An outbreak of infectious hepatitis in a housing project presented a fine, free field for an epidemiologic study of the disease. The investigators made the most of this opportunity—with findings you will want to know about.

Observations on an Outbreak of Infectious Hepatitis in Baltimore During 1951*†

ABRAHAM M. LILIENFELD, M.D., M.P.H., IRWIN D. J. BROSS, PH.D., AND PHILIP E. SARTWELL, M.D., M.P.H., F.A.P.H.A.

Assistant Professor of Epidemiology, Johns Hopkins University School of Hygiene and Public Health; Statistical Consultant, Cornell University Medical College, New York, N. Y.; and Associate Professor of Epidemiology, Johns Hopkins University School of Hygiene and Public Health, Baltimore, Md.

DURING 1951 an outbreak of infectious hepatitis occurred in a housing project in Baltimore which permitted a rather intensive epidemiological investigation. It was possible to obtain information on several population characteristics in relation to which the distribution of the disease could be studied. In addition, the uniform arrangement of household units within the housing project permitted an analysis of the spatial distribution of the disease which has some implications with regard to the method of study of other infectious diseases. Due to these interesting features, it was considered desirable to place these observations on record.

Attention of the Baltimore City Health Department was called to the existence of an outbreak of jaundice in July, 1951, by the staff of the Baltimore City Hospitals, located about one-quarter of a mile from the housing project. Approximately 30 cases were reported by the staff during the period from April through September although the disease was not legally reportable at the time. There was an increase in the incidence of jaundice in other parts of Baltimore during this period, but it probably was considerably less marked than in the project. The diagnosis of these cases by the hospital staff was infectious hepatitis. The exclusion of other causes of jaundice such as leptospirosis and mononucleosis was based on clinical grounds and appropriate laboratory tests. It was decided to conduct a systematic investigation, the plan of study consisting primarily of a house-to-house survey of the project to determine the actual number of cases that had occurred and their distribution according to various characteristics of the population.

DESCRIPTION OF THE HOUSING PROJECT

This housing project is operated by the Baltimore Housing Authority and is

* Presented before the Epidemiology Section of the American Public Health Association at the Eightieth Annual Meeting in Cleveland, Ohio, October 21, 1952.

† This investigation was carried out while the senior author was the health officer of the Southern Health District, Baltimore City (Md.) Health Department.

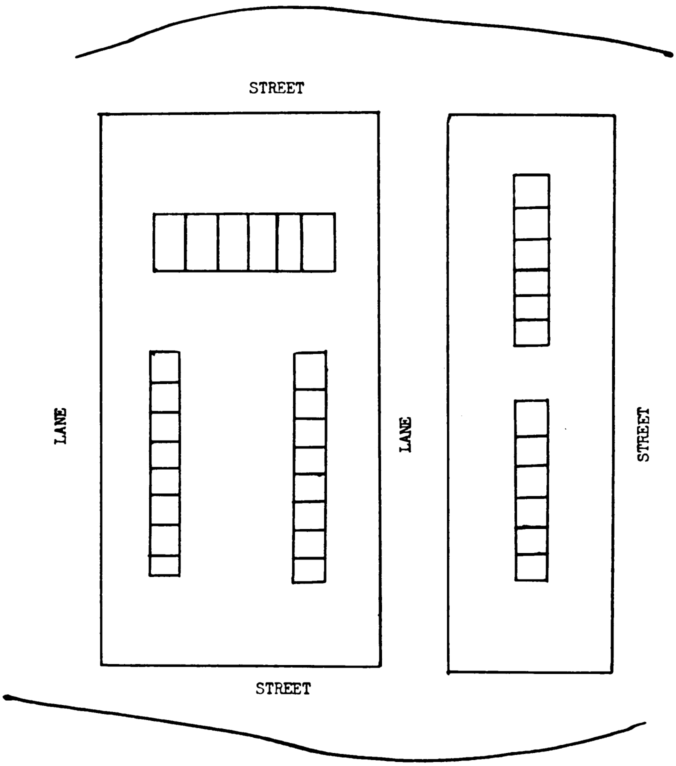

FIGURE 1—Map of section of housing project.

located in the southeastern section of the city in an industrialized area and contains 900 household units. The individual household units are attached in groups consisting of from 4 to 9 units. These groups are arranged in an orderly pattern and separated from each other by lanes and streets, the streets dividing the project into different areas. This can be noted from Figure 1 which consists of a map of a section of the project. Each unit is self-contained and consists of from 3 to 6 rooms, the predominant size being 5 rooms. The rooms are on 2 floors, except for the 3-room units. The project utilizes the city's water supply and sewage disposal systems.

The project was opened in 1943 as war housing with occupancy limited to white persons. At the close of World War II it was converted to a low-income project, the distinction from its previous status being that war housing has no income limitations while low-income projects are restricted to families with incomes below a range of approximately $2,500 to $3,500 a year, the variation depending upon the size of the household. From information made available by the project manager it was possible to obtain a fairly reliable classification of the households with regard to income status. Twelve per cent of the households received assistance from the Department of Public Welfare and 7 per cent, waiting to move, had a total income which exceeded the maximum limit allowable for this type of housing project. The remaining households, 80 per cent of the total, had incomes falling within the limitations established by the housing authority. The vast majority of the heads of the households were in the unskilled or semiskilled laboring class, their places of employment scattered throughout the industrial and business sections of the city.

The average household consisted of about 4.7 members. Taking into consideration the size of the household units, it would appear that overcrowding was not present. Within the project is a public elementary school (School A) which was attended by approximately 45 per cent of the residents of school age. Another elementary school (School B), located about 10 blocks from the project, was attended by about 10 per cent of the school-age children living in the project, who in turn comprised about 10 per cent of this school's total enrollment. The children attending School A were predominantly in the age group of 5–9 years, while those attending School B were 10–14 years of age. The remaining 45 per cent of school-age children in the project attended public and parochial schools located throughout the city. Included in this group were those children in the age group 14–18 years who attended high school.

METHOD OF STUDY

The survey of the housing project was begun in November and completed at the end of December, the interviewing being done by several physicians and public health nurses. The following information was obtained from an informant, usually the housewife, in each household: name, age, sex, school of attendance or occupation of each household member, the length of residence in Baltimore and in the project. The interviewer also inquired if any member of the household had received any injections during the past year and, if so, in what month. The informant was also asked whether or not any member had had jaundice or an illness with symptoms such as nausea, vomiting, fever, and malaise during the past year. If such an illness had occurred, information was obtained as to date of onset, where and by whom treated, and the diagnosis, if known.

Each of the 888 inhabited dwelling units was visited at least once and approximately 200 were visited twice since nobody was at home at the time of the first visit. The survey team was able to obtain the necessary information from 792, or 90 per cent, of the households. These 792 households contained 3,790 individuals.

In any study of this type certain errors may result from the method of collection of the data. One of these is the incomplete enumeration of cases by interviewing a member of the household. In order to estimate the size of this error, hospital records and physicians' reports were matched with the survey reports. From all these sources, it was found that 101 cases with jaundice had occurred by the time of the survey visit, of which 94, or 93 per cent, were found on survey, only 7 cases being missed by the interviewers. There may, of course, have been other cases unidentified by either method.

By matching these collateral records with the survey reports it was possible to verify the statements with regard to the month of onset of the case. The results of matching the records of 56 cases indicated that in general there was a tendency for the informant to state the month of onset closer to the time of interview than it actually was (in 41 out of the 56 there was no difference, in 7 it was given as one month later than the true month of onset, in 4 more than one month later, and in 4 one month earlier). We may therefore consider that the statement of month of onset was fairly reliable. However, the distribution of the differences would seem to indicate that a statement of dates of onset in time periods shorter than a month would not be sufficiently reliable to be justified. This creates some difficulty in defining secondary cases in a household, as will be discussed later.

In the survey the total number of cases found among the residents was 117, of which only 8 were cases without jaundice. In view of the small number of nonjaundiced cases and also because of the question of the reliability of a diagnosis in the absence of jaundice, further analysis will be limited to the jaundiced cases.

RESULTS

The 109 cases with jaundice were found to have occurred among 3,790 individuals during the year, giving a total annual attack rate of 2.9 per cent. On the whole, these cases were mild—as evidenced by the fact that only 4 out of the 109 were hospitalized—and there were no fatalities. The distribution of these cases according to month of onset (Table 1) indicates that in the early part of the year there were a few sporadic cases until June when an increase was first noted. During the summer there was an apparent decline followed by an increase to a maximum in September and October. The number of cases in November and December are probably underestimated since the survey was taking place during this period and unreported cases probably occurred in some households subsequent to the survey visit. That the number of cases did decrease in December was the impression of the staff physicians at the Baltimore City Hospitals. The decrease in incidence during the summer is consistent with the seasonal distribution reported by other observers.[1, 2]

TABLE 1

Distribution of Cases of Infectious Hepatitis with Jaundice by Month of Onset, During Period from December, 1950, to December, 1951

December, 1950	2
January, 1951	3
February	1
March	1
April	2
May	4
June	12
July	4
August	10
September	22
October	21
November	15*
December	8*
Not stated	4

* The number of cases for November and December are incomplete since the survey was being carried out during this period

The distribution of cases by age and sex is presented in Table 2 as age-sex specific annual attack rates. The attack rates were highest among children of school age, in the age group 5–14. The total attack rate for females (3.4 per cent) was higher than that for males (2.3 per cent). There seemed to be a tendency for females to be attacked at older ages since the male rate was higher than the female rate for the age group 0–4 years and the female rate markedly higher for the 15–19 age group. This

TABLE 2

Annual Attack Rates of Cases of Infectious Hepatitis with Jaundice by Age and Sex, 1951

Age Group Years	Males			Females			Both Sexes
	Population	Number of Cases	Annual Attack Rate Per cent	Population	Number of Cases	Annual Attack Rate Per cent	Attack Rate Per cent
0–4	370	5	1.4	328	3	0.9	1.1
5–9	381	17	4.5	383	27	7.1	5.8
10–14	290	13	4.5	315	26	8.3	6.4
15–19	157	1	0.6	177	7	4.0	2.4
20 +	578	4	0.1	811	6	0.1	0.1
Total	1,776	40	2.3	2,014	69	3.4	2.9

TABLE 3

Observed and Expected Numbers of Cases of Infectious Hepatitis with Jaundice in Relation to School Attended by Children Resident in Project

School	*Number from Project Attending*	*Number of Cases*	
		Observed	*Expected* *
A	764	45	44.9
B	161	17	9.9
Others	790	18	25.3
Total	1,715	80	80.1

* Expected numbers obtained by applying age-sex specific rates in Table 2 to number attending

may partially be the result of the age groupings used. The age distribution of attack rates is similar to what has been observed in other outbreaks, but the sex difference has not been previously reported.[1] We are unable to explain the differences in attack rates between the two sexes.

Other observers have reported outbreaks of infectious hepatitis as being primarily school epidemics.[1, 3] It was possible to classify the population of school children according to the schools of attendance and to see whether or not the outbreak was localized among those attending a particular school. The method of analysis was to calculate the number of cases to be expected among children attending a particular school from the age-sex specific attack rates of the total population of the project and the age-sex distribution of the children attending that school. These expected numbers were then compared with the observed number of cases. The results are presented in Table 3. There are no remarkable differences between observed and expected numbers.

In any outbreak of jaundice it is necessary to rule out the possibility that transmission was by means of parenteral injections. Twelve cases of hepatitis occurred among 406 individuals who gave a history of having received one or more injections during a year prior to interview, and 12.7 cases would be expected if the age-sex specific rates of the entire population were applied to this group, indicating that injections apparently had no influence. Although the histories as to injections are probably not very accurate, we think that if inoculations had played a major role in transmitting the virus, a difference between observed and expected numbers should have been found.

Socioeconomic status needs to be investigated in studying the distribution of any liver disease, particularly because of the possible influence of undernutrition. A fairly reliable classification of the population with regard to income (which represents one component of what is considered as socioeconomic status) permitted a comparison between 3 socioeconomic groups according to income. The results are presented in Table 4 and show no essential differences between the observed and expected numbers.

The possibility existed that cases of hepatitis might be occurring among households newly arrived in Baltimore or in the housing project, since such households might be particularly susceptible. To study this the population was divided according to length of residence in the city and the housing project and expected numbers were calculated and compared with the observed numbers, the comparisons being presented in Table 5. The observed and expected

TABLE 4

Observed and Expected Numbers of Cases of Infectious Hepatitis with Jaundice According to Income Status of Households Resident in Project

Income Status	*Population*	*Number of Cases* Observed	Expected *
Over Income	407	9	12.0
Low Income	2,857	82	76.1
Welfare Recipients	526	18	17.7
Total	3,790	109	105.8

* Expected numbers obtained by applying age-sex specific status in Table 2 to population in each category of income status

numbers are similar for length of residence in Baltimore. The situation is, however, quite different when length of residence in the housing project is considered. There were fewer cases than expected among those who had lived in the project under one year. This is somewhat different from the observations in military populations where recent arrivals in an epidemic area had higher attack rates than the more seasoned troops.[4] There are some possible explanations for the pattern observed in the present outbreak. Probably the most important reason is that those individuals who moved into the project during the year the outbreak was in progress had, on the average, a shorter period of exposure within the housing project than the others. In addition, there exists the possibility that in a housing project, a certain period of time elapses before social assimilation takes place, during which period relatively few extra-familial contacts are made. Admittedly, this is less likely with regard to the children of school age who were chiefly attacked.

One feature of the pattern of communicable disease that is of interest is

TABLE 5

Observed and Expected Numbers of Cases of Infectious Hepatitis with Jaundice According to Length of Residency in Baltimore and in Housing Project

Length of Residency	*Population*	*Number of Cases*	
		Residency in Baltimore	
Years		*Observed*	*Expected*
Under 1	70	1	1.2
1–4	221	4	5.2
5–9	487	18	13.6
Over 10	2,836	80	81.3
Not stated	176	6	4.4
Total	3,790	109	105.7
Years		*Residency in Housing Project*	
Under ½	332	0	9.0
½–1	284	3	6.8
1–2	381	12	9.2
Over 2	2.588	91	77.0
Not stated	205	3	5.6
Total	3.790	109	107.6

intrahousehold infection, as represented by secondary attack rates. Ideally, the secondary attack rate should measure the secondary cases resulting from exposure to the first or primary case in the household. These would be selected on the basis that they had occurred within the range of the incubation period of the disease, thereby eliminating most of the coprimaries, i.e., those persons who were exposed outside the household at approximately the same time as the primary case. To differentiate the coprimaries from the secondaries it is necessary to have a distribution of onsets by days or weeks. As was indicated earlier, there exists an error with regard to the date of onset which is small, when considered in terms of months, but it is probably considerable in terms of weeks or days. It was therefore decided to consider as secondary cases all those cases that had occurred in the household during a 2-month period following the first or primary case, recognizing that the rate would be overestimated somewhat by the inclusion of coprimaries. This cruder estimate actually has some advantage for comparative purposes because some such rate has been used in most other reports.[5, 6]

Another difficulty in computing secondary attack rates results from the fact that a certain number of households were visited soon after the time of onset of the first case. Since the reported range of the incubation period of infectious hepatitis is 10–40 days, we eliminated all affected households which were visited within 30 days of the occurrence of the first case. Out of the 79 affected households, 14 were in this category and were therefore not included in the computation of secondary attack rates.

In considering the intrahousehold occurrence of infectious hepatitis, it was possible to study the prophylactic value of gamma globulin. During the outbreak some members of the staff of the City Hospitals offered gamma globulin to the contacts in some of the affected households. This was not done on a systematic basis throughout the period, and it probably varied with the particular hospital staff member on duty. During the survey, interviewers secured information about gamma globulin, and contacts in the affected households were divided into two groups, those who received gamma globulin and those who did not. The secondary attack rates were computed for each of these groups. These data are presented in Table 6. The total secondary attack rate for those not receiving gamma globulin was 8.8 per cent. In other civilian outbreaks reported in the United States, the total secondary attack rates have, on the whole, been higher than that reported here, ranging generally from 20 to 40 per cent. However, in the London outbreak reported by Ford, the total secondary attack rate was 7.4 per cent.[6] Ford commented on the fact that in England secondary attack rates in urban outbreaks are, in general, lower than those in rural outbreaks which have rates of about 20 to 30 per cent. Interestingly enough, all of the outbreaks in the United States, in which secondary attack rates were computed and reported in the literature, were rural ones. Similar differences between rural and urban areas may exist in the United States and may reflect differences in the endemicity of the disease in rural and urban populations. If the infection is more prevalent in the city, there are likely to be fewer susceptibles so that when a focal outbreak does occur the secondary attack rate is lower.

Among the household contacts who received gamma globulin, 74 in all, only one secondary case occurred resulting in an attack rate of 1.4 per cent. This case had received the gamma globulin 2 days prior to onset but was included under the conditions set forth. The true difference in the attack rates may be even greater than the apparent difference

TABLE 6

Age-Specific Secondary Attack Rates Among Total Number of Persons Exposed to a Case in a Household According to Receipt or Nonreceipt of Gamma Globulin

	Did Not Receive Gamma Globulin		
Age Groups Years	*Number of Persons Exposed to Case Who Did Not Receive Globulin*	*Cases of Hepatitis*	
		Number	*Per cent*
0–4	42	2	4.8
5–9	45	5	11.1
10–14	32	6	18.8
15–19	26	3	11.5
20 and over	83	4	4.8
Total	228	20	8.8

	Received Gamma Globulin		
Age Groups Years	*Number of Persons Exposed to Case Who Received Globulin*	*Cases of Hepatitis*	
		Number	*Per cent*
0–4	17	1	..
5–9	21	..	..
10–14	13	..	..
15–19	3	..	..
20 and over	17	..	..
Total	71	1	1.4

since some of the individuals said not to have received gamma globulin may have received it. This error would result in a slight increase in the attack rate among those not inoculated and a decrease among those inoculated.

The value of gamma globulin in controlling a common vehicle epidemic of hepatitis was first demonstrated by Stokes and Neefe.[7] Its use was subsequently extended to propagated epidemics by Gellis, *et al.*,[8] who administered it to military squadrons and companies and by Havens and Paul[9] who studied an institutional epidemic. It appears that globulin can also play a useful role in preventing secondary cases among household contacts. In urban outbreaks with apparently low secondary attack rates this may be less useful than in rural areas.

One interesting aspect of the epidemiological pattern of an infectious disease is its spatial distribution in the area being studied. It would be desirable to know whether or not a household has an increased risk of becoming affected, i.e., having one or more of its members becoming ill if it is located next to or near another household which had been previously affected. We might consider this an extension of the concept of intrahousehold exposure, as measured by secondary attack rates, to population units consisting of several households. In the usual epidemic it is difficult to study this since the spatial distribution of the households is not uniform. In this housing project, there is a uniform arrangement of dwelling units as can be noted from Figure 1.

In order to obtain an over-all idea as to whether or not the risk varied from one household to another, it appeared reasonable to see if a binomial distribution would fit the observed distribution of the number of affected households within the sections. If the probability of becoming affected is the same in all sections, the observed data should be well approximated by a binomial distribution. The data were analyzed in this manner and the results are presented in Table 7 along with the theo-

TABLE 7

Distribution of Observed Number of Sections of Household Units According to Number of Affected Households Compared to Expected Numbers Derived from the Binomial Distribution

Number of Affected Household in a Section	*Observed Number of Sections*	*Expected Number of Sections According to Binomial Distribution*
0	70	56.9
1	33	43.9
2	11	16.1
3	6	3.5
4	2	0.5
Total	122	120.9

retical expectations according to the binomial distribution.

Household units are arranged in sections of from 4 to 9 households. The binomial expectations were computed for each group of sections containing the same number of household units with $p = 0.1$ (since 10 per cent of total households were affected) and $n =$ number of household units in the section. The expected numbers presented in Table 7 consist of the sum of the expectations for each group of sections. From Table 7 we note that the binomial gives a relatively poor approximation to the observed data as both tail ends of the distribution have excessive observed numbers. This indicates that the probability of a household becoming affected varies from section to section. One cause of this variation may be that the presence of an affected household in a section influences the probability of other households becoming affected. An attempt was therefore made to obtain a more direct method of indicating the "contagiousness" between households.

The method developed required an arbitrary classification scheme for varying degrees of contiguity, the household units being placed in 4 categories, A, B, C, and D, depending on the physical proximity of each unit to an affected household (as depicted in Figure 2). In classifying the households, it was decided that if a street intervened it would be considered a barrier and the classification scheme would end at this point. On the other hand, if the affected household adjoined a lane (or only a small distance separated this section from the next), the next category of the classification was skipped. For example, if a household on the edge of a section was affected, the first household in the next section was placed in the B category. Another problem arose in connection with the occurrence of secondary cases, and it was decided to consider the household again as an affected one if at least one month had elapsed between the 2 cases. (Actually there were few instances in which cases were separated by more than one month). Beginning in January and considering those households in categories A, B, C, and D in relation to the first one involved in the area as being exposed to the risk of becoming affected, we determined the percentage of related households that became affected during February. This was done for successive monthly time periods during 1951 and summed up for the entire year. The results are presented in Table 8. It is apparent that close proximity to an already affected household increases the risk of a household becoming affected. It must be borne in mind that these

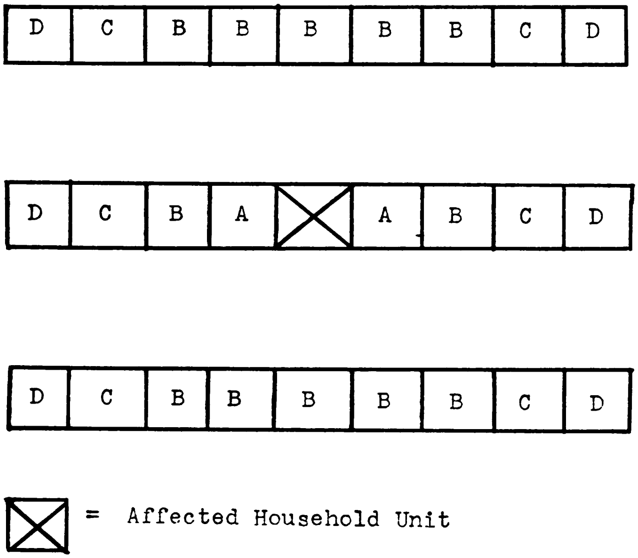

FIGURE 2—Classification of household units relative to an affected household.

percentages are basically monthly attack rates. The over-all percentage of affected households in the project was 10 per cent for the year and an average monthly rate would therefore be a little less than 1 per cent.

At the peak of the outbreak, i.e., in September and October, the monthly rate reached 3 per cent. It is apparent that the risk of contagion is markedly increased only for the most closely situated households—Class A—while those in Classes B, C, and D are fairly similar to the general average. This pattern may be indicative of the mode of spread of the virus. On hypothetical and intuitive grounds we could perhaps assume that a disease spread by the air-borne route would have an increased risk for categories B to D, gradually declining, of course, but not merely limited to Category A. On the other hand, a disease spread by the fecal-oral route, might be assumed to have an increased risk in Category A and very little, if any, increase in categories B, C, and D, which is the pattern of this outbreak. These considerations are compared with the observed data in Figure 3.

It must be emphasized that these in-

TABLE 8

Number and Per cent of Affected Households in Various Categories of Association with Other Affected Households

Category *	Total Number of Households in Category	Affected Households	
		Number	Per cent
A	130	8	6.2
B	724	12	1.7
C	341	3	0.9
D	295	5	1.7

* See text for discussion of method of classification

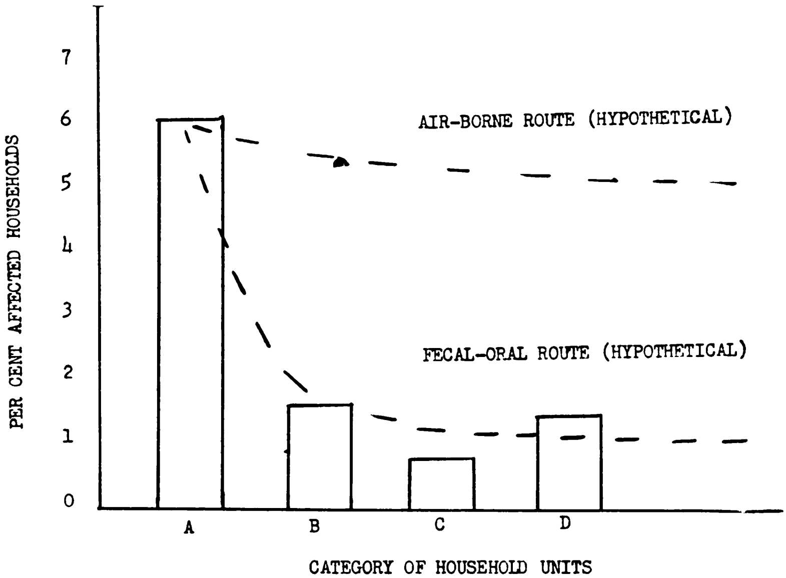

FIGURE 3—Comparison of observed per cent of affected household units in various categories of proximity with other households with hypothetically expected distribution based on different modes of transmission of virus.

ferences with regard to mode of transmission are purely speculative since we have no similar patterns for diseases with known modes of spread with which the present data could be compared. For the moment it is sufficient to indicate that the observed pattern might be utilized as a basis for applying gamma globulin in civilian populations to stop an outbreak. In institutional outbreaks it is feasible to administer gamma globulin to all the inmates. Although this is impossible in civilian life, it would be feasible to administer gamma globulin to the households which are in close proximity to an already affected one.

Another way of viewing the spatial distribution of a disease in an area is by means of spot maps of cases in successive time periods. These were prepared and indicated that cases would develop in one area of the project in one time period and in the next time period cases would occur in a contiguous area while there would be none or a marked decrease of cases in the original area. The disease seemed to spread from an initial focus near the center of the project in a way quite similar to the radial type of spread often seen in measles and poliomyelitis. This has also been observed in England.[10] The rate of spread appears to be slower than in outbreaks of measles and poliomyelitis, but this may be a result of the longer incubation period rather than differences in the mode of spread.

SUMMARY AND CONCLUSIONS

An outbreak of infectious hepatitis in a housing project in Baltimore during 1951 was studied by a house-to-house survey of 90 per cent of the 888 resident families. Over a one-year period the attack rate was 2.9 per cent. On the basis of comparison with physicians' and hospitals' reports, the case enumeration is considered fairly reliable. The age group 5–14 years experienced the highest attack rate and females a somewhat higher rate than males. Comparison of age-adjusted frequencies showed no important differences by school attended, by income status of family, by duration of residence in the city, or according to whether parenteral inoculations had been given. Individuals who had recently moved into the project had a lower attack rate than others.

Secondary attack rates were computed, based upon all cases occurring during the 2 months after an intial case. The secondary attack rate among those who had not received gamma globulin was 8.8 per cent, while one case occurred among those who had received it. The unprotected secondary attack rate was lower than in most reported outbreaks, but these were in rural communities. This difference, which is consistent with British reports, suggests a higher endemic level of infection in urban communities resulting in a smaller number of susceptibles available for infection upon the occurrence of a focal outbreak.

Study of the spatial distribution of the disease showed that persons in households immediately adjacent to an affected household had an increased risk of attack over those at a greater distance. On the basis of certain assumptions regarding differences in the pattern of distribution of diseases transmitted by the fecal-oral route as compared with the air-borne route, it is considered that the present data are more consistent with the fecal-oral route as the means of transmission of the virus.

ACKNOWLEDGMENT—The authors are indebted to Dr. Huntington Williams, commissioner of health, Baltimore, Md., for making this investigation possible. They are grateful for the assistance of the following in the collection of the basic survey data: Dr. John Skladowsky, health officer, Southeastern Health District, Dr. Myron Tull, director, Bureau of Communicable Diseases, both of the Baltimore City Health Department; Dr. James Strain, United States Public Health Service assigned to the State of Maryland Department of Health; to several public health nurses of the Baltimore City Health Department, and to the staffs of the Baltimore Housing Authority and the Baltimore City Hospitals.

REFERENCES

1. Havens, W. P., Jr. Infectious Hepatitis. *Medicine* 27:279–326, 1948.
2. Cree, E. M., and Brown, J. W. Observations on the Epidemiology of Infectious Hepatitis. *J. Lab. & Clin. Med.* 37:104–121, 1951.
3. Williams, H. Epidemic Jaundice. *New York State J. Med.* 22:150–155, 1922.
4. Gauld, R. L. Epidemiological Field Studies of Infectious Hepatitis in the Mediterranean Theatre of Operations. VII. Selection Among American Troops. Seasoning and Incidence, 1944–1945. *Am. J. Hyg.* 43:299–339, 1946.
5. Davis, D. J., and Hanlon, R. C. Epidemic Infectious Hepatitis in a Small Iowa Community. *Ibid.* 43:315–325, 1946.
6. Ford, J. C. Infective Hepatitis (Epidemic Catarrhal Jaundice). 300 Cases in an Outer London Borough. *Lancet* 244:675–678, 1943.
7. Stokes, J., Jr., and Neefe, J. R. The Prevention and Attenuation of Infectious Hepatitis by Gamma Globulin. *J.A.M.A.* 127:144–145, 1945.
8. Gellis, S. G., Stokes, J., Jr., Brother, G. M., Hall, W. M., Gilman, H. R., Beyer, E., and Morrissey, R. A. The Use of Human Immune Serum Globulin in Infectious Hepatitis in the Mediterranean Theater of Operations. *Ibid.* 128:1062–1063, 1945.
9. Havens, W. P., and Paul, J. R. Prevention of Infectious Hepatitis with Gamma Globulin. *Ibid.* 129:270–272, 1945.
10. MacCallum, F. O., *et al.* Infective Hepatitis. Studies in East Anglia During the Period 1943–1947. *Med. Res. Council Spec. Rep.* Series No. 273, 1951.