Epidemiologic Studies of Otitis Media Among Eskimo Children

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OTITIS MEDIA is a major health problem among indigenous populations of the North American continent and is the second highest cause of illness among Alaska Natives (*1-4*). This study, one of a series, is concerned with epidemiologic patterns of the disease among the group with the highest risk, the Eskimos. Our primary purpose was to make baseline observations of the occurrence of otitis media among the children of six Eskimo villages during a 12-month period. Additionally, we compared the usual treatment of otitis media with a regimen that we designed for remote areas.

Background

The six villages studied are among 50 Eskimo settlements in the deltas of the Yukon and Kuskokwim Rivers in southwestern Alaska. Topographically, the area is a vast treeless expanse of tundra, underlain with permafrost and covered with thousands of small ponds and sloughs. The climate is subarctic, ranging from an average of 54° F. in June to −7° F. in January.

In the typical household, six persons live in an inadequate one-room frame dwelling. The fire is usually allowed to die at night, and the indoor temperature drops below the freezing point. The children are often inadequately clothed for outdoor winter activities.

Medical services for the Natives in this area are provided by the Public Health Service Alaska Native Hospital at Bethel. Most villages have a shortwave radio, and a patient can receive advice from the radio medical clinic that is conducted daily by the hospital staff. Hospital physicians and field nurses from the Alaska Department of Health and Welfare visit the villages several times a year. Many villages also have a health aide, who has received a short course in first aid treatment. Because of limited transportation to these remote villages, most residents have no direct access to a physician, and their minor illnesses often go untreated.

Methodology

Monthly examinations were made from September 1965 through August 1966. We chose six villages—St. Mary, Mountain Village, and Emmonak on the Yukon River and Kwethluk, Nunapitchuk, and Tuluksak on the Kuskokwim River—on the basis of size, accessibility, and

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Kay Haley and Ardyce Alton, registered nurses in the health service, conducted the monthly examinations. Dr. Jon Aase made the initial pediatric examination, and Susan Struve Trout gave the audiometric tests. The staff of the Public Health Service Hospital in Bethel, Alaska, provided the medical records.

population stability. In four villages we observed treatment without interfering with the usual procedure; in the other two villages, we initiated a new regimen of treatment.

Initially, an otolaryngologist, an audiometrist, a pediatrician, two nurses, and an epidemiologist surveyed the villages. The two nurses had received special training in ear, nose, and throat examinations and in audiometry. We visited households to obtain general background information and to observe living conditions. A sanitary engineer later surveyed most households. All children under the age of 10 years were screened to detect hearing deficiencies greater than 25 decibels at any frequency from 500 to 4,000 Hertz. Children who failed the screening were given a complete hearing test.

Air and bone conductions were measured with a Zenith ZA–100–T diagnostic portable audiometer, which was calibrated to 1964 standards of the International Organization of Standardization. The audiometer was checked daily with a model RA–106 Rudmose calibration unit. Air and bone conductions, measured with a Beltone NB–101 narrow-band masking generator, were included when appropriate. The technique of testing was conditioned-play audiometry. The children were classified according to average hearing thresholds of pure-tone air at three frequencies: 500, 1,000, and 2,000 Hertz.

We obtained histories of otitis media through parental interviews and by reviewing the records of the village aides, the hospital, and the radio medical clinic. We also obtained monthly temperature and wind records from the weather station at Bethel.

The two nurses visited the six villages monthly to inteview parents and examine the children for evidence of otitis media. They also met with each village health aide, who recorded interval cases of otitis media including dates of onset, preceding illnesses, types of treatment, durations of illness, and complications. The nurses also checked the status of the children who had had otitis media at the time of their previous visits. Any new cases were reported to the village aide. On the 12th monthly visit, the otolaryngologist made the final examinations.

In the two villages where we initiated the new treatment, the village aides were trained to administer the special regimen, consisting of

Table 2. Percent of 641 children with new episodes of otitis media, by age and sex, September 1965–August 1966

Age last birthday (years)	Boys	Girls	Total
0	77	75	76
1	68	57	63
2	44	41	42
3	44	46	45
4	35	27	33
5	42	28	35
6	41	39	40
7	27	30	28
8	21	32	26
9	38	46	39
Total	44	41	43

Table 1. Number of children examined and percent with past history of otitis media, by age and sex, September 1965–August 1966

Age at last birthday (years)	Boys		Girls		Total	
	Number examined	Percent with history	Number examined	Percent with history	Number examined	Percent with history
0	35	37	28	25	63	32
1	38	63	30	63	68	63
2	46	67	32	50	78	60
3	32	78	28	75	60	77
4	34	68	36	64	70	66
5	26	76	29	65	55	71
6	32	62	33	78	65	70
7	44	57	30	57	74	57
8	29	65	28	57	57	61
9	21	80	30	73	51	76
Total	337	64	304	61	641	63

daily intramuscular injections of penicillin G for 5 days, and an injection of long-acting penicillin G on the sixth day. A 21-day course of long-acting sulfonamide was started the same day as the first injection of penicillin. If the ear was draining, the aide in one village cleaned it daily with a cotton-tipped applicator and then administered antibiotic otic drops. In the other village, the aide dusted the ear with chloromycetin powder. Beginning on the 21st day, the child received a monthly injection of long-acting penicillin G until the end of the study.

At least 1 month had to elapse between occurrences of otitis media for episodes to be counted separately. Any child whose ear continued to drain for a period of two visits was referred to the hospital.

Results

During the initial survey we examined 653 children under the age of 10 years, but 12 died within a few months of causes not related to otitis media, and they were not included in the calculations. The 641 children in the study group represented 95 percent of the 673 children known to be living in the six villages.

Table 1 shows the study group by age and sex and the percentages of children with a history of otitis media. A total of 404 children (63 percent) had positive histories. After the child's first year of life, little difference by age or sex was observed. A separate analysis showed little difference by village.

Age at onset of the first episode of otitis media was reported for 345 children; 41 percent occurred during the first year of life, 18 percent during the second year, and about 7 percent annually from the third through the eighth year.

Otoscopic examinations during the initial visit confirmed the histories. Eighty-seven percent of the children with positive histories had scars or perforations of the tympanic membranes, and an additional 11 percent had dull tympanic membranes indicative of past inflammation. Of the 237 children with no history of otitis media, only 11 percent had scars, perforations, or dull tympanic membranes.

Audiometric tests were performed on 404 children, including most children above age 3 years. Of this number 107 (27 percent) had a hearing deficiency of more than 25 decibels—compatible with the type of hearing loss expected with otitis media. The deficiency was bilateral for about one-fourth of those with hearing abnormalities. The percentage of children with a hearing deficiency was fairly constant in all age groups above 3 years and was similar for both sexes.

A positive association existed between hearing deficiencies and the reported number of past episodes of otitis media. Eleven percent of the children with no history had hearing deficiencies of more than 25 decibels, compared with 32 percent of the children who had one to three episodes and 53 percent who had four or more episodes.

Otitis media during the study year. During the study year, 275 (43 percent) of the 641 children experienced 532 episodes of otitis media. Table 2 shows the percentage of children with new episodes, by age and sex. Incidence was highest for children under age 2 years, and fairly consistent for the older age groups.

Incidence for children affected during the year was examined by histories of past episodes (table 3). In all age groups, incidence was higher for children with positive histories than for children without such histories. The difference was most marked after age 2 years.

Monthly incidence and prevalence rates per 100 children are shown in table 4 and illustrated

Table 3. Number of children and percent with new episodes of otitis media, by age and past history of the disease, September 1965–August 1966

Age last birthday (years)	Positive history		Negative history	
	Number	Percent	Number	Percent
0	20	95	43	67
1	43	79	25	36
2	47	49	31	32
3	46	56	14	14
4	46	41	24	17
5	39	44	16	6
6	46	47	19	16
7	42	46	32	6
8	36	41	21	5
9	39	49	12	0
Total	404	53	237	26

in the chart. Cases and rates are shown separately for the two "treatment" villages and the four "comparison" villages. There was no outstanding seasonal pattern. An outbreak of types A_2 and B influenza in the general area of these villages during February and March coincided with a slight increase in the incidence of otitis media in the treatment villages, but the pattern was not impressive.

Monthly averages of temperature and windspeed were plotted for the study year. No relationship was noted between weather conditions and the incidence of otitis media.

Personal and environmental factors. Forty-six children had tonsil-adenoidectomies before we initiated the study. Thirty-two (70 percent) of the 46 children experienced one or more episodes of otitis media during the study year compared with 41 percent of all children without a tonsil-adenoidectomy and 51 percent without a tonsil-adenoidectomy but with a history of otitis media.

Allergies are considered to be one factor in the occurrence of otitis media. We therefore chose 25 children with repeated episodes of otitis media and 25 children with no episodes for a series of 14 allergy scratch tests. No major reaction was seen in any child tested, no difference was seen between the two groups in the number of minor reactions that occurred, nor was a history of allergy associated with the occurrence of otitis media.

We also sought, but could not demonstrate, associations between the incidence of otitis media and size of family or sibship or indications of crowded living conditions such as number of square feet of housing area per person and number of people per bed. Similarly, we found no relationship with welfare assistance and parental interest and cooperation, as judged by the nurse, or with general sanitary conditions in the houses, as judged by sanitary engineers.

Clinical findings. The symptoms reported for the 532 episodes were often multiple, including draining ears in 384 (72 percent), ear pain in 137 (26 percent), fever in 103 (19 percent), and deafness in 16 (3 percent). Otitis media was diagnosed by ear, nose, and throat examinations in the absence of any symptoms for 50 (9 percent) of the episodes.

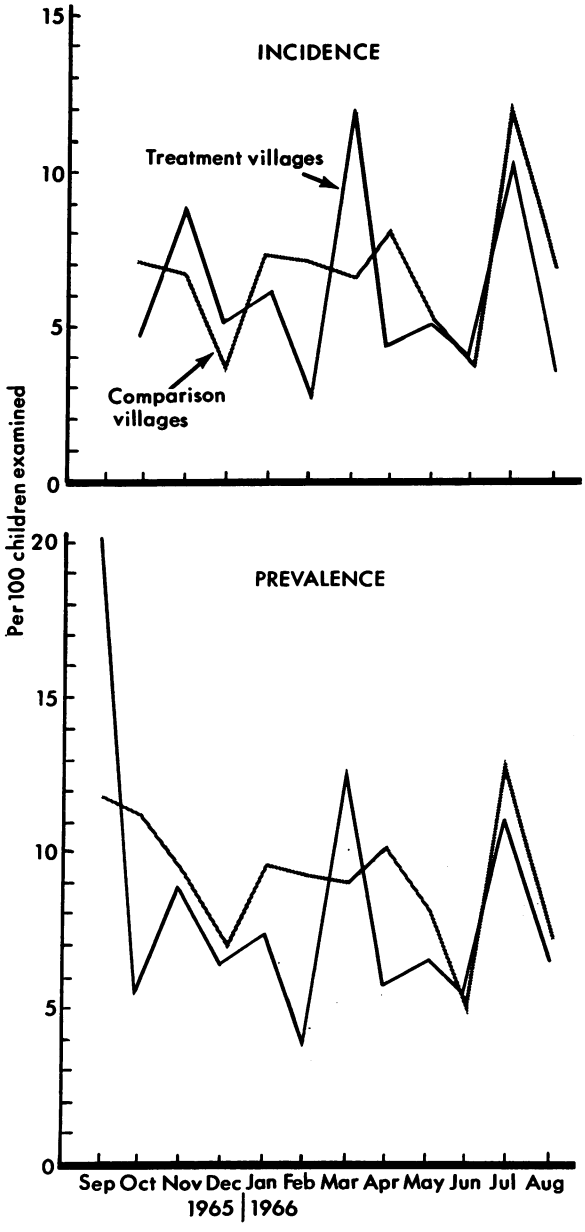
An otoscopic examination was performed during 425 episodes. Otorrhea was found in 323 (76 percent), acute perforation of the tympanic membranes without drainage in 58 (13 percent), and inflammation and pus in 13 (3 percent). For 31 (7 percent) no gross abnormalities were found, but symptoms of pain and fever and later reports of draining indicated the diagnosis.

In 409 episodes, illness preceded the onset of otitis media within 2 weeks. Of these episodes, 265 (65 percent) were preceded by upper respiratory infection, eight (2 percent) by lower respiratory infection, five (1 percent) by a childhood virus disease, and one by tonsillitis. No preceding illness was reported for 130 episodes (32 percent). Information about respiratory infections was not obtained for children having no episodes of otitis media.

Table 4. Monthly incidence and prevalence rates per 100 Eskimo children, by village classification

Month, 1965–66	Treatment villages					Comparison villages				
	Number examined	New cases	Existing cases	Incidence	Prevalence	Number examined	New cases	Existing cases	Incidence	Prevalence
September	248	--	50	--	20	393	--	46	--	12
October	243	9	13	4	5	376	26	42	7	11
November	238	21	21	9	9	383	25	36	7	9
December	236	12	15	5	6	361	13	25	4	7
January	235	14	17	6	7	377	27	36	7	10
February	226	6	9	3	4	373	26	34	7	9
March	232	27	29	12	13	381	25	34	7	9
April	227	10	13	4	6	377	30	38	8	10
May	186	9	12	5	7	380	19	30	5	8
June	202	8	11	4	5	356	13	18	4	5
July	101	10	11	10	11	332	39	42	12	13
August	232	8	15	3	7	364	25	26	7	7

Monthly incidence and prevalence rates of otitis media per 100 Eskimo children examined in six Alaskan villages, September 1965–August 1966



Treatment of otitis media. A general comparision of the effect of our treatment with the usual village treatment can be made using the chart. The monthly prevalence of otitis media was initially higher in the treatment villages, and then it dropped to rates similar to or lower than those for the comparison villages.

Monthly incidence rates were similar for the two groups of villages. The proportions of children experiencing a new episode of otitis media during the study year was 45 percent in the treatment villages and 41 percent in the comparison villages. The study treatment did not appear to have any effect on the monthly incidence or prevalence rates, and by the end of the year no impressive difference was noted between the two groups of villages.

We also attempted to evaluate the standard and experimental regimens of treatment in terms of duration of otorrhea or other symptoms. This evaluation proved to be meaningless because of differences in followup of the cases in the two groups of villages. More than half of the children in the comparison villages were seen only once by the village health aide, and the duration of episodes was uniformly recorded as 1 day.

We studied the duration for the experimentally treated group and for other children whose records indicated that their treatment included followup visits. Comparisons showed a mean duration of 12 days for those treated with penicillin only, 9 days for those treated with both penicillin and oral sulfonamide, and 6 days for those treated with the full experimental regimen. No meaningful differences were found in the duration of episodes between those treated with chloromycetin powder and those treated with antibiotic otic drops.

The effect of the monthly injection of prophylactic long-acting penicillin G was analyzed in terms of recurrent episodes after the prophylaxis was started. Of 97 children who received such prophylaxis, 54 (56 percent) experienced repeated episodes. By comparison, 89 (50 percent) of 178 children who did not receive the injections experienced repeated episodes.

Discussion

Little epidemiologic information about otitis media is available for comparison with our observations. The evidence of past otitis media among two-thirds of our study group is similar to results in our earlier cohort study of 437 Eskimo children (*5*). In that study, 62 percent of the cohorts had experienced one or more episodes of otorrhea, and 31 percent had a hearing impairment of 26 decibels or more by age 4 years.

The Medical Research Council (*6*) reported an annual incidence rate of 12 percent for otitis media in children under age 10 years seen in medical offices and 15 percent in a study of a general practice (*7*). Both of these English studies showed incidence peaks in the first and sixth years of life, with a sharp decline after age 6 years. Our annual incidence data showed that 43 percent of the children experienced new episodes, with the highest incidence occurring during the first year of life.

At the time of our initial survey, the prevalence of active otitis media was 15 percent. This figure is similar to the prevalence rate of 14 percent reported for Indians of all ages in British Columbia (*4*), and 17 percent for Alaska Natives under 17 years (*2*).

In the study series of the Medical Research Council (*6*) a seasonal variation was found in the incidence of otitis media among patients visiting physicians' offices. The highest incidence occurred during the first 3 months of the year, followed by a sharp decline in April. The lowest incidence was in August, and in September the incidence rose again. We found no indication of a seasonal distribution.

Associations between ear disease and socioeconomic status were reported in studies of British Columbia Indians (*4*) and Alaska Natives (*1*). Among the Canadian Indians whose social situation was rated "good" or "fair," the prevalence of active otitis media was about 6 percent; among those for whom the social rating was "bad," the prevalence was 35 percent. Fifty-one percent of Alaska Natives whose socioeconomic situation was rated "inadequate" had abnormal tympanic membranes, compared with 32 percent of those with "adequate" ratings. We found no association with specific factors such as crowding, sanitation, or welfare assistance, but would rate the socioeconomic status of all of the children studied from "poor to miserable."

Twenty-seven percent of the study children had hearing impairments of more than 25 decibels—much higher than the 1 percent reported among 5,000 New York City preschool children (*8*) or the 7 percent among 1,700 school children in Reading, Pa. (*9*). The impairment is similar, however, to the deficit of 20 decibels or more reported for 26 percent of 289 Aleut children (*10*) and for 23 percent of 899 Alaska Indians (*1*). Our results also approximated the deficit of 15 decibels or more reported among 31 percent of Canadian Indians (*4*).

The association of hearing loss and otitis media has been well documented by 6-month followup audiometric testing of children with otitis media. One study reported deafness of more than 30 decibels in 34 of 62 children (*7*); another reported a loss of 15 decibels or more, lasting 1 to 6 months, in 55 percent of affected children and more than 6 months in 12 percent (*11*).

Although bacteriological cultures were not feasible in this study, attempts were made to obtain cultures in the field during an earlier study (*2*). The unpublished results indicated that the most prevalent bacteria from acute cases were similar to those usually found by puncture aspiration: *Diplococcus*, *Hemophilus*, and *Streptococcus* (*12*). In chronic cases, gram-negative bacteria were most common.

Our choice of treatment was based on reports of the most effective regimens (*13*, *14*). Although a variety of treatments were given in the four villages where we did not intervene, more than half of the children received no treatment or only hydrogen peroxide drops. We believe our treatment was better, yet we were unable to show any meaningful difference in the prevalence or incidence of otitis media between the two groups of villages. Furthermore, our attempts to prevent recurrent episodes also were ineffective.

Penicillin was mentioned as an effective preventive of otitis media at a recent conference on Indian health, although no data were supplied (*15*). Long-acting sulfonamide also has been reported as an effective preventive among Indian children who have not had previous episodes of the disease and among children without mutilated drums, although the lack of an appropriate control group weakened this report (*16*). We speculated that the numerous episodes and mutilated ear drums which occurred before our study was started probably limited the effect of any treatment or preventive regimen we might use.

Tonsil-adenoidectomies have been considered as a preventive measure against otitis media among Eskimo children. The results of our

study showed that the pattern of repetitive episodes of otitis media was established among the children and that hearing deficiencies had occurred long before the age when an operation was safe. Furthermore, it showed that the risk of new episodes was higher for the children who had tonsil-adenoidectomies than among those who had not. One continuing study of our series is a controlled prospective investigation of the effect of this operation.

In conclusion, the results of our study indicated that middle-ear infections were established during the first year or two of life in almost two-thirds of the Eskimo children. Once affected, these children had a much higher risk of new episodes of otitis media and of a subsequent hearing deficiency than the children who were not affected during their first 2 years of life. It follows that any attempts to prevent otitis media and the resulting pathology would have had to be directed toward these children during their first 2 years of life.

Summary

A study of the occurrence of otitis media among Eskimo children in six Alaskan villages was done during a 12-month period in 1965–66. An initial survey revealed a history of one or more episodes of the disease for 63 percent of 641 children. Nearly all the children with a positive history had eardrum abnormalities, compared with 11 percent of the children without a history. A hearing deficiency of more than 25 decibels was found in 27 percent of the children above age 3 years; this deficiency was associated with a positive history of the disease.

Monthly followup examinations showed that 43 percent of the study children experienced new episodes of otitis media during the year. Incidence was highest for children under age 2 years and for children with a history of previous episodes. The prevalence and incidence rates of otitis media did not appear to be related to seasons or to weather conditions. No association was found between the incidence of otitis media and allergy, family size, measures of crowding and sanitation, or parental interest.

A special treatment regimen for children in two villages did not appear to affect the incidence or prevalence rates of otitis media when compared with rates in the other four villages. Monthly injections of long-acting penicillin G did not prevent repeated episodes of the disease. Forty-five percent of the children in the two treatment villages experienced a new episode during the study year and 41 percent in the four comparison villages.

REFERENCES

(1) Hayman, C., and Kester, F.: Eye, ear, nose and throat infections in natives of Alaska. Northwest Med 56: 423–430, April 1957.

(2) U.S. Children's Bureau: A documentation on the study and prevention of upper respiratory disease. U.S. Government Printing Office, Washington, D.C., 1962.

(3) U.S. Public Health Service: Indian health highlights. April 1964. Mimeographed.

(4) Cambon, K., Galbraith, J., and Kong, G.: Middle-ear disease in Indians of the Mount Currie Reservation, British Columbia. Canad Med Assoc J 93: 1301–1305, Dec. 18, 1965.

(5) Reed, D. Struve, S., and Maynard, J.: Otitis media and hearing deficiency among Eskimo children: A cohort study. Amer J Public Health 57: 1657–1662, September 1967.

(6) Medical Research Council's Working-Party for Research in General Practice: Acute otitis media in general practice. Lancet No. 6994: 510–514, Sept. 14, 1957.

(7) Lowe, J., Bamforth, J., and Pracy, R.: Acute otitis media: One year in a general practice. Lancet No. 7318: 1129–1132, Nov. 30, 1963.

(8) Mosher, W., and Maines, A.: A screening program for the detection of hearing loss in preschool children. Amer J Public Health 45: 1101–1108, September 1955.

(9) Wishik, S., Kramm, E., and Koch, E.: Audiometric testing of school children. Public Health Rep 73: 265–278, March 1958.

(10) Brody, J., Overfield, T., and McAlister, R.: Draining ears and deafness among Alaskan Eskimos. Arch Otolaryng 81: 29–33, January 1965.

(11) Olmsted, R., Alvarex, M., Moroney, J., and Eversden, M.: The pattern of hearing following acute otitis media. J Pediat 65: 252–255, August 1964.

(12) Gronroos, J., Kortekangas, L., and Vuori, M.: The etiology of acute middle ear infections. Acta Otolaryng 58: 149–158, August-September 1964.

(13) Rubenstein, M., et al.: The treatment of acute otitis media in children. III. A third clinical trial. Amer J Dis Child 109: 308–313, April 1965.

(14) Bass, J. W., et al.: Ampicillin compared to other antimicrobials in acute otitis media. JAMA 202: 697–702, Nov. 20, 1967.

(15) Association of American Indian Affairs in New York: *In* Proceedings of the Fourth National Committee on Indian Health. I. Respiratory infection. Arch Environ Health 17: 247–266, August 1968.

(16) Ensign, P., Urbanich, E., and Moran, M.: Prophylaxis for otitis media in an Indian population. Amer J Public Health 50: 195–199, February 1960.

Tearsheet Requests

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Education Notes

Residency Training in Preventive Medicine. The University of Michigan School of Public Health has organized a program of residency training in preventive medicine.

Designed to prepare physicians for administrative, research, and teaching careers and approved by the American Board of Preventive Medicine, this 3-year program permits residents to specialize in epidemiology, industrial medicine, maternal and child health, medical care organization, population planning, or public health administration.

Most first-year residents will enroll in the master of public health program, although this step is not essential to satisfactory completion of the program. Physicians with the master of public health degree or its equivalent may be admitted directly into the second year of residency training.

Further details and information about financial support may be obtained from Myron E. Wegman, M.D., Dean, School of Public Health, University of Michigan, Ann Arbor, Mich. 48104.

Hospital and Health Care Administration. The University of Minnesota program in hospital and health care administration is offering a doctoral program for persons interested in teaching, planning, and research in health care.

The curriculum is multidisciplinary and is organized around four core areas. These areas include (*a*) organization and administration of health care services, (*b*) social, political, and economic aspects of health care, (*c*) research and statistical analysis, and (*d*) comprehensive health planning.

Specific course offerings range from a comparative analysis of foreign health systems and examination of alternative patterns of health care to advanced statistical decision making, planning, and administration. The student may also elect a minor in related disciplines, such as business administration, economics, sociology, industrial relations, public administration, or political science. Time required to complete the program will vary.

Although a master's degree in hospital and health care administration is desirable, students with advanced degrees in business administration, industrial relations, medical sociology, public administration, comprehensive planning, public health, medical care, nursing, or medicine are encouraged to seek admission.

Stipends range from $2,400 to $2,800 plus $500 for each dependent. Traineeships are supported by a 5-year grant from the National Center for Health Services Research and Development, Public Health Service.

Additional information and application materials are available from Theodor J. Litman, Ph.D., Coordinator of Doctoral Studies, Program in Hospital and Health Care Administration, 1260 Mayo Memorial Building, University of Minnesota, Minneapolis, Minn. 55455.

Residency Training in Environmental Medicine. The University of Michigan School of Public Health is offering residency training in environmental medicine to physicians seeking careers in governmental agencies, academic institutions, and foundations.

While a structured program of training has not been established, the resources of the university are available for the study of environmental chemistry, epidemiology, human ecology, medical sociology, public administration and law, health planning, and mental health.

Further details and information about financial support may be obtained from Bertram D. Dinman, M.D., Professor of Environmental and Industrial Health, University of Michigan School of Public Health, Ann Arbor, Mich. 48104.

Announcements for publication should be forwarded to Public Health Reports 6 months in advance of the deadline date for application for admission or financial aid, whichever is earlier.