

1999

Annual Report on Occupational Noise-Induced Hearing Loss in Michigan



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Summary:

This is the sixth annual report on occupational noise-induced hearing loss (NIHL) in Michigan. Over 2,100 new people were reported in 1999 to the Michigan Department of Consumer and Industry Services (MDCIS) with hearing loss known or suspected to be caused by noise at work.

Occupational noise-induced hearing loss is affecting mainly men, with an initial onset when they are 35-64 years of age. Exposures to noise are occurring primarily in manufacturing facilities.

Thirty-five of the 81 (43.2%) companies identified for inspections by the surveillance system had no hearing conservation program or a deficient program despite the presence of noise levels above the legal limit.

There were 801 workplace inspections which were conducted by the Michigan Department of Consumer and Industry Services in 1999 in Michigan that were not initiated because of the noise-induced hearing loss surveillance system; 71 of the companies inspected were in violation of some portion of the noise standard. This is in addition to the 35 identified by the surveillance system. Fifty-three of these 71 companies were cited for having the complete absence of a hearing conservation program. It is important to recognize, however, that the majority of the 801 inspections were in response to a specific complaint or referral. Consequently, the scope of these inspections was primarily limited to the complaint or referral item unless other serious issues were observed during the course of each inspection.

The data in this report indicates that a large number of both small and large companies do not have hearing conservation programs despite a need for them. Follow-up of reports from non-company audiologists and otolaryngologists shows that almost half of the companies where patients with work related noise induced hearing loss have worked did not have a hearing conservation program at the time the employee worked at the company.

Patients exposed to noise in construction were almost never provided hearing testing (94%), although just over 40% of them were given hearing protection such as plugs or muffs. Workers exposed to noise in construction in more recent decades were more likely to be given hearing protection than workers exposed to noise before the 1980's. Fifteen percent of construction workers with noise-induced hearing loss who had no other types of job exposures to noise were exposed to construction-related noise for 5 or fewer years. The Federal Occupational Safety and Health Administration has indicated it intends to issue an advanced notice of proposed rule-making this year to address the inadequacies of the current noise standard for construction workers.

Noise-induced hearing loss is an insidious condition which may take years to develop to a stage where it affects an individual's ability to communicate at home and in the work place. Prevention of noise-induced hearing loss is one of the strategic goals of MDCIS. A new initiative to increase inspections in 26 industry categories likely to have noise exposure has been developed. Through surveillance of work-related hearing loss in Michigan along with work place interventions, the state is working to

reduce the burden of hearing loss among its workers.

Background:

Facilities covered by the general industry noise standard are required to institute hearing conservation programs to prevent noise-induced hearing loss if the 8 hour time weighted average noise levels are at or above 85 dBA. However, the construction industry as well as transportation, oil and gas well drilling and servicing, agriculture and mining are exempted from this standard. Project SENSOR (Sentinel Event Notification System for Occupational Risks), the Michigan Department of Consumer and Industry Services' surveillance program for occupational noise-induced hearing loss (NIHL), identifies facilities that lack hearing conservation programs despite excessive noise exposures.

Nationally, one million workers are estimated to have work-related hearing loss, primarily from manufacturing-related exposures to noise (Weeks et al, 1991). Based on data from the National Health Interview Survey, one would expect approximately 86,000 individuals in Michigan to have noise-induced hearing loss related to work place exposures (Ries, 1994).

In 1992, the Michigan Department of Consumer and Industry Services (MDCIS) with financial assistance from the National Institute for Occupational Safety and Health (NIOSH) initiated a special emphasis program for NIHL. The surveillance program is based on Michigan's Occupational Disease Reporting Law, Part 56 of P.A. of 1978, which specifies that any health professional who knows or suspects a patient has a work-related illness must report it to the MDCIS within ten days (Figure 1). The goal of the special emphasis program is to prevent additional work-related hearing loss by inspecting facilities where index patients with NIHL have worked. The sources used to identify persons with occupational NIHL are: (1) reports from audiologists and otolaryngologists, (2) reports from hospitals, (3) reports from companies, and (4) reports from the Bureau of Workers' Compensation. Both private practice audiologists and otolaryngologists and those working for industry send reports to the Michigan Department of Consumer and Industry Services. Reports from hospitals are requested once each year. Hospital discharge summaries for individuals with a primary or secondary diagnosis of hearing loss (International Classification of Diseases (ICD) codes 388.10-.12, 389.10-.18, and 389.9) are obtained and the work-relatedness of the condition is determined from the medical record.

An individual is considered to have occupational NIHL if a health professional determines the individual: (1) has audiometric findings consistent with noise-induced hearing loss and (2) has a history of exposure to sufficient noise at work to cause hearing loss. If asked for guidance, the following minimum hearing loss is suggested:

- (a) a standard threshold shift (STS) of 10 dB or more in either ear at an average of 2000, 3000 and 4000 Hz, (this is related to the MIOSHA enforcement standard) or;
- (b) a fixed loss (suggested definitions: a 25 dB or greater loss in either ear at an average of: 500, 1000 and 2000 Hz, or 1000, 2,000 and 3000 Hz, or 3000, 4000, and 6000 Hz; or a 15-25 dB or greater loss in either ear at an average of 3000 and 4000 Hz) (this recommendation was developed by the state advisory committee for occupational noise-induced hearing loss surveillance).

Patients reported by a company medical department with a standard threshold shift (STS) are already enrolled in their company's hearing conservation program (HCP). Those reported with a fixed loss by a private practice audiology clinic or by an otolaryngologist not part of a company's HCP are followed up to determine if the company where they are or were exposed to noise has a HCP. All patients with a fixed loss who are reported by private-practice audiologists and otolaryngologists are administered a brief questionnaire about the history of their exposures to noise. The questionnaire asks about the three most recent companies where the patient was exposed to noise; non-work exposures are not detailed, since the health professional who originally reported the individual already made a professional judgement that noise exposures at work contributed at least in part to the patient's hearing loss.

After the patient has been interviewed, an industrial hygiene investigation is conducted at the individual's workplace if the individual reports they were exposed to noise and were not provided regular audiometric testing and hearing protection by their employer within the last five years. Follow-up is typically not performed at companies for which the law does not require the provision of a comprehensive hearing conservation program such as in construction and agriculture. An industrial hygienist conducts monitoring for noise and reviews the completeness and quality of the company's hearing conservation program, if one exists. After the investigation is completed, a report of the results and any recommendations are sent to the company and union (or designated labor representative if the company does not have a union), as well as to the reporting audiologist or otolaryngologist. If the company is cited for violations of any regulations, they must post the citations at or near the location of the violations for a minimum of three days or until the items have been corrected, whichever is later.

Results:

The results in the sixth annual report are presented in the following order: a description of all of the occupational disease reports submitted to the MDCIS for NIHL in 1999; results of interviews of patients with fixed loss reported by non company audiologists and otolaryngologists from 1992-1999; and, a summary of the MIOSHA inspections from 1/1/99-12/31/99 where violations of the noise standard were found.

1999 Occupational Disease Reports for NIHL

Figure 2 shows the number of reports of hearing loss since 1985. Approximately 10% of all occupational disease reports submitted to the Michigan Department of Consumer and Industry Services are for hearing loss. Because of increased awareness of the reporting law by employers and health care providers there has been an increase in the overall number of reports received since 1989, and an increase in the number of non-company reports received, especially since 1994. In 1999, there were 2,119 reports of work-related hearing loss submitted to the Michigan Department of Consumer and Industry Services. Of the 2,119 reports submitted in 1999, 1,273 were submitted by company medical departments. The other 846 reports were submitted by private-practice audiologists and otolaryngologists. Table 1 shows the number of patients with a fixed hearing loss reported by the private-practice health professionals.

Patient Demographics

Eighty-nine percent (1,886) of the reports where gender was listed are for men. Although requested, information on race was missing for 1,320 (62%) of the reports. The mean age of individuals reported is 52 years, ranging from 20 to 92 years. Patients reported by companies were generally younger than patients reported by non-company audiologists and otolaryngologists. Approximately 84% of the individuals reported by company medical departments were between 30 and 59 years of age compared to 47% of non-company health professionals in the same age range (Figure 3). Some of the reports by non-company audiologists and otolaryngologists were of retired individuals. All reports from companies were of current workers.

Industry

Table 2 and Figure 4 show the number of employees working at the companies where the patients were exposed to noise. Most of the reports were for large companies employing 500 or more individuals, although the non-company health professionals reported more patients from smaller companies. Table 3 is a distribution of industry type of the patients reported. Most of the reports were for patients working in manufacturing facilities. This corresponds to companies which are more likely to have hearing conservation programs. However, the non-company health professionals reported more individuals from other types of industries, including agriculture, mining, construction, trade, services, and government than the company or contract medical departments. Companies report patients with NIHL as part of their hearing conservation program (HCP). In contrast, the patients reported by non-company hearing health professionals would not necessarily be working at a company with a HCP.

Interviews of Patients with a Fixed Loss, Reported by Non-Company Audiologists and Otolaryngologists from 1992-1999

A total of 2,583 of 2,754 (94%) patients reported by non-company audiologists and otolaryngologists between 1992 and 1999 have been interviewed. The interviews ask about the three most recent jobs

where a person was exposed to noise.

Patient Demographics

Ninety-three percent of the interviewed patients reported from 1992-1999 were men. Of the interviewed patients reported from 1992-1999, 87.6% were white, 10.2% were African American, 1.3% were Hispanic, 0.1% were Asian and 0.8% were other. Race was unknown for 122 individuals. Figure 5 shows the distribution of decade of birth for the patients reported. Over 87% of the patients reported were born between 1920 and 1959, and includes retirees with hearing loss unlike the reports from companies which only include actively working individuals.

Industry

Table 4 shows all the industries where the interviewed patients were ever exposed to noise. Over 58% of the 3,243 companies where the 2,583 patients ever worked were in the manufacturing industry. The 3,243 companies are not unique companies; more than one patient may have worked at the same company. Therefore, the company would have been counted more than one time.

Table 5 shows the most recent industries in which the interviewed patients were exposed to noise, and whether the company provided regular hearing tests for their employees. The percentages of companies where the patient reported they did not receive regular hearing testing ranged from 23% to 100% within industry types. Overall, 42% of the most recent companies where the patients were exposed to noise did not regularly test their employees' hearing. The number of companies in Table 5 are not unique companies; more than one patient may have worked at the same company. Therefore, the company would have been counted more than once.

Table 6 shows the number of employees working in companies where the interviewed patients were exposed to noise. Workers were exposed to noise in both small and large companies, with large percentages of workers reporting having received no regular hearing tests, especially in the smaller companies where 77% of the workers were not regularly tested. The number of companies reported in Table 6 are not necessarily unique companies; more than one patient may have worked at the same company. Therefore, the company would have been counted more than once.

The interviewed patients worked in noise for a variety of durations, ranging from less than 5 years to greater than 35 years (Figure 6). Over 23% of interviewed workers reported by non-company health professionals had worked in noise for less than 15 years.

Figure 7 shows the decade of the patients' first exposure to noise. Some patients had very early exposures to noise; however, over 15% of the patients had first exposures to noise from the 1980's to present (9.9% in the 1980's and 5.9% in the 1990's).

Table 7 shows the decade when the interviewed patients with fixed hearing loss were most recently exposed to noise by industry. The percentage of individuals at companies with no hearing tests

decreased over time within the industry types that have been required by OSHA (since 1972) to provide such hearing tests. Construction and agriculture industries had the highest percentages of workers with no regular hearing tests; these industries are not required by MIOSHA or OSHA to provide regular hearing tests.

Table 8 shows the decade in which cases most recently worked, and whether they were provided with hearing protection (plugs or muffs) by industry type. Over time, the percentage of workers not provided hearing protection decreased in all industries. The percentage of manufacturing workers given hearing protection improved the most of any industry type, with 92% of workers not given hearing protection in the 1940's and only 9% of workers not given hearing protection in the 1990s. Workers in agriculture had the lowest percentage provided with hearing protection.

Table 9 shows the decade when the interviewed patients with fixed hearing loss were most recently exposed to noise by company size. Larger companies had lower percentages of workers with no regular hearing tests and had the greatest improvement over time than smaller companies.

Table 10 provides a distribution of hearing testing status for interviewed patients reported by non-company health professionals. Twenty-seven percent of the most recent companies where the patients reported by non-company audiologists or otolaryngologists were exposed to noise had both baseline and regular hearing testing; 49% had neither.

Inspections

In response to the reports of hearing loss, inspections were conducted at 81 companies where the person reported they had never received audiometric testing within the last five years. Of the 81 companies, 47 (58.0%) were required to have a hearing conservation program (HCP) because they had noise levels at or above 85 dBA. Of those 47 companies, 35 (74.5%) had either no HCP or a deficient HCP. Thirty-seven of the 47 companies requiring a HCP were in manufacturing; five were in services; three were in government; one was in the trade industry; and one was in construction. Thirty-four of the 81 companies were not required to have a HCP because noise levels were below 85dBA. Table 11 lists the characteristics of the 81 companies inspected as part of the surveillance efforts.

In addition, three other companies were identified where the person reported they had never received audiometric testing; however, these three companies had been inspected for noise prior to the start of the State's follow-up efforts, between 1987 and 1992. Two of the three had noise levels above 85dBA and no HCP. The other company also had noise levels above 85dBA and a deficient HCP. All three of these companies were in manufacturing.

In 1999, there were also industrial hygiene inspections assessing noise exposures that were conducted independently of those referred for inspections based on the patient interviews as part of Project SENSOR. In Michigan, limited scope complaint or referral MIOSHA inspections normally will include review of compliance with the noise standard if the company under investigation clearly has

excessive noise levels and employees are observed not wearing hearing protection. During the 801 inspections conducted in 1999, 71 facilities received a citation for a violation of the noise standard. These facilities were generally small. However, 5 (7.0%) of the facilities had more than 250 employees (Table 12). In contrast 33% of the 35 companies from Table 11 that were inspected in response to hearing loss and received a citation for a violation of the noise standard had more than 250 employees. Fifty-three (74.6%) of the companies were cited for a complete lack of a hearing conservation program despite exposures to excessive levels of noise. The other companies were cited for violations of sections of the noise standard (Table 13). The manufacture of fabricated metal products, transportation equipment and primary metals were the most common types of companies cited (Table 14).

Noise in Construction

Of the 2,583 interviewed patients with a fixed loss reported to the State of Michigan from 1992-1999, 308 (11.9%) had at least part of their exposure to noise in construction jobs. The following discussion and associated tables presents the details of those construction-related noise exposures. The hearing loss patients exposed to noise in construction were mostly white males, born in the 1930's-1950's. Table 15 presents the demographic characteristics of these 308 patients.

At the most recent construction job where these 308 individuals were exposed to noise, approximately 94% had no regular hearing testing performed at their job (Table 16); however, approximately 44% of these individuals were given hearing protection (plugs or muffs). Table 17 presents the decade of most recent noise in construction exposures for these individuals, as well as the status of regular hearing testing and access to hearing protection. The majority of noise exposures in construction for these individuals were recent; 19% of the 249 individuals with known decade of exposure occurred in the 1980's and almost 60% of the most recent noise exposures in construction occurred in the 1990's. The percentages of individuals given regular hearing tests over time did not improve. However, the percentage of individuals given hearing protection over time did improve in the most recent decades. Some of these individuals had a relatively short duration of exposure to noise (Table 18), for example with 15% of these individuals working for 5 or fewer years.

Discussion:

This is the sixth annual report of occupational noise-induced hearing loss in Michigan. There were 2,119 reports of hearing loss submitted to the Michigan Department of Consumer and Industry Services in 1999. The reports submitted probably represent a substantial underestimate of the total number of individuals with work-related hearing loss. There are approximately 450 audiologists and 150 otolaryngologists in the state. Reports were received in 1999 from only 7 of the 80 estimated group practices in the state, and 26 practitioners not known to be associated with a group practice. This is down from 1998 when we received reports from 9 of the 80 estimated groups practices and 31 solo practitioners.

The potential number of individuals who should be reported is very likely to be much larger than the number of reports received. In Michigan, we estimate there are currently at minimum 145,000 manufacturing production workers, 20,700 construction workers, 500 miners, 27,200 blue collar workers in wholesale and retail trade, and 12,100 workers in noisy service industry environments exposed to daily noise levels of 85 dBA or greater (NIOSH, 1998 and Bureau of Labor Statistics, 1996). Table 19 provides estimates of blue collar workers in Michigan who are exposed to excessive levels of noise, by industry type. Based on data from the National Health Interview Survey, we would expect approximately 86,000 workers in Michigan to have occupational noise-induced hearing loss (Ries, 1994).

The reports submitted are mainly of men in their 30's to 60's, who work in large manufacturing companies. Follow-up of reports from non-company audiologists and otolaryngologists shows that 42% of noisy companies where the patients worked did not have a hearing conservation program when the individual worked there. Over time the numbers of companies that do not provide regular audiometric testing has decreased, especially among manufacturing companies with more than 100 employees. This is not true for smaller manufacturing companies, construction companies and the farming industry (Tables 7-9).

Approximately 12% of the patients that have been identified and interviewed were exposed to noise in construction. Yet construction workers are minimally covered by MIOSHA and OSHA laws. Interviews of these individuals reveals that almost none were given regular hearing testing, even in the more recent decades of exposures. However, half of these workers were provided hearing protection with the percentage of workers given ear plugs or muffs much greater in the 1980's and 1990's than before the 1980's. The lack of coverage for this group of workers potentially exposed to excessive levels of noise in their jobs highlights an industry that is not adequately covered by the laws and is not voluntarily providing audiometric testing to its workers. The worker using a jackhammer which can produce noise levels of 90-130 decibels is not required to be enrolled in a hearing conservation program that includes annual audiometric testing. The federal OSHA program has indicated its intention to initiate rule-making this year to address these deficiencies.

The report of an individual with work-related hearing loss is a sentinel health event that is critical to effective occupational disease surveillance. Reports from non-company health professionals provide the base upon which meaningful information on exposures to noise at work can be gained, with the

goal of intervening to prevent others from developing work-related hearing loss. There were 5,125 individuals at the worksites we inspected that had noise exposures of 85 dBA or greater, and lacked or had a deficient HCP who would directly benefit from these inspections. The results of initial follow-up inspections indicate the program has a high rate of success in identifying companies which although legally required to have a hearing conservation program are not in compliance with the law (Table 11).

The Michigan Department of Consumer and Industry Services has been focusing on hearing loss for six years now. In 1993, letters were sent to otolaryngologists, audiologists, speech and hearing clinics, occupational health nurses and mobile van units to educate these groups of health professionals about the reporting law and the importance of reporting known or suspected work-related hearing loss. In 1995, a reminder letter was sent to the state's audiologists and otolaryngologists. Other outreach efforts include presenting miniseminars at the Michigan Speech-Language-Hearing Association's annual conferences, exhibiting an educational booth about work-related hearing loss at various conferences and providing information on the status of the surveillance efforts through various association newsletters. In 1998, a quarterly newsletter on occupational NIHL that is mailed to the state's approximately 460 audiologists, otolaryngologists, mobile vans and clinics was initiated. In 1998, an internet web site that contains the annual reports and newsletters was developed; it can be accessed at: www.chm.msu.edu/oem/index.htm.

In January, 2000, a letter was sent to 719 Michigan hearing health professionals to provide them with a reminder about their obligation to report known or suspected occupational noise-induced hearing loss.

In June 2000, the Michigan Department of Consumer and Industry Services, Bureau of Safety and Regulation Occupational Health Division initiated an Occupational Noise Exposure Local Emphasis Program (LEP) to comply with one of MIOSHA's Strategic Planning Goals: to reduce NIHL/STS by 15%. Twenty-six categories of manufacturing industries are the focus of this initiative; these are industries known to have large numbers of noise exposed workers. Inspections will be conducted as planned program inspections (i.e. selected because they fell within the targeted industry categories) or as rollover inspections (i.e. the inspection was initiated for a reason other than noise but the facility falls within the LEP's targeted industry categories). At each inspection, the MIOSHA enforcement industrial hygienist will provide the employer with informational handouts that are appropriate to the operations carried out at that facility. Just like any other MIOSHA enforcement inspection, the company is required to correct any violations of the Michigan noise standard.

The number of reports of hearing loss submitted by non company hearing health professionals increased until 1995, decreased in 1996, increased in 1997, decreased in 1998 and increased in 1999. Ongoing, and renewed outreach efforts are needed. Project SENSOR will continue to encourage practitioners to report their patients who have work-related noise-induced hearing loss.

References:

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Ries PW. Prevalence and Characteristics of Persons with Hearing Trouble: United States 1990-1991. Vital Health Statistics (10). 1994; No. 188. DHHS Publication PHS 94-1516.

Weeks JL, Levy BS and GR Wagner, eds. Preventing Occupational Disease and Injury. American Public Health Association, 1991.

Figure 2. All Company and Non-Company Patients with Noise-Induced Hearing Loss Reported to the Michigan Department of Consumer and Industry Services: 1985-1999

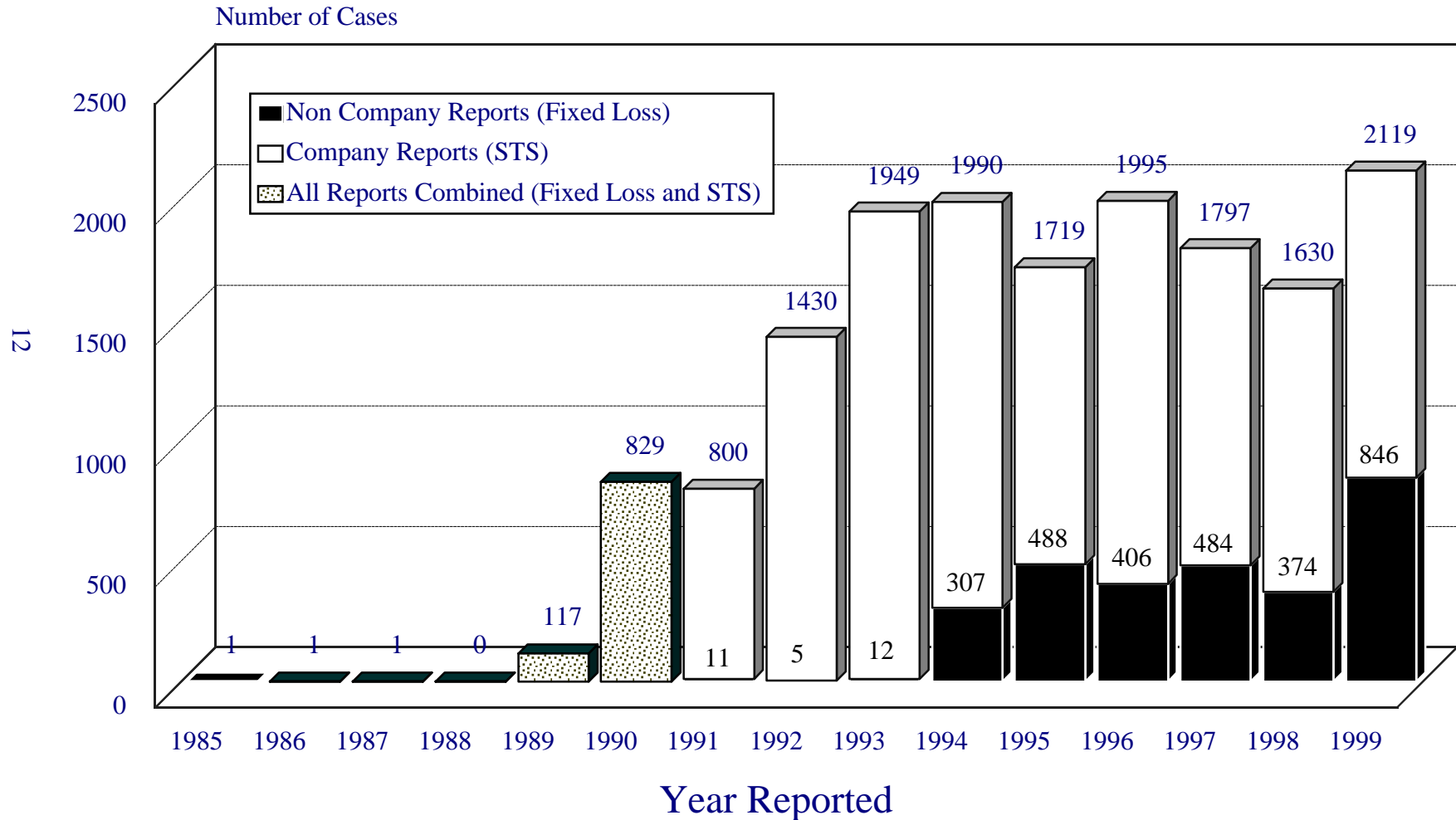
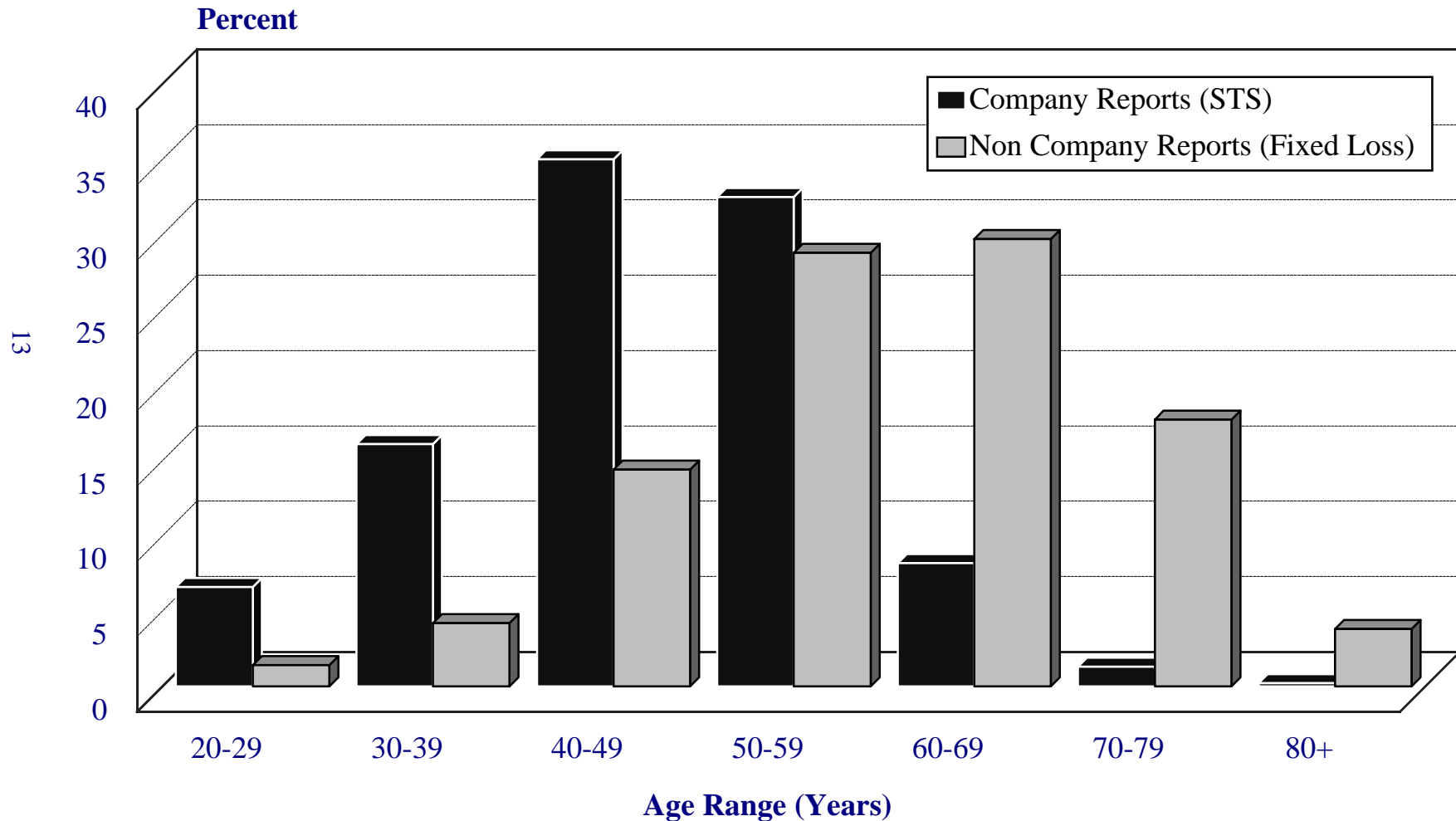
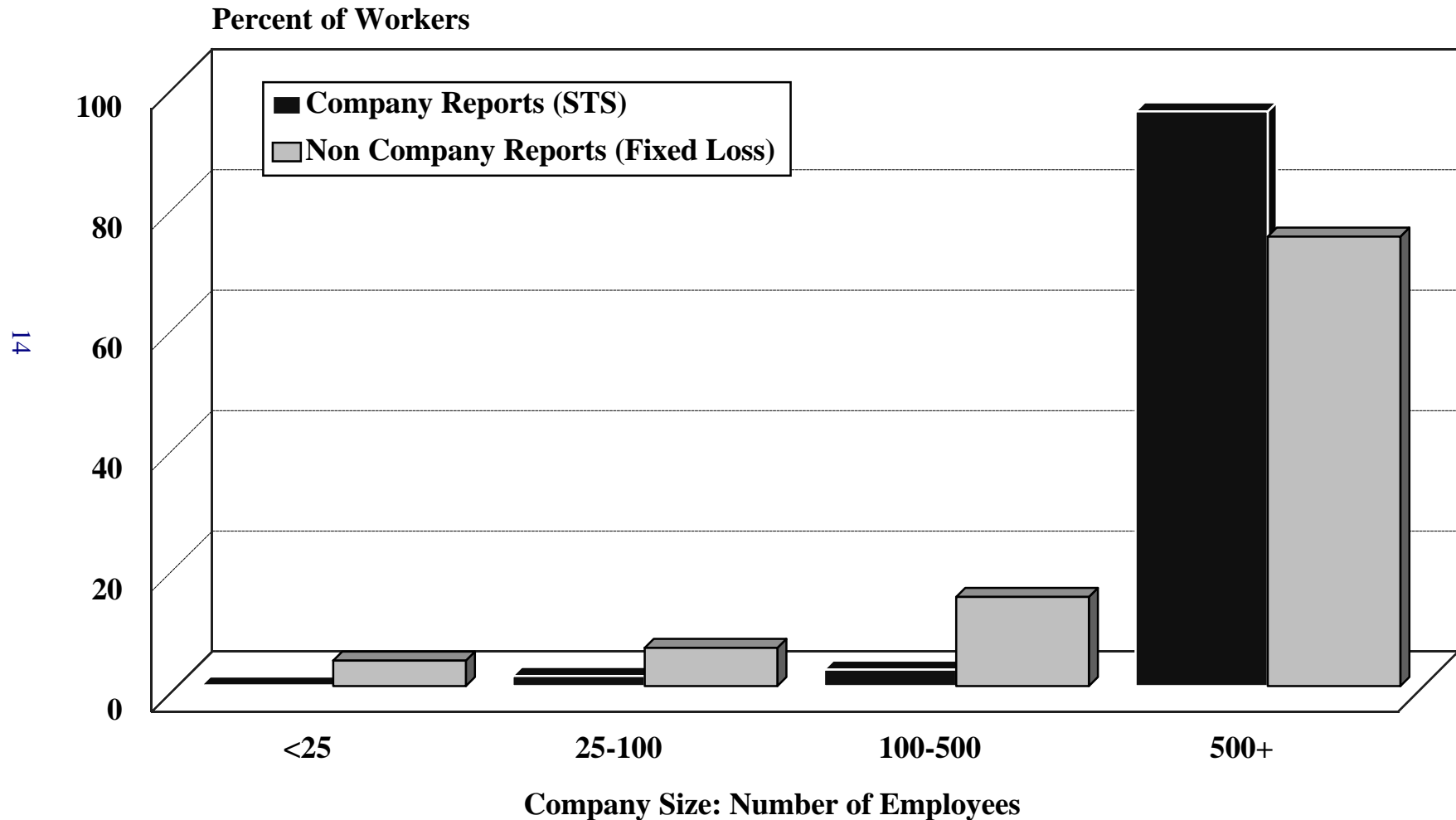


Figure 3. All Company and Non-Company Patients with Noise-Induced Hearing Loss Reported in 1999: Age Range* by Reporting Source



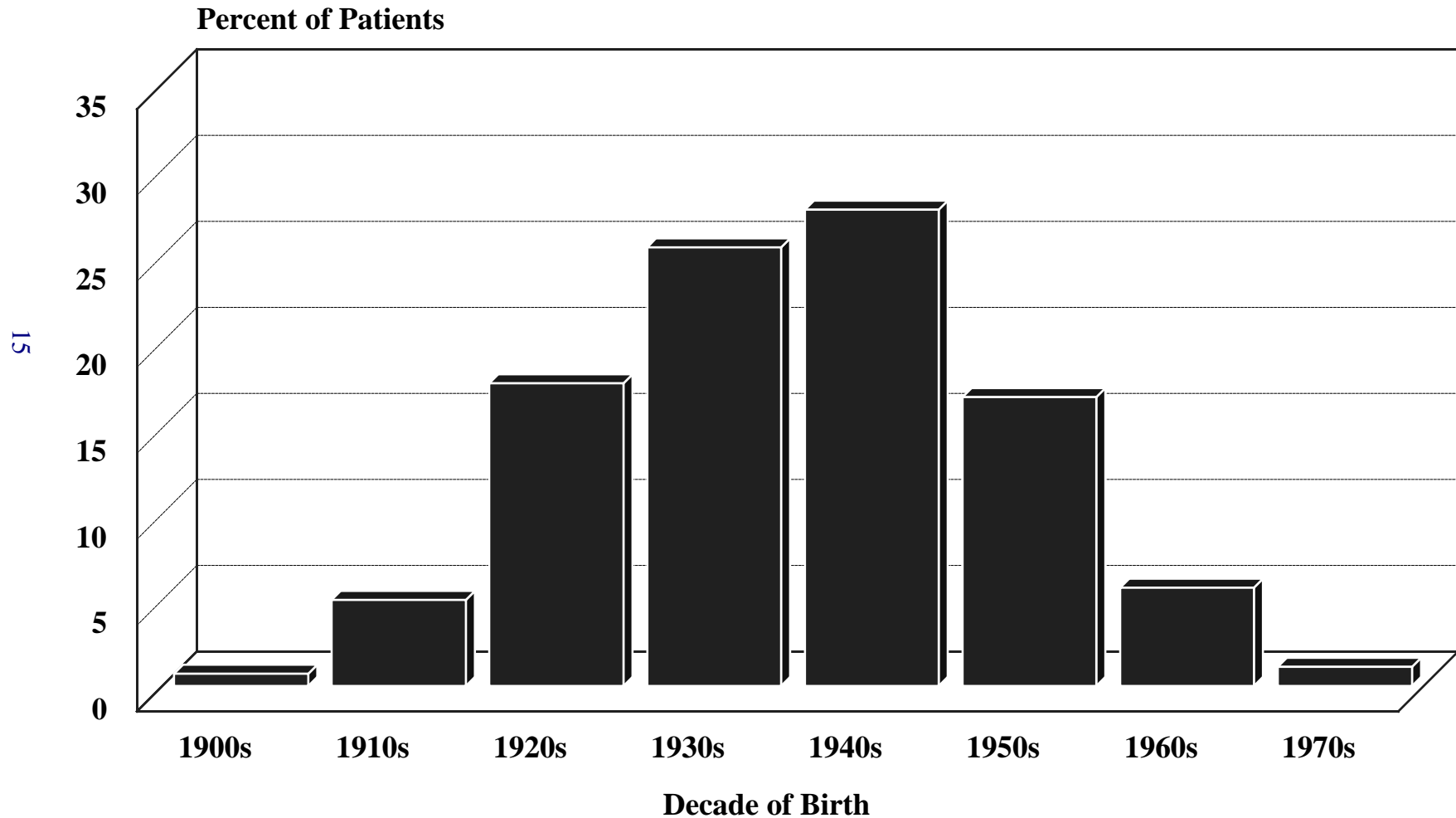
* Age was unknown for 9 individuals reported by company medical departments and 10 individuals reported by non company hearing health professionals.

Figure 4. All Company and Non-Company Patients with Noise-Induced Hearing Loss Reported in 1999: Number of Employees* at the Company Where Exposure to Noise Occurred



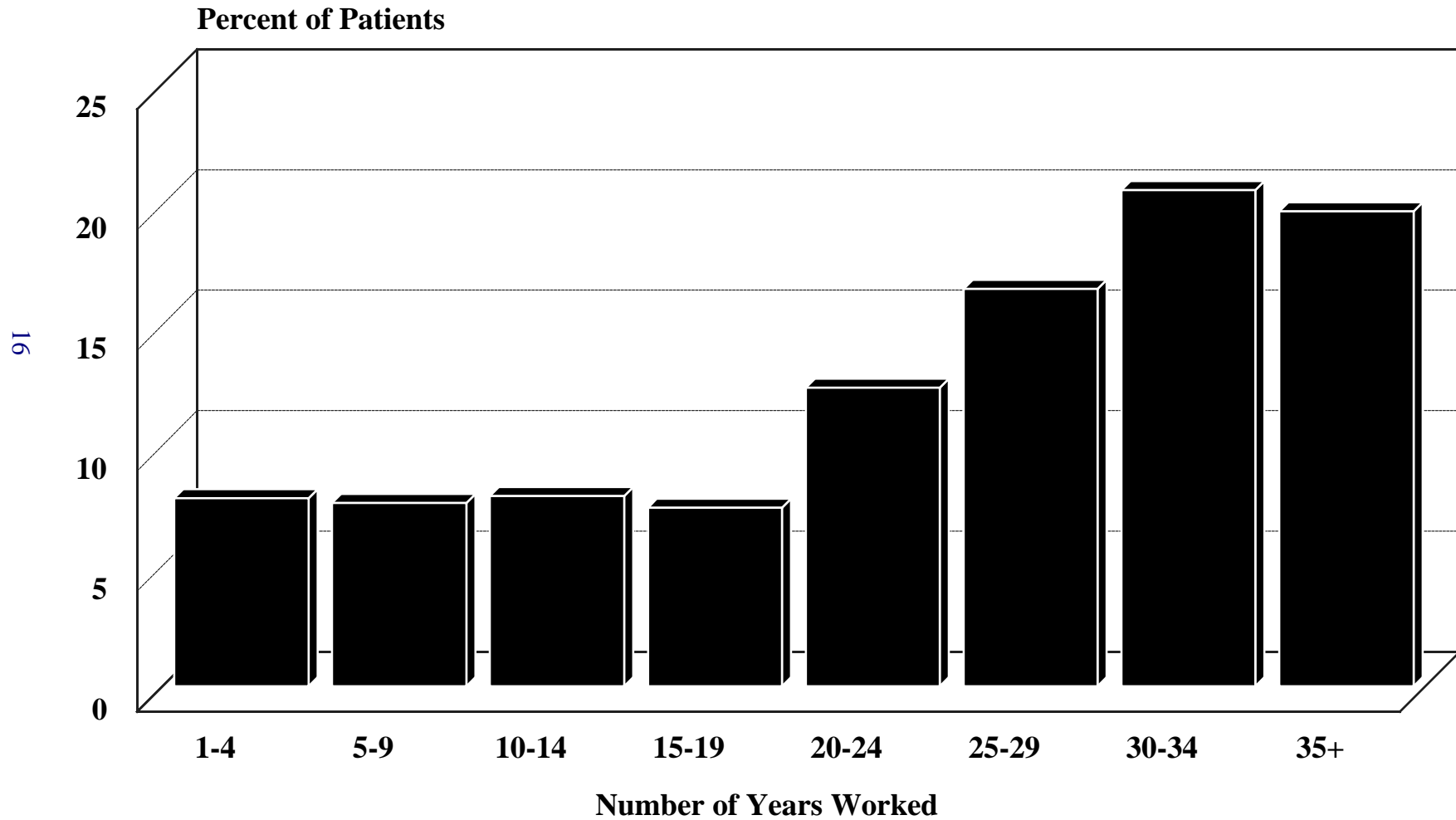
* Number of employees was unknown for 704 individuals reported by non company hearing health professionals.

**Figure 5. All Interviewed Patients with a Fixed Hearing Loss:
Distribution of Decade of Birth,* Michigan 1992-1999**



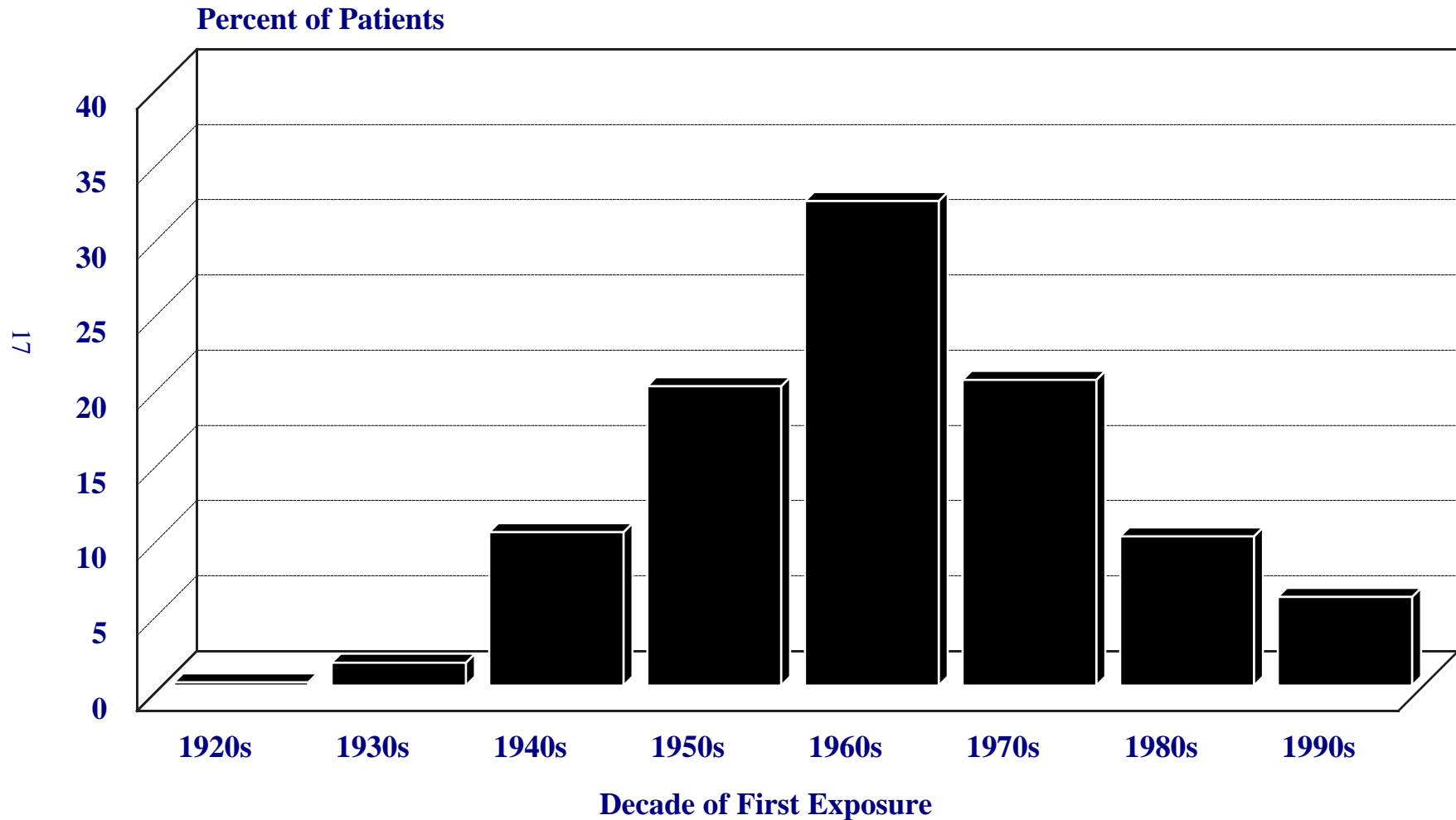
* Decade of birth was unknown for 22 patients.

**Figure 6. All Interviewed Patients with a Fixed Hearing Loss:
Total Duration of Years Worked* in Noise, Michigan 1992-1999**



* Duration was unknown for 381 patients.

**Figure 7. All Interviewed Patients with a Fixed Hearing Loss:
Distribution of Decade of First Exposure* to Noise, Michigan 1992-1999**



* Decade was unknown for 486 patients.

Table 1. Number of Non-Company Based Health Professionals Reporting Patients with a Fixed Noise Induced Hearing Loss in Michigan, in 1999

<u>Number of Patients Reported</u>	Health Professionals		Total Number of <u>Patients Reported</u>
	<u>Number</u>	<u>Percent</u>	
1	17	(51.5)	17
2-10	11	(33.3)	48
11-50	2	(6.1)	36
51+	3	(9.1)	745
<hr/>			
Total	33*	(100.0)	846

*Includes 7 group practices.

Table 2. All Company and Non-Company Patients with Noise-Induced Hearing Loss: Number of Employees at the Company Where Exposure to Noise Occurred

<u>Number of Employees</u>	<u>Total</u>		<u>STS***</u>		<u>Fixed Loss****</u>	
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
<25	7	(0.5)	1	(0.1)	6	(4.2)
25-100	31	(2.2)	22	(1.7)	9	(6.3)
100-500	56	(4.0)	35	(2.7)	21	(14.8)
500+	1321	(93.4)	1215	(95.4)	106	(74.6)
Total*	1415	(100.1)**	1273	(99.9)**	142	(99.9)**

*Number of employees was unknown for 704 companies reported by private practice health professionals.

**Percent does not add to 100 due to rounding.

***STS=Standard Threshold Shift, reported by company.

****Fixed=reported by audiologist/otolaryngologist in private practice.

**Table 3. 1999 Occupational Disease Reports of Noise-Induced Hearing Loss:
Industry of Patients Reported**

Standard Industrial Classification (SIC)*	Number of		STS****		Fixed Loss*****	
	Patients	Percent	Patients	Percent	Patients	Percent
Agriculture (01-07)	8	(0.4)	–	–	8	(1.1)
Mining (10-14)	2	(0.1)	–	–	2	(0.3)
Construction (15-17)	139	(7.0)	–	–	139	(19.1)
Manufacturing (20-39)						
Food (20)	20	(1.0)	16	(1.3)	4	(0.6)
Lumber (24)	2	(0.1)	–	–	2	(0.3)
Furniture (25)	31	(1.6)	28	(2.2)	3	(0.4)
Paper (26)	28	(1.4)	7	(0.6)	21	(2.9)
Printing (27)	6	(0.3)	–	–	6	(0.8)
Chemicals (28)	3	(0.2)	3	(0.2)	–	–
Rubber (30)	33	(1.7)	29	(2.3)	4	(0.6)
Stone/Clay/Glass (32)	4	(0.2)	2	(0.2)	2	(0.3)
Primary Metals (33)	297	(14.9)	62	(4.9)	235	(32.4)
Metal Fabrication (34)	225	(11.3)	208	(16.4)	17	(2.3)
Machinery (35)	40	(2.0)	29	(2.3)	11	(1.5)
Electronics (36)	32	(1.6)	28	(2.2)	4	(0.6)
Transportation (37)	918	(45.9)		(65.1)	90	(12.4)
Instruments (38)	2	(0.1)	–	–	2	(0.3)
Miscellaneous Mfg Industries (39)	34	(1.7)	1	(0.1)	33	(4.5)
Transport./Comm. Svcs. (40-49)	35	(1.8)	–	–	35	(4.8)
Wholesale Trade (50-51)	3	(0.2)	–	–	3	(0.4)
Retail Trade (52-59)	2	(0.1)	–	–	2	(0.3)
Finance, Insurance & Real Estate (60-67)	1	(0.1)	–	–	1	(0.1)
Services (70-89)						
Hotels (70)	1	(0.1)	–	–	1	(0.1)
Personal Services (72)	1	(0.1)	–	–	1	(0.1)
Business (73)	4	(0.2)	–	–	4	(0.6)
Automotive Repair (75)	4	(0.2)	–	–	4	(0.6)
Repair (76)	4	(0.2)	–	–	4	(0.6)
Recreation (79)	1	(0.1)	–	–	1	(0.1)
Health (80)	16	(0.8)	–	–	16	(2.2)
Education (82)	58	(2.9)	31	(2.4)	27	(3.7)
Engr./Mgt. (87)	4	(0.2)	–	–	4	(0.6)
Public Admin. (91-97)						
Government (91)	13	(0.7)	–	–	13	(1.8)
Police (92)	8	(0.4)	–	–	8	(1.1)
Military (97)	19	(1.0)	–	–	19	(2.6)
Total	1998	(100.2)**	1272	(100.1)**	726****	(99.8)**

*Standard Industrial Classification (1987 Manual).

**Percentage does not add to 100 due to rounding.

***SIC was unknown for 120 patients reported by private practice health professionals; and 1 patient reported by a company.

****STS=Standard Threshold Shift, reported by company.

*****Fixed =reported by audiologist/otolaryngologist in private practice.

**Table 4. All Interviewed Patients with a Fixed Hearing Loss:
Type of Industry at Any Company Exposed to Noise: Michigan
1992-1999**

<u>Standard Industrial Classification (SIC)*</u>	Companies	
	<u>Number</u>	<u>Percent</u>
Agricultural Production & Services (01-07)	100	(3.1)
Forestry (08)	2	(0.1)
Mining (10-14)	19	(0.6)
Construction (15-17)	369	(11.4)
Manufacturing (20-39)		
Food (20)	42	(1.3)
Apparel (23)	6	(0.2)
Wood (24)	22	(0.7)
Furniture (25)	16	(0.5)
Paper (26)	45	(1.4)
Printing (27)	23	(0.7)
Chemicals (28)	35	(1.1)
Petroleum Refining (29)	3	(0.1)
Rubber (30)	47	(1.4)
Leather (31)	4	(0.1)
Stone/Clay/Glass (32)	37	(1.1)
Primary Metals (33)	333	(10.3)
Metal Fabrication (34)	193	(6.0)
Machinery (35)	148	(4.6)
Electronics (36)	21	(0.6)
Transportation (37)	851	(26.2)
Measuring Instruments (38)	7	(0.2)
Miscellaneous Manufacturing (39)	77	(2.4)
Transportation/Communication Services (40-49)	202	(6.2)
Trade (50-59)	73	(2.3)
Finance, Insurance & Real Estate (60-67)	10	(0.3)
Services (70-89)		
Hotels (70)	3	(0.1)
Personal Services (72)	2	(0.1)
Telemarketing (73)	9	(0.3)
Automotive Repair (75)	52	(1.6)
Repair (76)	16	(0.5)
Amusement/Recreation (79)	19	(0.6)
Health (80)	34	(1.0)
Education (82)	145	(4.5)
Social Services (83)	4	(0.1)
Parks (84)	1	(<0.1)
Engineering/Management (87)	7	(0.2)
Geology (89)	2	(0.1)
Public Admin. (91-97)	264	(8.1)
Total	3243**	(100.1)***

*Standard Industrial Classification (1987 Manual).

**SIC was unknown for 54 companies.

***Percent does not add to 100 due to rounding. 21

Table 5. All Interviewed Patients with a Fixed Hearing Loss: Type of Industry and Performance of Regular Hearing Testing at Most Recent Company Exposed to Noise, Michigan 1992-1999

<u>Standard Industrial Classification (SIC)*</u>	<u>Companies Number</u>	<u>No Hearing Test Number</u>	<u>Percent</u>
Agricultural Production & Services (01-07)	69	44	(64)
Mining (14)	9	4	(44)
Construction (15-17)	230	165	(72)
Forestry (08)	1	0	(-)
Manufacturing (20-39)			
Food (20)	29	12	(41)
Apparel (23)	3	2	(67)
Wood (24)	16	12	(75)
Furniture (25)	9	6	(67)
Paper (26)	34	10	(29)
Printing (27)	16	12	(75)
Chemicals (28)	29	8	(28)
Petroleum Refining (29)	1	0	(-)
Rubber (30)	32	11	(34)
Leather (31)	2	1	(50)
Stone/Clay/Glass (32)	27	18	(67)
Primary Metals (33)	289	66	(23)
Metal Fabrication (34)	131	44	(34)
Machinery (35)	102	51	(50)
Electronics (36)	11	6	(55)
Transportation (37)	733	252	(34)
Measuring Instruments (38)	5	3	(60)
Miscellaneous Manufacturing (39)	47	16	(34)
Transport./Comm. Services (40-49)	165	58	(35)
Trade (50-59)	57	39	(68)
Finance, Insurance & Real Estate (60-67)	8	4	(50)
Services (70-89)			
Hotels (70)	2	2	(100)
Personal Services (72)	1	1	(100)
Telemarketing (73)	5	3	(60)
Automotive Repair (75)	35	24	(69)
Repair (76)	9	5	(56)
Amusement/Recreation (79)	14	10	(71)
Health (80)	33	16	(48)
Education (82)	135	70	(52)
Social Services (83)	4	3	(75)
Parks (84)	1	0	(-)
Engr./Mgt. (87)	3	2	(67)
Geology (89)	2	1	(50)
Public Admin. (91-97)	230	79	(34)
Total	2529**	1060	(42)

Table 6. All Interviewed Patients with a Fixed Hearing Loss:
 Number of Employees in Most Recent Company
 Exposed to Noise by Status of Hearing
 Testing, Michigan 1992-1999

<u>Company Size:</u> <u>Number of Employees</u>	<u>Number of</u> <u>Patients</u>	<u>No Hearing Test</u> <u>Number</u>	<u>Percent</u>
<25	303	233	(77)
25-100	258	180	(70)
100-500	322	159	(49)
500+	1188	390	(33)
<hr/>			
Total	2071*	962	(46)

*There were 512 companies with an unknown number of employees.

Table 7. All Interviewed Patients with a Fixed Hearing Loss:
Decade Last Worked and Status of Regular Hearing Testing at Most Recent Company
Exposed to Noise, by Industry Type, Michigan 1992-1999

Industry Type (SIC)**	Decade Last Exposed to Noise and Hearing Testing Status													
	1940's		1950's		1960's		1970's		1980's		1990's		2000	
	No. of Pts.	% no RHT***	No. of Pts.	% no RHT	No. of Pts.	% no RHT	No. of Pts.	% no RHT	No. of Pts.	% no RHT	No. of Pts.	% no RHT	No. of Pts.	% no RHT
Agriculture (01-07)	1	100	1	100	2	50	1	100	7	86	31	90	1	100
Mining (13-14)	0	--	0	--	0	--	0	--	1	100	5	40	0	--
Construction (15-17)	0	--	2	100	1	100	8	88	35	86	131	84	5	80
Manufacturing (20-39)	12	75	22	82	37	81	107	64	290	43	853	30	13	23
Transportation (40-49)	0	--	0	--	2	50	8	63	17	65	113	36	3	0
Trade (50-59)	0	--	1	100	1	0	1	****	3	67	41	85	0	--
Finance (60-67)	0	--	0	--	0	--	1	100	0	--	3	100	0	--
Services (70-89)	0	--	0	--	3	100	2	100	23	87	175	62	3	33
Public Administration (91-97)	2	****	4	100	4	100	6	67	15	60	89	61	1	0

*For 496 Patients, either industry type or decade last exposed to noise was unknown.

**Standard Industrial Classification (1987 Manual).

***Regular Hearing Test.

****There is no percentage in this column because the status of regular hearing testing was unknown.

Table 8. All Interviewed Patient's with a Fixed Hearing Loss:
Decade Last Worked and Status of Hearing
Protection Availability at Most Recent Company
Exposed to Noise, by Industry Type, Michigan 1992-1999

Industry Type (SIC)**	1940's		1950's		1960's		1970's		1980's		1990's		2000	
	No. of Pts.	% no HPD***	No. of Pts.	% no HPD	No. of Pts.	% no HPD	No. of Pts.	% no HPD	No. of Pts.	% no HPD	No. of Pts.	% no HPD	No. of Pts.	% no HPD
Agriculture (01-07)	1	****	1	****	2	100	1	100	7	71	31	52	1	0
Mining (14)	0	--	0	--	0	--	0	--	1	****	5	****	0	--
Construction (15-17)	0	--	2	50	1	100	8	63	35	51	131	24	5	20
Manufacturing (20-39)	12	92	22	77	37	68	107	35	290	23	853	9	13	8
Transportation (40-49)	0	--	0	--	2	50	8	63	17	59	113	33	3	0
Trade (50-59)	0	--	1	100	1	100	1	100	3	67	41	37	0	--
Finance (60-67)	0	--	0	--	0	--	1	100	0	--	3	33	0	--
Services (70-89)	0	--	0	--	3	33	2	100	23	78	175	25	3	33
Public Administration (91-97)	2	****	4	25	4	25	6	50	15	13	89	20	1	0

*For 379 Patients, either industry type or decade last exposed to noise was unknown.

**Standard Industrial Classification (1987 Manual).

***Hearing Protection Device (ear plugs or muffs).

****There is no percentage in this column because the availability of hearing protection was unknown.

Table 9. All Interviewed Patients with a Fixed Hearing Loss
Decade Last Worked and Status of Regular Hearing Testing
at Most Recent Company Exposed to Noise,
by Industry Size, Michigan 1992-1999

	Company Size (Number of Employees)							
	<25		25-100		100-500		500+	
	No. of <u>Pts.</u>	% with no <u>HCP**</u>	No. of <u>Pts.</u>	% with no <u>HCP</u>	No. of <u>Pts.</u>	% with no <u>HCP</u>	No. of <u>Pts.</u>	% with no <u>HCP</u>
1940's	1	100	1	100	0	--	7	86
1950's	3	100	3	100	5	80	12	83
1960's	6	83	5	60	6	67	27	85
1970's	13	92	19	89	18	89	71	54
1980's	36	83	34	76	42	69	237	40
1990's	219	76	178	69	234	44	718	28
2000	3	100	3	0	3	0	11	36

*For 668 patients, either company size or decade last exposed to noise was unknown.

**Hearing Conservation Program.

Table 10. All Interviewed Patients with a Fixed Hearing Loss:
 Status of Hearing Testing for the Most Recent Company
 Exposed to Noise, Michigan 1992-1999

<u>Regular Hearing Tests Conducted</u>	<u>Baseline Hearing Test Conducted</u>			Total
	Yes	No	Unknown	
Yes	433	244	115	792 (31%)
No	147	801	129	1077 (42%)
Unknown	22	23	669	714 (28%)
<hr/>				
Total	602 (23%)	1068 (41%)	913 (35%)	2583

Table 11. Eighty-One Companies Inspected Where Patient Reported They Had Not Received Audiometric Testing: Michigan 1992-1999

<u>Industry (SIC)*</u>	<u>Total Number of Inspections</u>		<u>Hearing Conservation Program (HCP) Required</u>		<u>Citation Issued Re: HCP</u>		<u>Total Number of Employees Exposed to Noise</u>
	#	%	#	(%)			
Construction (15-17)	1	(1.2)	* *		Deficient	-	-
					None	1	562
Manufacturing (20-39)	59	(72.8)	37	(62.7)	Deficient	17 (45.9)	2393
					None	11 (29.7)	1416
Transportation (40-49)	2	(2.5)	0	(-)			
Trade (50-59)	7	(8.6)	1	(14.3)	Deficient	-	-
					None	1 (100.0)	14
Services (70-89)	8	(9.9)	5	(62.5)	Deficient	-	-
					None	3 (60.0)	40
Government (91-97)	4	(4.9)	3	(75.0)	Deficient	2 (66.7)	700 (# employees unknown for 1 company)
					None	-	-

*Standard Industrial Classification (1987 Manual).

**Construction has separate regulations that require a less comprehensive program.

Table 12. Size of Companies Cited for Violations of the Noise Standard in Michigan: 1/1/99 to 12/31/99

<u>Number of Employees</u>	<u>Companies Number</u>	<u>Percent</u>
≤ 50	39	(54.9)
51 - 250	27	(38.0)
251 +	5	(7.0)
Total	71	99.9*

*Percentage does not add to 100 due to rounding.

Table 13. Violations of the Noise Standard in Michigan:
1/1/99 to 12/31/99

<u>Standard Violated</u>	<u>Number of Citations</u>	<u>Percent*</u>	<u>Percent**</u>
No hearing conservation program	53	(74.6)	(62.4)
Exceeded noise level	9	(12.7)	(10.6)
Training	5	(7.0)	(5.9)
Access to medical records	5	(7.0)	(5.9)
Noise monitoring	11	(15.5)	(12.9)
Provide hearing protection	1	(1.4)	(1.2)
Any audiometric testing	1	(1.4)	(1.2)

*A company may be cited for more than one type of violation, therefore these percentages are based on a total of 71 companies cited.

**Percentage based on a total of 85 violations.

Table 14. Type of Industry Cited for Violations of the Noise Standard
in Michigan: 1/1/99 to 12/31/99

<u>Industry (SIC Code)*</u>	Companies	
	<u>Number</u>	<u>Percent</u>
<u>Manufacture of:</u>		
Fabricated Metal Products (34)	26	(36.6)
Transportation Equipment (37)	15	(21.1)
Primary Metal (33)	9	(12.7)
Industrial and Commercial Machinery (35)	6	(8.5)
Rubber/Plastics (30)	4	(5.6)
Stone, Clay, Glass (32)	1	(1.4)
Paper and Allied Products (26)	2	(2.8)
Electronic Equipment (36)	1	(1.4)
<u>Trade:</u>		
Wholesale Trade (50)	3	(4.2)
<u>Services:</u>		
Business (73)	2	(2.8)
Automotive Repair (76)	2	(2.8)
Total	71	99.9**

*Standard Industrial Classification (1987 Manual).

**Percentage does not add to 100 due to rounding.

Table 15. Demographic Characteristics of 308 Patients with Noise-Induced Hearing Loss, with Noise Exposure in Construction: Michigan 1992-1999

Gender

	<u>Number</u>	<u>Percent</u>
Male	306	(99.4)
Female	2	(0.6)
	————	————
Total	308	(100)

Race

	<u>Number</u>	<u>Percent</u>
White	276	(92.9)
African American	15	(5.1)
Hispanic	2	(0.7)
Other	4	(1.3)
	————	————
Total	297	(100)

Race was unknown for 11 individuals.

Decade of Birth

Decade	<u>Number</u>	<u>Percent</u>
1910-1919	15	(4.9)
1920-1929	49	(16.0)
1930-1939	70	(22.9)
1940-1949	73	(23.9)
1950-1959	69	(22.5)
1960-1969	26	(8.5)
1970-1979	4	(1.3)
	————	————
Total	306	(100)

Decade was unknown for 2 individuals.

Table 16. Status of Regular Hearing Testing and Use of Hearing Protection at Most Recent Construction Job Where 308 Patients with Noise-Induced Hearing Loss were Exposed to Noise: Michigan 1992-1999

Regular Hearing Tests*			Given Hearing Protection**			
	<u>Number</u>	<u>Percent</u>			<u>Number</u>	<u>Percent</u>
Yes	14	(5.8)	Yes	97	(43.5)	
No	226	(94.2)	No	126	(56.5)	
<hr style="width: 50%; margin-left: 0;"/>			<hr style="width: 50%; margin-left: 0;"/>			
Total	240	(100)	Total	223	(100)	

*Status of testing was unknown for 68 individuals.

**Status of hearing protection was unknown for 85 individuals.

Table 17. Most Recent Decade Where 308 Patients With Noise-Induced Hearing Loss Were Exposed to Noise in the Construction Industry, and Status of Regular Hearing Tests and Use of Hearing Protection: Michigan 1992-1999

Decade*	Total Patients		Regular Hearing Tests					Given Hearing Protection				
	Number	Percent	No		Yes		Unk.	No		Yes		Unk.
			Number	Percent	Number	Percent	Number	Number	Percent	Number	Percent	Number
1940-1949	1	(0.4)	1	(100)	0	--	0	1	(100)	0	--	0
1950-1959	7	(2.8)	6	(100)	--	--	1	5	(83)	1	(17)	1
1960-1969	15	(6.0)	12	(100)	--	--	3	11	(100)	--	--	4
1970-1979	26	(10.4)	21	(91)	2	(9)	3	17	(81)	4	(19)	5
1980-1989	47	(18.9)	40	(93)	3	(7)	4	25	(66)	13	(34)	9
1990-1999	148	(59.4)	125	(95)	6	(5)	17	38	(33)	78	(67)	32
2000-2009	5	(2.0)	4	(100)	0	--	1	1	(25)	3	(75)	2
Total	249	(99.9)**	209	(95)	11	(5)	29	98	(50)	99	(50)	52

*Decade was unknown for 59 individuals.

**Percent does not add to 100 due to rounding.

Table 18. Duration of Years Worked for 187 Patients with
Noise-Induced Hearing Loss Who Were
Only Exposed to Noise in Construction
Jobs: Michigan 1992-1999

<u>Duration*</u>	<u>Number</u>	<u>Percent</u>
1-5	24	(15.1)
6-10	13	(8.2)
11-15	8	(5.0)
16-20	16	(10.1)
21-25	14	(8.8)
26-30	28	(17.6)
31-35	24	(15.1)
36-40	16	(10.1)
41-45	10	(6.3)
46-50	6	(3.8)
Total	159	(100.1)**

*Duration was unknown for 28 individuals.

**Percent does not add to 100 due to rounding.

Table 19. Estimates of the Number of Blue-Collar Workers in Michigan Exposed to Excessive Levels of Noise, by Industry Type

<u>Industry (SIC)*</u>	<u>Total No. of Workers**</u>	<u>% Exposed to Noise***</u>	<u>No. Workers Noise Exposed</u>
MINING			
Oil and Gas Extraction (13)	2100	23.1	485
CONSTRUCTION			
General Building Contractors (15)	26100	15.8	4124
Heavy Construction (16)	11700	24.0	2808
Special Trade Contractors (17)	88700	15.6	13837
MANUFACTURING			
Food (20)	32300	28.9	9335
Textiles (22)	400	42.6	170
Apparel (23)	16400	13.9	2280
Lumber and Wood (24)	13700	41.3	5658
Furniture (25)	25900	28.3	7330
Paper (26)	15600	33.8	5273
Printing (27)	24900	21.4	5329
Chemicals (28)	22000	17.3	3806
Petroleum and Coal (29)	900	19.9	179
Rubber and Plastics (30)	50700	22.8	11560
Leather (31)	3300	6.5	215
Stone, Clay and Glass (32)	12400	21.5	2666
Primary Metals (33)	28400	32.7	9287
Fabricated Metals (34)	101600	29.3	29769
Machinery, except Electrical (35)	86200	14.9	12844
Electrical Machinery (36)	24500	8.1	1985
Transportation Equipment (37)	198600	18.2	36145
Instruments (38)	10500	8.7	914
Miscellaneous Manufacturing (39)	5100	9.4	479
TRANSPORTATION			
Freight (42)	38800	7.0	2716
TRADE			
Wholesale Durable Goods (50)	110600	20.9	23115
Wholesale Nondurable Goods (51)	58600	5.3	3106
Retail (55)	70500	1.4	987
SERVICES			
Business (73)	228100	1.5	3422
Automotive Repair (75)	49600	10.6	5258
Health (80)	581800	0.6	3491

*Standard Industrial Classification (1987 Manual).

**Source: Bureau of Labor Statistics, Michigan Employment Security Commission, Current Employment Statistics. 1996 Annual Report of Michigan Production/NonSupervisory Workers.

***Source: National Institute for Occupational Safety and Health, Criteria for a Recommended Standard, Occupational Noise Exposure Revised Criteria 1998. June 1998. DHHS (NIOSH) Publication No. 98-126, Table 2-1. Percentages are estimates based on data collected in the National Occupational Exposure Survey (NOES). Excessive noise is defined as at or above 85 dBA.

