GASTRO-ENTERITIS IN INFANCY

FROM

THE PUBLIC HEALTH DEPARTMENT, LONDON COUNTY COUNCIL

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This paper describes a study of the epidemiology and the aetiology of infantile enteritis in two of the nine divisions into which the County of London is divided for day-to-day administration. The two divisions comprised the metropolitan boroughs of Chelsea, Fulham, Hammersmith, Kensington, Hampstead, Paddington, St. Marylebone, St. Pancras, and Westminster, with a total population of 994,000 at the 1951 census, and a total of 15,409 live births in 1950. The investigation began in July, 1949, and was continued until November, 1950. For the purpose of this study, enteritis was defined as diarrhoea and vomiting occurring in children under the age of 2 years, of such severity as to require admission to hospital (or to cause death before removal could be effected).

Enteritis is not a generally notifiable disease in London and it was necessary, therefore, to seek the co-operation of hospitals in a voluntary reporting system. This co-operation was freely forthcoming, and all fever hospitals, children's hospitals, and other hospitals likely to admit cases of diarrhoea in infants under 2 years of age agreed to notify the county medical officer of health of all such admissions.

METHOD OF INQUIRY

All these cases were registered in order to provide a general picture of the incidence of enteritis admissions. Those infants whose homes were in the survey area were the subject of domiciliary inquiry by health visitors for the appropriate districts. A whole-time health visitor was seconded for special duties in connection with the cases admitted to the enteritis unit at St. Ann's Hospital. A uniform questionnaire suitable for statistical treatment was designed, and the health visitors sought information on feeding and food preparation, size of family, occupation of principal wage-earner, housing and sanitation, previous medical history of the family, and possible sources of contact with infection.

When the domiciliary inquiries had been completed, the hospital was asked for an assessment of the severity

of the illness, indications of parenteral infection on admission, information on bacteriological findings, and, when applicable, results of *post-mortem* examination.

FINDINGS

INCIDENCE.—Table I shows the trend of admissions during the year in the two selected divisions and in the County of London as a whole.

TABLE I
INCIDENCE OF REPORTED ENTERITIS ADMISSIONS IN
4-WEEK PERIODS THROUGHOUT THE YEAR ENDED
JUNE 30, 1950

Period (wks)	Division 1	Division 2	London County
1-4	11	13	102
5-8	13	20	77
9-12	19	20	108
13-16	12	24	87
17-20	16	21	104
21-24	24	26	106
25-28	25	16	88
29-32	11	15	60
33-36	7	14	49
37-40	17	14	66
41-44	6	14	41
45-48	5	10	46
49-52	19	13	59
Total	185	220	993

Heavy concentrations of cases in infants admitted from families living in communal accommodation (rest centres, etc.) or from residential nurseries were observed. There was no evidence of any pronounced seasonal fluctuation. The falling off in reported cases in 1950 was part of a general decline in incidence of enteritis.

SAMPLE.—The 360 cases reviewed included seventeen which were re-admitted to hospital after an initial period of treatment and which were only counted once each in respect of their total periods of treatment. Their inclusion depended to some extent on the reporting zeal of the hospitals, and 220 came from the enteritis unit of St. Ann's Hospital; but in so far as all reported patients resident in the specified

TABLE II
DISTRIBUTION BY AGE; FEEDING, SEX, AND BIRTH WEIGHT

Sex	Age (mths)	Feeding			Total	
		Wholly Breast-Fed	Partially or Wholly Bottle-Fed	Other	No.	Per cent.
Male	0-2	1	65	—	66	29.5
	3-5	4	50	—	54	24.2
	6-8	4	22	—	26	11.7
	9-11	4	27	4	35	15.7
	12-17	—	10	14	24	10.8
	18-23	—	2	17	18	8.1
	Not known	—	2	7	9	—
	Total ..	13	177	42	232	100.0
Female	0-2	5	24	—	29	23.4
	3-5	1	35	—	36	29.0
	6-8	2	23	—	25	20.2
	9-11	—	10	4	14	11.3
	12-17	—	4	9	13	10.5
	18-23	—	1	6	7	5.6
	Not known	1	3	—	4	—
	Total ..	9	100	19	128	100.0
Both		22	277	61	360	—
Percentage		6.1	77.0	16.9	100.0	—
Birth Weight (lb.)	2½	—	4	—	4	1.3
	3½	—	9	1	10	3.1
	4½	—	23	2	25	7.9
	5½	3	46	10	59	18.5
	6½	4	85	20	109	34.3
	7½	6	60	9	75	23.6
	8½	2	23	5	30	9.4
	9½ and over	1	4	1	6	1.9
	Not known	6	23	13	42	—
	Total	22	277	61	360	100.0
	Mean Weight	7.63	6.93	7.10	—	—
	S.E. of Mean	0.28	0.09	0.17	—	—

area were included it would seem reasonable to consider them as representative of hospital cases generally.

SEX AND AGE INCIDENCE (Table II).—There were nearly twice as many boys as girls, from which it would seem that in this disease, as in many others, there is a higher susceptibility in male than in female infants. The normal sex ratio of male to female infants under two years is 1.05 : 1 (about half of both boys and girls were under 6 months of age).

In the cases admitted to St. Ann's Hospital from their own homes, a graph of the age at onset of illness showed a marked peak at 1-2 months, a gradual decline in the following months, and a second peak between 11 and 12 months. The cases admitted from institutions showed an even incidence from 1 to 5 months of age; in most cases the illness began soon after admission to the institution.

BIRTH WEIGHT AND FEEDING (Table II).—As might be expected, very few (only 22, 6.1 per cent. *i.e.*) of the

infants were completely breast-fed, the majority being bottle-fed or on mixed feeding.

Of the 22 breast-fed infants, thirteen had higher than average risks of exposure to infection (three came from rest centres, three had been hospital in-patients and one had been an out-patient in the 14 days preceding onset, two came from residential nurseries, one from a day nursery, and three were attending infant welfare centres); of these thirteen, eight had had a known contact with diarrhoea and vomiting within 14 days of onset. Of the remaining nine, four were known to have been in recent contact with enteritis. The breast-fed babies were not from especially poor families; of the fourteen for whom details were available, two were from Social Class II (as defined by the Registrar-General), eight from Class III, two from Class IV, and two from Class V (see also Table IV).

In the general population from which the sample was drawn, 76 per cent. of babies were breast-fed at 14 days and 31 per cent. were wholly breast-fed over the first 6 months of their lives (Douglas, 1950). Incidence of enteritis as defined was, therefore,

very much less in breast-fed than in bottle-fed infants, and so large a difference can hardly be accounted for by differential association with adverse socio-economic conditions, even though this factor is possibly related to the incidence of breast-feeding; nor is it wholly explained by the fact that many of the bottle-fed babies are nourished in that manner because they are prematurely born and are of low birth-weight. Even among the babies of normal birth-weight the breast-fed babies largely escaped disease of the character studied. The importance of breast-feeding emerges before that of any other preventive factor.

SEVERITY OF ILLNESS.—On discharge the cases were classified by the hospital physicians as follows (Table III):

About half the cases were mild or entirely without signs of diarrhoea during stay in hospital. Only one-fifth of all cases admitted to hospital were so severely ill with diarrhoea and vomiting as to require parenteral therapy. There were fifteen deaths, 4.6 per cent. of those with diarrhoea.

TABLE III
DEGREES OF SEVERITY OF ILLNESS

Symptoms	No.	Per cent.
No sign of diarrhoea	37	10.3
Mild	146	40.6
Moderate	106	29.4
Severe (requiring parenteral therapy)	71	19.7
Total	360	100.0

SOCIO-ECONOMIC BACKGROUND.—Sixty infants (16.2 per cent.) were illegitimate. This incidence of illegitimacy may be compared with the incidence of 9.6 per cent. in the general population of that area of London in which the study took place. The social class distribution of the cases may be

compared with that of the general population of the county as measured in the 1951 census (1 per cent. sample) (Table IV).

It will be seen that the proportion of infants coming from Social Classes IV and V was higher (45.1 per cent.) than from the general population (29.0 per cent.). The proportion coming from Social Classes I and II was abnormally low (5.2 per cent., compared with a county average of 19.3 per cent.). Taken in conjunction with the higher incidence of illegitimacy, these differences, which are statistically significant, suggest that the incidence of enteritis is higher in the lower social classes. Some of the reasons for this differential will emerge later.

SIZE OF HOUSEHOLD.—The average size of household in each group (excluding cases in communal accommodation or residential nurseries) is shown in Table V (opposite), with comparative figures for the whole county as indicated by the 1951 census, and for the study area as obtained from health visitors' records.

The figures for the county as a whole are not strictly comparable; it is possible to refer only to households with at least one child under age 5, and for these the average size was 4.2. The average size of the households studied was 5.3 and it appears therefore, that the infants admitted to hospital were drawn from larger than average households in the county. In interpreting this difference, which is statistically significant and consistent in all sub-groups of disease severity, three independent influences must be borne in mind:

(1) Difficult social conditions are taken into consideration in allocating hospital beds, and it may be that, even if the incidence of enteritis were equal in all sizes of household, cases in the larger households would be more frequently taken into hospital care because of difficulties in home nursing.

TABLE IV
SOCIAL CLASS

Social Class*	Principal Wage Earner in Families Studied										Heads of Private Households (1951 Census, London A.C.)	
	Total Cases		No sign of Diarrhoea		Enteritis							
					Mild		Moderate		Severe			
	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
I	2	0.7	—	—	1	0.9	1	1.1	—	—	352	3.7
II	13	4.5	1	3.8	3	2.6	7	8.0	2	3.3	1,496	15.6
III	143	49.7	18	69.3	56	48.7	42	48.3	27	45.0	4,949	51.7
IV	77	26.7	7	26.9	23	20.0	25	28.8	22	36.7	1,268	13.3
V	53	18.4	—	—	32	27.8	12	13.8	9	15.0	1,503	15.7
Not known	72	—	11	—	31	—	19	—	11	—	1,576	—
Total ..	360	100.0	37	100.0	146	100.0	106	100.0	71	100.0	11,144	100.0

*As defined by Registrar-General (1951). "Classification of Occupations, 1950". H.M.S.O., London.

TABLE V
SIZE OF HOUSEHOLD

Average Number in Family	Total	No Sign of Diarrhoea	Enteritis			London A.C. 1951 Census*	L.C.C. Divisions 1 and 2 Health Visitors' Survey 1951*
			Mild	Moderate	Severe		
Adults	2.49	2.45	2.54	2.34	2.59		
Children	Under Age 2	1.45	1.24	1.43	1.50	1.52	
	Age 2 or Over	1.35	1.29	1.43	1.41	1.14	
Total	5.29	4.98	5.40	5.25	5.25	4.2	4.3

*For households with at least one child under age 5.

(2) Larger families are known to be associated with lower social status. The association between size of family and incidence of enteritis may, therefore, arise from both these factors being correlated simultaneously with poor socio-economic conditions. Equally, the reverse could apply: the real association might be that between enteritis incidence and size of family, and the apparent connexion between social class and enteritis might arise spuriously from the larger families in lower social classes. This triangular effect is difficult to disentangle without a specially-designed factorial experiment.

(3) There is a *prima facie* hypothesis that infection will be more frequent where the number exposed to

risk of infection is larger. The larger the household the more likely is infection to be imported into the household, and the more likely is it to be transmitted from case to case. It has been found (Stein, 1952) that tuberculosis mortality is more closely associated with the number of persons per dwelling than with the extent to which those persons are crowded together.

HOUSING CONDITIONS.—The type and density of housing are shown in Table VI and the figures are compared with those of a recent survey in the study area (Gore and Hartston, 1953) and with certain census figures.

TABLE VI
HOUSING CONDITIONS

Type of Accommodation				Total		No Sign of Diarrhoea		Enteritis						Divisions 1 and 2 1952 Survey		London A.C. Census 1951 1% Sample
								Mild		Moderate		Severe		No.	Per cent.	
				No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.			
House	40	11	9	24	13	9	12	11	6	8	10	6				
Flat	67	19	8	22	27	19	19	18	13	18	47	26				
Rooms	165	46	16	43	65	45	48	46	36	52	115	64				
Communal	42	12	3	8	15	10	18	17	6	8	—	—				
Residential Nursery	44	12	1	3	25	17	8	8	10	14	—	—				
Other	—	—	—	—	—	—	—	—	—	—	8	4				
Not stated	2	—	—	—	1	—	1	—	—	—	—	—				
Total	360	100	37	100	146	100	106	100	71	100	180	100				
Persons per Room (excluding communal accommodation) ..				2.05		1.44		2.23		1.90		2.14		0.83		
Sanitation	W.C.	358		37		146		106		69						
	Other	2		—		—		—		2						
	Shared	215	60	15	41	88	60	68	64	44	62		35			
Washing Facilities	Good	105	31	14	40	36	27	33	33	22	33					
	Adequate	141	42	15	43	56	41	42	43	28	41					
	Bad	91	27	6	17	43	32	24	24	18	26					
	Not stated	23	—	2	—	11	—	7	—	3	—					
Washing-up facilities shared ..				115	34	5	14	51	38	30	30	29	43		†16	
Sanitary Defects	Dirty Dustbin ..	1		—		—		—		1						
	Condemned Property	4		—		3		—		—						
	Bad Drains	1		—		1		—		—						

*For households with at least one child under age 5.

†Sharing or without a kitchen sink.

With regard to type of accommodation, it will be seen that, compared with average conditions, the families in the study had access to a normal share of the available houses and flats, but that there was an unduly large representation of communally-accommodated families and of infants in residential nurseries. Nearly one-quarter of the cases (86) came from such a source, where, merely on the basis of the numbers at risk, the facility of transmission of infection in the presence of one infecting case is enhanced. Furthermore, excluding the communal accommodation, there was more than average crowding in these homes as measured by the density index of persons per room.

For all the families studied (excluding those in communal accommodation), the average density was 2.05 persons per room, compared with 1.38 for a sample survey of the general population of the area of similar household constitution. The census figure of 0.83 has been inserted for completeness, but it is naturally lower because it relates to the whole population including families without children.

Direct expression of this crowding or of conditions which are likely to be associated with crowding are given by the remaining figures in Table VI. Although actual personal washing facilities were bad in only a quarter of the households, conditions were much worse at "kitchen" level—one-third of the households had to share washing-up facilities with another household, a fraction twice as large as

in the county as a whole. With regard to sanitation, nearly two-thirds of the households had to share a water-closet; the proportion in the county as a whole is only half as large. These two factors have a similar action in increasing the likelihood of spread of infection from family to family.

CLEANLINESS IN THE HOME AND CARE OF FOOD.—The health visitors made personal, subjective, assessments of the standard of cleanliness in the homes. A little less than half (41 per cent.) of the households were regarded as barely satisfactory, and one-sixth (17 per cent.) were regarded as bad.

In their attitude towards the care of food, nearly one-half the families were careless or dirty (Table VII). Generally speaking, food was adequately protected against flies, vermin, and dust in some three-quarters of cases (the proportions are remarkably constant in the various groups). Heat was less well guarded against; only one-quarter of families took adequate precautions (of these two-thirds, 18 per cent. of the total, had refrigerators). Evidence of flies was seen in about one-fifth of households, and evidence of mice or other vermin in about the same proportion of cases. There is no control group with which to compare this information. Recalling also that there was no seasonal swing in incidence of admission to hospital, would not appear that a strong case could be made for suggesting that contamination of food by flies

TABLE VII
CARE OF FOOD*

Factors Examined		Total		No Sign of Diarrhoea		Enteritis					
						Mild		Moderate		Severe	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Hygiene	Clean	181	54	23	66	76	55	45	47	37	56
	Careless	120	36	11	31	49	36	36	37	24	36
	Dirty	34	10	1	3	13	9	15	16	5	8
	Not stated	25	—	2	—	8	—	10	—	5	—
	Total	360	100	37	100	146	100	106	100	71	100
Protection against	Heat	72	27	5	16	25	25	25	30	17	33
	Dust	208	78	26	81	73	73	66	79	43	83
	Flies	213	79	26	81	76	76	68	81	43	83
	Mice, etc.	190	71	27	84	64	64	64	76	35	67
	Not stated	92	—	5	—	46	—	22	—	19	—
Refrigerator		50	19	3	9	23	23	12	14	10	19
Vermin	Flies	67	20	2	6	29	21	22	23	14	21
	Mice, etc.	75	22	7	20	30	22	23	24	15	23

*Percentages are "of stated" cases.

or multiplication of organisms in food due to lack of refrigeration were major aetiological factors.

PET ANIMALS.—There was a cat in 81 households (23 per cent.) and a dog in 33 (9 per cent.). There were three canaries, and no parrots. The normal frequency of pets is not known but these figures would not be regarded as unduly large.

PREPARATION OF FOOD FOR BOTTLE-FED INFANTS.—We have seen that washing-up arrangements, and presumably other kitchen facilities, were shared in one-third of all cases; in fact, for the bottle-fed infants, only 164 (59 per cent.) mothers had separate facilities for preparing feeds. The materials used for bottle-feeds are shown in Table VIII. Three-quarters of the bottle-fed infants were being given dried milks, and the rest, with two exceptions, were having pasteurized or sterilized liquid cow's milk.

TABLE VIII
MATERIALS OF BOTTLE FEEDS

Bottle Feeds		No.	Per cent.
Cows' Milk	Pasteurized ..	62	22·4
	Sterilized ..	5	1·8
	Raw	2	0·7
Dried Milk		208	75·1
Total		277	100·0

Details of the methods of preparing feeds are shown in Table IX. In the opinion of the health visitors, bottles were adequately sterilized in little more than half the cases (57 per cent.), though the feeds themselves were boiled in nine-tenths of cases (88 per cent.). There were very few instances (4 per cent.) where milk was prepared for several feeds at one time. On the whole the impression

was that the standard of hygiene in bottle feeding could be improved, and that, apart from the presumed inferiority of cow's milk as compared with breast milk, the lack of cleanliness in feeding, particularly in relation to the sterilization of utensils, may have been an aetiological factor in the development of diarrhoea and vomiting.

The health visitor attached to St. Ann's Hospital who investigated a series of admissions to the enteritis unit in more detail reported as follows:

The care of feeding bottles and teats was poor. Of 112 mothers using bottles, only 34 used any form of detergent to cleanse them; the remaining 78 seemed to think that this would be harmful to the infant, and some used methods of their own for removing milk scum, such as tea leaves, wet newspaper and sand. Three mothers used the Milton technique of disinfection correctly, and two incorrectly; fourteen boiled both bottle and teat after each feed, seventeen boiled them at least once a day, five boiled sometime during the week; 41 relied on domestic scalding only, and 37 made no attempt to disinfect at all. A small proportion of mothers protected the bottle and teat between feeds with a clean cloth or in a special receptacle; the majority stored them in a cupboard or drawer with other crockery; and 37 left them exposed. This poor bottle hygiene was the same in all severity groups, in the group of cases with specific enteritis, in those with parenteral infection, and in the group of infants with no diarrhoea.

Information obtained from mothers of healthy infants from much the same type of homes, showed almost exactly the same picture. Of 159 mothers interviewed, 59 used a detergent and 100 rinsed with plain water only; 59 disinfected adequately once a day, 109 either scalded or made no attempt to disinfect; 114 covered or partially covered bottle and teat, 45 left them exposed between feeds. Of fifteen mothers attempting the Milton technique, fourteen were not carrying it out correctly, using too weak a solution, not covering bottle and teat adequately, or not changing the solution regularly.

TABLE IX
PREPARATION OF FEEDS

Methods		Total		No Sign of Diarrhoea		Enteritis					
						Mild		Moderate		Severe	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Bottles adequately sterilized		157	57	9	41	64	61	44	52	40	61
Feeds boiled		245	88	22	100	95	90	76	90	52	79
Feeds made up	Individually	265	96	20	91	101	96	82	98	62	94
	For several feeds at once ..	12	4	2	9	4	4	2	2	4	6
Total Cases		277		22		105		84		66	

MULTIPLE BIRTHS.—There were 29 twins in the series, an incidence of 8.0 per cent., compared with an expectation (on the basis of all maternities in England and Wales in 1950) of 2.4 per cent. This difference is statistically significant, and suggests that twins are more susceptible than infants of single births to attacks of diarrhoea. It may be directly due to the twins' initially smaller size and reduced resources, or indirectly to their being more likely to be bottle-fed.

MEDICAL HISTORY OF INFANTS AND FAMILY MEDICAL BACKGROUND.—Information obtained about other children in the household who had previously suffered from attacks of enteritis is shown in Table X.

A previous attack of enteritis had occurred in children of the same household in a large proportion of cases; in one-third of those with brothers or sisters one of them had been attacked, and in about a half of the households where there were unrelated children such children had been previously affected. If attacks within one month only are considered,

these proportions are reduced to one-seventh and one-third respectively, but are still substantial. It seems possible that some of the cases of enteritis in the study can be accounted for either by a common source of infection or by cross-infection from one child to another within the family, but it is not possible to identify such cases with any degree of certainty in a retrospective survey of this kind. The histories of the children in the study are shown in Table XI.

Nearly one-third of the children had a poor health record. One-tenth (10 per cent.) of them had been admitted for other infectious diseases, and a further 11 per cent. had received hospital treatment for non-infectious diseases. One would have expected a sample of children selected on account of hospital admission to be *ex hypothesi*, an unhealthy group, but one would hardly expect such a high incidence of previous hospital admission in children of this age. It suggests that constitutional or environmental defects were coincident with the accident of infection and possibly conditioned the development of disease.

TABLE X
FAMILY HISTORY OF ENTERITIS

Factors Assessed		Total		No Sign of Diarrhoea		Enteritis					
						Mild		Moderate		Severe	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Brother or Sister	Within 1 month	34	13	—	—	12	11	17	21	5	10
	Earlier	59	22	6	30	20	18	27	33	6	12
Siblings in Household		265	100	23	100	111	100	82	100	52	100
Other Children	Within 1 month	57	34	1	17	28	35	16	36	12	31
	Earlier	29	17	1	17	17	21	8	18	3	8
Other Children in Household		169	100	6	100	80	100	44	100	39	100

TABLE XI
HISTORY OF PATIENTS

Factors Assessed		Total		No Sign of Diarrhoea		Enteritis					
						Mild		Moderate		Severe	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
General Health	Good	251	71	28	78	101	71	74	70	48	69
	Poor	103	29	8	22	41	29	32	30	22	31
	Not assessed	6	—	1	—	4	—	—	—	1	—
	Total	360	100	37	100	146	100	106	100	71	100
Previous Hospital Admission for	Enteritis	36	10	3	8	17	12	14	13	2	3
	Other infection	29	8	4	11	11	8	8	8	6	9
	Other illness	38	11	6	16	16	11	12	11	4	6

TABLE XII
MEDICAL HISTORY OF FAMILIES

Factors Assessed		Total		No Sign of Diarrhoea		Enteritis					
						Mild		Moderate		Severe	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
General Health	Good	277	82	28	82	107	79	87	85	55	83
	Poor	61	18	6	18	29	21	15	15	11	17
	Not assessed	22	—	3	—	10	—	4	—	5	—
	Total	360	100	37	100	146	100	106	100	71	100
Severe Illnesses	Tuberculosis	32	9	5	14	10	7	14	13	3	4
	Other infectious disease . .	38	11	4	11	19	13	8	8	7	10
	Non-infectious disease . .	54	15	7	19	21	14	18	17	8	11

Table XII shows that the medical histories of the families, as distinct from the children of the study, were also poor, one-sixth having a poor health record. The incidence of histories of tuberculosis (9 per cent.) was not significantly higher than the normal figure (8 per cent.) for the area (Gore and Hartston, 1953), but considerable numbers of severe infectious and non-infectious diseases were encountered. We have already discussed the lower than average social conditions of these families; even the very limited information of the medical histories of these children and their families serves to illustrate the simple tenet of social medicine that families with socio-economic disadvantages may be an easier prey to infection and disease. Further, in a quarter of all cases admitted to the enteritis unit at St. Ann's from their own homes, there had been some recent domestic upset, which meant either that the infant had been looked after by someone other than his mother or that he had been exposed to a greater risk of infection. In most instances the upset was due to illness of the mother, illegitimacy, separation of parents, imprisonment of father, or holidays. In some instances illness or feeding problem in the infant had led to his admission to hospital or nursery. These upsets were marked in the group not showing signs of parenteral infection and these cases constituted a large proportion of the group having a definite history of contact with cases of diarrhoea or with an institution or other infant community. Illegitimacy appeared to be a problem in so far as breast-feeding in these cases had usually been abandoned from financial necessity, and hazards of exposure to infection thereby increased. This underlines the difficulty of trying to isolate specific aetiological factors in enteritis from the complex environment of such families.

MODE OF ONSET OF DIARRHOEA AND OTHER SYMPTOMS AND INCIDENCE OF PARENTERAL INFECTION.—Table XIII (overleaf) shows the mode of onset of the diarrhoea for which the children were admitted to hospital.

In two-thirds of the cases the onset of diarrhoea was abrupt, even in those in which there was no diarrhoea after admission to hospital, in one-quarter the onset was insidious, and in one-seventh the diarrhoea had been recurrent. In most, but not all, the diarrhoea itself was the first symptom. In about one-third there were signs of parenteral infection at the time of onset of diarrhoea and vomiting. Table XIII shows that symptoms of parenteral infection were present in more of the cases showing no sign of diarrhoea in hospital than in those with severe diarrhoea.

Contact with parenteral infection within 2 weeks of onset of diarrhoea was established as follows:

Coryza 32 per cent. Influenza 3 per cent.
Sore throat 5 per cent. Tuberculosis 1 case only.

A history of dietetic disorder preceding the onset of diarrhoea and vomiting was found in only a few cases. The dietetic factor was rarely found alone, some cases having parenteral infections and others having been recently in contact with diarrhoea or with an infant community.

CONTACT WITH DIARRHOEA (Table XIV, overleaf).—In almost half the cases recent contact with a case of diarrhoea could be established, most of them in children under 2 years of age. The degree of contact was consistent in the groups and was no greater in the severe than in the mild cases.

Among cases admitted to the enteritis unit at St. Ann's, a history of close contact with illness in the 2 weeks before onset was found most frequently

TABLE XIII
CIRCUMSTANCES OF ONSET

Factors Assessed		Total		No Sign of Diarrhoea in Hospital		Enteritis					
						Mild		Moderate		Severe	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Mode of Onset of Diarrhoea and Vomiting	Abrupt	220	62	23	65	86	61	64	61	47	67
	Insidious	88	25	9	26	34	24	28	27	17	24
	Recurrent	44	13	3	9	22	15	13	12	6	9
	Not known	8	—	2	—	4	—	1	—	1	—
	Total	360	100	37	100	146	100	106	100	71	100
Onset Associated with	Diarrhoea	312	87	31	84	126	86	93	88	62	87
	Vomiting	241	67	27	73	87	60	73	69	54	76
	Coryza	83	23	17	46	32	22	24	23	10	14
	Otorrhoea	19	5	1	3	11	8	5	5	2	3
	Bronchitis	18	5	1	3	8	5	6	6	3	4
	Pneumonia	6	2	—	—	2	1	3	3	1	1
	Other symptoms	165	46	24	65	57	39	51	48	33	46

TABLE XIV
CONTACT WITH OTHER CASES BEFORE ONSET

Factors Assessed		Total		No Sign of Diarrhoea		Enteritis					
						Mild		Moderate		Severe	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Children Under 2	Within 2 weeks of onset	88	24	2	5	37	25	29	27	20	28
	Over 2 weeks previously ..	15	4	—	—	10	7	4	4	1	1
Children Over 2	Within 2 weeks of onset ..	55	15	5	14	18	12	24	23	8	11
	Over 2 weeks previously ..	7	2	—	—	4	3	3	3	—	—
Adults	Within 2 weeks of onset ..	19	5	4	11	8	6	6	6	1	1
	Over 2 weeks previously ..	2	1	—	—	1	1	1	1	—	—
Total Cases		360		37		146		106		71	

in cases coming from another institution. Even in those coming from their own homes, with no history of contact with diarrhoea or parenteral infection, a substantial proportion had been resident in a hospital or other institution within 2 weeks of onset.

GENERAL CONTACT WITH OTHER PERSONS (Table XV, opposite).—This information is of epidemiological value in itself, since it shows how many people a child of under 2 years of age can meet in the space of a fortnight. Only one-sixth had no contact outside their own family. Nearly one-half (41 per cent.) were in contact with adults or children of other families. Only a very small number had been to day nurseries. A quarter of the cases (23 per cent.) came from communal accommodation or from residential nurseries where the opportunities for the spread of infection are inevitably enhanced. One in four of the children (24 per cent.) had been

attending a welfare centre, and a further fifth (21 per cent.) had been attending a hospital outpatient department. Clearly, apart from traced contact with infection, there was here a large reservoir from which infection could have come.

BACTERIOLOGY.—Laboratory investigations were not uniformly pursued in all hospitals, and this section of the study is, therefore, based on data from St. Ann's Hospital only. At this hospital, rectal swabs were taken from all 220 cases, and, with only eight exceptions, they were taken on admission.

The enteral pathogens found are listed in Table XVI (opposite).

Rectal swabs from 57 infants (three of whom were admitted twice) were also examined for the serological types *Bact. coli* 0 111 and *Bact. coli* 0 55; the first was isolated from six and the second from two infants.

TABLE XV
CONTACT DURING 2 WEEKS BEFORE ONSET

Type of Contact		Total		No Sign of Diarrhoea		Enteritis					
						Mild		Moderate		Severe	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Home	Own Family Only	56	15	6	16	18	12	15	14	17	24
	Other Families	148	41	14	38	67	46	44	42	23	32
	Child-minder	9	3	1	3	4	3	2	2	2	3
	Foster Parents	4	1	—	—	2	1	—	—	2	3
Institution	Day Nursery	21	6	1	3	12	8	5	5	3	4
	Rest Centre	42	12	3	8	15	10	18	17	6	8
	Residential Nursery or Hostel	41	11	1	3	22	15	8	8	10	14
	Child Welfare Centre ..	88	24	12	32	28	19	27	25	21	30
	Hospital (Out-patient Dept.)	35	10	2	5	15	10	10	9	8	11
	Hospital (Children's Dept.)	38	11	5	14	8	5	14	13	11	15
Other		—	—	3	8	4	3	3	3	3	4
Total Cases		360		37		146		106		71	

TABLE XVI
ENTERAL ORGANISMS (OTHER THAN *B. COLI*)

Organism		Total		No Signs of Diarrhoea		Enteritis					
						Mild		Moderate		Severe	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Salmonella	Typhi-murium	5	4	—	—	2	6	2	4	1	2
	Enteritidis	1		—		1		—		—	
	Morb. bovis	3		—		2		1		—	
Shigella		17	8	1	3	11	14	4	6	1	2
Lambliia		2	1	—	—	2	3	—	—	—	—
Total Cases		220	100	30	100	79	100	70	100	41	100

ORIGIN OF HOSPITAL ADMISSIONS.—The cases surveyed in this study were selected by virtue of hospital admission. It is of interest, therefore, to examine the origin of the certificate of diarrhoea and vomiting by which hospital admission was gained (Table XVII, overleaf).

Nearly two-thirds (60 per cent.) came from general practitioners, just over one-fifth (21 per cent.) came from out-patient departments, and a little more than one twentieth (6 per cent.) were transferred from in-patient departments; 43 cases (12 per cent.) came from residential nurseries. The distribution of origin of case was not related to severity of illness.

CONCLUSIONS

This survey was restricted to infants admitted to hospital for diarrhoea and vomiting and thus

to a selected group of the total cases of enteritis occurring in the area of study. They were selected on the grounds of severity and socio-economic factors also influenced admission to hospital. Nevertheless, the pattern, as it has emerged, is one of infection spreading among families of lower than average social conditions with poor medical records. The facility of transmission of infection was enhanced by a number of inter-related conditions. The large families, and in many cases the communal accommodation, associated with their lower social level, presented larger numbers at risk and a greater degree of herding; many were forced to share water closets and washing-up facilities. Many of the babies were underweight at birth, and, whether associated with this condition or not, most were bottle-fed. The standard of cleanliness in bottle-feeding was low though no worse than in a sample

TABLE XVII
ORIGIN OF CERTIFICATE OF DIARRHOEA AND VOMITING

Source		Total		No Sign of Diarrhoea		Enteritis					
						Mild		Moderate		Severe	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Out-patient Dept.	General Hospital	48	13	6	16	21	14	14	13	7	10
	Children's Hospital ..	29	8	2	5	7	5	15	14	5	7
In-patient Dept.	General Hospital	17	5	3	8	3	2	7	7	4	6
	Children's Hospital ..	3	1	—	—	2	1	—	—	1	1
Residential Nursery		43	12	1	3	24	16	8	8	10	14
General Practitioner		215	60	25	68	87	60	62	58	41	58
Welfare Centre		5	1	—	—	2	1	—	—	3	4
Total Cases		360	100	37	100	146	100	106	100	71	100

of healthy infants. There were few specific feeding disorders. Some two-thirds of the cases were considered to be due to alimentary infections, and in these there was a high degree of known contact with other cases of diarrhoea; one-third of the cases could be regarded as influenced by parenteral factors, and had signs or symptoms of parenteral infection at the time of onset of the diarrhoea.

The facts presented suggest that a reduction in the incidence of enteritis might be expected from:

(a) Improvement in housing, directed particularly towards avoiding the sharing of sanitary and kitchen accommodation.

(b) A study of the conditions influencing the rate of breast-feeding, with a view of increasing maintenance of breast-feeding.

(c) Better education on the hygiene of preparation of bottle feeds.

(d) Treatment as a priority class by health visitors of families with poor health records.

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