Prevalence, incidence, and carrier rates reveal that intestinal infection is common in Alaska, especially among infants and preschool children. The greatest incidence is in the summertime.

Acute Intestinal Infection in Alaska

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THE ARCTIC is no longer the isolated, almost legendary part of the world that it once was. The military consequences of an atomic age, the press for natural resources, and the demands of international air travel bring increasing numbers of people to arctic and subarctic regions, with a consequent need for information on medical problems incident to life in cold climates (*1*).

Epidemiological investigation in the arctic has a peculiar fascination; so little has been done that almost every observation is a contribution to knowledge. This satisfaction is tempered, however, by the realities of fieldwork in a physical environment demanding beyond most others. Hotels are not to be found in the far north; even a modest lodging house is rare; and the hospitality of what may be no more than a chance acquaintance becomes priceless. Travel is arduous. Long trips by commercial airline and local travel by boat, bush plane, and dog sled to collect information on a few hundred people are not unusual. A diet that includes whale meat and seal liver, although admittedly these are delicacies, still takes some accommodating.

The intestinal infections are an attractive starting place in arctic epidemiology because the mass behavior of these diseases has been well worked out through long study in temperate and tropical regions. Also, the required bacteriological procedures are relatively simple, a consideration of moment in the arctic where field conditions are as difficult as they are. Alaska was chosen as the first study area. As a cultural and administrative part of the United States, conditions were good for communication and cooperation.

The primary purpose was to determine under arctic conditions the mode of transmission of acute infectious diarrhea of man, and to learn something of prevalence and seasonal incidence. Also, intestinal parasites of dog and man were surveyed in two villages, and the ecology of fish tapeworm was examined in one area.

Recurring outbreaks of enteric disease have been recorded among Eskimo populations of Alaska for at least a century and a half, along with dramatic epidemics of smallpox, measles, and influenza. In 1807, Unalaska was devastated by an epidemic, presumably of bacillary dysentery, and the Klondike gold rush of the late 19th century brought outbreaks of dysentery and typhoid fever (*2*). *Salmonella typhosa* and other salmonellae were isolated repeatedly after the first public health laboratory was established in 1936. Seventeen cases of typhoid fever occurred in Anchorage and its

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vicinity in 1950 (*3*). Epidemics of shigellosis have been reported within the last decade in such scattered localities as Anchorage, Unalaska, the Kuskokwim delta, and Barrow (*2*). Acute diarrheal disease apparently is neither a new nor a negligible cause of morbidity and mortality in Alaska although it is better defined in the south than in truly arctic territory within the Arctic Circle. Such information as exists has been derived mainly from epidemic events; the endemic behavior of enteric and other diseases is little known.

Field Method and Procedure

A choice of study plans rested between a continuous investigation in a single area over a projected period of 3 years or a series of 1-year cross-section surveys in different but representative kinds of arctic environment. The far north with its tundra, taiga, and glacial topography is as varied as the tropics. The main purpose was to define principles governing the mass behavior of intestinal disease in arctic climates. Consequently the decision was for a series of studies in three characteristic regions, the tundra terrain of Alaska, the taiga of Lapland, and the glacier country of Greenland. Similar methods were used in each, and all were under the same field direction. This report concerns Alaska.

The Alaskan studies and those which followed determined primarily the qualitative nature and prevalence of acute intestinal disorders; less certain information on incidence was derived from histories of past illness. In all three areas interest has been such that the future long-term studies necessary for detailed knowledge may be anticipated from local sources.

One Alaskan study population included the Eskimo village of Wainwright, 100 miles west of Point Barrow on the Arctic Ocean, a truly arctic region. The second included three subarctic communities, predominantly Eskimo, in the Kuskokwim delta 400 miles west of Anchorage in southwest Alaska. The intent was to identify similarities and differences in disease behavior in arctic and subarctic situations.

Alaskan residents of the interior and the north live almost wholly in small settlements or villages, ranging from perhaps 25 inhabitants to centers of 1,000 or more, with 100 to 300 persons the usual concentration. The settlements are widely separated, oftentimes 100 miles apart. Scattered homesteads in a rural setting do not exist for the reason that there is no agriculture in arctic Alaska nor in a goodly part of the northern subarctic. Inhabitants of the villages migrate seasonally to temporary fishing camps or hunting locations on which depends the food supply for dog and man.

The terrain in all four areas was characteristically tundra, the counterpart of the tropical desert. The initial investigations were made during late summer and autumn of 1954 and winter of 1955. Both arctic and subarctic regions were observed again in late spring and early summer of 1955, the time of year when, according to local tradition, epidemics of intestinal disease are concentrated.

The field team included an epidemiologist, a bacteriologist, and an interpreter locally recruited in each village. By house-to-house visits we obtained a census of the community, data on families and family members, and information on physical and social features of the environment relating to the behavior of enteric disease. We examined patients with acute diarrhea and obtained histories of such illness for each family member during the preceding year, the criteria being three or more loose stools in a single day with variable symptoms and duration. The histories included dates of onset and time sequence within the household. Arrangements were made for stool specimens, and approximately 88 percent of the interviewed persons cooperated.

Histories of minor illness have recognized weaknesses, especially when concerned with events that occurred several months before. A good clinical description is scarcely to be expected, and the longer the interval, the less likely are illnesses to be recalled. Morbidity data on common endemic intestinal infections are almost completely lacking in these arctic regions, and they are sketchy at best for most populations anywhere. By taking an actual census of the study population and by making surveys at different seasons of the year, the frequency of diarrheal disease and the age groups most involved were reasonably estimated.

A conviction that the laboratory is an essential feature of fieldwork required full support in this instance, for it was necessary to transport 800 pounds of apparatus and materials in field chests by air either to Barrow or Bethel, and thence by multiple trips in small, chartered bush plane or river boat to the villages under study. Adequate and comfortable space was usually available in the community schoolhouse, but a laboratory in the arctic should not anticipate the usual niceties of running water, gas, and electric current.

Specimens of feces collected in the field were plated promptly on Salmonella-Shigella (Difco) agar, and also inoculated into selenite enrichment broth (*4*). The remainder was examined for intestinal parasites. After 18 to 24 hours incubation of the enrichment medium, a second SS agar plate was made. Suspicious colonies from both sources were picked into triple sugar iron agar (*5*). Cultures having growth characteristics compatible with *Shigella* or *Salmonella* were transferred to nutrient agar slants. Confirmation through biochemical tests and serologic typing was done later in Anchorage at the Arctic Health Research Center, Public Health Service. Ill-defined cultures ultimately were identified at the Laboratory Branch, Communicable Disease Center, Atlanta, Ga.

In addition to providing facilities of a base laboratory, the staff of the research center and of the laboratories of the Alaska Department of Health also took part in a number of the field studies. The knowledge they had of the country and of local disease behavior was of material aid. Subsequently, Fournelle and associates continued observations in the subarctic study area, the results of which are published in this issue of *Public Health Reports* (pp. 55–59).

Incidence of Acute Diarrheal Disease

The population of the four Alaskan communities of Wainwright, Bethel, Napaskiak, and Kwethluk, as determined by actual census, was 1,197 persons, of whom 692 were interviewed by household visit. Since whole families were the unit of observation, the study group was representative of age and sex distributions within the village. The number of cases of diarrhea recalled for the previous 12 months was 145, an incidence of 210 per 1,000 per year (table 1). The rate is conservative. Wainwright and Bethel were sampled in late summer and autumn, Napaskiak and Kwethluk in the spring. More nearly complete information is to be expected for months immediately preceding interview.

Table 1. Acute diarrhea in four Alaskan communities,[1] 1954–55, by age

Age (years)	Number of persons	Cases of diarrhea during preceding year [2]	Incidence per 1,000 population per year [2]	Observed cases of diarrhea [3]	Prevalence per 1,000 population
0–4	143	55	385	5	35
5–14	203	41	202	1	5
15–44	259	29	112	5	19
45 and over	87	20	230	0	0
Total	692	145	210	11	16

[1] Wainwright, Bethel, Napaskiak, and Kwethluk.
[2] Determined by household interviews.
[3] Determined by single visit.

In the late summer sample, data were collected shortly after maximum seasonal prevalence; in the spring sample, somewhat in advance of that event. Annual rates derived from the two surveys showed no material differences and both indicated a summer maximum. A July survey expectedly would give higher rates and January lower. Dispensary records in two villages, Napaskiak and Kwethluk, showed that 26 percent and 16 percent of the population, respectively, had received medication for acute intestinal disorders during the preceding year. Infants and children under 4 years of age were most commonly ill. This evidence agrees closely with the information obtained by household visit. The rate of 210 per 1,000 per year presumably expresses with fair reliability the frequency of the more severe diarrheal attacks.

The seasonal distribution of 145 recalled cases of diarrhea as obtained by household interview shows a well-marked preponderance in the summer months (table 2), nearly double the number for any other 60-day period.

Again, because of the time that surveys were made, a seasonal variation with most cases in early summer appears established; autumn and spring may be unduly weighted.

Because of deficiencies in memory of past minor medical events, these numbers certainly do not represent all cases of acute diarrhea during the year. Based on prevalence (table 1) and a duration of 5 days, the expected incidence is in excess of 1,150 per 1,000 per year.

Prevalence of Acute Diarrheal Disease

Eleven cases of acute diarrhea were encountered in this general population in the course of single household visits, to give a prevalence of 16 per 1,000 population (table 1). Shigellae were isolated from three. The frequency was greatest among children under 4 years of age, which coincides with the high incidence in this group as determined by histories of past illnesses. Next in rank was the age group 15–44 years, where little illness was recalled during the previous year. The small numbers permit no conclusions; they do suggest that diarrhea occurs more frequently in this middle-age range than was remembered or reported in the retrospective study of incidence.

Carrier Rates

Identification of shigellae or salmonellae in stools of healthy persons ranged from 0 in Napaskiak to 5 percent in Bethel (table 3). Despite failure to identify a carrier in Napaskiak, that community reported the highest annual incidence of acute diarrheal disease, 280 per 1,000, of any of the four communities. Only 2 of 17 carriers were adults, both from Kwethluk and both harboring *S. typhosa* of the phage type responsible for the 1950 epidemic in that village. Two carriers were adolescents; the remaining 13 were 12 years of age or less. Age distributions of persons examined are proportionately those of table 1, from which population they were drawn; the numbers differ because some people failed to supply specimens and others with clinical diarrhea were excluded. The low carrier rates for *Shigella* in Napaskiak and Kwethluk may well have been due to the time of year these communities were sampled, in late March and April and 7 to 8 months after the usual peak of summer diarrhea. A prolonged carrier state for *Shigella* is unusual. On the other hand, the results from Wainwright and Bethel were from the autumn survey, much closer to the epidemic season.

Of organisms isolated from carriers, 5 of the 10 shigellae were *S. flexneri* 2a, 3 were *S. flexneri* group form variant, 1 was *S. flexneri* 3, and 1, *S. sonnei*. Of the 7 salmonellae, 4 were *S. typhosa*, and 1 each, *S. typhimurium*, *S. infantis*, and *S. oranienburg*.

No pathogens were isolated from 54 specimens of dog feces which were examined because of the possible role of dogs as a reservoir of salmonellae. Salmonellae were also absent from 300 specimens of human feces collected in the same two villages. Other studies at Barrow (*6, 7*) revealed *S. typhimurium* in both

Table 2. Acute diarrhea in four Alaskan communities,[1] 1954–55; cases and annual rates per 1,000 population by 2-month intervals based on household interview

Months	Cases of diarrhea	Annual rate per 1,000 population
December–January	6	52
February–March	16	139
April–May	17	148
June–July	48	416
August–September	20	174
October–November	27	234
Unknown	11	95
Total	145	210

[1] Wainwright, Bethel, Napaskiak, and Kwethluk.

Table 3. Carriers of Shigella and Salmonella in four Alaskan communities, 1954–55; rates per 100 healthy persons examined

Community	Population	Number examined	Number of carriers		Total percent carriers
			Shigella	*Salmonella*	
Wainwright	230	188	6	0	3.2
Bethel	600	138	3	4	5.1
Napaskiak	130	115	0	0	0
Kwethluk	237	129	1	3	3.1
Total	1,197	570	10	7	3.0

human and dog feces, to give a relatively high community dosage but no clinical cases in man.

Epidemic Studies

Promptly with breakup of winter ice in the Kuskokwim River and the opening of navigation in May 1955, headquarters were set up in the village of Napaskiak to investigate in delta communities the anticipated epidemics of diarrheal disease reportedly associated with the spring thaw. The first clinical illness did not appear until mid-June. In nearby Oscarville, a small settlement with unusually poor living conditions, 5 active cases were identified in a population of 48 over a period of 3 weeks, and 4 other persons gave a history of diarrhea within the preceding 2 weeks. *S. flexneri* 2a was isolated from a sick child and from 2 sibling contacts, and *S. flexneri* 3 from an elderly man and his 5-year-old granddaughter, both clinically ill.

Casefinding investigations included 13 other settlements and salmon fishing camps scattered along 20 miles of river and the coastal village of Wainwright bordering on the Arctic Ocean where breakup occurs much later. In a population of 1,050 people observed for 6 weeks after breakup, 21 clinical cases of diarrhea were seen, and a history of 25 other recent illnesses was elicited. Fournelle and his associates resurveyed the Kuskokwim delta area that same autumn and again in late 1956. His reported results in this issue of *Public Health Reports* give details of his earlier communication to us: that in both years more than a quarter of the persons in the area had had diarrhea in the preceding warm weather months; *S. flexneri* 2a was isolated from carriers and patients, two-thirds of whom were less than 12 years old.

Bacillary dysentery, therefore, is endemic in the Kuskokwim area. The reputed occurrence of epidemics associated with breakup did not materialize. Rather, there was a slow buildup of cases, reaching a maximum morbidity in midsummer. Sporadic infections or family groupings of cases are the rule, although small outbreaks occur and *S. flexneri* is as regularly isolated in such instances as in endemic diarrheal disease. Infants and children are most commonly affected.

Conditions in the arctic community of Wainwright essentially duplicated those observed in the subarctic Kuskokwim in incidence, prevalence, and carrier rates, with shigellae again so much the predominating infectious agent that independent tabulations were not necessary.

Mode of Transmission

Acute intestinal disease in the arctic certainly originates in contaminated food or water. A classic outbreak of staphylococcal food poisoning affecting 12 of 35 persons in a camp of stateside workers was an incidental experience in the course of the studies of Eskimo populations. The walrus epidemic of trichinosis in Greenland (*8*) in 1948 was outstandingly a foodborne infection. The early history of enteric infection in Alaska contains repeated reference to waterborne typhoid fever, and such outbreaks still continue (*2*). The sanitary precautions accorded whale and caribou meat are such as to suggest to the outsider a distinct likelihood of intestinal infection. Family outbreaks may occur, but there is no record of a community epidemic from such sources.

The annual summer outbreaks of diarrhea are believed largely due to person-to-person contact. The evidence is fourfold. In the first place, cases in a population tend to occur sporadically as opposed to the multiple primary cases of a common-source epidemic with transmission by vehicle. Second, outbreaks are characteristically of slow evolution and protracted course, unlike the sharp-point epidemic related to contaminated community food or water supply. During our investigation, summer outbreaks occurred but not in proximity to the spring thaw and the breakup of ice in rivers and ocean, by which the accumulated wastes of the winter presumably are washed into surface waters. The first cases came some weeks later, and numbers built up gradually to reach a peak in midsummer. Some infections and particularly the earlier ones may well have originated in contaminated water, but the propagation and subsequent course was that of contact spread.

In the third place, food habits of the Eskimo villagers preclude common vehicle transmission since each family is largely responsible for procuring and preparing its own food and

drink. Finally, the *Shigella* group of enteric pathogens predominated in carrier surveys and among infectious agents isolated from patients. Shigellosis is notably spread by person-to-person contact, although of course vehicle transmission occurs.

Summary

Field studies in 4 Eskimo villages of Alaska, 1 on the arctic coast and 3 in the subarctic Kuskokwim delta region, demonstrated acute diarrheal disease to be common, especially among infants and preschool children. Incidence was greatest in summer. A variety of pathogenic bacteria were isolated from cases and carriers, with *Shigella flexneri* 2a and 3 in greatest frequency. Transmission of intestinal infection in sporadic cases, in family groupings, and in small outbreaks was mainly by person-to-person contact.

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New Clinical Neuropharmacology Research Center

A comprehensive study of drugs and their use in the treatment of mental illness will be conducted at a clinical neuropharmacology research center recently established at St. Elizabeths Hospital. The Federal mental hospital and the National Institute of Mental Health have joined forces in the project.

St. Elizabeths, with its 7,500 patients, provides an ideal setting for clinical studies. The building selected for the center houses 350 patients and is being equipped with laboratories and other facilities for basic research.

At the center, psychiatrists, psychologists, pharmacologists, biochemists, physiologists, and other specialists will conduct extensive studies to determine what happens, physically and psychologically, when tranquilizing and energizing drugs are used in the treatment of various types of mental disorder.

The project will also include research designed to measure the changes in hospital management and care brought about by the use of drugs and how such environmental changes affect the patient.

Dr. Joel J. Elkes, a National Institute of Mental Health pharmacologist and former chairman of the department of experimental psychiatry at the University of Birmingham in England, is the center's director.