THE EPIDEMIOLOGY OF GASTRO-ENTERITIS IN INFANCY: PART I*

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A recent editorial in the *South African Medical Journal*[1] urged that a broader view be taken when confronting the problem of diarrhoea in childhood, that sociological problems be included and attention focused on promotive and preventive methods in combating a scourge particularly besetting mothers less endowed with the knowledge and material comforts which higher social classes accept as commonplace.

Gastro-enteritis, a major public health problem, is estimated to kill 5,000,000 children in the world annually.[2]

THE COMMUNITY

This study was conducted mainly among the Bantu population of Johannesburg but also included Whites and Coloureds.

The city lies 5,850 feet above sea-level 300 miles from the eastern African seaboard, and has an essentially temperate climate although within 3 degrees of the Tropic of Capricorn. Humidity is low in winter, with summer rainfall, and the hottest months are usually from December to March.

Johannesburg has a cosmopolitan population of 1,327,352 inhabitants, of whom 449,700 are White, 733,339 Bantu, 107,420 Coloured and 36,893 Asiatic. It has an area of 115·63 square miles, 94·46 constituting the municipal area and 21·17 the Bantu residential area. Though the racial groups are separated into specific residential areas for purposes of domicile and recreational amenity, there is otherwise free intermingling of the people and a large number of Bantu commute daily to the central city and suburbs for purposes of employment. Bantu engaged as domestic workers by Whites either are housed on the properties of the latter or commute daily from the Bantu areas. The White population is mostly of a high socio-economic level, with the Coloured and Asiatic communities lying between this and the lower levels pertaining to the Bantu. The birth, infantile mortality and mortality rates for these population groups are reflected in Table I. Jellife[3] and others[4] have pointed out that the mortality rate for the 1 - 4-years age period is probably a more sensitive index of the public health situation in a population than the infant mortality rate, and it is contended[4] that a high mortality in this period reflects an unduly high prevalence of protein-calorie malnutrition. However, if it is accepted that the infantile mortality rate is a reasonable indicator of the health standards of a community, then the fall among Bantu from 579·87 deaths in the first year of life per 1,000 live births in 1940 to 78·83 in 1965 shows considerable socio-economic, environmental and health advancement in this group.

In the Bantu residential complex the population structure varies from recently detribalized persons to professional levels with academic qualification. There is retention of African superstition, tradition and concept in varying degree, depending on the length of urbanization; in the higher socio-intellectual strata the European way of life predominates. The socio-economic advancement of these people has been rapid but remains inadequate. The complex has 63,868 housing units and is developed on modern town-planning principles with macadamized roads, rail and motor transport facilities, sports fields, swimming baths, public and civic buildings, schools, pre-school institutions and areas set aside for trading. Public services include water-borne sewerage; a pure water supply, continually monitored and of high prescribed bacteriological standard, piped to each site; and a bi-weekly refuse removal service, each dwelling being provided with a regulation-type refuse receptacle renewed when necessary. The last remaining slum, which housed 7,000 families in this complex, is now being disestablished and rebuilt. The area has an extensive curative, midwifery, promotive and preventive medical service, incorporating a network of polyclinics and domiciliary coverage, forming an integrated system with base hospitals. The promotive and preventive medical services include child health, immunization, tuberculosis, family health, dental, health education, family planning and cervical cancer detection units. The City Health Department of Johannesburg employs 520 White and Bantu medical officers and nursing, health visitor, health inspectorate and other health per-

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TABLE I. BIRTH AND MORTALITY RATES

	Birth rate				*Infantile mortality rate*				*Mortality rate*			
Year	*W*	*C*	*A*	*B*	*W*	*C*	*A*	*B*	*W*	*C*	*A*	*B*
1940	24·71	31·64	60·71	12·58	52·13	189·22	120·59	579·87	9·10	21·46	17·68	14·91
1945	26·21	29·53	53·30	16·07	41·34	122·39	93·05	394·94	9·24	15·38	17·24	16·94
1950	24·55	46·15	54·62	20·30	31·90	95·51	75·13	232·00	8·11	18·19	12·60	11·72
1955	23·57	46·88	41·35	26·35	27·68	67·13	60·20	146·41	7·91	11·65	7·34	10·13
1960	23·92	39·05	29·52	32·07	28·27	64·40	48·71	122·75	8·38	9·85	6·34	10·93
1965	23·04	45·45	30·31	27·88	22·36	57·48	31·56	78·83	9·07	12·21	6·80	11·85

W = White, C = Coloured, A = Asiatic, B = Bantu

sonnel in clinic, domiciliary and environmental duties in this area.

Effective control of environmental sanitary circumstances is broadly maintained. While much shopping is done by Bantu in the metropolitan area, trading premises in these townships are regularly inspected and supervision exercised in the handling and preparation of foodstuffs. Constant action is necessary to control illegal trading, and while fresh milk supplied from licensed premises is pasteurized, milk hawking of illegally introduced milk sporadically recurs. Meat is supplied from licensed premises except where the slaughter of goats and sheep for religious and ceremonial purposes is permitted in the homes. The traditional demand for offal by this community persists and provides a cheap source of protein for the Bantu diet. Erection of offal stalls with licensing of offal traders permits sales of tripes, intestines, lungs, livers, spleens, chuck meats and ox heads—again, as in the case of milk, with sporadic recurrence of illegal hawking of these commodities. Apart from this meat being exposed to the hazards of the atmosphere, the yards of offal stalls, in spite of endeavours at control, are constantly soiled with scraps of bone, offal and waste water which attract flies, rodents and scavenger dogs. As the area lies in an endemic plague belt, stringent precautions, such as a rodent control belt round the area, are maintained, and the townships are kept reasonably free of rodent infestation.

Economic pressures force many mothers to seek work away from home, interfering with breast feeding and leaving many infants in the care of older children and frequently disinterested aged grandmothers. These children are often deprived of essential foods and neglected in unhygienic surroundings at the critical time of weaning. Though intensive health education is undertaken by health visitors in the homes of the people and at clinics, these techniques are inevitably undermined by the overwhelming, though lessening, socio-economic predicament.

THE PROBLEM

Following the introduction of massive field immunization campaigns[5-8] in the Bantu areas against diphtheria, whooping cough, tetanus, smallpox, poliomyelitis, measles and tuberculosis, with subsequent routine immunization of the newborn and appropriate booster measures, it was recognized that a remaining major priority among the Bantu was the critical problem of gastro-enteritis of infancy. It was much less of a problem among the other race groups.

Before embarking on this study, certain general views were held by the staff of the City Health Department arising from long association with this condition in the Bantu population, but no critical investigation had thus far been undertaken. It was accepted that large numbers of cases occurred at the same time, especially in the summer months; that there was high mortality; that it was an easily recognized primary entity and did not arise as a secondary manifestation of pathology in other systems, for example respiratory or ear infection; that symptomatology appeared consistent but there seemed to be no common aetiological factor; that it could occur in breast-fed as well as artificially fed infants; and that malnutrition seemed a frequent precipitating factor or rendered the condition more serious. The increasing acceptance and use of the feeding bottle by the Bantu, particularly the plastic variety esteemed by this community, was viewed by health staff with anxiety, and was the target of persistent educational endeavour. Infants brought to clinics by older children or grandmothers, or on their perambulations elsewhere, are usually accompanied by these bottles, often trundled on the ground as a plaything by infant or child attendant between being sucked for comfort or nourishment, and frequently, it would seem, merely topped up with fluid of dubious origin added to the assumed smouldering nidus of bacteriological growth in these inadequately and apparently seldom-cleansed containers. These were simply opinions and not scientifically controlled observations.

The problem for investigation was therefore defined as the high incidence of and mortality from gastro-enteritis in infancy in Johannesburg.

Objectives of the Study

The objectives were threefold:

1. To attempt to determine the epidemiological cycle of interrelated causative factors of primary infantile gastro-enteritis.

2. To determine methods of multiple interruption of this cycle of factors with the purpose of decreasing incidence and mortality and aimed towards control of this condition.

3. An associated objective was to utilize the planning and conduct of this study as a further exercise to encourage, permit participation and orientate medical officers and health visitors of the City Health Department in research projects of this type; to assist them by example in recognizing fields for research in the course of their routine duties; and to encourage them to plan, conduct and publish independent studies on projects thus selected and related to their spheres of activity.

Occurrence in Johannesburg

As gastro-enteritis is not a notifiable disease, no valid statistics are available of the true incidence in Johannesburg. Even though it were to be made a notifiable condition for future assessment purposes, it should not be assumed that this would necessarily enable incidence to be accurately determined among Bantu. Kwashiorkor was made a notifiable disease in 1962 and the notifications submitted to the City Health Department by the base hospital were considerably in excess of the case prevalence encountered by clinics, which screen all medical cases before admission to hospital except in instances of critical emergency. Even accepting some latitude of interpretation of specified diagnostic criteria, the variation warranted investigation. This showed a tendency of hospital staff towards notifying other and relatively minor malnutritional states as kwashiorkor, because, in terms of interest for their patients, they were aware that such cases would be followed and given supplementary feeding by the health visitor services on discharge from the hospital to their domiciles.

When an undertaking was given to follow and give supplementary feeding to all cases of malnutrition of which details were also to be given, and a more accurate

notification of kwashiorkor was requested on the basis of this undertaking, the discrepancy between clinic and hospital notifications diminished.

Other motivations giving rise to inaccurate notification were also apparent and sufficient to cast doubt on the precise usefulness of notification in non-communicable conditions of this type. Similarly, totals of cases attending clinics or hospitals give no really representative indication of incidence in Johannesburg, as not all cases are brought to these units. Some are attended by private medical practitioners and some may receive no medical coverage at all. Even though Baragwanath Hospital admits cases from other areas as well as from Johannesburg, the seriousness of the situation is evidenced by the fact that 3,741 Bantu children with gastro-enteritis were seen in its outpatient department in 1966.[9] Comparable seriousness is reflected at Red Cross War Memorial Children's Hospital in Cape Town, where Hansen[2] states that 40,000 children with gastro-enteritis are seen every year, 400 of whom died in 1966, and that the death rate for non-Whites was 25 times as high as that for Whites.

Apart from incidence, there is difficulty in assessing the percentage of children suffering from gastro-enteritis who actually die from the condition. Only the more serious cases are admitted to hospitals, and case mortality rates calculated from this source would likely be higher than those drawn from general practitioners or clinic services, thus giving a loaded concept of the seriousness of the condition.

Deaths from gastro-enteritis in Johannesburg in children of all races in the first year of life during the period 1955 - 1966 are shown in Table II. In establishing mortality rates for this age-group it was thought justifiable to apply the same formula as that used for the infantile mortality rate, namely, the number of deaths, in this instance from gastro-enteritis, in the first year of life per 1,000 registered live births. Similar rates could not be calculated for older age-groups of Bantu, as the total child population at risk in these groups was not sufficiently accurately known. As in the figures given by Hansen,[2] the death rate for non-Whites is far higher than for Whites, particularly in the Bantu, where in 1966 the rate was 32·2 times as high as that for Whites. Further, as might be anticipated in terms of the higher socio-economic level of the White, intermediary levels of Coloured and Asiatic and the lower levels of the Bantu, mortality rates are lowest for Whites, highest for Bantu and lie at intermediary levels for Coloureds and Asiatics.

There has been a progressive decline in mortality rates of gastro-enteritis (Fig. 1) particularly among Bantu, probably associated with improved socio-economic and environmental conditions and, to a lesser extent, medical services and therapeutic techniques. Though this rate is dropping, it cannot be known whether incidence is showing a parallel decrease, as valid statistics of incidence are not available; nor, therefore, can it be determined whether fewer deaths are associated with fewer cases or whether fewer cases of gastro-enteritis are dying of their illness, as a result, for example, of better and earlier treatment or improved nutrition.

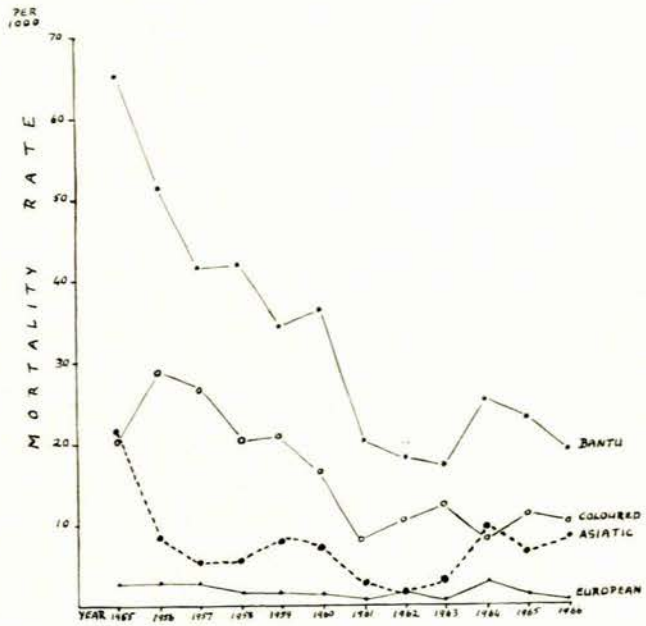

Fig. 1. Mortality rates for gastro-enteritis for the age-group 0 - 11 months during 1956 - 1966.

An explanation was sought for the rise in the gastro-enteritis mortality rate for Bantu in 1964 as there seemed no unusual increase in cases. A rise also occurred in the general infantile mortality rate. Births are notified to the City Health Department by hospital, practitioners or attendants of confinements, but there is a statutory obligation on parents to register the birth of a child. In terms of legislative requirement the infantile mortality rate is calculated on the number of registered births, and, in parallel, this was the basis used for determining the rate for gastro-enteritis in the first year of life.

Bantu frequently neglect to register births. As notified births therefore exceed registered births it means that infantile mortality rates for this community are actually lower than those shown, and they would be much more

TABLE II. DEATHS AND MORTALITY RATES: GASTRO-ENTERITIS IN CHILDREN AGED 0 - 11 MONTHS

	1955		1956		1957		1958		1959		1960		1961		1962		1963		1964		1965		1966	
Race	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*	*No.*	*Rate*
Asiatic	21	21·4	8	8·4	5	5·1	5	5·5	6	7·7	5	7·2	2	2·8	1	1·5	2	3·0	5	9·3	4	6·6	5	8·1
Coloured	33	20·7	42	28·5	36	26·7	27	20·1	31	20·8	27	16·1	14	8·0	19	10·3	25	12·4	18	8·6	25	11·4	25	10·4
Bantu	836	65·2	688	51·5	605	41·6	664	41·9	571	34·4	580	36·6	341	20·2	355	18·1	300	17·3	327	25·4	322	23·3	404	19·3
White	23	2·7	25	2·9	24	2·7	16	1·8	16	1·8	12	1·4	6	0·7	14	1·6	6	0·7	29	3·1	14	1·6	5	0·6
Totals	913	38·3	763	31·2	670	26·0	712	26·3	624	22·3	624	23·1	363	12·8	389	12·6	333	11·4	379	15·3	365	14·3	439	13·3

accurate if legislation permitted calculation on notified births in this area. Considerable persuasion had been directed to Bantu in Johannesburg to obtain greater co-operation in registration of the births of their children. However, co-operation waned in 1964, when 12,881 births were registered and 27,040 notified. In 1965, births registered were 13,827 and 27,063 were notified: in 1966, registered births were 20,941 and notified births were 26,436.

The only other possibly useful information which could be extracted from existing statistical records was a breakdown of deaths from gastro-enteritis in Bantu children in various pre-determined age-groups from birth up to the age of 9 years, as shown in Tables III and IV. These show that the greatest number of deaths occurred in children in the first year of life, the mortality being highest in the age-group 1 - 6 months with a slightly higher occurrence in the age period 4 - 6 months than for the period 1 - 3 months.

Confirmation of a higher seasonal summer incidence could not be obtained from statistical records, as the condition is not notifiable, but it is well shown by the number of children admitted to the rehydration unit at Baragwanath Hospital[10] illustrated in Fig. 2.

Though mortality from gastro-enteritis shows a progressive fall, the fact that 404 Bantu babies under the age of 1 year died of this cause in 1966 remains an appalling indictment.

METHOD OF INVESTIGATION

A simple, unsophisticated, epidemiological investigation was desired. In terms of the third objective, staff were given every opportunity to closely observe the planning of this project.

In view of the large amount of data to be collected and analysed in epidemiological studies of this kind, consideration was given at the outset to the advisability of

TABLE III. DEATHS FROM GASTRO-ENTERITIS IN BANTU CHILDREN AGED 0 - 11 MONTHS

	< 1 week		*1–4 weeks*		*Total under 1 month*			*1–3 months*		*4–6 months*		*7–9 months*		*10–11 months*		*Total 1–11 months*		
Year	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Total*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Total*
1955	7	4	26	7	33	11	44	116	115	125	124	100	91	63	58	404	388	792
1956	4	2	21	21	25	23	48	108	79	122	93	79	66	46	47	355	285	640
1957	3	4	21	20	24	24	48	99	93	84	75	76	58	36	36	295	262	557
1958	5	1	19	21	24	22	46	100	97	107	79	69	71	56	39	332	286	618
1959	—	4	13	13	13	17	30	98	79	79	79	65	70	30	41	272	269	541
1960	3	1	18	18	21	19	40	90	76	82	77	79	58	44	34	295	245	540
1961	1	2	5	5	6	7	13	44	48	56	43	46	35	28	28	174	154	328
1962	1	3	9	6	10	9	19	46	46	62	44	49	38	28	23	185	151	336
1963	3	—	7	4	10	4	14	56	34	46	37	33	30	24	26	159	127	286
1964	1	—	4	6	5	6	11	39	47	58	54	46	32	20	20	163	153	316
1965	2	3	5	3	7	6	13	48	47	63	48	36	35	18	14	165	144	309
1966	5	3	7	4	12	7	19	69	58	60	62	51	39	20	26	200	185	385

TABLE IV. DEATHS FROM GASTRO-ENTERITIS IN BANTU CHILDREN AGED 0 - 9 YEARS

	< 1 year		*1 year*		*2–4 years*		*Total under 5 years*			*Total 5–9 years*		
Year	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Total*	*Male*	*Female*	*Total*
1955	437	399	135	174	40	35	612	608	1,220	3	4	7
1956	380	308	135	128	19	31	534	467	1,001	1	5	6
1957	319	286	110	86	29	24	458	396	854	2	1	3
1958	356	308	111	91	19	26	486	425	911	2	—	2
1959	285	286	90	103	19	14	394	403	797	5	—	5
1960	316	264	115	125	23	26	454	415	869	2	1	3
1961	180	161	69	74	16	15	265	250	515	1	4	5
1962	195	160	53	66	21	18	269	244	513	1	1	2
1963	169	131	53	42	17	17	239	190	429	2	5	7
1964	168	159	51	47	22	10	241	216	457	2	1	3
1965	172	158	63	66	16	9	251	233	484	2	2	4
1966	212	192	79	84	19	14	310	290	600	2	1	3

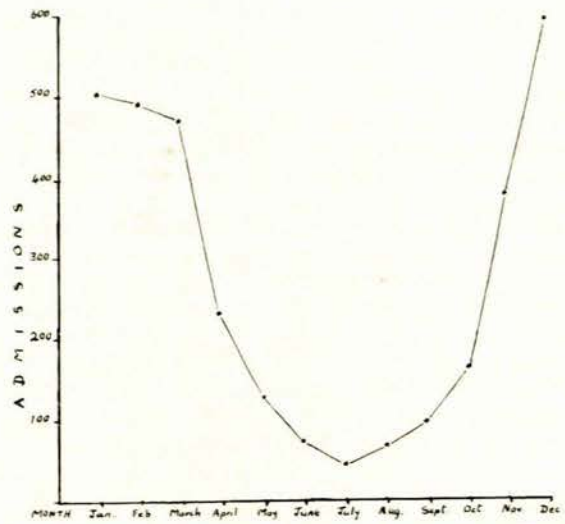

Fig. 2. Seasonal incidence of cases of gastro-enteritis admitted to the rehydration unit at Baragwanath Hospital in 1965.

utilizing the modern computer facilities available to departments of the Johannesburg City Council.

However, it is firmly contended that there is an inherent danger in modern mechanical data-processing of missing critically important observations such as an unusual clinical manifestation, prejudiced views of a questioner in obtaining completed questionnaires, or some minor but highly significant environmental factor. These salient, and often key, points are lost in the welter of figures categorized and recalled by the computer, and the advantage of speed and the easing of an onerous task is out-weighed by the hazard of producing an awesome array of figures of little subsequent benefit to the community. The computer has an increasingly important contribution to make to medical science and services, but does not replace the need of the thought processes of clinician, epidemiologist and laboratory worker in research analysis. These views are succinctly supported by Hammond and his co-authors,[11] who warn that a pencil guided by a brain remains necessary in the use of modern data-processing equipment in epidemiological research. They recommend that if the volume of information is relatively small the investigators should personally carry out the clerical tasks and, in thus keeping close to the data, will be in the best position to observe unexpected oddities. They further consider that a new idea most often occurs when such an oddity comes to the attention of a trained mind and that to reduce this possibility is a tragedy. A computer was not used in this study.

In general, in regard to clinical and field work, especial endeavour was made to eliminate variables as far as was practicable, and to avoid multiple observers. Precise adherence to defined criteria of the condition under investigation was insisted upon. Bias and prejudice were excluded as far as possible in the collation and analysis of data which was done without being directly concerned in the field work or involved as a routine in diagnosing and treating gastro-enteritis, but with a background of broad epidemiological, clinical and laboratory experience.

Criteria of the Condition under Investigation[12,13]

In drawing criteria the following definitions of terms were applied.

1. *Diarrhoea*: The passage of frequent watery stools, which were frequent in relation to the number of stools formerly passed while the infant was considered to be well; also yellow or bright green in colour and which may or may not have contained mucus or blood.

2. *Primary diarrhoea*: Diarrhoea which did not arise as a symptomatic manifestation of other concurrent physiological or pathological states, was often abrupt or even explosive in onset in severe cases, and in which soreness of the buttocks often appeared early.

3. *Secondary diarrhoea*: Diarrhoea which arose as a symptomatic manifestation of concurrent physiological or pathological states.

Secondary diarrhoea related to physiological states is exampled by loose or frequent stools common in the early weeks of life, particularly in breast-fed babies where several loose stools may be passed in a day, in sleepless, irritable, colicky, hypertonic infants, or in underfed babies where small frequent stools may be passed. As is well known, secondary symptomatic diarrhoea may occur in association with other pathological states such as respiratory infections, otitis media or kwashiorkor where it is possibly due to changes in the gut mucosa from malnutrition with overgrowth of pathogenic or even commensal organisms.

This investigation was concerned only with primary gastro-enteritis or enteritis and not with secondary diarrhoea associated with various physiological or other pathological conditions. It was further necessary to define that the primary diarrhoea should be significant, lest infants with minor upsets be included in the sample of cases. The demarcation line between insignificant and significant primary diarrhoea was difficult to define but was said to have been reached when any constitutional symptom related to the diarrhoea became manifest.

It was necessary to limit the extent of the study in relation to overburdened financial, staff and laboratory resources. As the highest mortality from gastro-enteritis in this area occurred in the first 3 years of life (Table IV), infants investigated were confined to this age-group.

Definition of criteria. Cases of gastro-enteritis included in the sample investigated were infants up to 3 years of age (2 years 11 months) presenting gastro-enteritis or enteritis with significant primary diarrhoea. Diarrhoea was significant when one or more of the following constitutional symptoms related to the diarrhoea occurred: vomiting with related refusal of feeds, pyrexia, weight loss, dehydration (marked by sunken eyes, depression of the fontanelle and loss of skin turgor), apathy, scaphoid abdomen, rapid, deep breathing, blood in stools or vomitus, intestinal distension, jaundice or sclerema.

Selection of Sample and Control Groups

The criteria drawn limited the sample of cases investigated to that precise category causing serious concern. In instances of work done elsewhere, control infants were often children suffering from other conditions but free from gastro-intestinal symptoms, for example admissions

to hospital wards. In the present survey it was thought preferable to have controls consisting of completely well babies.

The investigation was planned in December, when half the period of maximum summer incidence had already passed, but there was unwillingness to delay initiation of the project until the following year. The study was therefore confined to the remaining summer months, January to March, of 1967. All races were included, but because of the lower incidence among the White, Coloured and Asiatic communities and the relatively short duration of the project, it was accepted that cases from these groups would be insufficient to constitute a valid sample but might provide useful points of comparative interest. The problem and investigation primarily related to Bantu.

In the Bantu areas sample and control infants were selected from each of 5 polyclinics, the geographic distribution of which permitted a representative sample of the community in terms of socio-economic, environmental, cultural and other characteristics.

Sample group. It was not known to what extent Bantu cases complying with the defined criteria would exceed the resources of hard-pressed nursing and medical officer complements of the clinic and domiciliary services, which have attendances of over a milion cases a year. Similarly, associated bacteriological and viral studies had to be planned within the practical level of additional specimens which the laboratories could accept without unreasonable disruption of routine commitment.

Within these limitations a representative random sample was drawn in the Bantu areas by taking the first 10 or fewer cases of gastro-enteritis complying with the defined criteria which presented at each of the 5 selected polyclinics on 5 weekdays (Monday - Friday) each week. A full clinical history and medical examination of each case was completed by medical officers and a detailed epidemiological investigation made into the socio-economic and environmental circumstances at the domicile of each case by health visitors.

To ensure further random selection and to avoid overtaxing laboratory facilities, every third case of the sample was chosen for laboratory investigation. These cases had 2 rectal swabs taken for bacteriological investigation and 2 for viral studies. One of the bacteriological swabs, treated with charcoal, was broken off into a bijou bottle containing semi-solid agar (Stuart's transport medium) and the other into liquid Selegnite F medium as an enrichment for salmonellae. If stools could be obtained these were submitted. In addition, in each of these children from whom rectal swabs were taken, a specimen of artificial feed or other content of any feeding receptacle accompanying the child was sent to the laboratory in sterile screw-capped bottles.

All cases complying with the defined criteria which presented to White, Coloured and Asiatic services during the period of this project were subjected to the clinical, environmental and laboratory investigation described.

The forms completed by medical officers undertaking clinical examinations gave comprehensive coverage of the infant's personal details, precise criteria validating inclusion in the sample, history, which included data as to whether the child attended routine well-baby promotive and preventive clinics and similar pertinent factors, clinical findings and nutritional state.

The questionnaire used in the associated epidemiological field studies, conducted by Bantu health visitors in Bantu cases to ensure maximum rapport, strove to provide comprehensive detail, but again within the limitation of the routine duties of these workers who already shouldered intolerable case loads. Investigation of the household and family included how many people slept on the premises, whether the family was tenant, sub-tenant or visiting, parity of the mother, number of children alive, number under 5 years of age, those attending nurseries or schools and the names of these institutions for further attention if necessary, the father's occupation, number of contributory wage earners and the total income of the family, pensions, grants or assistance received, and whether hire-purchase was paid for articles in the home and how much weekly or monthly.

The living pattern was classified as tribal, mixed or Europeanized. Details were sought of the head of the family and whether the head lived in the same house, nearby, in rural areas or another town. Illness in the home was probed and, if present, was investigated if it had occurred within the past 2 weeks, particularly in the case of diarrhoea. Premises were inspected with regard to overcrowding, the type of accommodation provided, structural condition, the state of the grounds and presence of rubbish, whether vegetables were grown, sewerage provision and refuse removal, animals kept such as dogs, cats, fowls, goats and others and any recent sickness or death among such animals, rodent infestation and recent rodent mortality, cockroaches and flies.

Time did not permit use of the Scudder[14] technique to sample the density of housefly populations. Whether the water supply was obtained from an indoor, outdoor or communal tap, and whether storage was clean or dirty, covered or uncovered, was recorded. Milk used was studied with regard to it being fresh, dried or tinned, condensed milk; the source of supply of fresh milk, with detail of dairy or illegal pedlar; and how this milk was utilized in the feeding of the infant under investigation. The meat supply was investigated and it was determined whether the family ate offal or not, and, if so, from where it was obtained; whether the infant ate meat; and whether persons who tended the infant handled raw meat.

Details of the infant's nourishment were thoroughly probed as to whether the child was wholly, partially or not breast fed, and details obtained of artificial feeding methods and foods, gruels or solids; whether milk used in the feed was fresh, powdered or condensed; and whether gruel was given in a bottle or with a spoon. Further information concerning feeding covered the amounts of artificial feed prepared, whether for a whole day or individual feeds, whether refrigeration was used, the hygienic state of containers, whether feeds were likely to be contaminated during storage, whether the feeding bottle was constantly at hand as plaything or comforter, where it was usually kept and whether the teat was kept covered, what it contained and how long the bottle was

kept 'on the go' by being topped up, whether the apparatus was cleansed daily, weekly or hardly ever, and how it was cleaned. Mixing utensils were examined.

Medication given to the infant was investigated, particularly that administered within the previous 2 weeks, as to whether it was obtained from a clinic, medical practitioner, shop, herbalist or witchdoctor, and the type of medicine, whether laxatives or enemas were given and how often, on what occasion and of what type. Dummies were studied. Information was obtained as to whether mother, grandmother or children looked after the infant, their state of intelligence and cleanliness and their commitment to other duties, bearing in mind such unusual circumstances in the Bantu areas as the reversion of an infant to an often disinterested maternal grandmother because the husband had failed to pay *lobola*, which traditionally gives him the right to the womb and its issue. Field investigators were requested to record any additional pertinent factors encountered.

Control group. Randomly-selected well babies were used for control purposes. In the Bantu areas the first 10 clinically normal babies, or a lesser number to parallel the sample group, who presented at the child health promotive and preventive clinics of the 5 poly-clinics conducting the field study were selected on each day on which sample cases were drawn. These control cases were submitted to exactly the same clinical, domiciliary and laboratory investigations as the sample cases.

(To be continued)