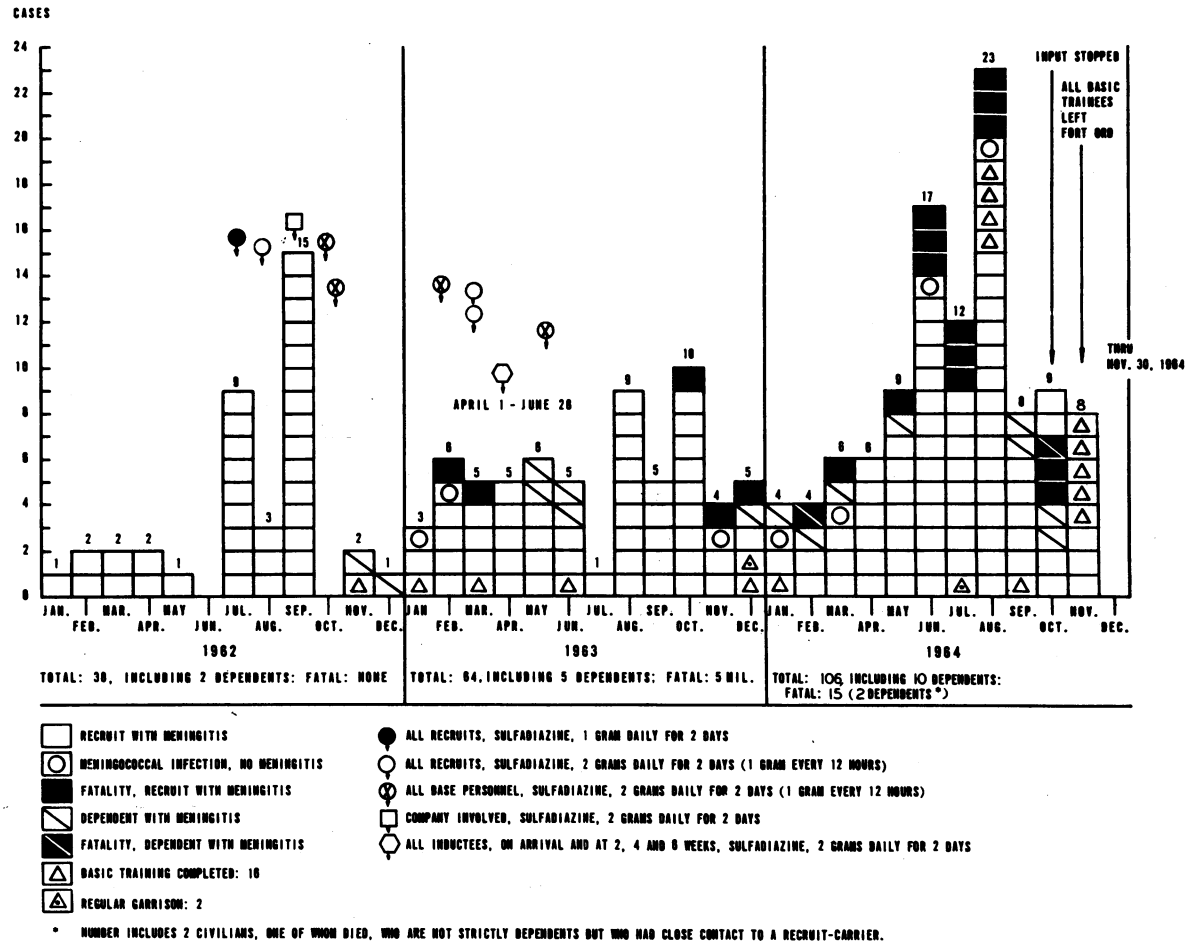


Chart 1.—Meningococcal Infections. Cases and Deaths, Fort Ord, California, January, 1962-November 30, 1964.

meningococci which were isolated were characterized. In none of the cases in dependents had the patient had contact with a patient who had meningitis. A typical example was the occurrence of meningitis in a 3½-year-old child of a member of the permanent garrison. Cultures revealed that the mother was the carrier of the Type B strain of meningococcus similar to that of the child. The single culture of the father failed to reveal the organism.

For treatment, the soluble salt of penicillin G, given intramuscularly in divided doses of about 2 million units every two to three hours, or approximately 24 million units in 24 hours, seems to have been the most successful therapeutic measure. The most difficult current problem relates to the management of carriers and contacts by chemoprophylaxis.

TABLE 3.—*Meningococcal Infections, Cases, Deaths and Rates, State of California, 1913-1964 Through November 18*

Year	No. of Cases	Rate per 100,000	No. of Deaths	Case Fatality Rate (Per Cent)
1913	67	2.4	49	73.1
1914	70	2.4	38	54.3
1915	46	1.5	22	47.8
1916	64	2.1	15	23.4
1917	133	4.2	31	23.3
1918	226	6.9	....	....
1919	103	3.1	77	74.7
1920	183	5.2	55	29.6
1921	176	4.6	63	35.8
1922	124	3.1	41	33.0
1923	135	3.2	47	34.8
1924	127	2.8	40	31.4
1925	122	2.6	39	31.9
1926	208	4.2	102	49.0
1927	260	5.1	101	38.8
1928	260	4.9	115	44.2
1929	738	13.3	381	51.6
1930	336	5.9	167	49.7
1931	261	4.5	152	58.2
1932	166	2.8	86	51.8
1933	141	2.4	77	54.6
1934	100	1.7	49	49.0
1935	275	4.5	124	45.0
1936	299	4.7	127	42.5
1937	245	3.8	102	41.6
1938	113	1.7	42	37.2
1939	84	1.2	29	34.5
1940	68	1.0	17	25.0
1941	87	1.2	22	25.3
1942	277	3.6	70	25.3
1943	1441	16.9	189	13.1
1944	1344	15.0	154	11.5
1945	759	8.1	126	16.6
1946	550	5.9	91	16.5
1947	291	3.0	66	22.7
1948	344	3.4	62	18.0
1949	288	2.8	61	21.2
1950	247	2.3	35	14.2
1951	342	3.0	66	19.3
1952	483	4.2	87	18.0
1953	501	4.1	107	21.4
1954	328	2.6	69	21.0
1955	291	2.2	50	17.2
1956	236	1.7	50	21.2
1957	197	1.4	62	31.4
1958	196	1.3	42	21.9
1959	190	1.2	36	16.4
1960	209	1.3	42	20.1
1961	236	1.4	50	21.2
1962	334	2.0	64	19.1
1963	388	2.2	72	19.1
1964*	473		49†	

*Through November 18, 1964.
†Data from death certificates, figures available through June, 1964.

Communicability

The Fort Ord outbreak demonstrates again that meningococcic meningitis is of low communicability. In ordinary circumstances the risk of acquiring this disease is minimal. It is obviously low even at Fort Ord. It is evident that there were literally thousands of contacts and opportunities for transfer of meningococci between individuals both civilian and military at Fort Ord. Yet there have been comparatively few cases of meningitis considering the high percentage of personnel whose throat culture was positive for serotype B meningococci. A tragic episode took place in October, 1964. A basic trainee on leave spent a day and evening with his fiancee. After his return to Fort Ord, fulminating meningococcal meningitis developed in the girl and she died. The trainee remained well. Type B meningococci were obtained by culture of both the man and his fiancee. The connection with the outbreak at Fort Ord

TABLE 4.—*Meningococcal Infections, Total California Population and Civilian Population of Monterey County*

	California		Monterey County (Exclusive of Fort Ord)	
Year	Cases	Deaths	Cases	Deaths
1964	473 (Jan.-Nov. 18)	51 (Jan.-June)	1 (Jan.-Sept.)	0 (Jan.-Sept.)
1963	388	72	16	2
1962	334	64	7	0
1961	236	50	10	0
1960	209	42	3	0

TABLE 5.—*Civilian Cases of Meningococcal Meningitis with no Known Contact to Military Personnel, California and Selected Health Jurisdictions January 1, September 26, 1964*

Area	Total Cases	Cases with No Known Contact	
		Number	Per Cent
California	269	229	85.1
Los Angeles County	59	57	96.6
San Francisco	16	15	93.8
San Bernardino	9	8	88.9
Santa Clara	15	10	66.7
Contra Costa	8	5	62.5

*41 Counties reporting representing 85 per cent of California population (15.4M).

seemed clear and received considerable attention by the press and public. Anxieties already present were heightened. Not until later was it shown that the meningococcus of the soldier and that of the girl were probably different strains. She most likely acquired the organism which caused her death from some other unknown person, a tragic coincidence.

A survey of Monterey County in which Fort Ord is located revealed only one case of meningococcal meningitis in the civilian population for the period January-September 1964 (Table 4). Table 5 covers the same period for most of the state and illustrates the civilian cases of meningococcal meningitis for whom no known contact with military personnel had preceded the disease. The per cent without contact with military personnel previous to illness varied from county to county. For the state, 85 per cent of all civilian patients with meningococcal meningitis during the period indicated denied contact with military personnel.

The age distribution shown in Table 6 is significant with reference to communicability. During 1964, through September 26, 56 per cent of the cases of meningococcic meningitis in civilians in California occurred in children four years of age or younger. Of the total, 74 per cent were under 15 years of age. There is little doubt that children are the most susceptible to this disease.[4,5,6] This is supported by the data for age distribution during 1961, 1962 and 1963 (Table 6).[5,6]

The Meningococci

All of the strains of *Neisseria meningitidis* which have caused meningitis at Fort Ord since 1962 were either serotype B or C, 90 per cent being Type B. This is also true for civilian cases in California. Throat culture surveys in both military and civilian groups have revealed Type A very rarely. Before 1962, Type A meningococci predominated during outbreaks, with Types B and C being found only occasionally in sporadic cases.[4,5]

Resistance to Antimicrobial Agents

By "resistant" is meant that the strain of meningococcus will grow in media containing 0.1 mg of sulfadiazine per 100 ml. It has been determined that this is the critical level insofar as sulfadiazine prophylaxis for the eradication of organisms from the nasopharynx of carriers is concerned, utilizing the standard prophylactic dose of sulfadiazine. When significant numbers of strains are resistant to this dose, its use for chemoprophylaxis in an outbreak will be unsatisfactory.[8] The result of its use in these circumstances has been increased resistance or an increase in the number of strains that are resistant. Although blood levels in patients are much higher than 0.1 mg per 100 ml during therapy, sulfadiazine does not act effectively when resistant strains, as defined above, are the cause of meningitis. Table 3 provides data which shows the influence of sulfonamides on case fatality rates over the years. A be-

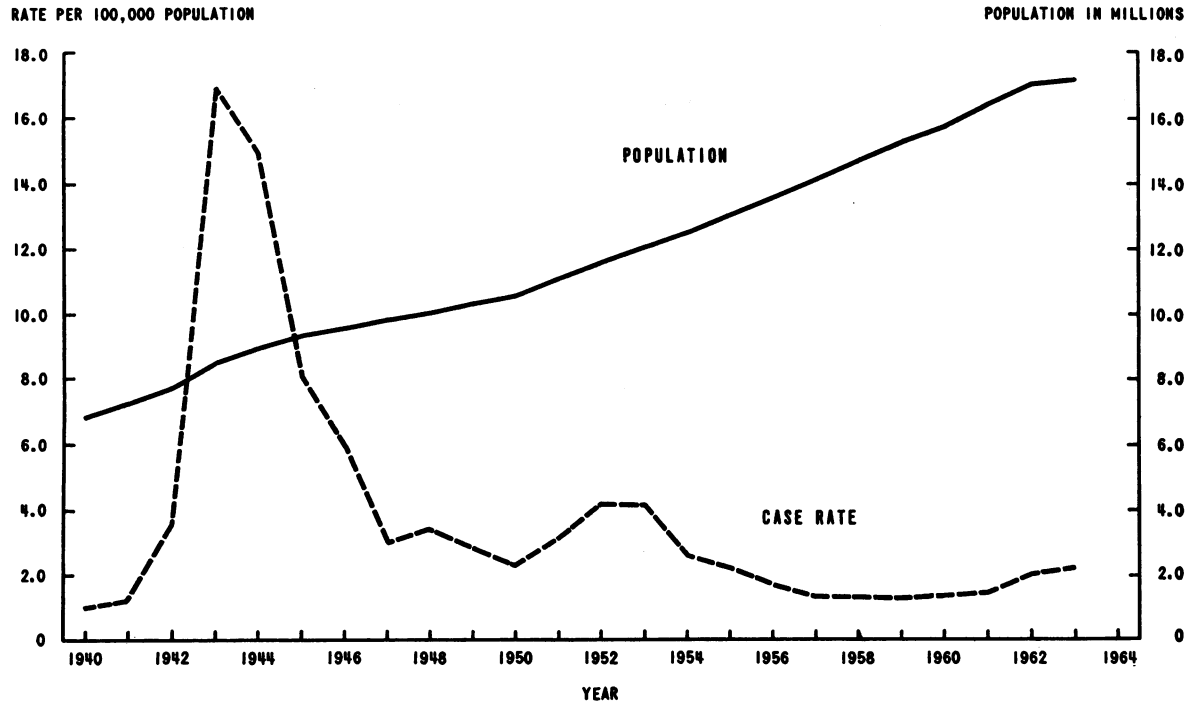


Chart 2.—Meningococcal Meningitis in California, 1940-1963.

TABLE 6.—*Age Distribution of Civilian Cases of Meningococcal Meningitis, California, 1961, 1962, 1963 Through December, 1964*

Cases	Total	Age: Under 1	1-4	5-9	10-14	15-19	20-24	25-34	35-44	45-64	65+	Not Dated
1961—												
Number	236	50	84	30	15	13	9	12	2	16	4	1
Per cent	100.0	21.2	35.6	12.7	6.4	5.5	3.8	5.1	0.8	6.8	1.7	0.4
1962—												
Number	334	77	84	29	13	52	42	6	7	17	7	
Per cent	100.0	23.1	25.1	8.7	3.9	15.6	12.6	1.8	2.1	5.1	2.1	
1963—												
Number	388	88	120	28	15	39	31	12	11	16	5	23
Per cent	100.0	22.7	30.9	7.2	3.9	10.1	8.0	3.1	2.8	4.1	1.3	5.9
*Cases**	*Total**	*Under 1*	*1-4*	*5-9*	*10-14*	*15-19*	*20-24*	*25-29*	*30-39*	*40-49*	*50-59*	*60+*
1964*—												
Number	269	44	107	28	20	22	13	1	10	14	5	5
Per cent	100.0	16.4	39.8	10.4	7.4	8.2	4.8	0.4	3.7	5.2	1.9	1.9

*41 counties reporting representing 85 per cent of California, through September 26, 1964.

ginning improvement in the case fatality rate is evident from 1938 and 1939 onward, with the most pronounced improvement beginning in 1943. Sulfanilamide became available on the West Coast about 1937, sulfadiazine by 1941. During 1938 and 1939 sulfapyridine and sulfathiazole respectively were introduced and shown to be effective against the meningococcus. However, sulfadiazine became the drug of choice and continued to be so until 1962 for both treatment of cases and for mass chemoprophylaxis in outbreaks. No strain of meningococcus was reported to be resistant to sulfadiazine until the outbreak of meningitis at the San Diego Naval Training Center in 1962. Several strains in that outbreak which were very resistant to sulfadiazine were found and characterized. Since then numerous resistant strains have been isolated from both civilians and military personnel. Meningococci have retained

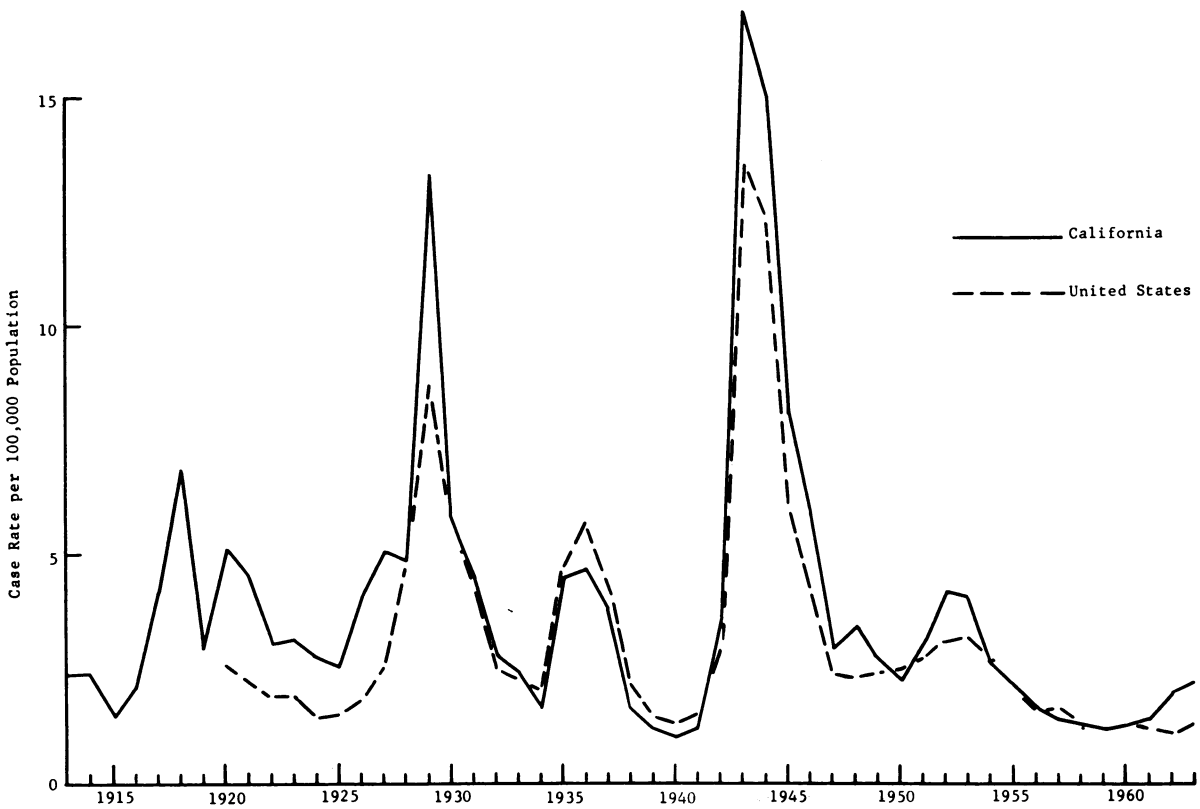


Chart 3.—Case Rate of Meningococcal Meningitis, California and United States, 1913-1963.

TABLE 7.—*Results of Serotyping and Sulfonamide Sensitivity Testing of 91 Strains of Meningococci from all Parts of California*

	Total	Number Resistant to Sulfa	Per Cent Resistant to Sulfa	Number Sensitive to Sulfa	Per Cent Sensitive to Sulfa
NUMBER OF STRAINS OF MENINGOCOCCI					
Total examined	91†	31	36	66	64‡
Number Type A	1	0	0	1	0
Number Type B	72	30	42	42	62.5
Number Type C	16	1	6.2	14	94
Per cent Type B	79				
Per cent Type C	17				

*By the Microbiology Laboratory, California State Department of Public Health, in collaboration with the Communicable Disease Center, Atlanta, Georgia.

†2 strains were too rough to type.

‡A strain of type B was not tested.

unchanged their sensitivity to penicillin, tetracycline, chloramphenicol and most broad spectrum antimicrobial agents. This is fortunate for treatment but none of these agents has been shown to be effective for mass prophylaxis of carriers in doses less than the full therapeutic amounts.

Drug Prophylaxis

During 1962 and 1963 mass chemoprophylaxis with sulfadiazine was carried out on nine occasions at Fort Ord. Doses of 2 and 4 grams were used at different times. In the Fall of 1962 the case rate diminished following administration of sulfadiazine to all base personnel. When this was repeated in 1963 it was ineffective and new cases continued to occur, Chart 1. Mass chemotherapy as a control measure was discontinued after June 28, 1963. It was the opinion of the Committee on Meningococcal Meningitis of the Armed Forces Epidemiological Board that there is sufficient evidence available to state that no known single antimicrobial agent or combination of agents currently available is satisfactory for mass prophylaxis of contacts or the treatment of carriers in outbreaks due to sulfonamide resistant meningococci. The continued routine use of sulfonamide prophylaxis for meningococcal infections at Fort Ord was not recommended. The committee stated that sulfadiazine prophylaxis according to previously accepted dosage schedules should be utilized in outbreak situations only after laboratory studies have established that the organism is sensitive to this drug.

A rationale exists for the use of sulfadiazine prophylactically for prevention of meningococcal meningitis in contacts of sporadic civilian cases of the disease. To date two-thirds of these cases have been due to sulfonamide-sensitive organisms.

TABLE 8.—*Meningococcal Meningitis Cases by Area,* California, January-November, 1964*

Area, County and Health Jurisdiction	Cases† Total	Civilian	Military‡
California	(496)	(380)	(116)
North Coast	(12)	(12)	.....
Humboldt-Del Norte	5	5	.....
Lake	1	1	.....
Mendocino	6	6	.....
Sacramento Valley	(14)	(14)	.....
Sacramento	7	7	.....
Sutter	1	1	.....
Tehama	1	1	.....
Yolo	4	4	.....
Yuba	1	1	.....
Mountain	(5)	(5)	.....
El Dorado	1	1	.....
Nevada	2	2	.....
Shasta	2	2	.....
San Francisco Bay	(108)	(107)	(1)
Alameda County	26	26	.....
Contra Costa	13	12	1
Marin	2	2	.....
San Francisco	23	23	.....
San Mateo	11	11	.....
Santa Clara County	30	30	.....
Solano	3	3	.....
Central Coast	(103)	(8)	(95)
Monterey	96	1	95
San Luis Obispo	3	3	.....
Santa Cruz	4	4	.....
San Joaquin Valley	(36)	(36)	.....
Fresno	11	11	.....
Kern	6	6	.....
Kings	4	4	.....
Merced	2	2	.....
San Joaquin	5	5	.....
Stanislaus	2	2	.....
Tulare	6	6	.....
South Central Coast	8	8	.....
Santa Barbara County	2	2	.....
Ventura	6	6	.....
Los Angeles Metropolitan	(158)	(157)	(1)
Los Angeles County	140	139	1
Orange	18	18	.....
San Diego	(38)	(19)	(19)
San Diego	38	19	19
Southeast	(14)	(14)	.....
Riverside	3	3	.....
San Bernardino	11	11	.....

*Counties are listed only if cases were reported.

†Numbers in parentheses are totals for the area.

‡Figures are those reported by health jurisdictions and may differ from military reports.

Source: California State Department of Public Health, Morbidity Records.

Incidence of Carriers

Surveys were made during 1964 by the Sixth Army Laboratory on groups of men reporting to the Armed Forces Recruitment Center in Oakland, California, for preinduction physical examinations. These men, still in civilian clothes, had no previous opportunity for contact with army personnel. New trainees at Fort Ord had throat cultures immediately

on arrival. A group of about 30 men have had a culture each day at the post over a one-month period. Others had serial cultures at weekly intervals. Platoons within companies and battalions had throat cultures. Several hundred University of California students had throat cultures taken by the Microbiology Laboratory of the State Department of Public Health during one day as a further control on the carrier rate in civilian groups in ages 17 to 24. Serotyping was done on all meningococci isolated and sulfonamide sensitivity determined on each strain.

Amongst these groups, the carrier rate for meningococci averaged 20 per cent on first culture, with a range of 9.4 to 25 per cent. This is believed to reflect the current carrier rate in the adult male civilian population in California. During basic training the carrier rate may reach 70 to 90 per cent by the eighth week. However, no correlation has been apparent between the carrier rate and the occurrence of cases of meningitis. The carrier state in an individual may be transient, in that a man may show the organism on culture of his throat on one day and not the next, or vice versa. Over 90 per cent will have menin-

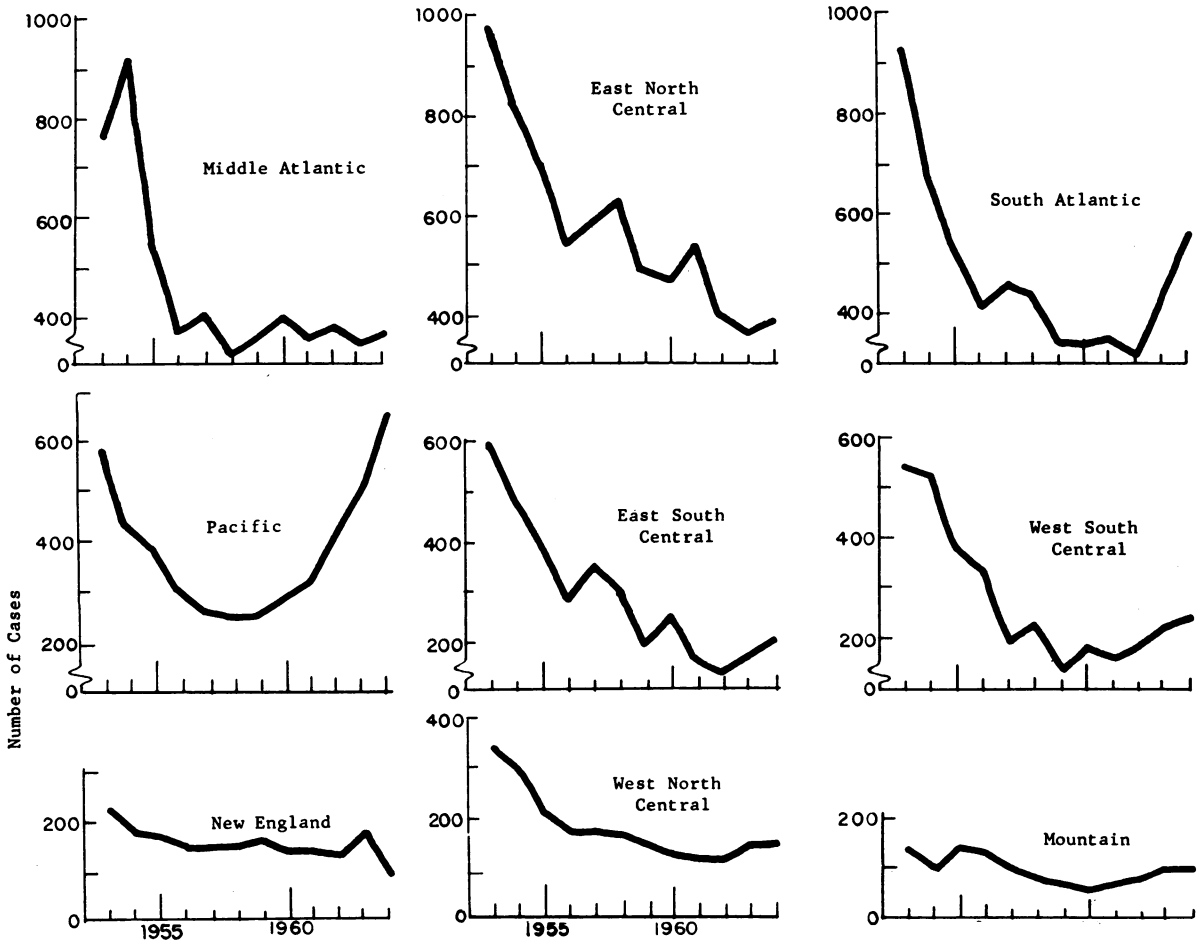
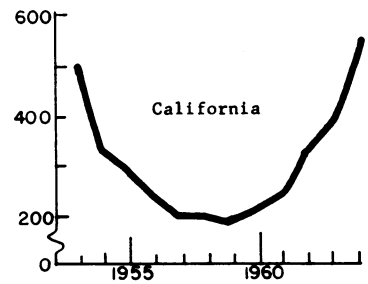


Chart 4.—Cases of meningococcal meningitis, California and each area* of the United States, 1953-1964.†



*Areas contain the following states: *New England:* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut; *Middle Atlantic:* New York, New Jersey, Pennsylvania; *East North Central:* Ohio, Indiana, Illinois, Michigan, Wisconsin; *West North Central:* Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas; *South Atlantic:* Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida; *East South Central:* Kentucky, Tennessee, Mississippi; *West South Central:* Arkansas, Louisiana, Oklahoma, Texas; *Mountain:* Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada; *Pacific:* Washington, Oregon, California, Alaska, Hawaii.

†1964 totals estimated assuming cases will continue to occur throughout 1964 at the same frequency of occurrence as in October and November 1964.

gococci one or more times if a series of daily cultures are made.

Most of the strains isolated from the civilians were sulfonamide-sensitive, Table 7. Organisms grown on cultures obtained from trainees, cadremen and personnel generally on the Army post were more frequently resistant to sulfadiazine than organisms from cultures in the civilian population. This was variable between companies.

The meningococci isolated from clinical cases of meningitis at Fort Ord showed approximately 50 per cent of the strains to be resistant to sulfadiazine. The organisms were all group B or C.

Civilian Population

Examination of 91 strains of meningococci from patients with meningitis located in all parts of the state began on April 1, 1964, in collaboration with the Communicable Disease Center, Atlanta, Georgia. Serotype A was found only once, Table 8. Table 7 indicates that it is the type B which is most often resistant to sulfadiazine. Only two of 16 Type C strains obtained were resistant. Sixty-three per cent of the type B strains were sensitive to sulfadiazine.

The rapid population growth in California and the case rate per 100,000 population are noted in Chart 2. The death rates and case rates for California since 1913 are shown in Table 3. The numbers of cases and of deaths are also given. The last peak in the cyclical occurrence of meningococcal meningitis was in 1953 with 501 cases and a rate per 100,000 of 4.1. There were 5,077 cases reported for the entire United States, a rate of 3.2 per 100,000 population. Then the number of cases declined each year to the low when 190 cases were reported in California and 2,180 for the United States—case rates of 1.2 and 1.2 respectively. Since 1959 there has been a slow and gradual increase in the number of cases. In 1963, 388 cases were reported for the state, a case rate of 2.2.

To December, 1964, 496 cases had been reported in California or 2.7 per 100,000 population, Table 8. The rates for the United States as a whole for 1963 and the first ten and a half months of 1964 were 1.1 and 1.2 respectively. Case rates in California are compared with those of the United States in Chart 3. Chart 4 shows the incidence of meningococcal infection by area throughout the United States. Every region except New England shows a beginning rise in incidence. California shows a sharp increase.

Precautions at Fort Ord

Precautions against spread and measures to prevent meningococcus infection at Fort Ord are of several orders:

A. *Now in effect:*

1. The input of new basic combat trainees and of Army Reserve personnel to Fort Ord has been discontinued temporarily. There were no basic trainees at this Post as of December 1, 1964. It was planned to permit one or two months to elapse before training is resumed. This applies only to men in their first eight weeks of training and to Army reservists.

2. When training is resumed, visitors to trainees will be limited to parents while the trainee is in residence at Fort Ord.

3. Upon completing the eight weeks of basic training trainees will be transferred immediately to their next duty assignment without a leave or pass at that time.

4. When training is resumed, all the precautions which were in effect when the input of trainees was stopped will be reinstituted.

B. *Preventive measures initiated by order dated August 4, 1964, and subsequent orders.*

These precautionary measures are for the purpose of preventing indiscriminate intermixing of many groups of trainees:

1. The reception procedure was changed so that all men were assigned to a platoon as soon as they arrived at the post. The individual remains with the same trainees throughout the roughly 72 hours of reception procedures and he remains in his assigned platoon for the eight weeks of basic training. The "buddy platoon" method, in which only two platoons of a company are allowed to mix freely, is employed.

2. Leaves or passes were cancelled for the duration of the eight-week training period.

3. The trainees were not allowed to leave their company area or to go to other company areas or to the Post Exchange, the theatre or chapel. Religious services, movies and Post Exchange services were brought to the companies individually and provided out of doors.

4. For classroom work the classes were divided to provide a vacant seat between each man.

5. Additional barracks were provided to make possible an interval of two weeks between the evacuation of the barracks by one group on completion of training and the refill of these barracks by newly arrived trainees. This prevented the so-called "back-to-back" filling of barracks and provided a two week free period for the cadremen who live with the recruits. They are assigned to other duties when their company area has been evacuated.

6. The input of new trainees was reduced to 800 per week during September and was projected at 700 a week or less during October. This compares with a weekly input of 1,000 to 1,200 or more men up until the end of August.

C. *Other preventive measures:*

1. A system of close surveillance of recruit personnel was put into effect. Any trainees showing indication of a respiratory infection, headache or other minor symptoms which might suggest impending meningococcal infection were put in hospital on suspicion for a 48-hour period of observation. This step was important for early recognition. Early diagnosis and treatment seems to have been a most important factor for the success of treatment.

2. Physical conditioning activities were lightened to limit the chance of over-fatigue.

Living conditions for the troops appear to be excellent and to maintain the principle of limited intermixing. The barracks, kitchens and utilities are scrupulously clean. The men have a full 72 square feet of space each. However, the double decker bunk system is still used.

Expert consultants, civilian and military, have come to Fort Ord to consider the problem of meningococcal meningitis and its prevention there. A team from the Walter Reed Army Institute of Research (WRAIR) made throat culture surveys on several occasions during the past two years. The Committee on Meningococcal Meningitis of the Armed Forces Epidemiological Board spent two days at Fort Ord during September, 1964, for a review of the meningitis problem.

Headquarters, Sixth Army maintains a day to day surveillance and the Sixth Army Laboratory has developed the capability for comprehensive studies.

The California State Department of Public Health has close liaison with officials at Fort Ord and Sixth Army headquarters. The Post was visited each week for several weeks. The Microbiology Laboratory of the State Health Department collaborated in making throat cultures.

Discussion

The natural habitat of *Neisseria meningitidis* is the nasopharynx of human beings.[3,4] The results of studies in progress suggest that nearly all people have the organism in their nasopharynx at some time or other, if not continuously. The dispersal of the organism throughout a population, civilian or military, is apparently very rapid. However, it is probable there are several thousands of carriers of the organism for every case of meningococcal meningitis. No other animal has been shown to act as either reservoir or vector in the transmission of this organism.[4] Also not involved are fomites, such as soiled linen, blankets and mattresses used by former patients or carriers.

Currently about 20 per cent of the 17 to 24-year-old male civilian population are carriers of Type B meningococci. Contact with meningococci is quite possible without exposure to military personnel. The organism is so widely disseminated throughout the population that it is impossible to decide with certainty the source of the organism infecting any given individual. Multiple opportunities for exposure are constantly present. This is a finding which has been emphasized and extended by studies associated with the episode at Fort Ord. Further studies will indicate whether the carrier rate remains high throughout the year.

It is doubtful if military groups pose any greater hazard to the civilian population than the hazard encountered by civilian groups in their daily exposure to carriers in the civilian population. The occurrence of cases must be the result of a failure on the part of the host to resist invasion. It is the consensus that meningitis is less likely to develop in persons who harbor the organism than in those who do not. A resistance is acquired, the duration of which remains to be clarified. These are aspects of the problem which would bear on the effectiveness of a vaccine.

An analysis of cyclical trends in the occurrence of meningococcal meningitis in California since 1918 indicates that this disease occurs in irregular cycles which average nine years duration. It is probable that the present upward cycle may continue for another two years.

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