

A STUDY OF SUMMER DIARRHOEA IN WARRINGTON IN 1911.

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IN the summer of 1911 in order to ascertain the sanitary conditions existing in houses in Warrington in which deaths from epidemic diarrhoea of patients under one year of age had taken place, I visited the houses in all cases where the entry on the death certificate issued by the medical practitioner was such as to suggest the possibility of the death having occurred from this disease. The total number of houses visited was 66.

The enquiries were framed with a view of eliciting the chief symptoms of the illness, the method of feeding, the nature, source, and conditions of storage of the food, the sanitary conditions of the home and the social status of the parents. Information only on the more striking results of the enquiry are given below.

A. *Clinical aspects.*

A following definition of epidemic or summer diarrhoea will probably receive wide acceptance—a disease of sudden onset in which the passage of frequent, much altered stools is almost invariably accompanied by a severe degree of vomiting and early collapse—the acute phase of the disease terminates within a week or ten days.

My enquiry made it evident that this type of diarrhoea is relatively very rare; the definition, however, describes the fulminating cases admitted into the wards of general hospitals. The rarity of this type of the disease possibly accounts to some extent for the difficulty experienced by the general practitioner when called upon to certify the form of disease of the alimentary tract from which a patient has died.

The questions asked of a clinical nature included the following:—

- (1) Was the illness of sudden onset?
- (2) Did the child vomit?
- (3) Did the vomiting continue up to the last?
- (4) Did the belly become larger?
- (5) Were the stools green; offensive; frothy; watery?
- (6) Did the stools contain slime, blood or curds?
- (7) Did the face of the child look pinched at the last?
- (8) Did the child have cramps in the stomach?

The history of the illness in 67 patients was investigated.

A sudden onset of the disease occurred in 38 patients, a gradual onset in 24; the parents of five patients could give no definite information on this point.

In the case of the patients whose illness commenced suddenly vomiting occurred in 29; the vomiting was of a severe degree in 14, a moderate degree in 6 and a slight degree in 9. No vomiting occurred in 7 cases; no definite information on the point was available in 2 cases.

Definite evidence in relation to vomiting was obtained in regard to 62; of these 46 (72%) vomited. It is worthy of remark that vomiting was stated to be present in 72% of cases investigated by Dr Niven in Manchester in 1905.

Slime was observed in the stools in 15 cases, and blood in 4; watery stools were noticed in 4 cases; watery and green stools in 3, and green but not watery in 26. In 18 cases the motions were very offensive. Eleven patients suffered from convulsions. In only one case with a sudden onset did severe vomiting and watery stools occur.

B. *Multiple invasion of houses.*

In Warrington instances of multiple invasion of houses occurred in connection with 19 (29%) of 67 fatal cases investigated. By asking the mother whether any other person living in the house had suffered from diarrhoea either before or after the baby commenced to suffer from this complaint, some information was obtained as to the occurrence of this symptom and it was ascertained that the majority of these associated patients suffered from severe diarrhoea; it is probable that many cases of "looseness of the bowels" escaped the notice of the informant.

Persons suffering from this slight degree of abnormality may be suffering from the effects of a bacterial invasion of the alimentary tract; for this reason therefore an understatement may have been made of the number of cases in which the disease was acquired from another person in the house already suffering from diarrhoea.

The information obtained relating to multiple infection is given in tabular form below:

No. 4. The father suffered from diarrhoea on a Monday and Tuesday; he was under the care of a doctor for 14 days; recovery took place.

The baby aet. 5 weeks commenced to suffer from diarrhoea on the subsequent Wednesday; the father looked after him for a short time; the illness of the baby lasted 17 days.

The sanitary conditions of the house were excellent.

No. 7. Two other children had diarrhoea (3-4 motions a day) after the baby's illness had commenced.

No. 9. One girl aet. $1\frac{3}{4}$ years and another aet. $2\frac{4}{5}$ years had diarrhoea before the infant.

No. 13. A boy aet. $2\frac{6}{7}$ years had diarrhoea for 2 months subsequently to the onset of the disease in the baby whose illness lasted 2 months.

No. 20. The grandmother living in the same house had diarrhoea for 2 months subsequently to the onset of diarrhoea in the baby.

No. 25. The baby suffered from diarrhoea for 14 days; an interval of a few days elapsed before a second attack occurred.

A boy aet. 3 years had diarrhoea after the baby commenced to suffer from the second attack.

A girl aet. 2 years suffered from diarrhoea after the baby started with the second attack.

The diarrhoea in the case of these two children lasted for a day or two; they had not been eating fruit just before the attack.

No. 26. A girl aet. 3 years had diarrhoea subsequently to the onset of the attack in the baby; she had been eating apples just before the attack.

Nos. 29 and 30 (illegitimate twins). Mary H— died Aug. 28th; she was ill for 3 weeks; Muriel H— died Oct. 4th—the diarrhoea started on Sept. 23rd, *i.e.* 25 days after the death of her sister; she was ill for 11 days.

- No. 37. A girl aet. 2 years suffered from diarrhoea on a Monday; it lasted for 15 days. The baby had diarrhoea on the subsequent Thursday; death took place.
Another child, a girl aet. 6 years, is in the Infirmary suffering from "windy bowels"; the disease commenced with diarrhoea.
- No. 38. The baby commenced to suffer from diarrhoea on August 27th—he died on August 29th.
The father suffered from diarrhoea subsequently to the attack in the baby; later the mother and the children, aet. 2, 7, 9 and 10 years respectively were attacked: all the members of this household were attacked.
- No. 41. The mother had diarrhoea which commenced 2 days after the onset of the disease in the baby.
- No. 45. One of twins—the other had diarrhoea at the time of my visit a few days after the death of the first child—death did not occur in the case of the second child.
- No. 47. A boy aet. 1½ years had diarrhoea before the onset of the attack in the baby.
- No. 48. The mother stated that all her children were "purged a bit." The first group affected comprise Annie and Herbert who first suffered from diarrhoea on July 6th, 3 weeks before the baby started.
The father was off work suffering from "piles" 3 weeks before the baby was taken ill.
The second group comprise Lily, Edie, and Elsie who commenced with diarrhoea "the last week but one before the baby," *i.e.* July 12th.
The third group comprise the baby whose illness started on July 27th. The mother while the baby was ill, *i.e.* from July 27th to August 10th, although not "purged" had colicky pains.
The fourth group comprise Samuel and Stanley who suffered from diarrhoea on August 10th and 11th.
- No. 52. The baby's illness commenced on August 1st; he died on August 4th. A boy aet. 16 years suffered from diarrhoea which commenced on August 6th.
- No. 55. A boy aet. 7 years had diarrhoea after the onset of the illness in the baby.
- No. 60. The mother had diarrhoea which commenced two days after the death of the baby who had been ill for 17 days.
- No. 65. The mother had "ptomaine poisoning" (with diarrhoea) for two days before the baby was taken ill with diarrhoea.
- In the two following cases the proximity of a previous case of diarrhoea suggests the probability of this being the source of infection.
- No. 33. Three of the family living next door had diarrhoea a few days before the onset of diarrhoea in this patient.
- No. 47. A boy aet. 2 years living next door had diarrhoea a few days before the patient was taken ill.

Simultaneous onset in primary cases occurred in only two out of the 16 households, a simultaneous onset in secondary cases in three; this may be accounted for by simultaneous infection from the primary case.

Consecutive onset was the rule; only in one instance however were all the (seven) members of a family attacked more or less consecutively.

An average interval of eight days occurred between the onset in the primary and secondary cases. In only one instance did the secondary case succeed the primary case within four days; the usual interval

varied between four and nine days; longer intervals of which three weeks was the exception.

An instance suggesting how diarrhoea spreads from one house to another is seen in the case of No. 21. This child died of diarrhoea at No. X, *a* Street on September 14th. Her uncle, a baby (No. 11) had died of diarrhoea at No. Y, *β* Street on August 13th. The mother of the patient No. 11 spent much of her time at No. X, *a* Street and helped her mother to attend to the baby while he was ill.

Observations by Drs Niven, Sandilands, Peters and Dudfield have previously shown the frequency of multiple attacks in houses. Dr Niven in 1904 found that multiple attacks had occurred in 36 families in connection with 111 fatal cases (32% of the invaded families); in 35 fatal cases investigated by Dr Sandilands, 12 families (34%) showed multiple invasions; in Dr Peters' series in 83 (47%) out of 174 invaded families multiple cases occurred.

Dr Dudfield's observations showed that 41 families with multiple cases were found in connection with 423 cases (9·8%).

C. *Consecutive date of onset in multiple cases.*

It might be argued that even if invasion of houses or families occurs, the disease might be due to the action of a common cause such as the consumption by the several members of the household of contaminated milk. The consecutive date of onset in such cases, however, suggests that the disease was communicated from one person to another.

As regards the Warrington series in connection with this point, the collection of cases of which No. 48 forms one exhibits in marked degree the successive onset of the disease; in this set all the members of the household were affected; the cases occurred in four groups. In connection with No. 38 all the members of the household suffered from diarrhoea and although the cases cannot be absolutely differentiated into several groups, three groups could be distinguished.

In the following cases where particulars on the point have been ascertained, details are given as to the interval between primary and subsequent cases:

In connection with patient No. 4.	2 days intervened between the onset of the primary case (which lasted 14 days) and the secondary.
„ „ patient No. 37.	3 days intervened (the primary case lasted 15 days).
„ „ patient No. 41.	2 days intervened (the secondary case commenced 2 days after the onset of the illness in the primary case).

In connection with patient No. 48.	6 days intervened between the primary and secondary cases. 15 days intervened between the secondary and tertiary cases. 12 days intervened between the tertiary and quaternary cases.
„ „ patient No. 52.	5 days intervened between the primary and secondary cases.
„ „ patient No. 60.	19 days intervened between the primary and secondary cases (the primary case was ill 17 days).
„ „ patient No. 65.	2 days intervened between the primary and secondary cases.

An average of 5.5 days therefore intervened between the primary and secondary cases.

The phenomenon of simultaneous onset in secondary and subsequent groups of cases occurred in connection with patients Nos. 38 and 48.

In the course of an investigation into deaths from diarrhoea which occurred in Kensington in the third and fourth quarters of the year 1909, Dr Sandilands obtained records of twelve families in which multiple cases of diarrhoea had occurred.

Simultaneous onset in primary cases occurred in only two of the 16 households; a simultaneous onset in secondary cases in three; this, however, may be accounted for by simultaneous infection from the primary case. Consecutive onset was the rule; only in one instance were all the (seven) members of a family attacked more or less consecutively.

An average interval of eight days occurred between the primary and secondary cases; "in only one instance did the secondary case succeed the primary case within four days; the usual interval varied between four and nine days; longer intervals of which three weeks was the maximum period recorded, were bridged by continuous illness in the primary case."

Dr Dudfield in Paddington was unable to demonstrate the consecutive dates of onset in the instances of 32 patients (who belonged to eight houses) suffering from diarrhoea; only two of these patients fell ill on the same day.

D. *The diarrhoeal death rate in the several wards of a town.*

When the prevalence of diarrhoea is receiving consideration much attention is devoted to the meteorological conditions and especially to the temperature either of the earth or atmosphere and the rainfall. For all practical purposes however we are justified in assuming that the temperature and rainfall in the several wards of a town with a population of 70,000 are identical.

The following table is a comparison of the average diarrhoeal death rate for the several wards of Warrington with the average birth rate, the zymotic rate corrected for zymotic diarrhoea, and the relative poverty or otherwise of the inhabitants of the ward.

TABLE I. *Comparison of average diarrhoeal death rate, birth rate, corrected zymotic rate and rateable value of dwelling houses.*

Ward	No. of deaths from diarrhoea	Average diarrhoeal death rate	Position in list	Average birth rate	Position in list	Average zymotic rate corrected for diarrhoea	Position in list	Average rateable value of dwelling houses	Position in list
St Austin's	99	·1071	1st	22·3	1st	1·8933	1st	£16·34	2nd
Town Hall	146	·148	2nd	25·3	2nd	2·224	2nd	£16·77	1st
Latchford	197	·1603	3rd	30·0	3rd	2·240	3rd	£11·71	4th
Bewsey	184	·2029	4th	31·1	4th	3·8176	8th	£11·18	6th
White Cross	247	·2045	5th	39·0	9th	3·23	5th	£10·17	8th
Fairfield	222	·2072	6th	32·0	5th	2·891	4th	£11·33	5th
Howley	255	·2194	7th	36·8	7th	3·4189	6th	£11·97	3rd
St John's	412	·2475	8th	37·7	8th	4·097	9th	£9·21	9th
Orford	309	·2653	9th	33·1	6th	3·711	7th	£10·19	7th

The average diarrhoeal death rate for each ward has been calculated from the rates for the years 1892–1910 inclusive; the average birth rate has been calculated for the nine years previous to and including 1910. It is only claimed that the position in the list in each case is comparable.

A close relation is seen to exist between the birth rate and the diarrhoeal death rate; the higher the birth rate in a ward the higher is the mortality from diarrhoea.

A deviation from this rule is seen in the case of White Cross Ward which has the fifth lowest diarrhoeal rate but the highest birth rate. The vital statistics of this ward have been, as a rule, comparatively satisfactory, *e.g.* in 1903 the Medical Officer of Health commented on the high birth rate (40·2) compared with the birth rate (35·6) for the whole of the town and the comparatively low general death rate (14·3 for the ward, 18·4 for the whole of the town) and infantile mortality rate (125 for the ward, 154 for the whole of the town). Marked features of this ward are the modern construction of the houses and the absence of overcrowding of the area with houses.

The correspondence in position in the table of the diarrhoeal rate and the zymotic rate (corrected for the diarrhoeal rate) is very close with the exception of Bewsey Ward. This ward while relatively free

from diarrhoea has suffered extensively from zymotic disease; no obvious explanation, however, presents itself.

The general close correspondence between these two rates suggests that diarrhoea is of the nature of an infectious disease.

A comparison of the incidence of typhoid fever and the mortality rate from diarrhoea in the several wards of the town is given in the following table:—

TABLE II. *Incidence of typhoid fever and mortality from diarrhoea in the several wards of Warrington.*

Ward	Average diarrhoeal rate	Position in list	No. of cases of typhoid fever 1892—1910	Average population 1892—1910	Average rate of incidence	Position in list
St Austin's	·1071	1st	37	5163	·716 ÷ 19	1st
Town Hall	·148	2nd	57	5536	1·029 ÷ 19	4th
Latchford	·1603	3rd	65	8223	·79 ÷ 19	2nd
Bewsey	·2029	4th	57	5430	1·049 ÷ 19	5th
White Cross	·2045	5th	119	8139	1·46 ÷ 19	7th
Fairfield	·2072	6th	63	7097	·88 ÷ 19	3rd
Howley	·2194	7th	102	6073	1·529 ÷ 19	8th
St John's	·2475	8th	198	9892	2·001 ÷ 19	9th
Orford	·2653	9th	104	8113	1·28 ÷ 19	6th

While a certain amount of correspondence of position in the list appears to exist, the degree of correspondence is much less than in the other data compared, and on the whole the evidence tends to show that there has been no close correspondence between the incidence of typhoid fever and the deaths from diarrhoea in the several wards of the town.

This is also borne out by a special Report by the Medical Officer of Health in 1899 which attempted with considerable success to connect the prevalence of typhoid fever with a particular part of the town; diarrhoea was fairly evenly distributed, showing no preponderance in one district over another.

The general opinion of epidemiologists is that diarrhoea is a class disease and that it affects the poorer classes of the community, the middle and upper classes being comparatively unattacked by the disease.

A measure of the relative poverty or otherwise of the inhabitants of a ward is afforded by the average gross rateable value of each dwelling house in the ward. In ascertaining these figures for the wards of Warrington care has been taken to eliminate from the calculation those buildings such as the public buildings, workhouse, hospitals, barracks

and shops, the inclusion of which, for obvious reasons, would render the comparison less accurate.

On reference to Table I a general correspondence between a low diarrhoeal rate and a high average gross rateable value is seen to exist—the most striking exception is seen in the case of Howley Ward. The outstanding particular in which this ward differs from the rest of the town is its low-lying situation. In Woolwich it was found that, as a rule, the highest diarrhoeal incidence and death rate occurred in districts situated on the lowest levels and vice versa. Dr Davies goes on to say:—“This may be partially due to the poorer class of population being usually found on the lower ground but the whole of the difference could hardly be thus explained.”

E. *Sanitary conditions inside houses.*

(1) *Overcrowding.* In my series of cases the total number of occupants of 324 rooms (66 houses) was 405, an average of 1.25 persons per room; the average number per house was 6.13.

The mean population of Warrington for the year 1911 was 72,375; assuming that the number of inhabitants of the Poor Law institutions, barracks and hospitals was 600 (an under-estimation rather than an over-estimation), the number of persons occupying 14,124 houses (the number of occupied houses in June, 1911) was 71,675 or 5.07 per house. Relative overcrowding, therefore, occurred in those houses in which deaths took place from diarrhoea.

In the Woolwich series of cases, in 99 out of 820 houses there were more than two persons to a room, *i.e.* in about 12% there was overcrowding. The estimated proportion of overcrowding in the Borough is decidedly under 1%, “so that there is reason to think that overcrowding greatly affects the prevalence of diarrhoea.”

The degree of overcrowding in both series of cases is shown in the following table:

TABLE III. *Overcrowding and diarrhoea.*

	Total No. of cases	No. under 1.5 persons to a room	No. with 1.5 and under 2 persons to a room	No. with 2 or more persons to a room
Woolwich	820	516 (62.9%)	204 (24.9%)	100 (12.2%)
Warrington	67	45 (67.1%)	13 (19.4%)	9 (13.4%)

Dr Dudfield, however, as the result of his enquiry in Paddington in 1911, considers that the number of occupants per house has very little, if any, influence on the prevalence of diarrhoea.

(2) *Cleanliness of houses.* In 48 of my series of cases, the house was clean, in 17 fair and in 2 dirty. Eleven of the children were entirely breast fed; in these eleven cases 5 houses were clean, 4 fair and 2 dirty; in the other 56 cases 43 houses were clean, 14 fair and none dirty; these figures indicate that the houses were less clean in the case of the entirely breast fed children who died of diarrhoea than in the other cases and points to a possible reason why, in spite of their having the advantage of being breast fed, they contracted the disease.

A comparison of the sanitary conditions in the houses of the children who were healthy and those who were unhealthy before the fatal attack of diarrhoea shows that the houses were somewhat more cleanly in the case of the healthy children. The figures are given below:

TABLE IV. *Cleanliness of houses of children who have died of diarrhoea.*

Cleanliness of home	Child healthy before attack	Child unhealthy before attack
Satisfactory	30 (75 %)	18 (69 %)
Medium	10	7
Unsatisfactory	1	1

F. *Sanitary conditions outside houses.*

(1) *Ashpits.* The condition of the ashpits belonging to the houses visited in Warrington was unsatisfactory, although in almost every case the ashbin was of the galvanised iron variety and not the old-fashioned receptacle made of brick with a wooden cover. The top of the bin was found in position in one case only out of 66 houses visited.

There were various degrees of defect existing but the net result in the majority of cases was the existence of a potential offensive surface more or less exposed to the air of the back yard and serving both as a medium for bacterial growth and a breeding ground for flies in the neighbourhood of the houses.

(2) *Proximity to stables &c.* In 22 instances stables were in the proximity of the houses in which deaths from diarrhoea took place. In two of these instances two stables were near the house; in another case a tannery in addition to a stable was near the house. In two other instances a nuisance of a similar nature was close to the house; in one case a tanyard, in the other a middenstead.

The following table (V) gives a comparison of the number of flies present in the household, near stables, &c. and the other households:—

TABLE V. *Number of flies present in houses of children during a fatal attack of diarrhoea.*

	Households near stables, &c.	Other households
Many flies seen in the house during illness	9 (37·5 %)	12 (36·3 %)
Moderate number of flies seen in the house during illness	9 (37·5 %)	1 (3·3 %)
Few flies only seen in house during illness	6 (25 %)	20 (60·6 %)

The table shows that the number of flies were more abundant in the houses near stables than in the others.

I have to thank Dr J. Coote Hibbert, now Medical Officer of Health of Blackburn, and Dr Graham-Smith for their kind assistance.

SUMMARY AND CONCLUSIONS.

(1) The type of summer diarrhoea usually seen in the wards of general hospitals was rare in Warrington in the summer of 1911.

(2) Multiple invasion of houses occurred in 19 (29 %) of 67 fatal cases investigated.

(3) Consecutive onset of the disease among the members of the household was the rule.

(4) The average diarrhoeal rate for the several wards of the town varied directly as

- (a) the average birth rate;
- (b) the zymotic rate corrected for zymotic diarrhoea;
- (c) the relative poverty of the inhabitants of the ward.

(5) Relative overcrowding existed in the houses in which deaths took place from diarrhoea.

(6) Cleanliness of houses is an important factor in the prevention of diarrhoea.

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