The Changing Pattern of Poliomyelitis Observed in Two Urban Epidemics

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IN 1959, two large epidemics of poliomyelitis occurred in the middle west, one in Des Moines, Iowa, and the other in Kansas City, Mo. The epidemiologic patterns of the two epidemics were similar. Essentially, they were characterized by a distinct geographic localization of cases, high attack rates in the lower socioeconomic segments of the population, with low incidence in the upper socioeconomic groups, and a preponderance of cases in unvaccinated children of preschool age.

The data presented in this paper indicate that the 1959 epidemics had an epidemiologic pattern different from that generally observed prior to the Salk vaccine era. The evidence derived from the Des Moines and Kansas City studies suggests that the altered epidemiologic pattern observed was related to the large-scale use of the Salk vaccine in recent years.

Materials and Methods

Both epidemics were extensively studied. A study team composed of personnel from the Communicable Disease Center, the Des Moines-Polk County Health Department, the Public Health Nurse Association, and the Iowa State Department of Health investigated the Des Moines cases; the nursing staff of the Kansas City (Mo.) Health Department investigated the Kansas City cases. The clinical and epidemiologic data were recorded on a standard form, which included the usual identifying information—date of onset of illness, vaccination status, clinical diagnosis, 60-day muscle evaluation, and the pertinent epidemiologic information. The hospital charts provided the clinical data, and the patients or their relatives supplied the epidemiologic data. The number of injections of Salk-type vaccine given up to 2 weeks before the onset of symptoms determined the vaccination status. The clinical classification was based on the presence or absence of significant muscle weakness at the time of the 60-day examination.

The investigations included extensive etiological studies. The specimens consisted of feces, either stools or rectal swabs, or both, and paired serums. In addition, throat washings were available on many of the Des Moines cases and on some of the Kansas City cases.

Virus isolations and identifications were performed in monkey kidney monolayer cultures. Poliomyelitis antibodies were measured by the complement fixation (CF) test, and antibodies for other enteroviruses were assayed by the neutralization test. Detailed descriptions of the methods appear elsewhere (*1–6*).

The vaccination status of the population was determined by household surveys conducted according to the methods described by Serfling and co-workers (*7*). Experienced statisticians in collaboration with local and State health department personnel supervised the surveys. Volunteers—Red Cross nurses, Gray Ladies, and Junior League members—performed the interviews in Des Moines; in Kansas City, in-

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terviews were conducted by the city public health nurses, under the direction of Thomas C. Dundon, director, bureau of vital statistics, Missouri Department of Health. The vaccination levels determined were based on all vaccinations given up to June 1, 1959.

In 1959 Des Moines had a population of 203,100, including 192,800 whites and 10,300 Negroes. This estimate was made by the City Plan and Zoning Commission in January 1959. The 1952 and 1954 populations were derived by simple linear interpolation, using the 1959 estimate and the 1950 U.S. census. The age estimates were based on the 1950 U.S. census data except that the 1959 age estimates for persons under 21 years of age used the school census data of 1958. The 1950 census also provided data on socioeconomic classification of the population.

The population of Kansas City, Mo., estimated by the City Plan Commission survey in 1957, was 499,700. Of these, 381,500 were whites and 118,200 were Negroes. The 1957 survey also provided data on socioeconomic classification of the population. The 1959 vaccination survey provided the proportional age distribution for estimating the population in each age group. The 1950 census data were used to calculate the 1946 and 1952 rates.

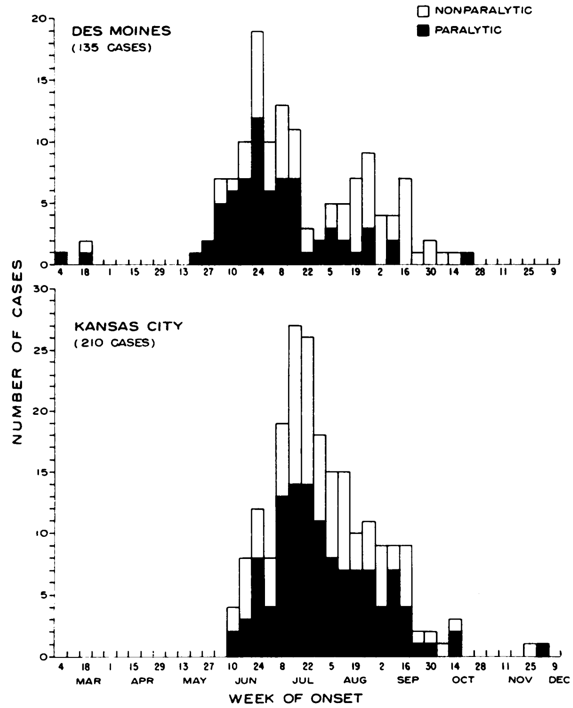
The proportion of Negroes in the Des Moines population remained stationary, while the percentage of Negroes in Kansas City had increased 1.7 times since 1950.

Clinical and Etiological Observations

During 1959, Des Moines had 135 cases of poliomyelitis; 70 were paralytic and 65 were nonparalytic. Four of the paralytic cases were fatal. An additional patient with bulbospinal paralysis died 10 months after onset of illness. Of the 135 patients, 102 were whites and 33 were Negroes, representing a specific rate of 52.9 and 320.4 per 100,000, respectively.

Virus isolations were attempted on fecal and throat specimens from 120 patients; 59 were paralytic, and 61 were nonparalytic. Poliovirus type 1 was recovered from 49 (83 percent) of the paralytic cases and from 19 (31 percent) of the nonparalytic cases. Nine patients with nonparalytic disease excreted a non-

Figure 1. Poliomyelitis cases in Des Moines, Iowa, and Kansas City, Mo., 1959, by week of onset and paralytic status



poliovirus; among them, one had ECHO virus type 7, two had Coxsackie B virus type 2, and the remaining six had unidentified agents. None of the patients harbored either type 2 or type 3 poliovirus.

Antibody studies were performed on paired serums of 31 patients; 28 did not have detectable virus in their feces or throat washings and 3 did not submit specimens for virus isolations. CF antibody response (fourfold or greater) to poliomyelitis was demonstrated in 13 patients—10 against type 1 and 3 against type 3; 2 of the 10 patients with type 1 antibody response also developed antibodies against other serotypes—one against type 2 and one against both types 2 and 3. Two additional patients developed neutralizing antibody against other enteroviruses—one against ECHO 7 and another against Coxsackie B2.

On the basis of these virus and antibody studies, 92 patients had enterovirus infections; 87 percent of them were associated with type 1 poliovirus.

The number of poliomyelitis cases reported in Kansas City during 1959 was 210; 118 were paralytic and 92 were nonparalytic. Eleven of the paralytic cases were fatal. There were 146 cases among Negroes and 64 cases among whites, resulting in a racial incidence of 123.5 and 16.8 per 100,000, respectively.

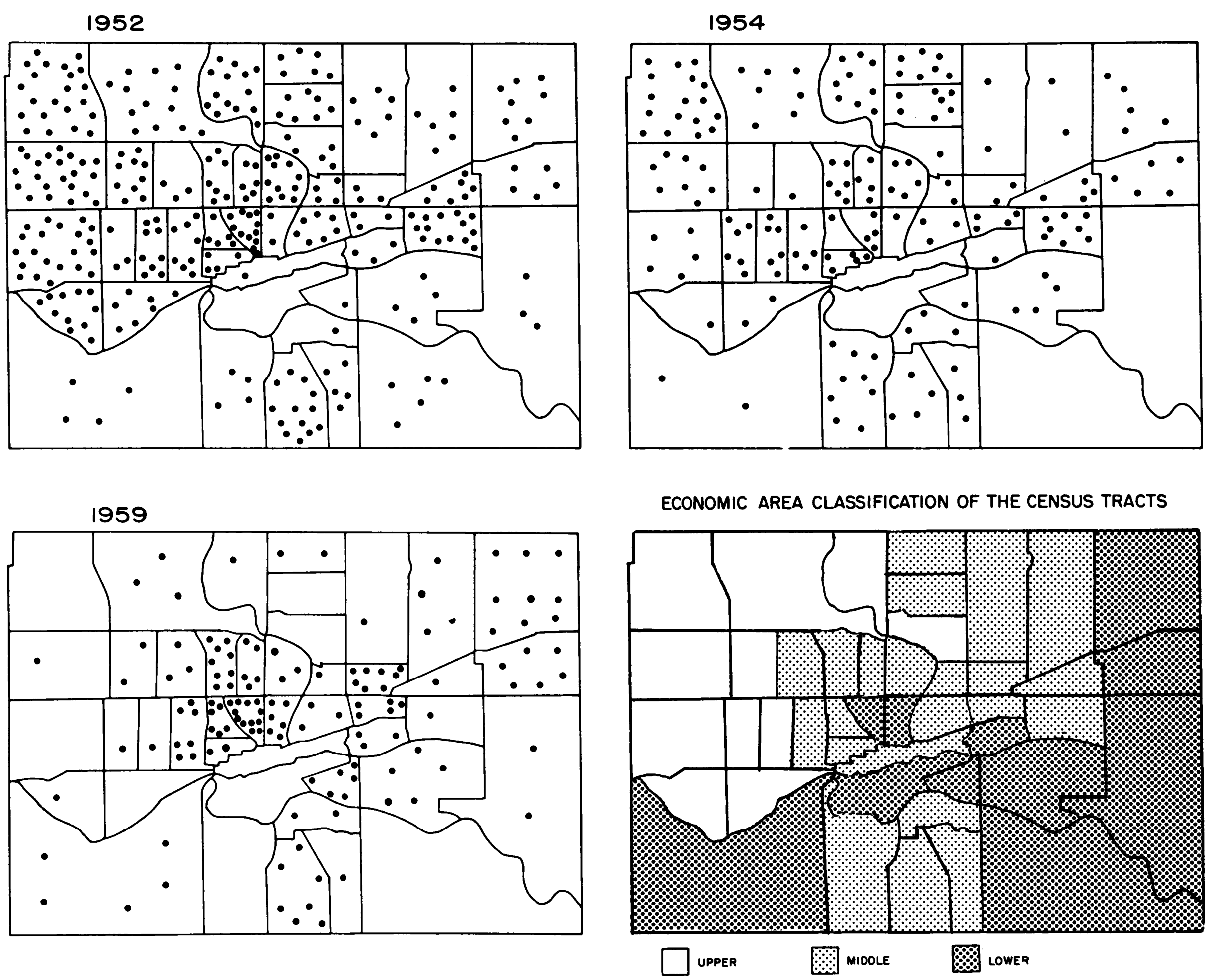
Virus studies were performed on the fecal specimens of 166 patients, 87 paralytic and 79 nonparalytic. Poliovirus type 1 was isolated from 76 percent of the paralytic cases and 67 percent of the nonparalytic cases. Other types of poliovirus were not detected. A nonpoliovirus, however, was recovered from eight patients, one with paralytic disease and seven with nonparalytic disease. The agents in two cases, both nonparalytic, were identified as Coxsackie B virus, one type 2 and the other type 5; the agents in the remaining six cases were unidentified.

Poliovirus CF tests were performed on paired serums from 24 patients who did not have virus in their feces and on 5 patients who submitted only paired serums. Fourfold or greater antibody response to poliovirus type 1 was detected in four patients, one having had a concomitant rise to poliovirus type 2.

Based on these results, 124 patients had proved enterovirus infections; type 1 poliovirus was the agent involved in 94 percent of these cases.

Although type 1 poliovirus was the principal causative agent of these two 1959 epidemics, Des Moines had a higher proportion of nonpoliomyelitis cases than Kansas City. Nearly 30 percent of the etiologically identified nonparalytic cases occurring in Des Moines did not have poliovirus infection, while only 12 percent of the

Figure 2. Distribution of reported poliomyelitis cases, by census tract, Des Moines, Iowa, epidemic years 1952, 1954, and 1959



virus-positive nonparalytic cases in Kansas City were associated with a nonpoliovirus.

Seasonal Pattern

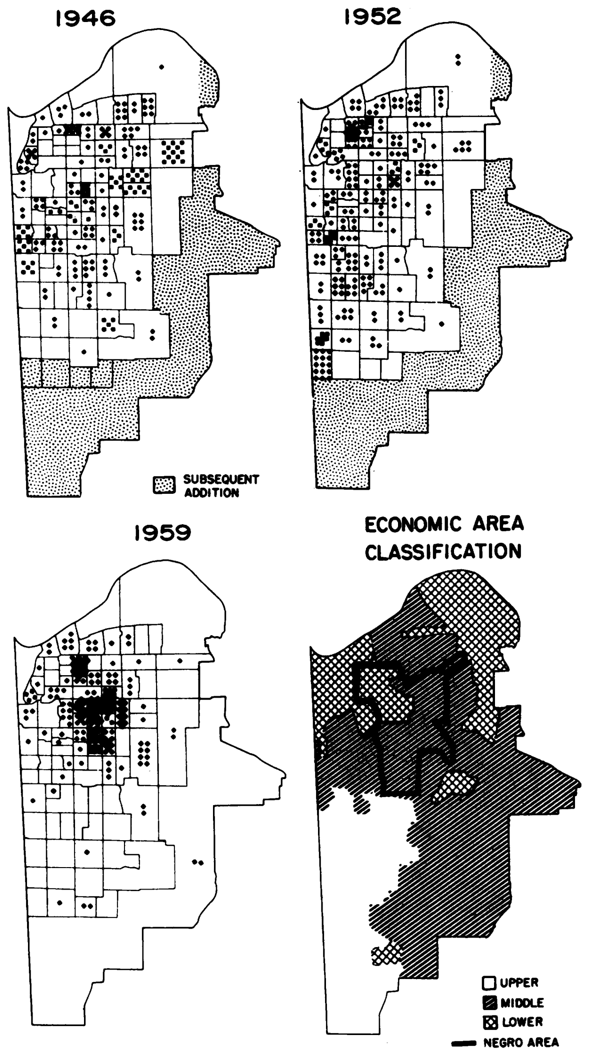
The epidemic curves depicting the distribution of the 135 Des Moines cases and the 210 Kansas City cases by week of onset and paralytic status are illustrated in figure 1.

The Des Moines epidemic began in the latter part of May and ended in October. Three cases occurred in March. The epidemic had two distinct peaks, one during the week ending June 24 with 19 cases and the other during the week ending August 26 with 9 cases. In the first half of the epidemic, paralytic cases predominated over nonparalytic cases almost two to one. In the second half, the majority of cases were nonparalytic. All the etiologically proved nonpoliomyelitis cases occurred during the latter period. Therefore, the secondary peak was related to an increase of nonpoliovirus infections.

The Kansas City epidemic began in early June and ended in the middle of October. The number of cases increased rapidly and reached a peak of 27 cases during the week ending July 15. The paralytic cases predominated throughout the epidemic with no secondary rise of cases.

Both the Des Moines and Kansas City epidemics appeared unusually early in the year. When compared with the usual seasonal peak of poliomyelitis for the respective cities, the peak incidence of the 1959 Des Moines outbreak occurred about 2 months earlier and that of the Kansas City epidemic occurred 3 to 4 weeks earlier than usual.

Figure 3. Distribution of reported poliomyelitis cases, by census tract, Kansas City, Mo., epidemic years 1946, 1952, and 1959



Geographic Distribution

Figure 2 presents the distribution of the Des Moines cases by census tract. A definite concentration of cases occurred in the center of the city. The distribution pattern for the 1952 and 1954 epidemics is also shown. In these 2 years, the cases were widely distributed with no obvious concentration in any part of the city. This relationship is also evident when the geographic pattern of the 1959 Kansas City cases is compared with that of the 1946 and 1952 cases (fig. 3).

Since the lower socioeconomic segments of both the Des Moines and Kansas City populations are concentrated in the central census tracts, the localized geographic pattern observed in 1959 is a reflection of the frequent occurrence of poliomyelitis among the lower socioeconomic classes.

Socioeconomic Correlation

The attack rates of poliomyelitis in the Des Moines and Kansas City epidemics according to socioeconomic status are summarized in table 1. In 1959 the Negroes of both cities, who largely fall into the lower socioeconomic group, had the highest rate, and the incidence decreased with increasing socioeconomic status. The Negro rate in Des Moines was 20 times higher than the white rate in the upper socioeconomic group; in Kansas City the corresponding rates showed a 32-fold difference. In contrast, the white rate in the upper socioeconomic group exceeded the Negro rate in the 1952 and 1954 Des Moines outbreaks as well as in the 1946 and the 1952 Kansas City outbreaks.

Age Distribution

In 1959 the highest incidence of poliomyelitis in both cities was in children under 5 years of age, with the children aged 5–9 years having the next highest rate (table 2). In Des Moines, the attack rate of preschool children was 1½ times greater than that of the group aged 5–9 years; in Kansas City, a threefold difference was observed between the rates of the two age groups. In Des Moines, the incidence among the children 10–14 years old was three times less than that of the group aged 15–19 years; this difference, however, was not noted in Kansas City. During the 1952 and 1954 epidemics in Des Moines, as well as during the 1946 and 1952 epidemics in Kansas City, the preschool children had lower rates than the children 5–9 years old.

Table 1. Poliomyelitis cases and rates,[1] by socioeconomic groups, in Des Moines, Iowa, 1952, 1954, and 1959, and in Kansas City, Mo., 1946, 1952, and 1959

Race and socioeconomic group	Des Moines						Kansas City					
	1952		1954		1959		1946		1952		1959	
	Number cases	Rate	Number cases	Rate	Number cases	Rate	Number cases	Rate	Number cases	Rate	Number cases	Rate
White:												
Upper	134	224.4	63	101.4	10	15.6	51	38.0	105	78.3	4	3.8
Middle	128	143.3	81	87.6	50	51.5	102	62.1	64	39.0	41	17.5
Lower	50	159.7	25	80.6	42	132.9	61	68.9	64	72.3	19	44.7
Negro	3	30.9	3	30.3	33	320.4	1	1.8	19	33.9	146	123.5
All groups	315	165.8	172	88.0	135	66.5	215	48.6	252	56.9	210	42.0

[1] Number of cases per 100,000 population.

Table 2. Age-specific attack rates [1] of poliomyelitis in Des Moines, Iowa, 1952, 1954, and 1959, and in Kansas City, Mo., 1946, 1952, and 1959

Age group (years)	Des Moines						Kansas City					
	1952		1954		1959		1946		1952		1959	
	Number cases	Rate	Number cases	Rate	Number cases	Rate	Number cases	Rate	Number cases	Rate	Number cases	Rate
0–4	73	396.7	27	142.8	54	271.4	53	136.6	77	198.4	125	190.2
5–9	82	525.6	68	404.8	38	189.0	66	235.7	60	214.3	39	63.5
10–14	39	304.7	22	163.0	6	37.5	27	114.9	25	106.4	11	21.0
15–19	30	254.2	18	146.3	16	112.7	37	150.4	22	89.4	7	26.0
20–39	80	131.8	32	51.5	16	26.0	29	19.9	67	45.9	25	23.3
40 and over	11	15.6	5	7.0	5	7.0	3	1.6	1	.6	3	1.6
All ages	315	165.8	172	88.0	135	66.5	215	48.6	252	56.9	210	42.0

[1] Number of cases per 100,000 population.

Table 3 summarizes the age-specific attack rates of the Des Moines residents by socioeconomic status for 1952, 1954, and 1959. In this table, a comparison is made of the rates between two major socioeconomic groups: the upper and middle white population versus the Negro and lower white population. In 1952 and 1954, the children in the upper and middle socioeconomic groups aged 5–9 years had the highest incidence of poliomyelitis; in the Negro and lower white socioeconomic group, the rates between the groups aged 0–4 and 5–9 years were not significantly different. In the 1959 epidemic, the preschool children of both socioeconomic groups had the highest rates. Also, in the 1952 and 1954 epidemics the rates among preschool children in the two major socioeconomic groups showed little difference. In contrast, during the 1959 epidemic the attack rate among preschool children in the lower white and Negro groups was more than five times that of preschool children in the upper and middle white groups. A similar relationship exists for Kansas City when the 1959 age pattern is compared with the age patterns of 1946 and 1952 (table 4).

Table 3. Poliomyelitis cases and rates,[1] by age and socioeconomic status, Des Moines, Iowa, 1952, 1954, and 1959

Age group (years)	1952				1954				1959			
	Upper and middle whites		Lower whites and Negroes		Upper and middle whites		Lower whites and Negroes		Upper and middle whites		Lower whites and Negroes	
	Number cases	Rate	Number cases	Rate	Number cases	Rate	Number cases	Rate	Number cases	Rate	Number cases	Rate
0–4	54	388. 5	19	422. 2	17	118. 9	10	217. 4	20	131. 6	34	723. 4
5–9	63	538. 5	19	487. 2	60	468. 8	8	200. 0	15	100. 6	23	442. 3
10–14	36	375. 0	3	93. 8	19	186. 3	3	99. 9	2	16. 8	4	97. 6
15–19	26	288. 9	4	142. 8	14	147. 4	4	142. 9	11	100. 0	5	156. 2
20–39	75	155. 9	5	39. 7	29	58. 5	3	24. 0	9	18. 0	7	60. 3
40 and over	8	14. 1	3	21. 4	5	8. 6	0	0	3	5. 1	2	15. 3
All ages	262	175. 8	53	129. 3	144	93. 1	28	68. 4	60	37. 2	75	179. 0

[1] Number of cases per 100,000 population.

Table 4. Poliomyelitis cases and rates,[1] by age and socioeconomic status, Kansas City, Mo., 1946, 1952, and 1959

Age group (years)	1946				1952				1959			
	Upper and middle whites		Lower whites and Negroes		Upper and middle whites		Lower whites and Negroes		Upper and middle whites		Lower whites and Negroes	
	Number cases	Rate	Number cases	Rate	Number cases	Rate	Number cases	Rate	Number cases	Rate	Number cases	Rate
0–4	29	119. 3	24	165. 5	37	152. 3	40	275. 9	20	54. 2	105	364. 6
5–9	51	281. 8	15	151. 5	35	193. 4	15	151. 5	5	13. 8	34	134. 4
10–14	20	130. 7	7	85. 4	18	117. 6	7	85. 4	3	8. 7	8	44. 2
15–19	27	166. 7	10	119. 0	16	98. 8	6	71. 4	1	5. 9	6	60. 6
20–39	23	23. 7	6	12. 2	52	53. 6	15	30. 6	14	19. 5	11	31. 2
40 and over	3	2. 3	0	0	1	. 8	0	0	2	1. 4	1	2. 3
All ages	153	51. 3	62	42. 9	159	53. 3	83	57. 4	45	13. 3	165	102. 7

[1] Number of cases per 100,000 population.

Influence of Salk Vaccination

The data in table 5 correlate the paralytic attack rates of children under 15 years of age by socioeconomic and vaccination status. In both epidemics, the upper socioeconomic white population had the highest level of vaccination (three or more injections), and the level of vaccination decreased with descending socioeconomic status. The incidence of paralytic poliomyelitis was inversely related to the vaccination level. For example, the upper white group, who were best protected by the Salk vaccine, had the lowest incidence of paralytic disease; the Negroes and lower white groups, who had the smallest number of inoculations, had the highest incidence.

On the basis of these data, it appears that the Salk vaccine had a marked influence on the incidence of paralytic poliomyelitis in both the Des Moines and Kansas City epidemics. The estimated effectiveness of the vaccine in reducing the incidence of paralytic poliomyelitis in persons under 40 years of age was 80 percent for Des Moines and 77 percent for Kansas City. The methods used for calculating these estimates are shown in tables 6 and 7.

The incidence of paralytic poliomyelitis among unvaccinated children under 15 years of age in Des Moines and Kansas City is summarized in table 8 according to socioeconomic status. The paralytic attack rates among the unvaccinated children also varied inversely with their socioeconomic levels. In the upper white population of Des Moines, 1,600 children under 15 years of age were unvaccinated; not one case of paralytic poliomyelitis was reported in this group. On the other hand, 12 cases of paralytic poliomyelitis were observed in 1,700 unvaccinated Negroes under 15 years of age. In Kansas City, no paralytic cases occurred among 2,600 unvaccinated upper white children under 15 years of age, whereas 32 cases were observed among 10,800 unvaccinated Negroes of lower income families in this age category.

Discussion

In the past several years, epidemic poliomyelitis in the United States has manifested a different epidemiologic pattern from that usually observed. This alteration in pattern was first noted in the Chicago poliomyelitis epidemic of

Table 5. Incidence of paralytic poliomyelitis, by age, socioeconomic status, and vaccination status, Des Moines, Iowa, and Kansas City, Mo., 1959

Age, race, and socioeconomic group	Des Moines				Kansas City			
	Population		Cases		Population		Cases	
	Total	Percent with 3 or more inoculations	Number	Rate per 100,000 population	Total	Percent with 3 or more inoculations	Number	Rate per 100,000 population
0–4 years								
White:								
Upper	6, 900	65	2	29. 0	9, 200	64	1	10. 9
Middle	8, 300	58	10	120. 5	27, 700	46	10	36. 1
Lower	3, 200	36	13	406. 2	7, 500	35	6	80. 0
Negro	1, 500	30	4	266. 7				
Middle					11, 900	30	23	193. 3
Lower					9, 400	11	32	340. 4
5–14 years								
White:								
Upper	12, 400	90	0	0	22, 800	95	0	0
Middle	14, 400	60	5	34. 7	47, 700	75	2	42. 2
Lower	6, 200	58	8	129. 0	9, 900	79	2	20. 2
Negro	3, 100	43	12	387. 1				
Middle					19, 200	60	7	36. 4
Lower					14, 300	43	9	62. 9

1956 (*8*). A similar observation was reported in the 1957 epidemic in Washington, D.C. (*9*), and in the 1958 Detroit epidemic (*10*). In these, as well as in the 1959 epidemics in Des Moines and Kansas City, high rates prevailed among the preschool children. In Des Moines, 41 percent of the paralytic cases were in children under 5 years of age (*11*); in Kansas City, 61 percent were in children of this age category (*12*).

The Negroes were the most susceptible group in the population. The attack rate for the Negroes in Des Moines was 20 times higher than that for the upper whites, and in Kansas City, it was 32 times higher. Comparison of the rates for the lower and upper whites showed more than an eightfold difference in the Des Moines epidemic and a twelvefold difference in the Kansas City epidemic. The marked geographic localization of the cases reflects the frequent occurrence of poliomyelitis among the Negroes and lower whites living in the crowded areas in the center of the city (figs. 2 and 3).

The altered epidemiologic pattern observed was apparently related to the varying levels of vaccination in the population. In both Des Moines and Kansas City, the Negroes and lower whites had the highest attack rates, while the upper whites had the lowest. This difference in attack rates correlates well with the low vaccination status of the Negroes and lower whites and with the high vaccination status of the upper whites. Similarly, the shift in the age distribution of the 1959 cases can be attributed to the differential levels of vaccination among persons of various age groups. The preschool children had lower levels of vaccination than older children in all socioeconomic groups. This difference was particularly marked in Kansas City. In the previous epidemics (tables 3 and 4), the children in the upper and middle socioeconomic groups aged 5–9 years had the highest incidence of poliomyeli-

Table 6. Estimated effectiveness of vaccine [1] in reducing incidence of paralytic poliomyelitis in persons under 40 years of age, Des Moines, Iowa, 1959

Age, race, and socioeconomic group	Population, by number of vaccine doses		Paralytic cases, by number of vaccine doses		Paralytic cases per 100,000 in unvaccinated population	Expected cases in vaccinated population
	0 dose	3 or more doses	0 dose	3 or more doses		
0–4 years						
White:						
Upper	800	4, 400	0	2	0	0
Middle	2, 100	4, 800	7	0	333. 3	16. 00
Lower	1, 200	1, 200	8	2	666. 7	8. 00
Negro	600	400	2	1	333. 3	1. 33
5–14 years						
White:						
Upper	800	11, 100	0	0	0	0
Middle	2, 500	8, 600	2	2	80. 0	6. 88
Lower	1, 400	3, 600	3	3	214. 3	7. 71
Negro	1, 100	1, 300	10	0	909. 1	11. 82
15–39 years						
White:						
Upper	5, 300	12, 400	0	0	0	0
Middle	21, 300	10, 100	4	1	18. 8	1. 90
Lower	6, 800	3, 900	2	0	29. 4	1. 15
Negro	1, 700	500	4	0	235. 3	1. 18
Total	45, 600	62, 300	42	11		55. 97

[1] Vaccine effectiveness $= \frac{\text{Expected cases} - \text{observed cases}}{\text{Expected cases}} = \frac{55.97-11}{55.97} = 0.803.$

Table 7. Estimated effectiveness of vaccine [1] in reducing incidence of paralytic poliomyelitis in persons under 40 years of age, Kansas City, Mo., 1959

Age, race, and socioeconomic group	Population, by number of vaccine doses		Paralytic cases, by number of vaccine doses		Paralytic cases per 100,000 in unvaccinated population	Expected cases in vaccinated population
	0 dose	3 or more doses	0 dose	3 or more doses		
0–4 years						
White:						
Upper	2, 100	5, 900	0	1	0	0
Middle	8, 300	12, 600	7	2	84. 3	10. 62
Lower	3, 400	2, 600	4	1	117. 6	3. 06
Negro:						
Middle	6, 000	3, 500	15	3	250. 0	8. 75
Lower	5, 900	1, 000	28	1	474. 6	4. 75
5–14 years						
White:						
Upper	500	21, 600	0	0	0	0
Middle	4, 700	35, 600	0	2	0	0
Lower	1, 100	7, 800	1	0	90. 9	7. 09
Negro:						
Middle	4, 400	11, 400	4	1	90. 9	10. 36
Lower	4, 900	6, 200	4	1	81. 6	5. 06
15–39 years						
White:						
Upper	9, 000	13, 800	0	1	0	0
Middle	28, 300	21, 400	9	1	31. 8	6. 80
Lower	6, 800	3, 600	1	0	14. 7	. 53
Negro:						
Middle	12, 300	3, 600	6	0	48. 8	1. 76
Lower	10, 100	2, 800	5	0	49. 5	1. 39
Total	107, 800	153, 400	84	14		60. 17

[1] Vaccine effectiveness $=\frac{\text{Fxpected cases}-\text{observed cases}}{\text{Expected cases}}=\frac{60.17-14}{60.17}=0.767.$

tis, while the rates among the Negro and lower socioeconomic white children under 5 years either equaled or exceeded those of the group aged 5–9 years. Therefore, this relative shift of the 1959 age distribution toward preschool children is related principally to the marked reduction of poliomyelitis among school-age children of the upper and middle socioeconomic classes.

The data reported in this paper indicate that Salk vaccination was highly effective in reducing the incidence of paralytic poliomyelitis among individuals who had received three or more injections of vaccine. The levels of protection observed in these studies were comparable to those reported in the 1954 poliomyelitis vaccine field trial (*13*).

Of particular interest are the data concerning the incidence of paralytic poliomyelitis among unvaccinated persons of various socioeconomic groups. In both the Des Moines and Kansas City studies, the incidence of paralytic poliomyelitis occurring among children under 15 years of age was inversely related to their socioeconomic status. These data, summarized in table 8, seem to suggest that the extent of poliovirus infection was different in different areas of the community. If the poliovirus were widely disseminated in all areas, one would expect a higher incidence of poliomyelitis among the unvaccinated upper white population than was observed. This wide dissemination of poliovirus infection in previous epidemics is suggested by the similarity of poliomyelitis rates among preschool children in both major socioeconomic groups (tables 3 and 4). These observations imply that Salk vaccine might have had an indirect effect on reducing the incidence of infection in the highly vaccinated upper white population. Although

Table 8. Incidence of paralytic poliomyelitis in unvaccinated children under 15 years of age, by socioeconomic status, Des Moines, Iowa, and Kansas City, Mo.

Race and socioeconomic group	Des Moines			Kansas City		
	Unvaccinated population	Number of cases	Rate per 100,000	Unvaccinated population	Number of cases	Rate per 100,000
White:						
Upper	1, 600	0	0	2, 600	0	0
Middle	4, 600	9	195. 6	13, 000	7	53. 8
Lower	2, 600	11	423. 1	4, 500	5	111. 1
Negro	1, 700	12	705. 9			
Middle				10, 400	19	182. 7
Lower				10, 800	32	296. 3

other factors might also have been operative, it appears reasonable to speculate, as Salk did (*14*), that when the vaccination level of a given area is sufficiently high, the immunity induced in the community by the vaccine might have an influence on limiting the spread of poliovirus in that area. In the Des Moines study, an attempt was made to determine the distribution of poliovirus by serial sampling of raw sewage in various areas of the community. The results indicate that the frequency of isolation of poliovirus from sewage obtained from the upper socioeconomic areas was significantly lower than that from the lower socioeconomic areas. These data will be presented in detail elsewhere (*15*).

Summary

In 1959, major epidemics of type 1 poliomyelitis occurred in Des Moines, Iowa, and Kansas City, Mo. A total of 135 cases were reported in Des Moines, and 210 cases were reported in Kansas City. In both epidemics the majority of the cases occurred among Negroes and the poorer white residents in the center of the city. The poliomyelitis attack rate among Negroes in Des Moines was 20 times that of the upper white population; in Kansas City, the difference was 32-fold. In both epidemics the incidence of poliomyelitis was highest in children under 5 years of age; this was at variance with the age distribution observed in previous epidemics in these two cities when the rates were generally highest in children 5–9 years old.

The epidemiologic pattern observed in the 1959 epidemic was different from that of previous epidemics. The change appears to be related largely to the widespread use of the Salk vaccine during recent years.

Both the Des Moines and the Kansas City data indicate that the Salk-type vaccine was highly effective in protecting adequately immunized individuals against paralytic poliomyelitis. The efficacy was estimated to be 80 percent in the Des Moines study and 77 percent in the Kansas City study. The data suggest that high levels of vaccination might also have an influence on limiting the spread of poliovirus in the community.

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Antibiotic Substance Found in Limburger

An antibiotic substance has been isolated from Limburger cheese by Nicholas Grecz, Ph.D., as part of his graduate work at the Illinois Institute of Technology. The work was performed by special arrangement at the Food Research Institute of the University of Chicago, under National Institutes of Health grant RG–5837 (C–1).

In the 1880's, in the early days of microbiology, there were numerous food poisoning outbreaks attributable to a Cheddar-type cheese. At that time it was observed that food poisoning outbreaks were never caused by Limburger-type cheese. Furthermore, it was known at that time that aged Limburger cheese did not become moldy.

Dr. Grecz, under the guidance of Dr. G. M. Dack, director of the Food Research Institute of the University of Chicago, and Dr. L. R. Hedrick, chairman of the biology department of the Illinois Institute of Technology, set out to determine what it was in Limburger cheese that protected it from food poisoning bacteria and from mold spoilage. Dr. Grecz was able to extract the active principle from Limburger cheese aged in the refrigerator for 8 weeks or longer. Extremely small amounts of the refined extracts prevented the growth of microorganisms which ordinarily cause food spoilage and food poisoning, as well as of some disease-producing germs.

The source of the antibiotic substance was traced to pigmented yellow-orange colonies of a bacterium which appears under the microscope as a minute, short rod. The scientific name of the bacterium is *Brevibacterium linens*. The germ becomes predominant on the surface of Limburger-type cheese at the late stages of the curing process. In addition to the production of the antibiotic substance, *B. linens* is thought to be responsible for the production of the brown surface smear on Limburger cheese. The antibiotic substance survives heating for almost 1 hour at pressure cooker temperature. When chemically refined, the substance is effective in extremely small amounts, which cannot be detected by taste. *B. linens* is also present on other surface ripened cheese, such as Brie, Liederkranz, Romadour, Tilsiter, Port du Salut, Muenster, Beer, Brick, Trappist, Harz, St. Mang, and others.

This antibiotic may have other potential uses in foods which to date have not been determined.

Education Notes

Hospital Administration. The University of California School of Public Health is offering a new program in hospital administration. Doctors of medicine, osteopathy, dentistry, and the paramedical disciplines and other candidates specially qualified by academic training or experience are offered a program leading to the master of public health degree. Students with a bachelor's degree are eligible for the degree of master of science in public health.

Academic courses include 18 units of hospital administration, medical care, and health administration plus 9 units in epidemiology, biostatistics, and environmental health. Minor deviations may be permitted, depending on the student. Certain students may concentrate in mental health administration, either in mental hospitals or community mental health agencies.

A 12-month administrative residency is required in the M.S. program, but in the M.P.H. program the residency may be reduced on the basis of experience, special studies, or planned periods of travel and observation. Residencies will be in the Los Angeles area, thus permitting continued contact between the faculty, preceptor, and resident.

Additional information may be obtained from Paul A. Lembcke, M.D., M.P.H., University of California, Los Angeles.

Occupational Health Nursing. A new master's degree program offered by the University of Washington School of Nursing is designed to prepare nurses for responsible positions in occupational health.

Open to nurses with a bachelor's degree, the program requires four academic quarters. Course content is flexible so that it will be of value to nurses with little or no occupational health experience as well as those with much experience. Additional work may be taken in business administration, sociology, public health, and related areas.

Enrollees are accepted at any time, but a better sequence of courses is available by beginning the summer or fall quarter. Candidates are eligible for Public Health Service professional nurse traineeships and nurse-education stipends from State health departments.

Applications and additional information are available from the School of Nursing, University of Washington, Seattle 5, Wash.

Cancer Fellowships. The International Union Against Cancer, through funds available from the Eleanor Roosevelt Cancer Foundation, will award annually fellowships for research.

These senior postdoctoral awards are designed to support full-time staff members of universities, teaching hospitals, research laboratories, or other institutions who have demonstrated interest and outstanding ability or potential as independent investigators in research on basic cancer or its experimental and clinical aspects, and who wish to study in another country.

The fellowships ordinarily will be awarded for 1 year, but this period may be extended or shortened in special circumstances. The stipend will be based on the applicant's current salary and the salary of persons of comparable qualifications in the place where he expects to study. Allowance will be made for dependents and travel.

Additional information may be obtained from the International Union Against Cancer, P.O. Box 400, Geneva 2, Switzerland.

Epidemiology. A 3-year residency, offered by the New York State Department of Health to a small number of physicians and holders of doctorates in related disciplines, will train the recipients as epidemiologists. Stress will be placed on coordinating clinical, laboratory, and field investigations and on research methods, particularly those applicable to diseases of noninfectious and unknown etiology.

During the first year fellows will work with practicing epidemiologists concerned with both applied and research problems. They will also have opportunity to observe other public health activities. Second-year fellows will be expected to attend one of the graduate schools of public health and to complete requirements for the master of public health degree. The last 16 months will be spent in substantially independent research.

Fellows will receive full support, tuition, and dependency allowances throughout the 3 years. Applicants with appropriate experience may enter the program at the second- or third-year level.

Additional information may be obtained from William Haddon, Jr., M.D., Director, Epidemiology Residency Program, New York State Department of Health, 84 Holland Avenue, Albany 8, N.Y.