"normal" temperature recorded in the out-patient department (usually axillary recording) which became "febrile" when the child was warmed up in bed was seen so often as to be regarded as a routine phenomenon—dangerous as it may be.

Too much must not be deduced from the small number of children observed, but from nearly four hundred recorded temperatures it is justifiable to conclude (1) that the highest temperature recorded is in the rectum, which is approximately 1°F (0.55°C) higher than in the groin, 0.2°F (0.11°C) higher than in the mouth, and 1.3°F (0.72°C) higher than in the axilla; (2) that the lowest recording is that in the axilla, which is approximately 0.4°F (0.22°C) lower than in the groin and considerably lower than in the mouth and rectum; (3) that the average ("half-minute") clinical thermometer does not attain a maximum reading until at least five minutes when the skin temperature is being recorded in the axilla and in the groin.

No doubt some of these discrepancies could have been avoided with more accurate thermometers and perhaps with more expert observers; but they represent the ordinary everyday methods employed in a hospital ward with ordinary instruments and the observations of competent nurses in training, supervised for the purpose of this investigation by the senior nursing staff.

Discussion

It may be argued that the slight differences discovered are of little significance. It is true that with a case of pneumonia it does not matter greatly whether the temperature recorded is 104°F (40°C) rectal or 102°F (38.9°C) axillary. But in cases of rheumatic carditis, for example, or primary tuberculosis, a temperature curve never rising above the "normal" marked on the chart as recorded in the axilla or groin may quite mask a low-grade pyrexia revealed by recordings in the mouth or rectum.

These facts have long been known even if in clinical work they are sometimes forgotten. Wright (1945) may be taken as typical of standard teaching. He quotes the normal temperature range (presumably in adults) as $96.7\text{--}99^{\circ}\text{F}$ ($36\text{--}37.2^{\circ}\text{C}$) in the mouth and $97.2\text{--}99.5^{\circ}\text{F}$ ($36.2\text{--}37.5^{\circ}\text{C}$) in the rectum. He states that the rectal temperature is the highest of the various routes—averaging 0.5° to 0.75°F ($0.267\text{--}0.42^{\circ}\text{C}$) higher than the mouth. In warm surroundings (i.e., in bed) he thinks the buccal temperature about equals the rectal. Temperature-recording in the axilla or groin he condemns as "inaccurate in thin subjects" (but note the fat child mentioned above) "and otherwise approximates to buccal." For the purpose of clinical paediatrics children may generally be regarded as "thin subjects," and this condemnation may be viewed in glaring contrast to the usual standing orders to nursing staff in children's hospitals to use the axillary or groin situations. Inquiries made during the present investigation suggest that not all children's physicians are aware of the methods of temperature-recording used for patients under their care. It would appear that the rectal site is best for babies under 1 year and presents little difficulty. For children over 5 years and certainly over 8 the mouth can be used, especially if the tougher type of "rectal" thermometer is employed to avoid the small danger of breakage. Between these ages, in the toddler, the choice is not so easy.

Psychological objections to the rectal site have been urged, but the evidence seems more theoretical than practical. It may be stated in reply that the rectal route at all ages is widely, if not exclusively, used on the continent of Europe, and the incidence of grave psychological trauma has not been seriously advanced for this large section of the world's population. Secondly, as with so many procedures in chil-

dren, it all depends on the attitude of the nurse dealing with the child. If this is "matter-of-fact" and kindly, and if children are aware of others undergoing the same investigation, it is extremely doubtful if harm is done by the insertion of a thermometer into the rectum. The time factor may be a more serious consideration, for it is generally conceded that the nurse should stand by the child during the rectal reading, whereas skin-recording, and even mouth-recording in older children, can be done for a group at once. What is needed is an instrument which not only claims to be a "half-minute" thermometer but actually records its maximum during this period.

The question of infection is obviously of great theoretical importance, as Green and Penfold (1947) have indicated, an especially when the mouth or rectum is used. The only solution is to have a separate thermometer for each child, kept permanently in a suitable disinfectant between readings. This is, in fact, the practice at many children's hospitals.

For accurate readings the rectal site should be chosen for all children under 5 years and the mouth after this age in most cases. Axillary and groin readings should be given up as inaccurate. Temperature charts should always record which situation has been used.

Summary

Simultaneous temperature-recordings in various situations—mouth, rectum, groin, and axilla—in an unselected series of 32 children show differences of some practical importance. It is argued that the axilla and groin should be discarded as sites for temperature readings. Possible difficulties from the point of view of psychological trauma and infection are discussed.

Thanks are due to the nursing staff of the Hospital for Sick Children, Great Ormond Street, for their careful collaboration.

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INFANTILE DIARRHOEA AND VOMITING

A REVIEW OF 456 INFANTS TREATED IN A HOSPITAL UNIT FOR ENTERITIS

BY

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Units for the treatment of enteritis of infants were established at most of the infectious diseases hospitals administered by the London County Council. The unit at the North-Eastern Hospital came under my care in January, 1945. The cases recorded in this paper were admitted during the years 1945 and 1946. Early in 1947 the unit was moved to more suitable accommodation in single-cell wards. The experience of that year is not comparable with that of previous years and has therefore been excluded.

The object of this paper is to describe the organization and working of the unit, to discuss the type of case treated, and to analyse the results of treatment.

Organization

Accommodation and Equipment.—Throughout the period 1945–6 the unit was contained in two wards of the composite, or Hiorns, type (Harries and Mitman, 1947). Each ward was designed to provide accommodation for 31 patients, distributed as follows: 5 in single cells, 6 in double cells, and 20 in groups of 4 in the five bays of the

main ward. In practice it was found desirable to limit the number of cots in the main ward to 12, with a maximum of 14. The total number of patients in each ward therefore did not exceed 25. Each ward was fully equipped for barrier-nursing. Each bay of the main ward and each cell contained a fixed hand-basin with elbow taps. Two steam sterilizers were available—one for instruments and one for crockery. The ward kitchen contained a refrigerator. In addition each ward was equipped with the instruments and apparatus required for intravenous therapy in infants. A set of sterilized instruments and other necessary apparatus were kept on a trolley, ready for immediate use in urgent cases. Sterile fluids for intravenous administration were supplied from a central laboratory in 500-ml. bottles with screw caps.

Staff.—Both wards were under the direction of the same resident medical officer throughout the two-year period. Off-duty and holiday relief was provided by resident medical officers who had become familiar with the established routine. Uniformity of treatment was thus maintained. Routine medical ward rounds were made three times a day, and the medical officer was available at any time. Each ward was in the charge of a sister who had had general hospital and fever hospital training. So far as was possible, transfers of ward sisters were avoided. The nursing staff comprised fever-trained nurses, general-trained and probationer nurses in training for fever certificates, assistant nurses, and ward orderlies. Frequent changes of nursing staff were unavoidable. The number of nurses allocated to the wards varied widely. At first 11 staff by day and 4 by night were available for each ward of 23 to 25 patients, allowing a ratio of one nurse on duty to every six infants. As the shortage of nurses became more acute the total allocation for each ward (including sister, nurses, and ward orderlies) was reduced to 6 or 7 by day and 2 by night. Consequently, there were generally three, and often only two, nurses on duty in the ward at any one period of the 24 hours. All nurses were familiar with the technique of barrier-nursing and the general management of infants. In the unit they were taught the indications for the institution and termination of intravenous therapy and the methods of maintaining intravenous drip infusions in small infants.

General Management.—Few breast-fed infants were admitted with enteritis. The mothers of these were accommodated with their infants in the cells off the main ward. Maintenance or re-establishment of breast-feeding was usually all that was required for their recovery. The majority of infants with enteritis, and almost all the severe cases, had been artificially fed before admission. For these, feeds were prepared in the kitchen of each ward. All dried-milk feeds were freshly made up as required. Benger's modified milk was prepared twice a day and stored in the refrigerator in the ward kitchen. Hartmann's Ringer-lactate solution (*Extra Pharmacopoeia*, 22nd edition, 1941) was available, sterilized, in 500-ml. bottles.

Prevention of Cross-infection.—The cots were widely spaced in the bays of the main ward, and bed-isolation and barrier-nursing techniques were employed throughout the unit. Infants with parenteral infections associated with diarrhoea and vomiting were, so far as was possible, nursed in complete isolation in the cells off the main ward. The system of "clean" and "dirty" nurses could not always be employed owing to the shortage of staff. Napkin-changing rounds were made two-hourly, and were so arranged as to be completed before the times of feeds. Individual rectal thermometers were supplied for each infant. Separate gowns were worn when attending to each baby. Soiled linen and napkins were placed in closed bins containing "white disinfectant fluid" and sent to the

laundry twice daily. No sluicing of napkins or other articles was permitted in the wards. Feeding-bottles, teats and valves, measuring-jugs, and other articles required for preparing feeds were sterilized after each feed and stored in covered containers.

Laboratory Investigations.—The routine investigations were cultures of faeces and rectal swabs for known pathogens, red blood cell counts, and haemoglobin estimations. White cell counts were made in all cases at first, but were found of limited value, and were later confined to selected cases. Other laboratory investigations were made as required, but biochemical investigations other than total-serum-protein estimations were not made. Specimens of fluids for intravenous administration were taken at the beginning and the end of all intravenous infusions and cultured for contaminating organisms.

Treatment

The methods of treatment were based on previously reported experience (Alexander and Eiser, 1944). The underlying principles are of sufficient importance in practice to merit restatement.

1. Careful assessment of the infant's condition on and after admission, with particular reference to (a) clinical evidence of dehydration; (b) its degree and duration; (c) the presence of parenteral infection.
2. (a) Prevention of dehydration by ensuring a sufficient fluid intake; or (b) its prompt correction by the administration of adequate fluids by the appropriate route.
3. A short initial period of starvation followed by an early return to milk-feeding.
4. Adequate treatment of parenteral infections.

The methods employed were made as simple and as uniform as possible consistent with the varying needs of the individual case. The classification of cases with regard to treatment was into two broad groups—namely, those without clinical evidence of dehydration (non-dehydrates), and those with clinical evidence of dehydration (dehydrates). The dehydrates were further subdivided into two groups: (a) mild or moderate cases which might be expected to respond to oral rehydration, and (b) severe cases for which intravenous therapy was essential. Details of the methods of treatment of artificially fed infants are given below.

Non-dehydrates

An infant who was not dehydrated on admission was given half-strength Hartmann's solution by mouth two-hourly for 18 to 24 hours, in the usual allowance of 2½ oz. per lb. (156 ml. per kg.) body weight per day. No milk feeds were given during this period and no purgatives were permitted.

After 18 to 24 hours dilute milk feeds were given in the form of one-third-strength Benger's modified milk, 2½ oz. per lb. per day. If this was well tolerated the feeds were increased to half-strength Benger's the next day, to two-thirds strength on the day following, and then to three-quarters-strength. The size of the feeds was increased and the intervals between feeds lengthened after the first or second day.

As soon as the stools became normal the feeds were changed to the milk on which the infant had been fed before admission, beginning with a third-strength dilution of the half-cream mixture and working up gradually by daily increases to the full-strength feeds—half-cream in the case of smaller infants and full-cream for infants over 3 months of age or 10 lb. (4.5 kg.) in weight. Those of 6 months and over were given a weaning diet. The infant was discharged as soon as he was able to take an adequate diet with no return of diarrhoea or vomiting and was gaining weight.

If at any time the diarrhoea or vomiting recurred the infant was again given half-strength Hartmann's by mouth for 12 hours and then dilute feeds as before. If, however, diarrhoea was excessive or vomiting was persistent, or if the infant refused feeds or became dehydrated, feeds were stopped and intravenous therapy instituted.

Dehydrates

An infant who was mildly or moderately dehydrated on admission but who was in good general condition and able to take sufficient fluid by mouth was treated on the same lines as those who were not dehydrated. The usual allowance of fluid was given by mouth, plus 5 to 10 oz. (140–280 ml.) per day with the object of restoring the fluid deficit. If dehydration was not readily corrected by this means, or if the general condition deteriorated, oral replacement of fluid was abandoned and intravenous therapy begun without delay.

If on admission dehydration was severe or the infant in a collapsed state intravenous therapy was immediately instituted. These infants were given enough fluid intravenously to satisfy their daily requirements, with a supplementary allowance to replace the fluid lost—usually 10 to 20% of body weight in the more severe cases.

The technique of intravenous fluid administration was in accordance with accepted methods (cf. Garrod, Batten, and Thursfield, 1947). Strict attention was paid to the prevention of local sepsis and contamination of intravenous fluids. Therapy was begun with 300 ml. of half-strength Hartmann's plus 5% glucose given by a slow drip adjusted to deliver the amount required by each infant in the 24 hours. This was followed by 400 ml. of human serum or plasma diluted with 150 ml. of half-strength Hartmann's. For infants weighing less than 7 lb. (3.2 kg.) the initial quantities were halved—i.e., 150 ml. of half-strength Hartmann's plus 5% glucose, followed by 200 ml. of serum diluted with 100 ml. of half-strength Hartmann's.

For the first 18 to 24 hours no feeds were given, but the infant was allowed $\frac{1}{2}$ oz. (14 ml.) of half-strength Hartmann's two-hourly to keep the mouth moist. Small feeds—1 oz. (28 ml.) of half-strength Hartmann's and then of one-third-strength Benger's—were started after this period, the rate of drip being gradually reduced and the amount of feeds slowly increased. The drip was continued, giving alternate Hartmann's and serum, until the infant was fully rehydrated and able to take enough fluid and food by mouth for the daily requirement. If severe diarrhoea, vomiting, or dehydration recurred feeds were stopped and a new intravenous infusion begun. When intravenous therapy was completed the subsequent treatment was as described for non-dehydrates.

If signs of anoxaemia, such as cyanosis or pallor, were present oxygen was administered, using an oxygen tent. Many of the severe cases showed a degree of pallor, and oxygen was freely used on the assumption that this was a sign of incipient circulatory failure. The marked clinical improvement frequently observed would seem to justify this precaution.

Infants with red blood cell counts of less than $2\frac{1}{2}$ millions or haemoglobin readings below 50% were given whole blood intravenously, but only after haemoconcentration had been corrected.

Additional Therapy

If a parenteral infection was found or suspected the infant was treated with one of the sulphonamides. The drug of choice was sulphadiazine given in doses of 0.5 g. four-hourly (3 g. per day) for five days to an infant under 1 year of age. Penicillin, when indicated, was given in doses of 20,000 to 40,000 units intramuscularly at four-

hourly intervals for 5 to 7 days. A combination of sulphadiazine and penicillin was thought generally to be more effective than penicillin alone. Sulphadiazine was usually well tolerated and was given orally even to those infants receiving intravenous alimentation. The relatively unabsorbed sulphonamides, such as sulphaguanidine, were not found to be effective in the control of diarrhoea.

The only other drug used was iron, in the form of a ferrous sulphate mixture, for the treatment of some cases of anaemia. Vitamins A, C, and D were given to all infants, and Vitamin K and the B complex when indicated.

General Analysis of Cases

Method of Admission

Administrative procedure had an important bearing on the type of case admitted to an enteritis unit, and must be taken into account before any critical analysis of results is attempted. Admission was arranged centrally by the Public Health Department of the London County Council at the request of medical practitioners. So far as was possible, a patient was sent to the unit nearest to his home, but if no bed was available there he was sent to any unit which had a vacancy. Each unit therefore admitted cases from all parts of the London County Council area.

The criteria for admission accepted by the Public Health Department were: (1) Residence within the County Council area; (2) an age limit of two years; (3) a medical certificate that the case was one of "enteritis" or "gastro-enteritis" and required admission to hospital.

Infants arriving at an infectious diseases hospital in an L.C.C. ambulance and certified as suffering from enteritis had to be admitted. The medical staff could exercise no selection in the matter of admission to the hospital. Admissions therefore included cases of diarrhoea and vomiting of all types and of all degrees of severity. Admission of the case to the enteritis unit, however, was at the discretion of the admitting officer, and infants with diarrhoea incidental to some specific infectious disease could usually be accommodated in other wards of the hospital.

Admissions to Enteritis Unit

During the two-year period 1945–6 the number of infants admitted to the enteritis unit of the North-Eastern Hospital was 686, of whom 541 were under the age of 1 year and 145 were between 1 and 2 years of age. These infants came from all parts of the L.C.C. area. Some were admitted from their homes, some from residential nurseries, and some from general hospitals. The numbers of infants in each of these age groups admitted during each year are shown in Table I. In 53 cases no evidence of disease could

TABLE I.—All Cases Admitted to Unit, 1945–6: Age and Diagnosis

Year	Age in Years	Total Cases Admitted	Diagnosis		
			No Obvious Disease	Diseases Other than Enteritis	Enteritis
1945	0–1 1–2	261 97	8 20	24 36	229 41
Total	0–2	358	28	60	270
1946	0–1 1–2	280 48	20 5	33 19	227 24
Total	0–2	328	25	52	251
Grand total	0–2	686	53	112	521

be found; 112 infants had other diseases, including bacillary dysentery (36), other specific infections (17), respiratory infections (39), and miscellaneous illnesses (20). All these have been excluded from this series.

During 1946 an effort was made to limit the number of admissions of infants over 1 year of age. Of the 65 infants over 1 year old who had enteritis only two were sufficiently dehydrated to require intravenous therapy and none died. This group will therefore not be considered further in this series. The subsequent analysis deals only with the 456 infants under 1 year of age treated in the unit for diarrhoea and vomiting.

Analysis of Enteritis Cases 0-1 year

Table II gives an analysis of these 456 cases showing the number of cases in each 3-months age group, the number of infants who were dehydrated on or after admission, and the number of deaths. Comparison of the dehydration rates with those quoted in previous series (Campbell and Cunningham, 1941; Alexander and Eiser, 1944) shows that

TABLE II.—Enteritis Cases under 1 year: Dehydration and Mortality

Age Groups	No. of Enteritis Cases	Dehydrated on Admission	No. Dehydrated after Admission Only	Total Dehydrated on or after Admission	Per cent Dehydrated	No. of Deaths	Fatality Rate % All Cases	Fatality Rate % among Dehydrates
I: 0-2 months ..	149	54	27	81	54.4	11	7.4	13.6
II: 3-5 " ..	171	84	26	110	64.3	6	3.5	5.5
III: 6-8 " ..	77	41	6	47	61.0	3	3.9	6.4
IV: 9-11 " ..	59	16	4	20	33.9	2	3.4	10.0
Total ..	456	195	63	258	56.6	22	4.8	8.5

the cases were as severe as any likely to be encountered in a representative sample of infants with enteritis and comparable with any other such sample.

The majority of the infants (320) were under the age of 6 months on admission, and 17 of the 22 deaths occurred in this group. There were 15 infants under the age of 28 days, and of these two died.

The fatality rates are shown for all cases and for infants who were dehydrated. All the deaths occurred among infants who were dehydrated on or after admission. The usual fall in fatality rate with increasing age is shown, but, owing to the small number of deaths and the small number of cases in age groups III and IV, the differences between age groups do not reach statistical significance in this series.

A total of 258 infants were dehydrated during the course of their illness. Of these, 146 were dehydrated on admission only, 10 (6.8%) of them dying. Forty-nine of the infants dehydrated on admission responded to treatment, but became dehydrated again more than seven days after admission; in this group there were six deaths (12.2%). Sixty-three infants became dehydrated for the first time more than seven days after admission, and of these six died (9.5%). Thus 112 infants relapsed with dehydration, with 12 deaths (10.7%).

TABLE III.—Cases of Enteritis Treated during each 6-Months Period of 1945-6, with Dehydration and Fatality Rates

6-Monthly Periods	No. of Enteritis Cases	Dehydration		Deaths		
		No.	%	No.	Fatality Rate % All Cases	Fatality Rate % among Dehydrates
Jan.-June, '45 ..	106	69	65.1	12	11.3	17.0
July-Dec., '45 ..	123	62	50.4	3	2.4	4.8
Jan.-June, '46 ..	85	53	62.4	2	2.4	3.7
July-Dec., '46 ..	142	74	52.1	5	3.5	6.7
Total 1945-6 ..	456	258	56.6	22	4.8	8.5

Of the 236 infants who were dehydrated and recovered 73 were rehydrated by oral administration of fluid. The remaining 163 required intravenous therapy for correction of their dehydration. In all, 244 separate infusions were given.

Table III shows the number of infants treated in the enteritis unit during each of the four six-months periods of 1945 and 1946, the number who were dehydrated and the number of deaths. The number of admissions and the dehydration rates were fairly constant for each year. There was a sharp fall in the case mortality from 11.3% in the first six-months period to 2.4% in the second period, and this latter rate was maintained for the succeeding two periods. The differences between the first and subsequent periods are statistically significant: in each case an exact probability test gives $P < 0.02$.

Parenteral Infections

Among the 456 infants of this series a parenteral infection was found on admission in 238 cases (52.2%). In a further 46 cases a parenteral infection became apparent for the first time after admission. In the remaining 172 cases no evidence of parenteral infection was found throughout

TABLE IV.—Incidence of Parenteral Infections on Admission and after Admission

Age Groups I-IV	No. of Enteritis Cases	Parenteral Infections on Admission		Parenteral Infections on and after Admission	Parenteral Infections after Admission Only	Total Parenteral Infections	
		No.	%			No.	%
I: 0-2 months	149	74	49.7	29	18	92	61.7
II: 3-5 "	171	89	52.0	40	18	107	62.6
III: 6-8 "	77	37	48.0	9	6	43	55.8
IV: 9-11 "	59	38	64.4	3	4	42	71.2
Total ..	456	238	52.2	81	46	284	62.3

the stay in hospital. Table IV shows the number of infants in each age group who had parenteral infections on or after admission.

The type of parenteral infection found on admission in each age group is given in Table V. It will be seen that

TABLE V.—Showing Types of Parenteral Infections Found on Admission in Each Age Group

Parenteral Infections on Admission	II				I-IV
	0-2 Months	3-5 Months	6-8 Months	9-11 Months	Total
Upper respiratory infections, excluding O.M.	27	18	13	19	77
Suppurative otitis media alone	7	10	2	1	20
Suppurative otitis media + other conditions	4	10	4	6	24
Bronchitis	8	14	6	6	34
Bronchopneumonia	11	23	7	2	43
Skin infections	8	5	2	1	16
Miscellaneous	9	9	3	3	24
Total parenteral infections on admission	74	89	37	38	238
Total cases of enteritis ..	149	171	77	59	456

the majority were infections of the respiratory tract—the miscellaneous group includes urinary infections, stomatitis, etc.

It is of interest to note that only 44 infants showed evidence of suppurative otitis media on admission. In 32 infants this condition developed during the course of their illness. Thus only 76 of the 456 infants in this series had suppurative otitis media. Nine others had "red drums" associated with upper respiratory infections—these have been classified under the heading of "coryza." In all cases the ears were inspected on admission and whenever a pyrexia or any relapse of the diarrhoea or vomiting occurred. Myringotomies were performed in 49 cases. Mastoidectomy was carried out in only four cases. Post-mortem examinations were made of all but five of the 22 infants who died, and in only one case was pus found in the middle ears at necropsy.

Table VI is an analysis of the association of dehydration with parenteral infection found on admission. Of the total of 456 infants, 238 (52.2%) showed evidence of parenteral infection on admission, and in 218 (47.8%) no parenteral

TABLE VI.—*Relationship of Parenteral Infection to Dehydration on Admission*

Dehydration on Admission	Parenteral Infection + on Admission		No Parenteral Infection on Admission		Total
	No.	%	No.	%	
Dehydration + ..	112	57.4	83	42.6	195
Not dehydrated ..	126	48.3	135	51.7	261
All cases	238	52.2	218	47.8	456

$$\chi^2 = 3.75. \quad P = 0.053.$$

infection could be found. Among the 195 infants who were dehydrated on admission parenteral infections were found in 112 (57.4%) and were not detected in the remaining 83 (42.6%). A χ^2 test on this Table gives only weak support to any suggestion of association between dehydration and parenteral infection.

Analysis of Deaths

There were 22 deaths in this series. Three infants had overwhelming parenteral infections associated with severe dehydration which failed to respond to intensive treatment. Four infants died of severe parenteral infections which, in retrospect, must be regarded as having been inadequately treated. In one of these the institution of intravenous therapy also appears to have been delayed. In one case bronchopneumonia and an empyema were not discovered until necropsy. No sulphonamides had been administered.

Four cases were moribund on admission. One of these had already been given abundant subcutaneous saline infusions, and was waterlogged and oedematous on arrival. Another of these infants was extremely dehydrated and collapsed. Intravenous therapy was attempted but was unsuccessful, and the child died 15 hours later. Two infants were severely dehydrated on admission, failed to respond to adequate intravenous therapy, and died in five and eight days, respectively. It is thought that in these two cases the dehydration was irreversible.

Two infants, and probably a third, were given amounts of fluid intravenously which proved to be excessive and died of cardiac failure. In one case the routine red blood cell count was inadvertently omitted and a severe anaemia—R.B.C. 1,910,000—was not discovered until the day of death. This infant had a severe bronchopneumonia which failed to respond to chemotherapy. It is possible that she would have recovered with the aid of a blood transfusion.

The four remaining cases failed to respond to apparently adequate treatment of their dehydration.

Discussion

The cases described in this series may be considered a representative sample of infants admitted to an enteritis unit in the London County Council area. They were of average severity, and the clinical findings and results of treatment should therefore be generally applicable to infants admitted to hospital with enteritis.

No discussion of the aetiology of infantile diarrhoea and vomiting will be attempted here. It is of interest, however, that the findings in this series are not in accord with the view that parenteral infections are the main causative factor in the onset of diarrhoea and vomiting. From Table VI it may be seen that in a high proportion of the more severe cases of enteritis parenteral infections were not detected although carefully sought.

Neither can otitis media be implicated as a major factor in the onset or relapse of diarrhoea and vomiting in this series, since it was found in only 76 of the 456 infants. It seems probable that the smallness of the number of mastoidectomies required was due to the more effective methods available for the treatment of suppurative otitis media and to the earlier correction of dehydration.

Parenteral infections, however, when present, may adversely affect the infant's response to treatment of the diarrhoea and vomiting, especially when associated with dehydration. It is essential, therefore, that these should be carefully sought for in all cases and energetically treated. Failure of dehydration to respond to adequate intravenous therapy should suggest the possibility of an associated parenteral infection. In such cases, if there is continued pyrexia with no improvement in the general condition, it has become the custom in this unit to give the infant a full course of sulphadiazine even though no definite parenteral infection has been found. It is considered that this practice is amply justified by cases such as those described in the analysis of deaths.

Dehydration remains the chief cause of the continued high fatality rate of infantile diarrhoea and vomiting, and its prevention or early correction constitutes the most important factor influencing recovery. In this series there were no deaths among the 198 infants who were not dehydrated. Among the 258 infants who were dehydrated there were 22 deaths. With earlier recognition and correction of dehydration nearly half of these deaths might have been prevented.

The ability of the infant to conserve water is relatively less than that of the adult. Therefore in any condition characterized by continued fluid loss dehydration occurs more readily in infants and reaches an irreversible stage more rapidly (Gamble, 1947). The condition which most commonly produces dehydration in infants is diarrhoea and vomiting. It should be remembered that this condition also leads to starvation. Therefore an infant who has become dehydrated is in need of food as well as of water and electrolytes. If these cannot be supplied by the oral route parenteral alimentation becomes essential.

Feeding by the gastric drip method does not permit of complete alimentary rest for the infant with severe diarrhoea and vomiting. Diarrhoea usually continues, absorption is uncertain, and dehydration and starvation are prolonged. This method was tried in a series of 22 dehydrated infants, and dehydration was corrected in only two cases. The remaining 20 infants became more severely dehydrated and required prolonged intravenous therapy. The gastric drip method was therefore abandoned.

Water and electrolytes may be administered by the subcutaneous or intraperitoneal routes, but in all but the mildest degrees of dehydration absorption is unreliable. Neither is it possible to provide the infant with adequate amounts of food by these routes. The intravenous route is the only reliable way of supplying such an infant with water and electrolytes, and food in the form of glucose and serum or plasma.

Early institution of intravenous therapy is essential for infants with diarrhoea and vomiting who are severely dehydrated. By this means complete alimentary rest is assured, dehydration is corrected promptly, and starvation is prevented. It is the practice in this unit to continue intravenous alimentation until diarrhoea has ceased or greatly decreased, dehydration is fully corrected, and the infant able to take sufficient fluid and food by mouth for daily maintenance. If watery diarrhoea or dehydration recur, oral feeding is stopped and intravenous therapy reinstituted.

Approximately 40% of the infants admitted to the unit required intravenous therapy. This could have been administered only in a hospital with the necessary facilities. The success of treatment is therefore dependent on: (1) recognition of dehydration in its early stages and admission to hospital of all but the mildly dehydrated; (2) correct assessment of the degree of dehydration in relation to the requirements of treatment; (3) a team of trained and experienced staff to carry out the necessary treatment. These requirements are best fulfilled by the establishment of self-contained hospital units for the treatment of enteritis.

The recognition of dehydration in its early stages is within the province of all medical practitioners, and the need for early treatment should be more widely appreciated. The assessment of the degree of dehydration and the treatment required in each case is essentially dependent on clinical judgment gained through practical experience. The successful application of these methods of treatment depends upon the training of the medical and nursing staff of the unit.

The figures shown in Table III lend support to this view. The fall in fatality rates after the first six months of 1945 appears to be directly related to the training of the nursing staff, since the technique of treatment was the same throughout the two years and the degree of severity of the cases did not vary from one year to the next. The distribution in age groups did not vary significantly in successive periods, nor during the first six-months period was there any preponderance of the younger age groups, in which a higher fatality rate might be expected. Owing to necessarily frequent changes of staff, in approximately six months most of the nurses in the hospital had worked in the enteritis unit and had become familiar with the routine management and treatment established there. Thereafter, although shortage of staff became a serious problem, all the available nurses were acquainted with the nursing and treatment of the dehydrated infant and were able to maintain the high standard of care necessary for these babies.

In this series 112 infants relapsed with dehydration. Since the nature of the infecting organism or organisms in diarrhoea and vomiting is not yet known, it is not possible to say what proportion of these relapses was due to cross-infection or to re-infection. The possibility of such an occurrence, especially in an open ward, must, however, be borne in mind. The observations in a previous series (Alexander and Eiser, 1944) are of interest in this connexion. In that series the infants were nursed in two different wards—an "open" barrier ward and a single-cell barrier ward. The technique of nursing and treatment were identical, and the numbers of admissions and dehydration rates on admission were the same for both wards. Yet the relapse rate in the open barrier ward was four times as great as that in the single-cell ward.

It seems advisable, therefore, that bed-isolation and barrier nursing should be rigidly enforced in enteritis units, which should, whenever possible, be accommodated in wards of single rooms or cells. By the establishment of such units, staffed by trained medical officers and nurses, much may be done to reduce the number of infants still dying of diarrhoea and vomiting.

Summary

The organization of a hospital unit for enteritis of infants is described and the treatment is outlined.

The results of treatment for the years 1945 and 1946 are detailed: 456 infants under the age of 1 year were treated in the unit during this period; 258 (56.6%) of these infants were dehydrated during the course of their illness. There were 22 deaths, giving a case mortality of 4.8% for all cases, or 8.5%

for infants who were dehydrated. There were no deaths among infants who were not dehydrated. Parenteral infections were found on admission in 238 cases (52.2%).

The association between parenteral infections and dehydration is low, and this series does not support the view that parenteral infections are a major factor in the causation of diarrhoea and vomiting. The need for careful search for parenteral infections is, however, stressed from the point of view of treatment.

The importance of prevention or early correction of dehydration, the necessity for intravenous therapy in severe cases, and the need for prevention of cross-infection are emphasized. This implies the provision of adequate facilities and a staff of medical officers and nurses experienced in the technique of barrier nursing and the treatment of dehydration in infants.

It is suggested that these requirements are best fulfilled by the establishment of self-contained hospital units for the treatment of enteritis.

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MULTIPLE MYELOMA TREATED WITH STILBAMIDINE AND PENTAMIDINE

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Von Rustizky (1873) was the first to describe the disease of multiple myeloma, the name of plasma-cell myeloma being proposed 27 years later by J. H. Wright (1900). Macintyre (1850) had already described a case of multiple bone tumour, calling it mollities ossium, which had a peculiar "animal matter" in the urine that became evident on gentle heating and disappeared on further heating. He sent the urine to Bence-Jones (1848) for examination, and the substance subsequently became known as Bence-Jones protein. About the same time Dalrymple (1846) gave a clear description of the bony changes in a case he reported on as mollities ossium.

Life insurance tables give the incidence of multiple myeloma as 0.03% of all malignant growths or 3% of all bone sarcomas, but recent collections of cases published suggest that the figures may be higher. Thus Batts (1939) found 40 cases in 200 primary malignant tumours of bone, and Bayrd and Heck (1947) saw 18 in a period of six months. Improved methods of pathological investigation and the attention drawn to the disease by publications have no doubt been largely responsible for the increased number of cases diagnosed.

Multiple myelomatosis is usually described as a fatal disease of middle life, occurring twice as often in males as in females and characterized by multiple tumours growing from the marrow and eroding the bone in a characteristic