Epidemiology of Civilian Streptococcal Outbreaks Before and After Penicillin Prophylaxis

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Because no civilian study of this kind seems to have been reported a great deal of detailed information, which might ordinarily be omitted from such a discussion, is included here for the benefit of other workers in this important field.

The use of mass prophylaxis against streptococcal epidemics among large military populations is well established as a useful preventive measure. Watson and his associates [1] first reported the use of sulfadiazine in such situations in 1943. Employing 0.5 gm twice daily they were able to control the clinical manifestations of a scarlet fever epidemic at a Naval station, although the carrier rate was not affected markedly. The extensive control studies conducted by the U. S. Navy during World War II have been summarized by Coburn and Young.[2] In these, sulfadiazine was employed effectively in several prophylaxis programs, but the emergence of resistant strains of streptococci in both military and civilian populations [3-11] demonstrated the limitations of the sulfonamide drugs for such purposes.

Oral [12-20] and injected [12, 19, 21-23] penicillin have been found to be effective in the control of streptococcal epidemics providing that at least 250,000 units are administered twice daily for 10 days by the oral route and penicillin is available in the host for a similar period when the parenteral route is utilized. Increased resistance of Group A streptococci to penicillin has not been encountered as a practical problem.

Though mass prophylaxis has often been employed in military groups, comparable data are not available from civilian populations. Reinstein [24] used single injections of benzathine penicillin to terminate an epidemic caused by a nephritogenic strain of streptococcus on the Red Lake Indian Reservation. Breese and Disney [25] have administered single injections of the same preparation in the treatment of a large number of cases of streptococcal disease and in suspicious family contacts encountered in the course of a civilian pediatric practice.

In one instance oral penicillin was

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employed for group prophylaxis in a rural school comprising 66 pupils.[26] Here 200,000 units of penicillin G were given twice daily, five days a week for a total of 13 days of treatment; this was accompanied by a marked decline in the carrier rate. Bunn and Bennett[27] discuss the difficulties inherent in a school-centered rheumatic fever prevention program in which careful screening of all pupils was carried out each morning by the teachers and symptomatic children were cultured and referred for treatment. In this routine asymptomatic carriers remained undetected and untreated.

The application of the mass prophylactic measures which were developed in military studies to streptococcal epidemics in children[28] is of particular importance, not only because of the relatively high rate of infection among children, but also because the hazards of associated illnesses such as rheumatic fever are particularly great among them. Unlike the military groups where discipline can be enforced to insure the acceptance of medication, civilian populations present a number of potentially difficult administrative problems.

In December, 1955, the Bureau of Epidemiology and Communicable Disease Control of the New York State Department of Health received notification that a large number of cases of streptococcal disease were occurring in Schoharie County. The three towns which were principally involved were Cobleskill, Richmondville, and Sharon Springs. Each has a central school which serves the surrounding area. Following the Christmas vacation the outbreak in Cobleskill seemed to be subsiding, while those in Richmondville (population 1,800) and Sharon Springs (population 1,500) appeared to be progressing; the school absentee rates were in the vicinity of 13–15 per cent each day. These communities appeared to be suitable places for the evaluation of mass penicillin prophylaxis procedures.

Cobleskill (population 3,000) is the central community in Schoharie County. Richmondville lies five miles to the southeast and Sharon Springs seven miles to the northeast over moderately traveled two-lane highways. Communication between the two smaller villages occurs through Cobleskill, principally, and contact between the two populations is probably limited to casual exposure there. The county is a dairy and farming area. Though this portion of New York State is subject to heavy snowfall in winter, the roads are kept clear and only rarely are the school buses unable to traverse their five– to 20–mile routes. The population is a relatively stable one and comprised largely of families who have lived in the area at least for two generations.

Methods

Complete school rosters by classes were obtained from the two schools and every fifth name selected in order. This sample of pupils was cultured prior to penicillin therapy and at intervals thereafter. The entire staffs of both institutions, consisting of teachers, custodial personnel, cafeteria employees, and bus drivers were also cultured.

In addition to the studies carried on in the school, 56 families of the Sharon Springs school children were further investigated and cultured * before and after penicillin therapy in an attempt to determine the relationship of streptococcal diseases among school children to other members of their families.

Throat swabs were plated directly on sheep's blood agar plates, then placed in modified Pike's broth,[29] and transported as quickly as possible to the

* Twenty members of the class of 1958 of the Albany Medical College made these home visits and obtained the necessary cultures before and after the school prophylaxis program.

Table 1—Participation in Penicillin Prophylaxis Studies

Place	Population		Participants		Received Penicillin		Incomplete Penicillin		Received Tetracycline	
	Group	No.	No.	Per cent of Population	No.	Per cent of Participants	No.	Per cent of Penicillin Recipients	No.	Per cent of Participants
Richmondville	Students	463	441	95	435	99	12	2.8	6	1
	Staff	37	35	95	35	100	2	5.7	0	0
	Total	500	476	95	470	99	14	3.0	6	1
Sharon Springs	Students	379	366	97	353	96	11	3.1	13	4
	Staff	37	33	89	33	100	4	12.1	0	0
	Total	416	399	96	386	97	15	3.9	13	3

laboratory in Syracuse. All streptococci isolated were grouped and typed.* [30]

Written approval was obtained from the parents for their school children to participate in the penicillin prophylaxis study. Such permission was obtained from the parents of 95 per cent of the children in Richmondville and 96 per cent of the children in Sharon Springs (Table 1). The students and staff comprised 500 individuals in Richmondville and 416 in Sharon Springs. At the time that parental agreement was obtained a history of previous exposure and reactions of any kind to penicillin was requested. Table 2 indicates the high proportion of individuals who had received penicillin on other occasions.

* We are indebted to Dr. Elaine L. Updyke of the Communicable Disease Center, Public Health Service, Chamblee, Ga., for the grouping and typing sera.

Table 2—Frequency of Previous Penicillin Experience Among Two School Populations

Place	Age Group (Years)	Histories (No.)	Previous Penicillin	
			Received (Per cent)	Reactions (Per cent)
Richmondville	4–9	211	75	2.5
	10–14	152	72	0.9
	15–19	69	71	4.1
	20+	26	69	0.0
	Total	458	73	2.1
Sharon Springs	4–9	173	87	2.7
	10–14	131	69	5.5
	15–19	60	78	2.1
	20+	27	67	5.6
	Total	391	78	3.6

Table 3—Effects of Two Penicillin Prophylaxis Regimens upon Group A Streptococcal Rates in Two School Populations

Richmondville	Persons (No.)	Day 1 * Culture (No.)	Day 1 * Group A (Per cent)	Day 7 Culture (No.)	Day 7 Group A (Per cent)	Day 24 Culture (No.)	Day 24 Group A (Per cent)	Day 62 Culture (No.)	Day 62 Group A (Per cent)
K-5 ‡	265	50	50	46	0	49	8	46	13
6–12	198	35	26	34	0	35	0	37	11
Staff	37	36	8	23	0	26	4	25	4
Total	500	121	31	103	0	110	5	108	10

Sharon Springs	Persons (No.)	Day 0 † Culture (No.)	Day 0 † Group A (Per cent)	Day 10 Culture (No.)	Day 10 Group A (Per cent)	Day 24 Culture (No.)	Day 24 Group A (Per cent)	Day 55 Culture (No.)	Day 55 Group A (Per cent)
K-5	211	37	70	30	40	32	62	22	77
6–12	168	33	24	30	7	28	14	25	20
Staff	37	27	11	22	9	19	5	14	7
Total	416	97	38	82	20	79	32	61	38

* Day 1 = 1st day of ℞ penicillin G 250,000 U. B.I.D. P.O. for 10 days.
† Day 0 = day before ℞ began penicillin G 250,000 U. O.D. P.O. for 10 days.
‡ Kindergarten through 5th grade.

There is only a small variation among the age groups, ranging from 67 per cent in one group of adults to 87 per cent in the four- to nine-year-olds in Sharon Springs. A history of previous penicillin reactions was obtained in 2.1 per cent of individuals in Richmondville and 3.6 per cent of individuals in Sharon Springs (Table 2).

All permission slips were reviewed by a physician. Those in which any indication of sensitivity was reported were separated from the penicillin group. Penicillin-sensitive individuals were treated for 10 days with tetracycline,* 250 mg twice daily; 13 students in Sharon Springs and six in Richmondville received this treatment.

Class rosters were established for those persons remaining in the penicillin study group. These children received penicillin daily in school from the teacher and were given a suitable number of tablets to take home over the week end together with a check sheet to be signed by the parent who indicated when each tablet had been taken.

In Richmondville, 250,000 units of oral potassium penicillin G † were administered twice daily (9:00 A.M. and 3:00 P.M.) on 10 consecutive days. In Sharon Springs, 250,000 units of oral potassium penicillin G † were given once daily (9:00 A.M.) for 10 days. Any individual who missed more than a single dose of penicillin was considered to have received incomplete therapy. As shown in Table 1 only 3.0 and 3.9 per

* Supplied as Polycycline by Bristol Laboratories, Inc., Syracuse, N. Y.

† In the form of Cilloral, Bristol Laboratories, Inc.

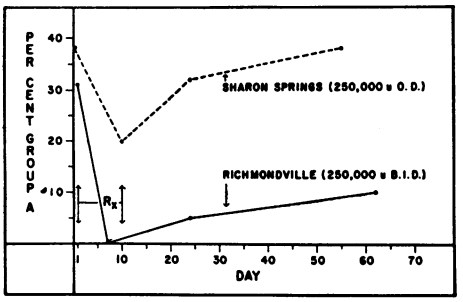

Figure 1—Effects of Two Penicillin Prophylaxis Regimens Upon Group A Streptococcal Rates

cent of the participants failed to complete the entire 10-day course. Those who received incomplete therapy were eliminated from the evaluation of the efficacy of the prophylactic measure. Further cases of streptococcal sore throat and scarlet fever were seen and treated as usual with intramuscular penicillin by the local physicians. During the school study cultures were taken only in school so that any child who was ill on any culture day was omitted from that particular culture series.

Results

School Study

Table 3 indicates the results obtained in the prophylaxis programs. These data are summarized graphically in Figure 1.

In Richmondville, where 250,000 units of oral penicillin were administered twice daily, 50 per cent of the children in the kindergarten through fifth grades were positive for Group A streptococci prior to therapy. Twenty-six per cent of those in grades six through 12 and only 8 per cent of the staff were positive. On day seven of therapy all cultures were negative. Fourteen days after the completion of therapy 5 per cent, and 52 days after completion of therapy 10 per cent, of the sample were again positive for Group A streptococci.

Concomitant with the fall in carrier rates, there was a decline in absenteeism to the expected normal rate for the season and cases of streptococcal sore throat virtually disappeared.

In Sharon Springs, where 250,000 units of penicillin were given only once daily, 70 per cent of the kindergarten through fifth-grade children were positive prior to therapy. Twenty-four per cent of the sixth through twelfth graders and 11 per cent of the staff were also positive for Group A streptococci.

On the last day of therapy 40 per cent of the kindergarten through fifth-grade group and 20 per cent of all individuals were still positive. By day 24 the rate had risen to 32 per cent and by day 55 it had risen to the level present prior to therapy (Table 3). Shortly after the last cultures were taken the Sharon Springs school was closed by the administration because of the high rate of absenteeism resulting from streptococcal disease. The diminishing number of individuals cultured in Sharon Springs on each occasion (97 to 61) reflects the large numbers of absentees in this school.

It will be noted that the cultures were not taken at precisely the same intervals in both communities because of the need to conform to the schedules and conveniences of the school programs, but it is unlikely that the culture results on the seventh and tenth days of therapy would have differed appreciably.

Figure 1 summarizes the experience with prophylactic penicillin in the two communities. The line connecting days seven and 24 in Richmondville only associates two points. The precise interval during which the carrier rate remained below the 5 per cent level in Richmondville is unknown.

The per cent of Group A strains among the positive cultures decreased markedly with increasing age as shown in Table 3. Although fewer positive cultures were obtained from the older

Table 4—Per cent of Streptococcal Isolates Identified as Group A in Two School Populations

Richmondville	Day 1		Day 7		Day 24		Day 62	
	No. Positive	Per cent Group A	No. Positive	Per cent Group A	No. Positive	Per cent Group A	No. Positive	Per cent Group A
K-5 *	29	86	0	0	11	36	9	67
6–12 †	17	53	2	0	5	0	11	36
Staff	7	43	1	0	3	33	2	50
Total	53	70	3	0	19	26	22	50

Sharon Springs	Day 0		Day 10		Day 24		Day 55	
	No. Positive	Per cent Group A	No. Positive	Per cent Group A	No. Positive	Per cent Group A	No. Positive	Per cent Group A
K-5 *	29	90	13	92	22	91	17	100
6–12 †	12	67	6	33	13	31	12	42
Staff	5	60	4	50	4	25	3	33
Total	46	80	23	70	39	64	32	72

* Kindergarten through 5th grade.
† Sixth through 12th grades.

age group, they had a higher proportion of nongroup A organisms (Table 4). In contrast with the 86 per cent of the kindergarten through fifth-grade pupils who had Group A organisms, only 43 per cent of the Richmondville adults with positive cultures were in this category.

The streptococcal types isolated from the two communities were different (Table 5). In Richmondville, Type 3 accounted for 41 per cent of the positive cultures prior to therapy; Type 6, 27 per cent; Types 12 and 1, 8 per cent together. The remaining 24 per cent were nontypable strains. In Sharon Springs Type 1 was present in 62 per cent of the positive cultures and Type 3 in 14 per cent. The remaining 24 per cent were nontypable strains. The general pattern of type occurrence remained constant throughout the study, but only a few positives were encountered in Richmondville after therapy.

Table 6 compares the types and groups isolated before and after penicillin administration in Sharon Springs. Of 24 individuals with typable streptococci, 11 retained the same type and one later was found to have a nontypable strain. Two cases that were originally found to have nontypable organisms continued to have nontypable strains. Despite 10 days of penicillin therapy, 14 individuals retained the same type or a nontypable organism and one child actually acquired a Group A streptococcus while on therapy.

Eleven of the children who received tetracycline were cultured before and after therapy. Of this group, four were positive before the administration of tetracycline and one of these was positive following 10 days of therapy.

Complications of Therapy

Penicillin was administered altogether to 856 individuals. Three possible reactions occurred. A 28-year-old male school teacher developed angioneurotic

Table 5—Distribution of Group A Streptococcal Types Detected in Two School Populations

Richmondville	Day 1 *					Day 7	Day 24					Day 62				
	Type						Type					Type				
	1	3	6	12	NT †		1	3	6	12	NT	1	3	6	12	NT
No.	1	15	10	2	9	No. Group A	0	2	0	0	3	0	5	1	0	5
Per cent	3	41	27	5	24	Isolated	0	40	0	0	60	0	45	10	0	45

Sharon Springs	Day 0 ‡			Day 10			Day 24 **			Day 55		
	Type			Type			Type			Type		
	1	3	NT	1	3	NT	1	3	NT	1	3	NT
No.	23	5	9	11	1	4	14	5	5	8	3	12
Per cent	62	14	24	69	6	25	58	21	21	35	13	52

* Day ℞ began.
† N.T. = Nontypable.
‡ Day before ℞ began.
* * One Type 28 Group A culture is not included.

edema beginning on the day following the completion of his course of 10 daily doses of 250,000 units of penicillin. He had never had penicillin previously and had no history of an allergic reaction of any kind. The other two reactions were minor in nature. One occurred in a 54-year-old female cafeteria worker who developed a mild rash involving a small area of the chest and neck after five doses of 250,000 units of penicillin. She had neither a history of penicillin therapy nor an allergic history. A rash also occurred in a six-year-old female school child. A mild exanthem involving the abdomen and back followed two doses of penicillin. This patient had had penicillin by injection once previously without reaction.

If each of these three individuals is

Table 6—Comparison of Pre- and Postpenicillin Streptococcal Culture Results in Sharon Springs

Initial Culture (Day 0)	Postpenicillin Culture (Day 10)					
	Group A Type			Other Group	Negative	Total
	Same	Different	NT *			
Group A, typable	11	0	1	1	11	24
Group A, NT *	0		2	1	3	6
Other group	0		0	4	4	8
Negative	1		0	1	34	36
Total	12		3	7	52	74

* Nontypable.

considered to have had a penicillin reaction, then 2.9 per cent of the 68 adults and 0.1 per cent of the 788 children had such reactions.

Other Epidemiologic Data

Examination of the data indicates that the transmission of infection most probably occurred in the school classrooms. The rates of infection were essentially the same on each of the 14 bus routes serving the two schools. All the bus drivers in the two communities had negative cultures despite their exposure to children in the school buses. As might be expected in institutions with completely mixed classes, no significant difference was evident in the attack rates for each sex.

No differences could be demonstrated between those children residing in the villages of Richmondville and Sharon Springs and those coming from the surrounding rural areas.

Family Study

As was indicated previously in the village of Sharon Springs, 56 families (300 persons) of children included in the school population were cultured prior to and after penicillin prophylaxis, but only the family members attending school received the daily dose of penicillin. Forty-nine per cent of the individual members of these families were of school age.

Little information is available on the prevalence and spread of streptococcal infection within the family group. Dingle and his associates [31] are intensively studying respiratory infections, including those due to streptococci, in a selected group of families in Cleveland, Ohio. They have observed that acute streptococcal pharyngitis accounts for only 2.4 per cent of the acute respiratory infections experienced by their family units. Breese and Disney,[32] studying streptococcal cases encountered in their private pediatric practice, similarly found that one-half to one-fourth of siblings developed streptococcal disease while only one in 20 parents seemed to contract it from a sick child. The attack rate was highest in the three- to four-year age group and diminished below two and above 10 years. Because it is believed that the source of streptococcal infections frequently is the school-age child,[31] it would be important to ascertain the effects of school epidemics of streptococcal disease upon the associated families. The present study provides information on a few aspects of spread within the family.

Analysis of the members of our family study group by age (Table 7) reveals that the kindergarten through fifth-grade

Table 7—Comparison of Pre- and Postpenicillin Culture Results in Sharon Springs Groups

Group	Persons (No.)	Prepenicillin (Day 0)			Postpenicillin (Day 24)		
		Culture (No.)	Group A (Per cent)	Nongroup A (Per cent)	Culture (No.)	Group A (Per cent)	Nongroup A (Per cent)
Preschool	24	19	58	0	24	33	4
K–5 *	83	81	62	4	69	54	9
6–12 †	63	59	33	12	50	26	22
Adult	130	107	10	15	90	12	18
Total	300	266	35	10	233	30	15

* Kindergarten through 5th grade.
† Sixth through 12th grades.

Table 8—Pre- and Postpenicillin Group A Isolations at Various Ages and Adult School-Child Exposures

Age Group (Years)	Persons (No.)	Average School-Child Exposure	Prepenicillin (Day 0)		Postpenicillin (Day 24)	
			Culture (No.)	Group A (Per cent)	Culture (No.)	Group A (Per cent)
<1	7	3.3	4	0	7	14
1–3	10	4.3	8	50	10	30
4–7	45	...	43	79	38	63
8–11	47	...	47	53	39	44
12–15	41	...	39	36	32	28
16–19	22	...	19	26	18	22
20–29	12	2.2	9	33	9	11
30–39	41	3.4	31	16	26	12
40–49	35	2.4	29	4	24	21
50–59	20	1.9	20	0	15	7
60+	11	1.4	11	9	9	11
Unknown	9	2.4	6	17	6	0
Total	300	...	266	35	233	30

children had the highest carrier rate for Group A streptococci, 62 per cent, in contrast to only 10 per cent of the adults. On the other hand, the Non-group A streptococcal carrier rate increases with the age of the sample. When these data are recalculated by years (Table 8), it is apparent that the highest carrier rates occur from one to 11 years and diminish thereafter. Positive cultures in adults apparently were not related to the amount of contact they had had with school children, as is indicated by comparing the average school child exposure * with the number of positive adults in each age group.

* Average number of school children to whom members of a particular nonschool age group are exposed.

Table 9—Number of Group A Streptococcal Types Isolated from Family Units in Pre- and Postpenicillin Surveys

No. of Group A Cultures in Family and Number of Types	Prepencillin (Day 0)				Postpencillin (Day 24)			
	No. of Families	No. of Members	No. Cultured	No. Group A	No. of Families	No. of Members	No. Cultured	No. Group A
Two or more Group A	24	163	141	80	17	116	102	52
1 Type	16	104	89	49	12	75	65	32
2 Types	5	43	37	24	4	37	33	18
3 Types	1	6	6	3	0	0	0	0
All Nontypable	2	10	9	4	1	4	4	2
One only Group A	13	56	52	13	17	92	61	17
No Group A	19	81	73	0	22	92	70	0
Total	56	300	266	93	56	300	233	69

Because the course of treatment in Sharon Springs was only minimally effective, the impact of adequate school prophylaxis on other members of the family and community could not be evaluated. No essential change was effected in nonschool-age family members.

The types of Group A streptococci isolated from the family units are summarized in Tables 9 and 10. Prior to penicillin therapy, among the 56 families, 19 were negative for Group A streptococci, 13 had only one individual with a Group A strain, and 24 families had two or more positive members. In 18 of the families with multiple positive cultures the type isolated was the same for all members of the family with streptococci. In five instances two types were isolated and in one instance three different types were isolated from the same family. Following penicillin therapy, only four families revealed more than one streptococcal type.

The type isolations within family groups bear out the results in the two school studies, namely, that two types of streptococci were predominantly present in each of the two communities. No consistent pattern appears in the distribution of the two types in either of

Table 10—Culture Results of Families with More Than One Group A in Either Culture

Family Identity No.	No. of Persons	Prepenicillin (Day 0)			Postpenicillin (Day 24)		
		No. Cultured	No. Group A	No. of Types	No. Cultured	No. Group A	No. of Types
26	6	6	1	1	4	2	1 + NT
1	5	5	2	1 + NT*	4	2	1 + NT
3	5	4	2	NT	5	2	1 + NT
9	6	6	2	1 + NT	5	1	1
21	10	6	2	2	5	1	1
23	8	5	2	1	6	4	1
25	4	4	2	1 + NT	4	2	NT
29	4	4	2	1 + NT	4	2	1 + NT
37	10	8	2	1	10	2	1 + NT
48	4	4	2	1	3	2	1
55	5	5	2	NT	4	0	...
13	5	5	3	1 + NT	3	1	1
24	6	6	3	3	5	3	1 + NT
27	5	5	3	1 + NT	5	2	1 + NT
30	7	6	3	2	6	5	2
2	10	5	4	1 + NT	10	6	2 + NT
6	11	10	4	1 + NT	11	2	2
8	9	6	4	1	4	1	1 + NT
10	5	5	4	1	4	3	1
16	6	6	4	1 + NT	4	1	NT
19	6	5	4	1 + NT	5	2	1
22	6	6	4	2	6	1	1
17	6	6	5	1 + NT	1	1	NT
12	9	8	6	2 + NT	6	5	2 + NT
32	11	11	9	2 + NT	10	6	1
Total	169	147	81		134	59	

* Nontypable.

the school groups or in the family study by grade, sex, family size, or location. These data seem to show that the two types existed together and simultaneously affected the same population groups. Because mass penicillin therapy interrupted the natural course of the epidemics, we were unable to ascertain the temporal relationship between each type and the illnesses which it produced. It may be that one was increasing in occurrence while the other was diminishing and being replaced.

Discussion

These studies indicate that mass administration of oral penicillin in appropriate dosage to school populations during epidemics of streptococcal disease is a practicable and efficacious prophylactic measure. A high proportion of the most susceptible and heavily infected groups are thus treated and the carrier rate appears to be markedly suppressed for a number of weeks. As was true of the military experiences [14–16, 18, 19] 250,000 units of potassium penicillin G, twice daily by mouth for 10 days, was found to be effective.

These epidemics, like many communicable disease outbreaks, were focused in the schools, most particularly the kindergarten through fifth-grade groups. Under such conditions, school-wide, mass penicillin prophylaxis is effective, but it is possible that such epidemics can be controlled by treating only the members of the lower five grades.

It has been pointed out that adult infection was not related to the extent of contact with the school-age population. It is more likely that the school and nonschool sample culture results are related to the type-specific immunity status of the individuals rather than to the other possible factors. If such is the case, then one would expect the number of streptococcal cases in a given family to mirror the previous experiences of its members with streptococci of the offending type. If the streptococcal types present in any one community are stable over a period of years,[33] one might expect the adults who have resided in that area for some years to have become immune to the common types. The results which we observed would not be inconsistent with this hypothesis.

Summary

Two epidemics of streptococcal disease in rural communities were treated by the mass administration of oral potassium penicillin G to the school populations. In one community 250,000 units were given twice daily for 10 consecutive days, with a marked and prolonged decline both in the carrier rate and clinical cases. In the second community 250,000 units of potassium penicillin G were administered only once daily for 10 consecutive days which resulted in a minimal fall in the carrier rate and a prompt return to a high level of infection and clinical illness. A study conducted in 56 families of the school children of one community revealed that the children age four to seven years had the highest rate of infection (79 per cent) while only 10 per cent of the adults were positive. Information is presented on the school-wide and familial occurrence of the different types and groups.

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REFERENCES

1. Watson, R. F.; Schwentker, F. F.; Fetherston, J. E.; and Rothbard, S. Sulfadiazine Prophylaxis in an Epidemic of Scarlet Fever. J.A.M.A. 122:730–733, 1943.
2. Coburn, A. F., and Young, D. C. The Epidemiology of Hemolytic Streptococcus. Baltimore, Md.: Williams and Wilkins, 1949.
3. Epidemiology Unit No. 22. Sulfadiazine Resistant Strains of Beta Hemolytic Streptococci. Appearance during the Course of Sulfadiazine Prophylaxis at a Large Naval Training Center. J.A.M.A. 129:921–927, 1946.
4. Damrosch, D. S. Chemoprophylaxis and Sulfonamide Resistant Streptococci. J.A.M.A. 130:124–128, 1946.
5. Van Ravenswaay, A. C.; Westwater, J. A.; and Holbrook, W. P. An Epidemic Caused by a Sulfadiazine Resistant Strain of Group A Type 17 Streptococcus. M. Clin. North America 30:707–715, 1946.
6. Delamater, E. D.; Jennings, R.; and Wallace A. W. Preliminary Report of an Outbreak of Streptococcal Disease Caused by a Sulfadiazine Resistant Group A Type 17 Hemolytic Streptococcus. J. Infect. Dis. 78:118–127, 1946.
7. Wilson, O. G. An Outbreak of Sulfadiazine Resistant Streptococcus Infection at Lowry Field, Colorado. J. Infect. Dis. 78:147–152, 1946.
8. Mitchell, R. B.; Tuttle, E. E.; Dingledine, L. C.; Grams, L. R.; Erdman, G. L.; Lombs, F. S.; and Holbrook, W. P. The Interpost Dissemination of Epidemic Strains of Hemolytic Streptococci by Troop Movement. J. Infect. Dis. 78:134–218, 1946.
9. Roberg, N. B. An Epidemic Caused by a Sulfadiazine Resistant Strain of the Streptococcus Hemolyticus Group A (Type 17). J. Infect. Dis. 78:135–146, 1946.
10. Johnson, R. D., and Hartman, T. L. Sulfadiazine Resistant Streptococcal Infections in a Civilian Community. J. Clin. Investigation 26:325–328, 1947.
11. Hartman, T. L., and Weinstein, L. The Problem of Sulfonamide-Resistant Hemolytic Streptococci. New England J. Med. 238:560–563, 1948.
12. Bynoe, E. T.; MacLennan, J.; Williamson, J.; Carpenter, J.; and Armstrong, C. Penicillin in Hemolytic Streptococcal Infections of the Throat, Canad. M. A. J. 53:471–478, 1945.
13. Wannamaker, L. W.; Denny, F. W.; Perry, W. Y.; Rammelkamp, C. H., Jr.; Eckhardt, G. C.; Houser, H. B.; and Hahn, E. O. The Effect of Penicillin Prophylaxis on Streptococcal Disease Rates and the Carrier State. New England J. Med. 249:1–7, 1953.
14. Bernstein, S. H.; Feldman, H. A.; Harper, O. F., Jr.; and Klingensmith, W. H. Mass Oral Penicillin Prophylaxis in Control of Streptococcal Disease. Arch. Int. Med. 93:894–898, 1954.
15. Bernstein, S. H.; Feldman, H. A.; Harper, O. F., Jr.; Klingensmith, W. H.; and Cantor, J. A. Observations in Air Force Recruits of Streptococcal Diseases and Their Control With Orally Administered Penicillin. J. Lab. & Clin. Med. 44:1–13, 1954.
16. Seal, J. R.; Mogabgab, W. J.; Friou, G. J.; and Banta, J. E. Penicillin Prophylaxis of Epidemic Streptococcal Infections. I. The Epidemic and the Effects of Prophylaxis on the Clinical Manifestations of Acute Streptococcal and Non-streptococcal Respiratory Infections. II. The Effects of Small and Large Doses of Oral Penicillin on Epidemic Streptococcal Infections and on Carriers of Group A Streptococci. Ibid. 44:727–753, 831–859, 1954.
17. Naval Med. Research Unit No. 4. Antibiotic Prophylaxis of Respiratory Infections. I. Evaluation of Small Oral Doses of Penicillin and Aureomycin in the Prevention of Streptococcal and Other Respiratory Infections Among Navy Recruits. Res. Proj. Report NM 005.051.01, 1953.
18. Seal, J. R. Oral Penicillin Prophylaxis of Streptococcal Infections. A.J.P.H. 45:662–672, 1955.
19. Chancey, R. L.; Morris, A. J.; Conner, R. H.; Catanzaro, F. J.; Chamovitz, R.; and Rammelkamp, C. H., Jr. Studies of Streptococcal Prophylaxis. Comparison of Oral Penicillin and Benzathine Penicillin. Am. J. Med. Sc. 229:165–171, 1955.
20. Gezon, H. M.; Cook, J. S., Jr.; Magoffin, R. L.; and Miller, C. H. The Use of Penicillin and Sulfadiazine as Prophylactic Agents Against Streptococcal and Non-specific Respiratory Infections Among Recruits at a Naval Training Center. Am. J. Hyg. 57:71–100, 1953.
21. Hamburger, M., Jr., and Lemon, H. M. The Problem of the Dangerous Carrier of Hemolytic Streptococcus. III. The Chemotherapeutic Control of Nasal Carriers. J.A.M.A. 130:836–841, 1946.
22. Stollerman, G. H., and Rusoff, J. H. Prophylaxis Against Group A Streptococcal Infections in Rheumatic Fever with New Repository Penicillin. J.A.M.A. 150:1571–1575, 1952.
23. Chamovitz, R.; Catanzaro, F. J.; Stetson, C. A.; and Rammelkamp, C. H., Jr. Prevention of Rheumatic Fever by Treatment of Previous Strep. Infections. I. Evaluation of Benzathine Penicillin G. New England J. Med. 251:466–471, 1954.
24. Reinstein, C. R. Epidemic Nephritis at Red Lake, Minnesota. J. Pediat. 47:25–34, 1955.
25. Breese, B. B., and Disney, F. A. The Successful Treatment of Beta Hemolytic Streptococcal Infections in Children with a Single Injection of Repository Penicillin (Benzathine Penicillin G). Pediatrics 15:516–521, 1955.
26. Hill, T. B. Treatment of Streptococcal Carrier State in a Rural School. Am. J. Dis. Child. 90:280–282, 1955.
27. Bunn, W. H., and Bennett, H. N. Community Control of Rheumatic Fever. J.A.M.A. 157:986–989, 1955.
28. Poskanzer, D. C.; Feldman, H. A.; and Beadenkopf, W. G. Mass Penicillin Prophylaxis in the Control of Civilian Streptococcal Epidemics. Presented at the annual meeting of the Am. Rheumatism A., Chicago, Ill., June 9, 1956.
29. Kuroda, K., and Feldman, H. A. A Simplified Modification of Pike's Broth. J. Lab. & Clin. Med. (In press.)
30. Swift, H. F.; Wilson, A. T.; and Lancefield, R. C. Typing Group A Hemolytic Streptococci by M Precipitin Reactions in Capillary Pipettes. J. Exper. Med. 78:127–133, 1943.
31. Dingle, J. H.; Badger, G. F.; Feller, A. E.; Hodges, R. G.; Jordan, J. S., Jr.; and Rammelkamp, C. H., Jr. A Study of Illness in a Group of Cleveland Families. Am. J. Hyg. 58:16–46, 1953.
32. Breese, B. B., and Disney, F. A. Factors Influencing the Spread of Beta Hemolytic Streptococcal Infections Within the Family Group. Pediatrics 17:834–838, 1956.
33. Feldman, H. A.; Kuroda, K.; and Harmon, W. (To be published.)