

OTITIS MEDIA AMONG NORTH AMERICAN INDIANS : THE NAVAJO

JOSEPH L. STEWART, Ph.D.*

Otitis media (OM) is the leading cause for hearing impairment world-wide and is one of the most universal diseases known to Man. It appears that every child in the world will at one time have at least one episode of the acute stage of the disease. In common with other such pervasive diseases, it seems to strike most frequently and most devastatingly those children living in areas where treatment services are remote, in short supply, or otherwise not readily accessible. Recent surveys of the literature, reviewed by Stewart (1985) indicate particularly high prevalences among the North American Indian and Eskimo populations, the Aboriginal people of Australia, and the various island populations in the western and southern Pacific. While high rates of OM are not limited to these geographical areas, the genetic commonalities of many of them lend even higher support to the roles of anatomical and immunological variables which add to the susceptibility of these people to the disease.

In many respects, the North American Indian population still represents a microcosm of many of the peoples in the developing countries of the world with one major exception : the provision, by the U.S. Government, of extensive medical facilities and services for their use. The present study is one of many evaluations which attempts to determine the effectiveness of these services on the prevalence of this disease. To the extent that OM is largely not preventable and as further evidence implicates genetic variables associated with high incidence, the task of the service provider is intensified and the need for evaluation and modification of the delivery of these services made mandatory. The findings of this, and similar studies, have implications for service providers wherever this disease is known to be highly prevalent.

While the excessively high incidence of OM in the North American Indian population has been extensively documented over a number of years the tribal-specific and problem-specific nature of the various studies has resulted in a fragmentary picture of the overall problem. Various investigators have been interested in topics as diverse as the people themselves. While the results of these studies may have broad implications, the multitude of problems posed by generalising

*Chief, Sensory Disabilities Program, Indian Health Service, Headquarters West, 2401, 12th Street, N.W., Albuquerque, New Mexico 87102.

specific results to the over 100,000 federally recognized American Indians throughout the United States make any discrete research topic limited in application to this largely heterogeneous group of people whose commonalities are largely low socio-economic status and rural residence.

In an effort to minimize these problems, a single tribe of Indians. The Navajo, were selected for intensive study of (1) the effectiveness of the Indian Health Service (IHS) OM program ten years after its establishment as reflected in hospital visits and (2) persistent OM, at the extreme lower ends of the age spectrum.

The Navajo were selected for a number of reasons: as the largest Indian tribe, a substantial number of patient records could be counted on for study; the Navajo are among the most homogeneous Indian groups with comparatively little intermarriage, of importance in speculating on racial and genetic variables in OM; the Navajo are among the most at risk for OM; the Reservation is one of the few where, due to the presence of "small cities," "urban" and "rural" comparisons of disease rates may be made; the Reservation has a well-established health care delivery system with both otolaryngologic and pediatric services available, and, through the IHS system, a consistent data base is readily available.

The logistics of providing health care on the Navajo Reservation are particularly challenging. The Reservation is very large and the population of nearly 150,000 persons equals a population density of about six persons per square mile. Most of the Reservation is poorly served by dirt roads, many of which become impassable during much of the winter.

The Navajo Area, IHS, is one of ten field located administrative offices serving American Indians nation-wide and covers portions of the States of Arizona, Utah, and New Mexico. Within the Area are eight Service Units, each of which oversees a variable number of hospitals, health centers, and school health centers. Each Service Unit is a medical facility. The two major hospitals on the Reservation, Gallup Indian Medical Center (GIMC) and Tuba City Hospital (TCH), provide a number of speciality medical services and are the bases for outreach speciality clinics throughout the Reservation.

Materials and Methods

The primary source of research data are IHS Ambulatory Patient Care (APC) forms upon which individual patient encounters are recorded separately. For purposes of definition, an "episode" is a visit for a separate and distinct disease occurrence while an "encounter" is a hospital visit not reflecting a new disease bout. Visits where ten or fewer days had elapsed from the first episode, or where

the hospital record indicated "resolving" OM or disease "under treatment" were counted as "encounters" and were totalled with the "episodes" for final tally of total numbers of hospital visits.

Computer printouts for each OM encounter in THS facilities on the Reservation for fiscal year (FY) 1980 and 1981 were obtained from the IHS Data Processing Service Center. The two year span was selected, first, to enable inferences to be made on the reliability of the data over time and, second, to provide a longer term base for the evaluations to be made.

A comparison of the services provided in 1981 (FY 81) is presented in Table I where disease percentages are contrasted with percentages of the population served by each Service Unit,

TABLE I (a). Acute Otitis Media—Navajo Area—FY 81

Age	Percentages		Sex		
	Patient Visits	Total Population	M	F	Unc.
0-27 Days	.3	.04	33	25	
28 Days-11 Mo.	28.0	3.2	2483	2177	21
1-4 Yr.	34.0	4.0	2899	2869	31
5-9 Yr.	12.0	1.4	931	1066	15
10-14 Yr.	6.0	.7	417	551	8
15-19 Yr.	3.8	.4	232	405	7
20-24 Yr.	2.8	.3	151	310	7
25-44 Yr.	8.0	.9	506	840	9
45-64 Yr.	3.6	.4	195	405	5
65 + Yr.	1.5	.2	96	156	1
Unclassified	.6	.1	.9	44	18
Totals	100%	11.6	7982	8848	122
			47%		

Total Patients : 16,952

Total First Visits and Revisits : 28,655

Navajo Area Population : 145,657.

TABLE 1(6). Chronic Otitis Media—Navajo Area—FY 81

Age	Percentages		Sex		
	Patient Visits	Total Population	M	F	Unc.
0-27 Days	.1	.002	2	1
28 Days-11 Mo.	9.4	.2	169	132	...
1- 4 Yr.	15.6	.3	279	216	4
5- 9 Yr.	13.1	.3	231	187	1
10-14 Yr.	14.0	.3	215	229	3
15-19 -Yr.	7.8	.2	124	123	3
20-24 Yr.	4.2	.1	66	68	...
25-44 Yr.	18.3	.4	220	360	5
45-64 Yr.	10.8	.2	121	225	...
65 + Yr.	5-8	.1	64	120	1
Unclassified	.63	.01	5	14	1
Totals	100%	2.1	1496	1675	18
			47%	53%	

Total Patients : 3,189
 Total First Visits and Revisits : 4,632
 Navajo Area Population : 145,657.

A high degree of consistency in diagnoses between the two years is seen at each Service Unit, indicating reliability of diagnosis regardless of provider which may result from on-the-job training sessions by staff otolaryngologists to a wide variety of Service Unit personnel over the preceding ten years.

A major apparent discrepancy to be noted in Table I relates to the excessively high disease rates for GIMC and TCH. This finding is probably a result of patients going to the nearest facility with continual otolaryngology services available. The extremely low number of encounters at Shiprock is felt to result from its proximity to GIMC and a coexisting tendency for many rural patients served by that hospital not to avail themselves of the services available. (Personal communication, P. Watkins, Otitis Media Program Director, Navajo Area, 1983.)

Additional support for this assumption can be derived by comparing the COM rates with population percentages for COM for both years at two additional Service Units (Crowpoint and Fort Defiance), both of which are located relatively near the GIMC.

As predicted from other research, AOM is found to be most prevalent after the neonatal period and prior to age five, patients in this age span accounting for over 60% of the total patient first visits and affecting seven percent of the total Navajo population. Of additional concern in this overall age distribution is the incidence of OM among the elderly, rarely reported in the literature as a problem for this age group. Only two studies, one by Corcoran and Axline (1982) were dealing with this, issue. These authors related AOM in the elderly to entry of oropharyngeal organisms through negative middle ear pressure resulting from oxygen absorption secondary to Eustachian tube (ET) obstruction. The second study, by Mori, Kita *et al* (1981) from Japan, reported an increase in COM among the elderly which was in turn related to the increasing number of elderly people in the population. As North American Indians are of Oriental stock, such a finding points toward the need for additional research on the genetic factors in OM incidence.

At first glance, most of the sex distributions reported in Table I would appear to indicate a more severe problem among females. As the sex ratio among the Navajo is 48 : 52 male to female, this distribution is accurately reflected in the Tables with only slightly more females generally affected.

Between FY 73 and FY 81, a significant change in AOM visits took place ; the rate dropped from 21% in FY 73 to 11-6% in FY 81. The assumption made when the program was initiated, and confirmed in other IHS Areas, was that COM would be more likely to be reduced than AOM if the program were effective. COM has remained essentially unchanged as measured by hospital encounters and surveys of schools.

The ratio of first visits to revisits has also shown a decided shift. In FY 73 the ratio of first visits to revisits for AOM was 81 : 19 ; in FY 81, 59 :41. To the extent that this shift might reflect revisits for resolved AOM, it is a positive trend. To the extent that it may also reflect subsequent episodes it is encouraging only if it is an indication of better use of services. In no case is the ratio felt to be adequate if measured against the care available.

The data in Table I would indicate, based upon hospital visits, that COM rates are essentially unchanged from FY 73 when the figure was 2.2%. These findings do indicate that a consistent number of patients do seek services for COM. For comparative purposes, the data for school age children (5 to 14

years) were determined separately, with rates of .59% and .58% respectively for the two years. This would appear to reflect a major reduction in COM since Johnson's 1967 study reported 7% of Navajo school children scicened to have current or past evidence of COM. Unfortunately, this is not the case. Nelson and Berry (1984), in a survey Conducted between 1978 and 1980, found the COM rate to be 4-0%, essentially the same as found by Jaffe in 1969. While the age range in these studies did not correspond exactly with those reported here, there is no disputing the finding that new cases ,of COM are being generated- at the same rate as 16 years ago.

The first visit-revisit ratio for COM indicates a dramatic reversal from FY 73 to FY 81. In FY 73 twice as many visits (66%) were revisits where, as in FY 81 the ratio is more than exactly reversed. The reasons for this finding cannot be deduced from the data but the same trend was found in many IHS Areas reporting for FY 73.

In order to reduce further the probability of diagnostic error,the two hospitals were extensive speciality services. GIMC and TCH, were selected for more detailed analysis of hospital records for infants.

Each hospital is located near a Reservation border, GIMC on the east and TCH on the west. Separated by nearly two hundred miles, each serves as a referral center for approximately one half of the Reservation. While these facilities serve less than 30% of the total population, the two Service Units s e v e r e nearly 50% of all COM patients.

Since the Navajo infants are known to have substantially more OM than is reported for the non-Indian population, and since the life-long effects of early disease are now being better recognized, separate analysis of the APC data are made at these ages.

AOM was clearly found to be a significant health problem for Navajo infants and young children. At GIMC in FY 81, the 1800 patients seen in this age bracket represent 8.3 % of the Service Una population and 66% of the total AOM patient population. At TCH in FY 81, 1684 children represented 9.8% of the population and 65% of the patients seen for AOM.

These findings are slightly higher than for the rest of Navajo Area where the 10,538 children at these ages represent 7.2% of the population and 02-5% of the AOM patient population. In order to investigate the onset and progression of OM in the very young, APC data on all children born in FY SO and 81 were tabulated, Table II, to determine consistency of diagnosis.

Two findings in comparing FY 80 and 81 are particularly apparent. AOM declined by 289 patients between these years while COM increased by 83 patients (27%). The reversed sex ratio, compared with previous observations, is consistent for AOM and COM through both years, indicating markedly more males affected at this critical age range, implying more males than females likely to be affected in the socio-educational skills developing later in childhood, if

TABLE 11(A). Otitis Media Distribution among Navajo Patients One Year of Age

Service Unit		ACUTE OTITIS MEDIA			Total	% Patients	% Population
		M	F	Uncl.			
Chinle	FY80	447	413	9	869	.17.3	14.1
	FY81	355	318	3	676	14.3	4.1
Crownpoint	FY80	167	169		336	6.7	7.8
	FY81	172	198	1	371	7.8	7.8
Ft. Defiance	FY80	330	314	15	659	13.1	14.1
	FY81	350	312	1	663	14.0	14.1
Gallup	FY80	414	388	8	810	16.1	14.9
	FY81	524	395	4	923	19.5	14.9
Kaycanta	FY80	203	194		397	7.9	8.2
	FY81	200	182	7	389	8.2	8.2
Shiproek	FY80	301	251	5	557	11.1	21.9
	FY 81	305	220	3	528	11.2	21.9
Tuba City	FY 80	396	371	2	769	15.3	11.8
	FY81	446	439	1	886	18.7	11.8
Winslow	FY80	340	277	2	619	12.3	7.2
	FY81	156	135	...	291	6.2	7.2
Totals	FY80	2598	2377	41	5016		
		(52%)	(48%)				
	FY81	2508	2199	20	4727		
		(53%)	(47%)				

TABLE 11(6). Chronic Media Distribution among Navajo Patients One Year of Age

Service Unit		ACUTE OTITIS MEDIA			Total	% Patients	% Population
		M	F	Uncl.			
Chinle	FY80	21	20		41	18.6	14.1
	FY81	23	14		37	12.2	14.1
Crownpoint	FY80	10	7		17	7.7	7.8
	FY81	9	5		14	4.0	7.8
Ft. Defiance	FY80	9	12	1	22	10.0	14.1
	FY81	22	28		50	16.5	14.1
Gallup	FY80	22	15		37	16.7	14.9
	FY81	23	21		44	14.5	14.9
Kayenta	FY80	12	15		27	12.2	8.2
	FY81	23	16		39	12.8	8.2
Shiprock	FY80	12	7		19	8.0	21.9
	FY81	14	9		23	7.6	21.9
Tuba City	FY80	25	22		47	21.3	11.8
	FY81	46	37		83	27.4	11.8
Winslow	FY80	7	3		10	4.5	7.2
	FY81	10	3 ...		13	4.3	7.2.
Totals	FY80	118	KM	1	220		
		(54%)	(46%,				
	FY81	170	133		303		
		(56%)	(44%)				

currently prevailing assumptions on the effects of early OM ON such skills has validity, The consistency of this finding throughout this young age indicates the more severe and earlier OM episodes to be sex-linked.

Children recorded with four or more visits during the year were arbitrarily classified as "recurrent" and assumed to be at higher risk for repeated OM episodes and more subject to complications. In order that the children whose records were to be analyzed in greater detail have the most accurate diagnosis possible, the decision was made to select only children served by GIMC and TCH.

Analysis of the APC data on the children served at either hospital with an Initial episode of OM during the first year of life and at least three additional encounters during the year revealed the following :

In FY 80, 86 children were seen at GIMC, 45 males (52%) and 41 females (48%). The mean age at first episode for males was 5.7 months and 6.8 months for females. In FY 81, 166 children fit the criteria, 94 males (57%) and 72 females (43%). The mean age at first episode for males and females was 6.0 months. Modal ages, FY 80, for males was 5.0 months and 8.0 months for females. In FY 81, the modal age for males was 5.0 months and 3.0 months for females.

In TCH, 164 children were seen in FY 80, 97 (59%) males and 67 (41%) females. The mean age of first episode was 5.2 months for males and 5.9 months for females. Modal age for males and females both was 4.0 months. In FY 81, 258 children were seen, 133 (52%) males and 125(48%) females. The mean age at first encounter was 6.0 months and the modal age 4.0 months for both sexes.

In order to follow the progression of OM throughout the first two years of life, the APC data from the facilities were further examined to include all children with a first episode before 24 months of age with at least three subsequent episodes during the year. At GIMC, 115 children (55 males, 60 females) in FY 80 and 205 (120 males, 85 females) in FY 81 fit these criteria. The additional 12 months raised the mean age at first episode to 7.3 months for males in FY 80 and 9.3 for females ; the modal ages were five and six months respectively. The sex ratio, male to female, is 48 : 52. In FY 81, the mean age at first episode was 8.2 months (mode = 5.0) for males and 8.0 months (mode = 5.0) for females. The sex ratio male to female is 59 :41.

At TCH, in FY 80, 212 children fit the criteria, 116 males (55%) with a mean age of first episode of 7.0 months (mode =4.0 months). Ninety-six females (45 %) had a mean age of first episode of 7.3 months (mode = 3 months). In FY 81, 296 children fit the criteria, 153 males (52%) with a mean age of 7.5 months and a mode of 4.0 months. Females comprised 143 patients (48%) with a mean age of first episode of 7.1 months, mode = 4.0 months.

A significant finding in this analysis is the disproportionate amount of AOM at this age compared to other Service Units, with the data from TCH being of particular concern. While the mean age of first episode at each hospital is essentially the same, greater disease severity at Tuba City can be inferred from the greater number of episodes for both sexes in the first year, a tendency even more evident when the first and second year are combined. The tendency for patients to be seen for follow-up visits is evidenced in comparing episodes with encounters; while the TCH mean number of encounters is only one more than for GIMC, the mean number of episodes are 4.3 more for TCH. At TCH, 85% of the visits were episodes compared with 65% at GIMC.

In order to more fully examine disease patterns among the very young, thirty charts, from a total of 674 Navajo children, were selected at random from each facility. As AOM is most severe in this population before the age of two years, only the first 24 months of each child's record were analyzed in detail; this enabled a full two year record to be analyzed for every child born in either year.

The analysis of the findings from this record search is summarized in Table III.

TABLE III. Otitis Media during First Two Years of Life—GIMC and TCH

	Age at First Episode (months)		Number of Episodes First Year		Episodes First Two Years		Total Encounters		
	GIMC	TCH	GIMC	TCH	GIMC	TCH	GIMC	TCH	
Mean =	4.1	4.0	6.9 8.8		11	15.3	17	18	
range =	1-10	1-12	2-13	2-20	5-15	8-23	6-31	10-28	
Mean, male =	3.9	3.8	3	9.7	11.2	15.4	16.8	18.4	
range =	1-7	1-12	2-13	5-14	6-17	10-20	6-31	10-27	
Mean, female =	4.2	4.3	6.5	8.2	10.7	15.3	17.2	17.6	
range =	1-10	2-9	2-11	2-20	5-11	8-23	9-26	10-28	
Number of Children	30	21							

A number of the tendencies noted previously are borne out in this analysis of the total sample of children up to 24 months of age. Generally there are more males than females affected at an earlier age. The overall severity of disease is greater at TCH as measured by number of encounters. The only point of similarity in number of encounters between the two hospitals occurs at 24 months. This is further evidence of the tendency for TCH parents to return their children less often even though the disease is more severe there. Further support for this finding can be seen in comparing the number of first year visits and the eventual development of COM. The ratio of eventual COM to AOM only is 11.1 to 8.8 episodes (.93 per month compared with .73 per month) at TCH while at GIMC 6.9 episodes (.58 per month) is the same for both classes of patients. At TCH, therefore, the greater number of episodes are indicative of more probable development of COM while at GIMC the mean number of episodes are not only less, but show no difference between AOM and eventual COM during the first two years of life. This same trend is seen when both years are combined. At TCH, the ratio of 19.7 to 15.3 eventual COM is substantially greater than the 13.4 to 11.0 ratio at GIMC. The overall trend for greater numbers of episodes leading to eventual COM is seen throughout except for the first year at GIMC where the means are identical.

Fifteen of the records (nine at GIMC, six at Tuba City) also showed at least one diagnosis of COM during the first year; in two of these records, COM was the initial diagnosis. For the remainder, the mean length of time from the initial AOM to initial COM diagnosis was 4.9 months. All but two of the children showed healing after treatment. One child had not been seen again in the nine months prior to chart review with the final entry indicating a visit for the latest in a protracted series of bilateral draining episodes. Her overall medical record was very poor, with numerous episodes of diarrhoea and dehydration. The second child's final entry, two and one half months prior to the chart review, indicated resolving OM with one perforation.

Age at first AOM episode was assumed to have bearing on disease severity using eventual COM as the criterion, so the mean ages at first episode for those with eventual COM were compared with AOM only. The mean age at TCH of 3.9 months is essentially identical with the overall mean age of 4.0 months. At GIMC the COM mean age of 4.3 months is only slightly higher than the overall mean of 4.1 months. The anticipated relationship between age at first episode and severity as measured by COM does not hold.

Comparisons of first ear affected shows high consistency between the two facilities. The right ear was first for six at TCH, seven at GIMC. Left ear was the first affected for seven at TCH and eight at GIMC. Bilateral involvement was first for eight at TCH and 15 at GIMC. Every child at each facility showed bilateral OM at some point in his chart during the first two years of life.

As noted, COM is seen more at TCH with eight of the 21 children affected compared to eight of 30 at GIMC. Five charts at TCH also showed a diagnosis of SOM while this diagnosis was made but once at GIMC. No diagnosis of cholesteatoma was made in any record.

Utilization of services and distance- from the child's home to the nearest health care facility have been assumed to be closely related, so the address of each child was recorded. While the usual rural urban dichotomy does not apply on the Reservation, those children listed as in or near either Gallup or Tuba City, or similarly sized town served-by either Service Unit, were evaluated separately from those whose addresses were clearly rural—such as " four miles southwest of Pinedale Trading Post ".

The mean age of first episode for the TCH sample was 4.0 for the urban children (N = 11) and 4.6 for the rural children (N= 10). At GIMC the mean age of first episode for the rural children was 3.7 months (N=15) and 4.4 months for urban (N= 15). For those children showing a diagnosis of COM, at GIMC five were urban and three rural : at TCH, three were rural and four were urban. No effect of home location on OM prevalence or severity could be inferred from these data. For the total sample of children, age of first episode shows a definite bias in favor of children living near the hospital ; at GIMC, consistent with other findings throughout, the reverse was found. The youngest ages at first episode, two weeks, were recorded for two children at GIMC, one urban, one rural.

Conclusions

Analyses of the two major aims of this study, the assessment of IHS OM program effectiveness on the Navajo Reservation over a ten year period, and the study of persistent OM among the very young do not lead to many concise and unequivocal conclusions.

Program effectiveness, if viewed as disease reduction alone, must be limited to the positive finding of a marked decrease in AOM over the ten years. This achievement is diminished by the negative finding that COM appears not to have been reduced at all. To the extent that current hospital visit figures have remained high may be, in part, a reflection of increased awareness of the importance of treating ear disease. The increasing tendency for more revisits is a welcome trend in this respect. The finding by Nelson and Berry (1984) that COM in school age children is unchanged in 15 years, and not reflected in hospital visits, is a cause for immediate concern.

For those patients with highly persistent disease, standard treatments do not appear to be effective. Based upon leads from previous research directions future

investigators might find fruitful might best be oriented toward families with histories of extensive disease episodes and studies of the immunological systems of those at highest risk, particularly the very young. Even though their numbers are small those patients with up to 24 hospital visits a year for OM are in need of intensive study.

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