1997 Annual Report on Occupational Noise Induced Hearing Loss in Michigan

A Joint Report
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Summary:

This is the fourth annual report on occupational noise-induced hearing loss (NIHL) in Michigan. Almost 1, 800 new people were reported in 1997 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 of 3564 years of age. Exposures to noise are occurring primarily in manufacturing facilities.

Seventeen of the 43 (39.5 %) 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.

Of the approximately 739 workplace inspections conducted by the Michigan Department of Consumer and Industry Services in 1997 in Michigan, another 54 of the companies inspected were in violation of some portion of the noise standard; this is in addition to the 43 identified by the surveillance system. Forty-three of these 54 companies were cited for having the complete absence of a hearing conservation program.

The data in this report indicates that a large number of 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 (96%), although approximately half of them were given hearing protection such as plugs or muffs. Workers exposed in more recent decades to noise in construction were more likely to be given hearing protection than workers most recently exposed to noise before the 1980's. Twenty-five percent of construction workers who had no other types of job exposures to noise were exposed to noise for 5 or fewer years.

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. 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. Additional protection is needed for workers in construction and other industries inadequately covered by the noise standard.

*Effective May 14, 1996, the Michigan Department of Consumer and Industry Services, Division of Occupational Health became part of the Bureau of Safety and Regulation within the newly created Department of Consumer and Industry Services (MDCIS). This division and its authority to collect occupational disease reports were transferred through executive orders 1996-1 and 1996-2.

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 (NIOSH, 1996). 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 (Ries, 1994).

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 (ICD codes 388.10-.12, 389.10-.18,and 389.9) are obtained and the work-relatedness of the condition is determined. Data from the Michigan Health and Hospital Association's (MHA) Michigan inpatient database for the hearing loss ICD codes was obtained to verify the completeness of reporting by the hospitals.

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, we suggest the following minimum hearing loss:

(a) a standard threshold shift (STS) of 10 dB or more in either ear at an average of 2000, 3000 and 4000 Hz, 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).

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. 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 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 fourth annual report are presented in the following order: a description of all of the 1997 occupational disease reports submitted to the MDCIS for NIHL; results of interviews of patients with fixed loss reported by non company audiologists and otolaryngologists from 1992-1997; and, a summary of the MIOSHA inspections from 1/1/9712/31/97 where violations of the noise standard were found.

1997 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 1997, there were 1,797 reports of work-related hearing loss submitted to the Michigan Department of Consumer and Industry Services. Of the 1,797 reports submitted in 1997, 1,313 were submitted by company medical departments. The other 484 reports were submitted by private-practice audiologists and otolaryngologists. Table I shows the number of patients reported by the private-practice health professionals.

Patient Demographics

Ninety percent (1,622) of the reports where gender was listed are for men. Although requested, information on race was missing for 1, 372 (76 %) of the reports. The mean age of individuals reported is 50 years, ranging from 17 to 95 years. Patients reported by companies were generally younger than patients reported by non-company audiologists and otolaryngologists. Approximately 80% of the individuals reported were between 35 and 64 years of age (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. The distribution of industries worked of individuals reported by non-company health professionals includes all industries where noise is a problem, not just those that have hearing conservation programs.

Interviews of Patients with a Fixed Loss, Repotted by Non-Company Audiologists and Otolaryngologists from 1992-1997

A total of 1,378 of 1,477 (93.3%) patients reported by non-company audiologists and otolaryngologists between 1992 and 1997 have been interviewed. The interviews ask about the three most recent jobs where a person was exposed to noise.

Patient Demographics

Ninety-two percent of the interviewed patients reported from 1992-1997 were men. Over 90% of the interviewed patients reported from 1992-1997 were white, 7.0% were African American, 1. 1 % were Hispanic, and 1. 3 % were other. Figure 5 shows the distribution of decade of birth for the patients reported. Over 86% 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 70% of the 1,862 companies where the 1,378 patients ever worked were in the manufacturing industry. The 1,862 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 29% to 100% within industry types. Overall, 46% 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 over 70% 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 at each noisy company for a variety of durations, ranging from less than 5 years to greater than 35 years (Figure 6). Over 50% of interviewed workers reported by non-company health professionals had worked at a given noisy company 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 17% of the patients had very recent first exposures

to noise, from the 1980's to present.

Table 7 shows the decade when the interviewed patients with fixed hearing loss were last exposed to noise by industry. The percentage of individuals at companies with no hearing tests decreased over time and within the industry types that are required to provide such hearing tests since 1972 by OSHA. Construction and agriculture industries had the highest percentages of workers with no regular hearing tests; these are industries not required by OSHA to provide regular hearing tests.

Table 8;shows the decade cases were most recently provided with hearing protection (plugs or muffs) by industry. 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.

Table 9 shows the decade when the interviewed patients with fixed hearing loss were last 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. Nineteen 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; 36% had neither. Again, the number of companies reported in Table 9 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.

Inspections

In response to the reports of hearing loss, inspections were conducted at 43 companies where the person reported they had never received audiometric testing. Of the 43, 23 companies had noise levels above the MIOSHA action level of 85dBA; and 17 of those either had no HCP or a deficient HCP. Thirty-one of the 43 companies were in manufacturing; four were in the trade industry; one was in construction; four in services; one was in transportation; and two were in government. Table 11 lists the characteristics of the 43 companies inspected as part of our surveillance efforts.

In addition, three other companies were identified where the person reported they had never received audiometric testing; however, these three companies had already been inspected for noise prior to the start of our 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 1997 there also were industrial hygiene inspections assessing noise exposures that were conducted independently of those referred for inspections based on our patient interviews. In Michigan, a significant portion of MIOSHA inspections include review of compliance with the noise standard if the company under investigation clearly has high noise levels. During the 739 inspections conducted in 1997, 54 facilities received a citation between l/l/9712/31/97 for a violation of the noise standard. These facilities were generally small. However, 3 (5.5%) of the facilities had more than 250 employees (Table 12). Forty-three (79.6 %) 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 1,378 interviewed patients with a fixed loss reported to the State of Michigan from 1992-1997, 132 had at least part of their exposure to noise in construction jobs. The following 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's1950's (average year of birth 1945). Table 15 presents the demographic characteristics of these 132 patients.

At the most recent construction job where these 132 individuals were exposed to noise, over 96% had no regular hearing testing performed at their job (Table 16); however, approximately half 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; 15% of the 100 individuals with known decade of exposure occurred in the 1980's and 67% of the most recent noise exposures in construction occurred in the 1990's. The percentages of individuals given regular hearing tests over time differed negligibly. However, the percentage of individuals given hearing protection over time did improve in the most recent decades.

Sixty-three of the 132 individuals exposed to noise in construction were also exposed to noise in other industries, primarily manufacturing. For these individuals, the average percent contribution of noise from construction out of the total duration of years exposed to noise in any job was 49% (sd 30%, range 2% - 98%). Four of the 63 individuals were not included in these percentages because the duration of years worked by industry type was unknown.

Among the 69 individuals who reported noise exposures only in construction, the same patterns exist as when we looked at all 132 individuals exposed to noise in construction and other jobs. Most of the patients exposed to noise only in construction were not given regular hearing testing, although over half were provided with hearing protection (Table 18). Further, most of these individuals were most recently exposed to noise in the 1980's (14 %) and 1990's (82%). It was in the more recent decades that these individuals were given hearing protection (Table 19). Some of these individuals had a relatively short duration of -exposure to noise (Table 20), for example with 25% of them working for 5 or fewer years. The average number of years worked in construction-only jobs was 1,8.6 years, with a standard deviation of 12.8 years.

Discussion:

This is the fourth annual report of occupational noise-induced hearing loss in Michigan. There were 1,797 reports of hearing loss received in 1997. 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 have been received from only 7 of the 80 estimated group practices in the state, and 42 practitioners not known to be associated with a group practice. The seven groups reporting patients represents 41 audiologists and otolaryngologists, therefore we estimate that 83 or about 14% of audiologists/otolaryngologists reported at least one case in 1997.

Further, the potential number of individuals who should be reported is much larger than the number of reports received. In Michigan, we estimate there are currently at minimum 176,000 manufacturing production workers, 110,500 construction workers, 7,200miners and 213,500 blue collar workers in wholesale and retail trade exposed to daily noise levels of 85 dBA or greater (NIOSH, 1996 and Bureau of Labor Statistics, 1996). Table 21 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 show that 46% 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, among manufacturing companies with more than 100 employees. This is not true for smaller manufacturing companies, construction companies and the farming industry.

Approximately 10% of the patients we have identified and interviewed were exposed to noise in construction. Yet construction workers are minimally covered by OSHA laws. Interviews of these individuals revealed that almost none were given regular hearing testing even in the more recent decades of exposures. However, about 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 under served by the laws. 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 to help assess the effectiveness of the program. Additional protection for workers in the construction industry is needed.

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 potentially 758 individuals at the work sites we inspected that had noise levels 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 four 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. We recently began a quarterly newsletter on occupational NIHL that will be mailed to the state's audiologists, otolaryngologists, mobile vans and clinics.

The number of reports on individuals with hearing loss submitted by non company hearing health professionals increased until 1995, decreased in 1996 and increased again in 1997. Ongoing, and renewed outreach efforts are needed. We hope our initial success in identifying companies which need hearing conservation programs will encourage practitioners to report their patients who have work-related noise-induced hearing loss.

References:

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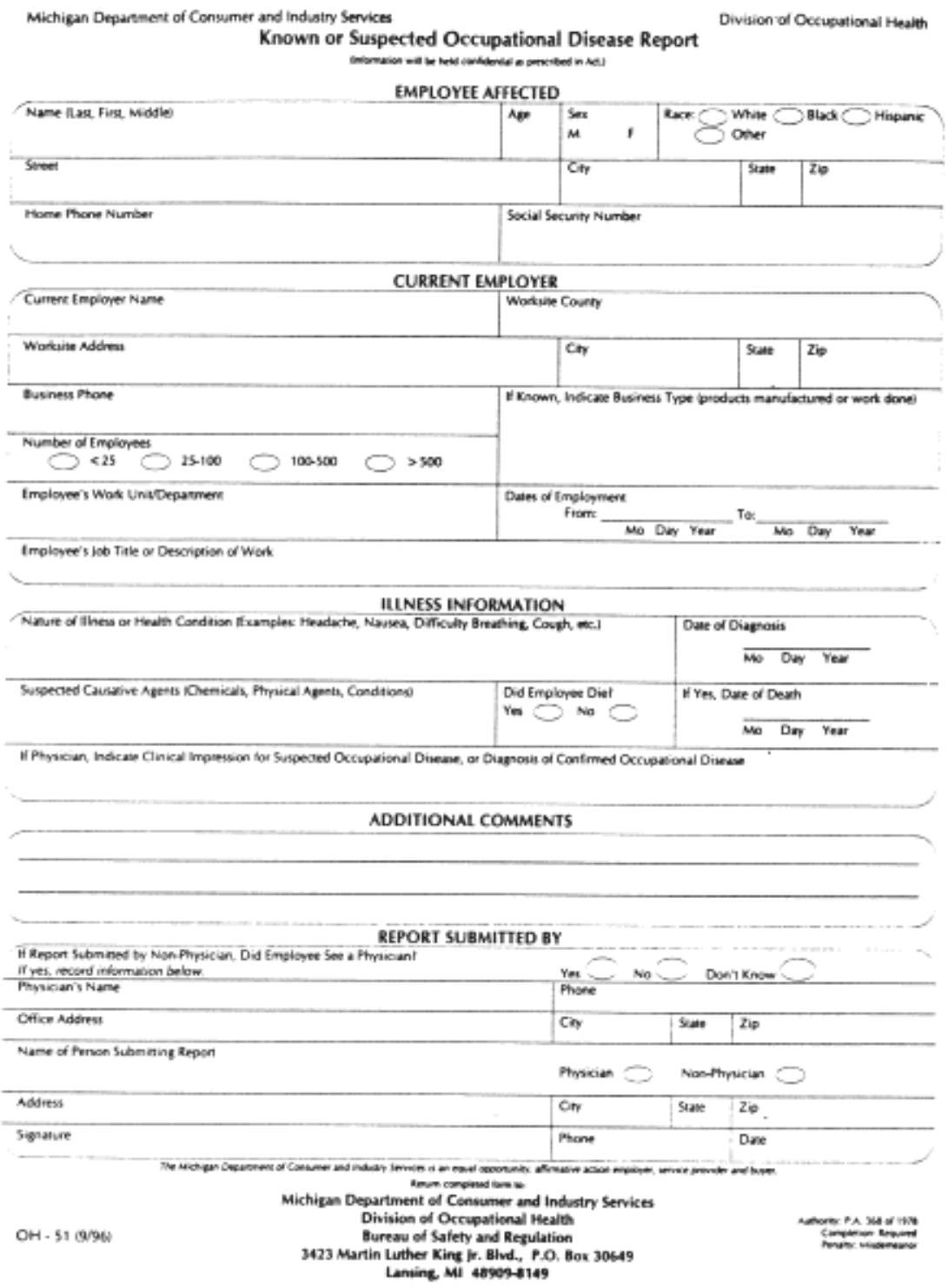
National Institute for Occupational Safety and Health. Criteria for a Recommended Standard, Occupational Noise Exposure Revised Criteria 1996. August 12, 1996, DHHS (NIOSH) Publication No. 96-XXX.

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 1.



Michigan Department of Consumer and Industry Services — Division of Occupational Health

Known or Suspected Occupational Disease Report

(Information will be held confidential as prescribed in Act.)

EMPLOYEE AFFECTED

Name (Last, First, Middle) | Age | Sex M F | Race: White Black Hispanic Other

Street | City | State | Zip

Home Phone Number | Social Security Number

CURRENT EMPLOYER

Current Employer Name | Worksite County

Worksite Address | City | State | Zip

Business Phone | If Known, Indicate Business Type (products manufactured or work done)

Number of Employees: <25 25-100 100-500 >500

Employee's Work Unit/Department | Dates of Employment From: ____ To: ____ (Mo Day Year)

Employee's Job Title or Description of Work

ILLNESS INFORMATION

Nature of Illness or Health Condition (Examples: Headache, Nausea, Difficulty Breathing, Cough, etc.) | Date of Diagnosis (Mo Day Year)

Suspected Causative Agents (Chemicals, Physical Agents, Conditions) | Did Employee Die? Yes No | If Yes, Date of Death (Mo Day Year)

If Physician, Indicate Clinical Impression for Suspected Occupational Disease, or Diagnosis of Confirmed Occupational Disease

ADDITIONAL COMMENTS

REPORT SUBMITTED BY

If Report Submitted by Non-Physician, Did Employee See a Physician? Yes No Don't Know

If yes, record information below.

Physician's Name | Phone

Office Address | City | State | Zip

Name of Person Submitting Report — Physician Non-Physician

Address | City | State | Zip

Signature | Phone | Date

The Michigan Department of Consumer and Industry Services is an equal opportunity, affirmative action employer, service provider and buyer.

Return completed form to:

Michigan Department of Consumer and Industry Services
Division of Occupational Health
Bureau of Safety and Regulation
3423 Martin Luther King Jr. Blvd., P.O. Box 30649
Lansing, MI 48909-8149

OH - 51 (9/96)

Authority: P.A. 368 of 1978
Completion: Required
Penalty: Misdemeanor

Figure 2. Patients with Noise-induced Hearing Loss Reported
to the Michigan Department of Consumer and Industry Services
1985-1997

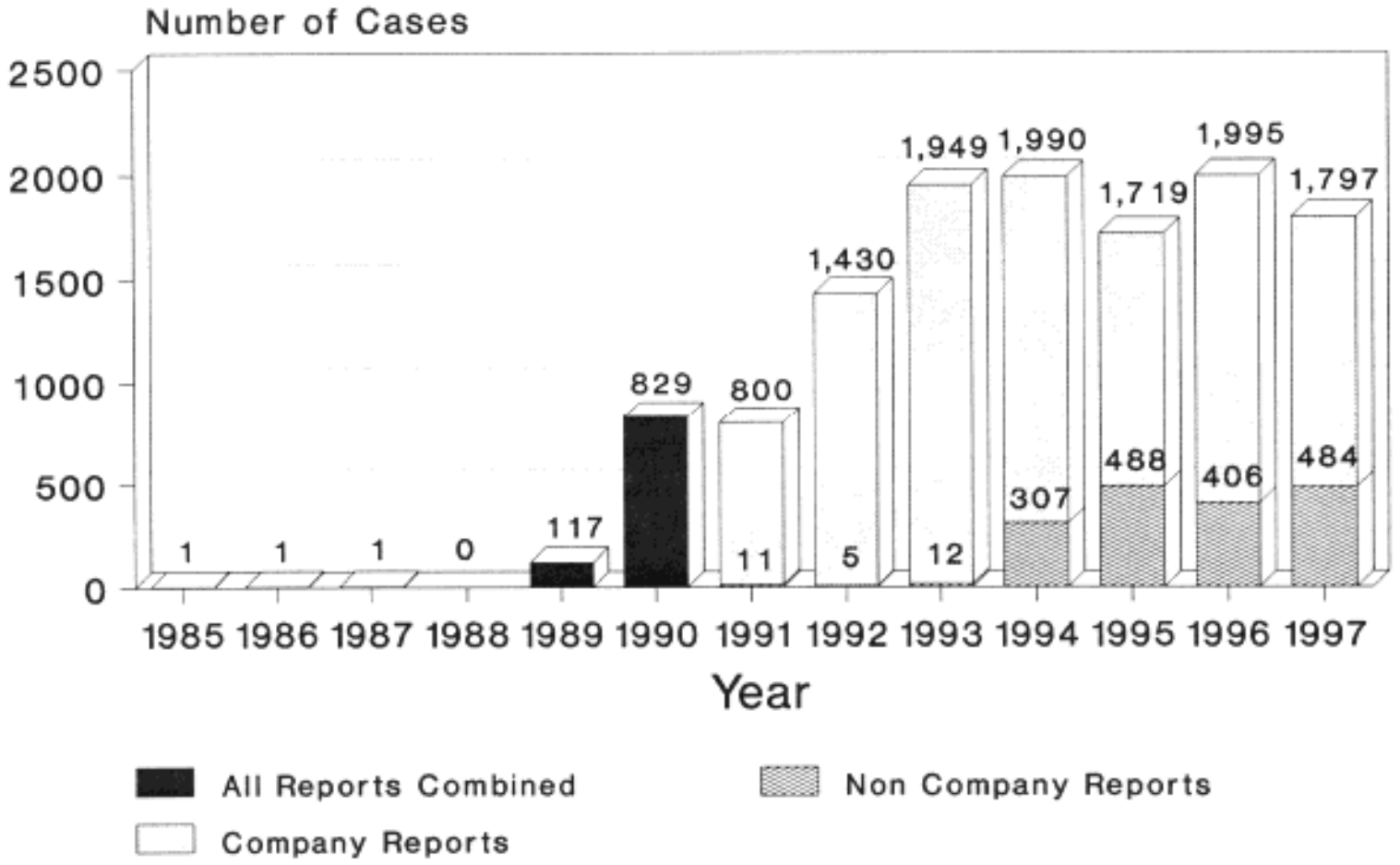
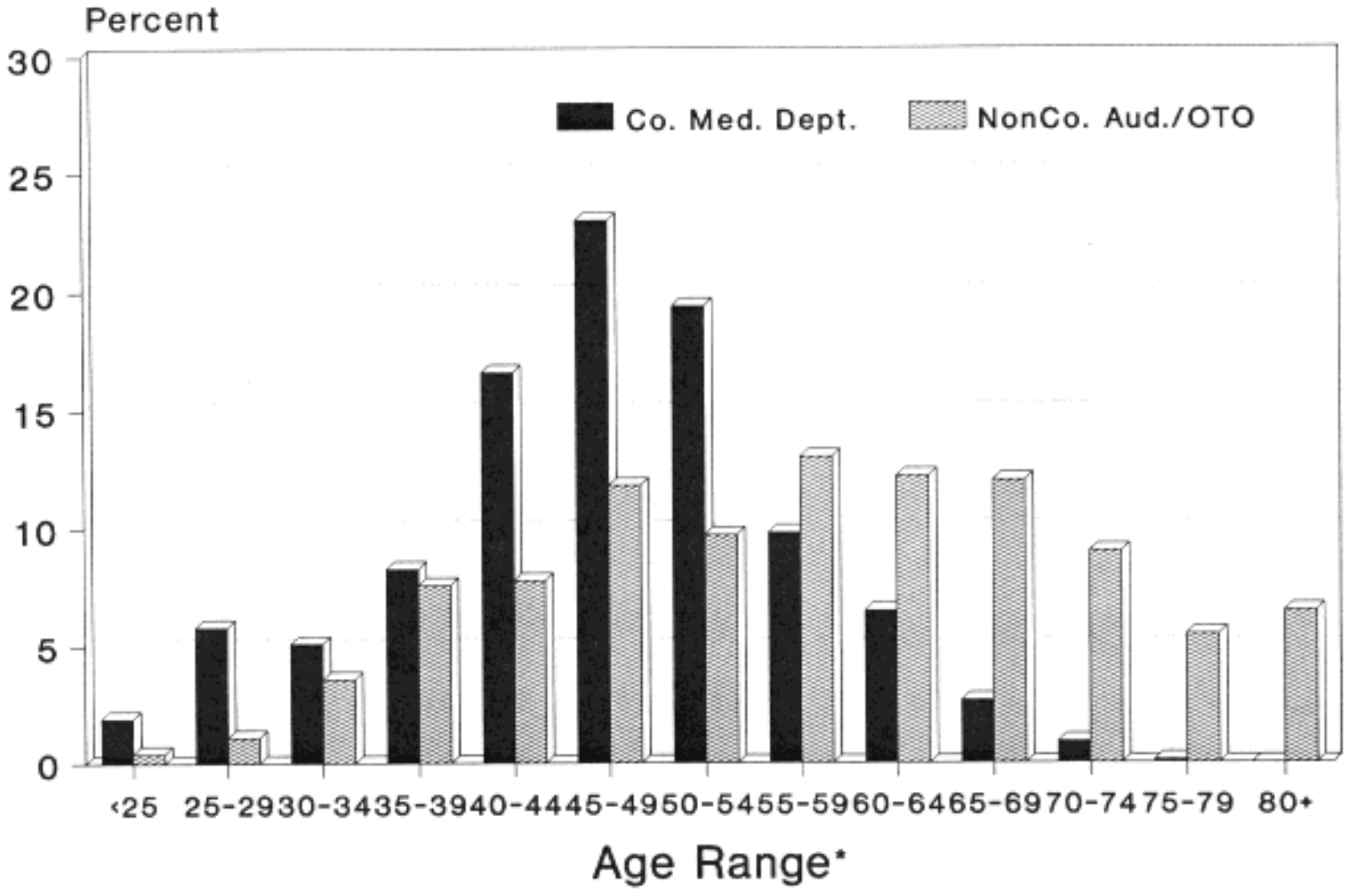
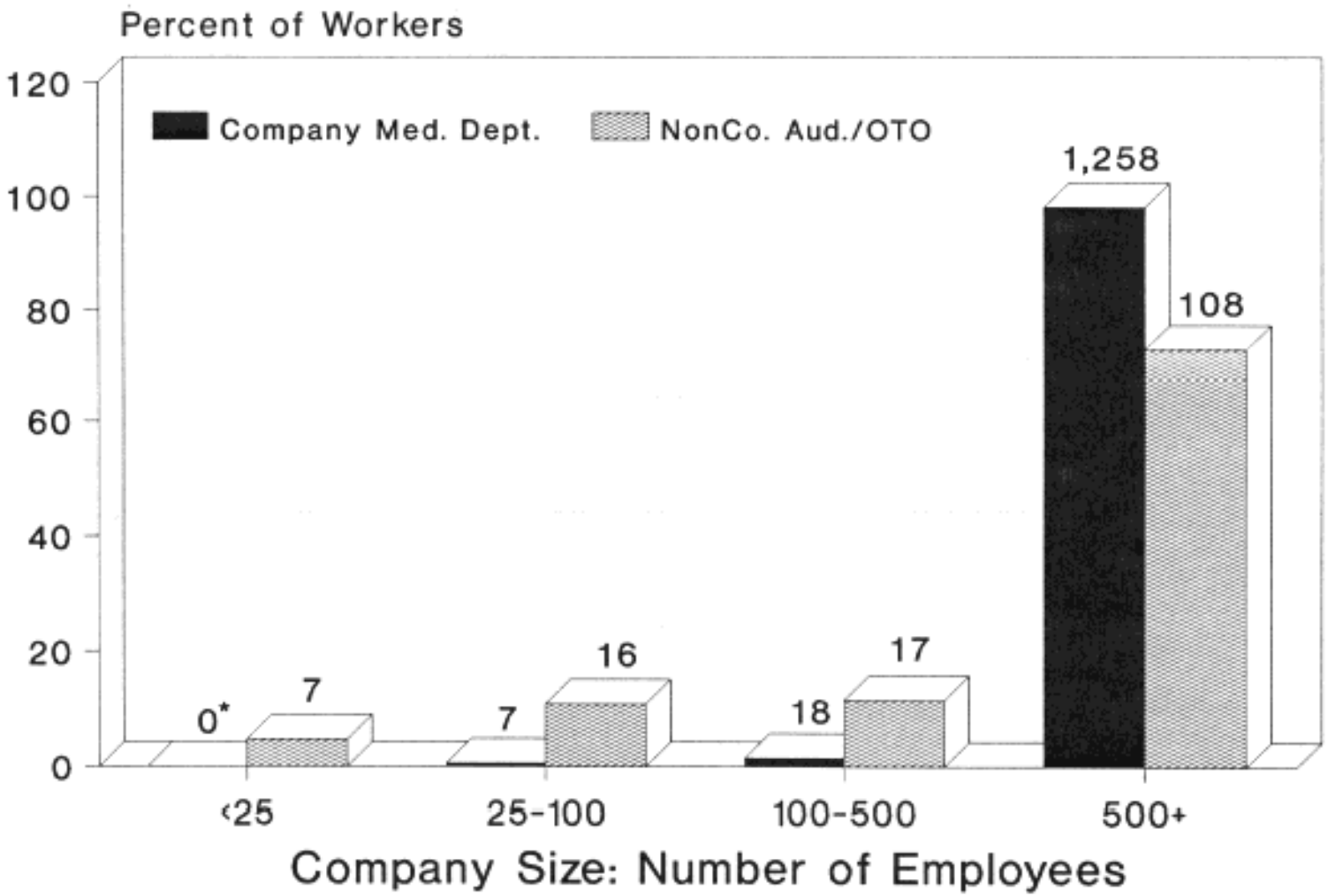


Figure 3. 1997 Occupational Disease Reports of Noise-induced Hearing Loss: Age of Patients by Reporting Source



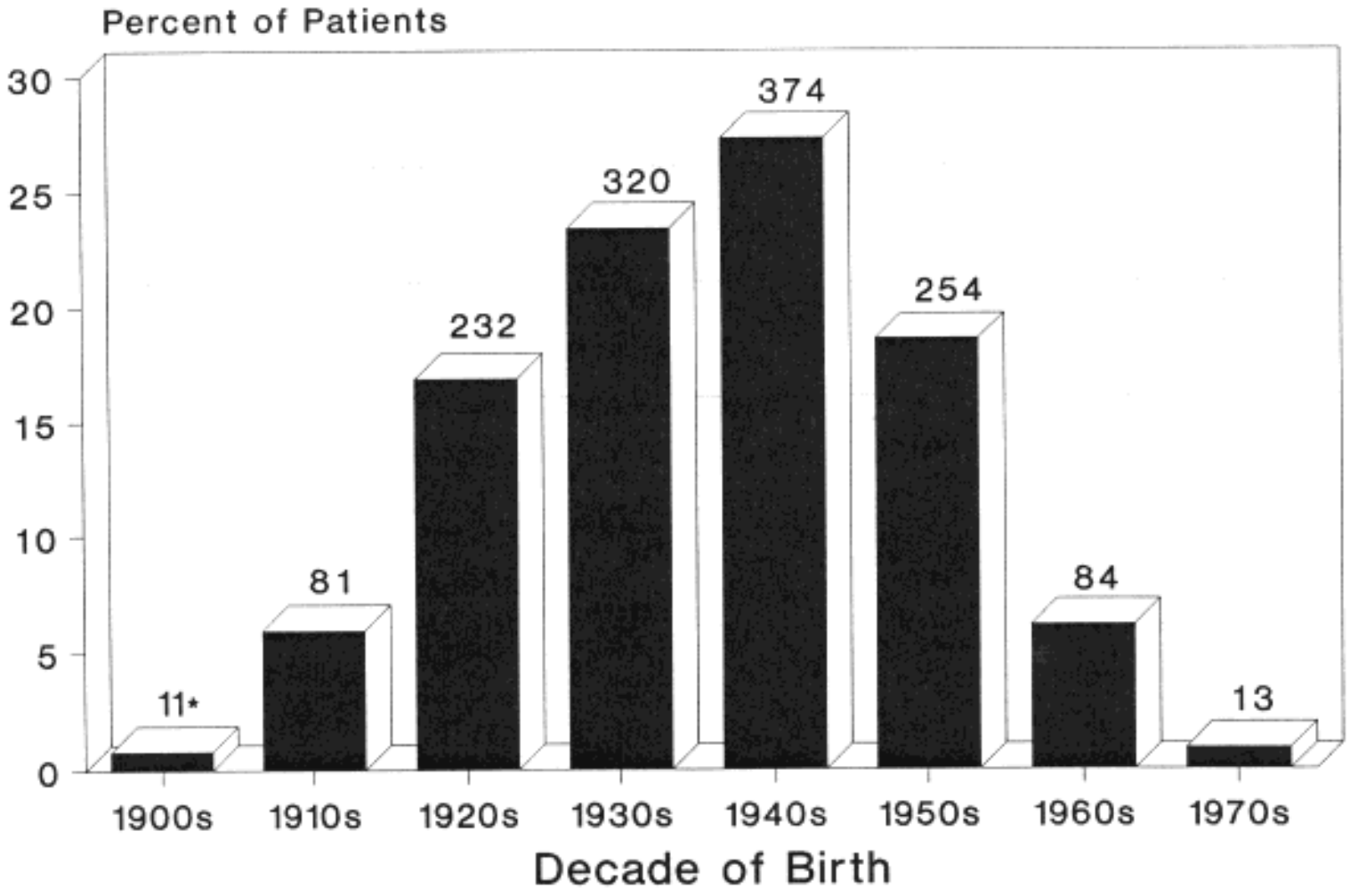
* Age was unknown for 35 individuals.

Figure 4. Occupational Disease Reports of NIHL: Number of Employees at the Company where Exposure to Noise Occurred



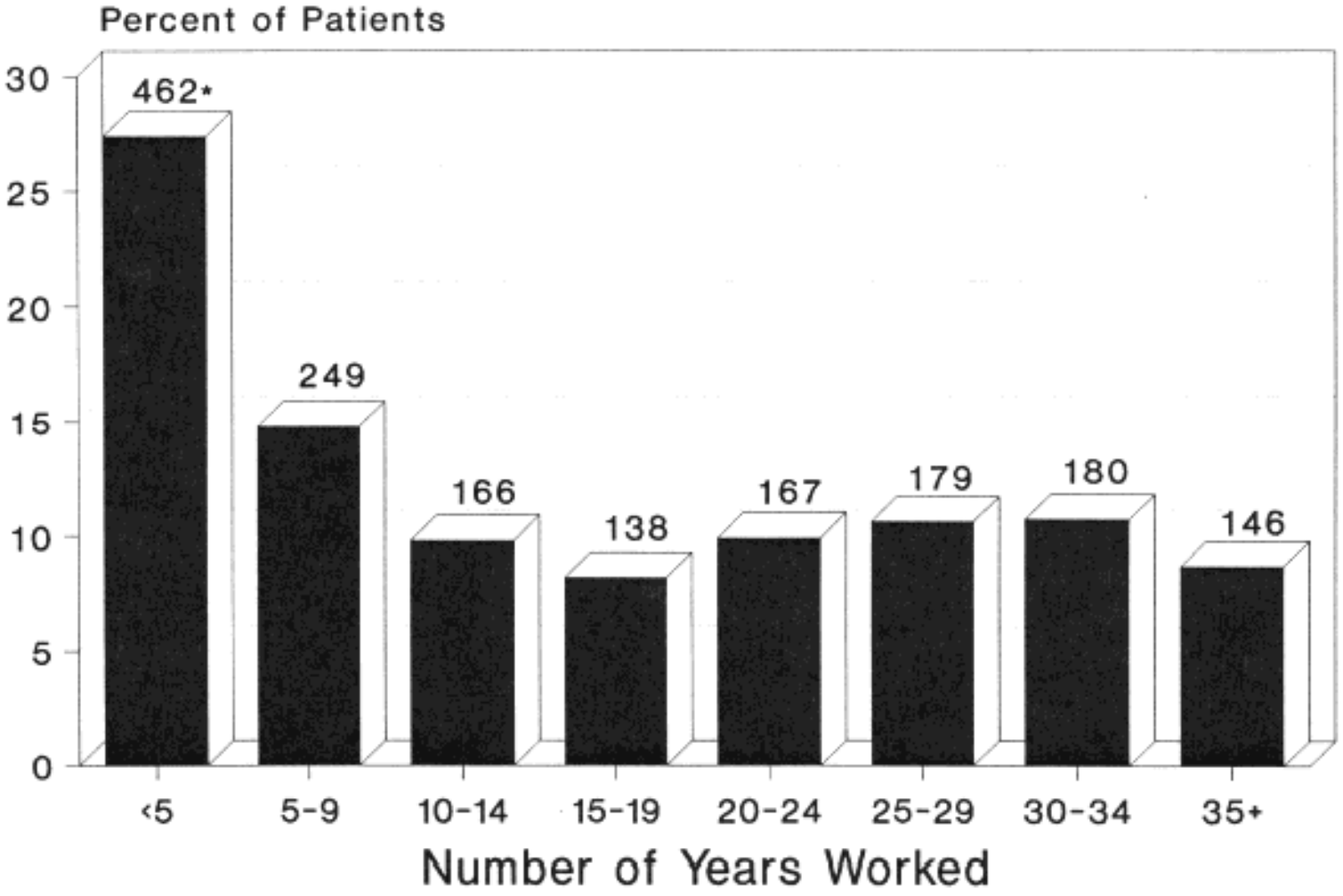
* Number of employees. Number of employees was unknown for 30 company reports and for 336 companies from private practice health professionals.

Figure 5. Distribution of Decade of Birth of Hearing Loss
Patients with a Fixed Loss: Michigan 1992-1997



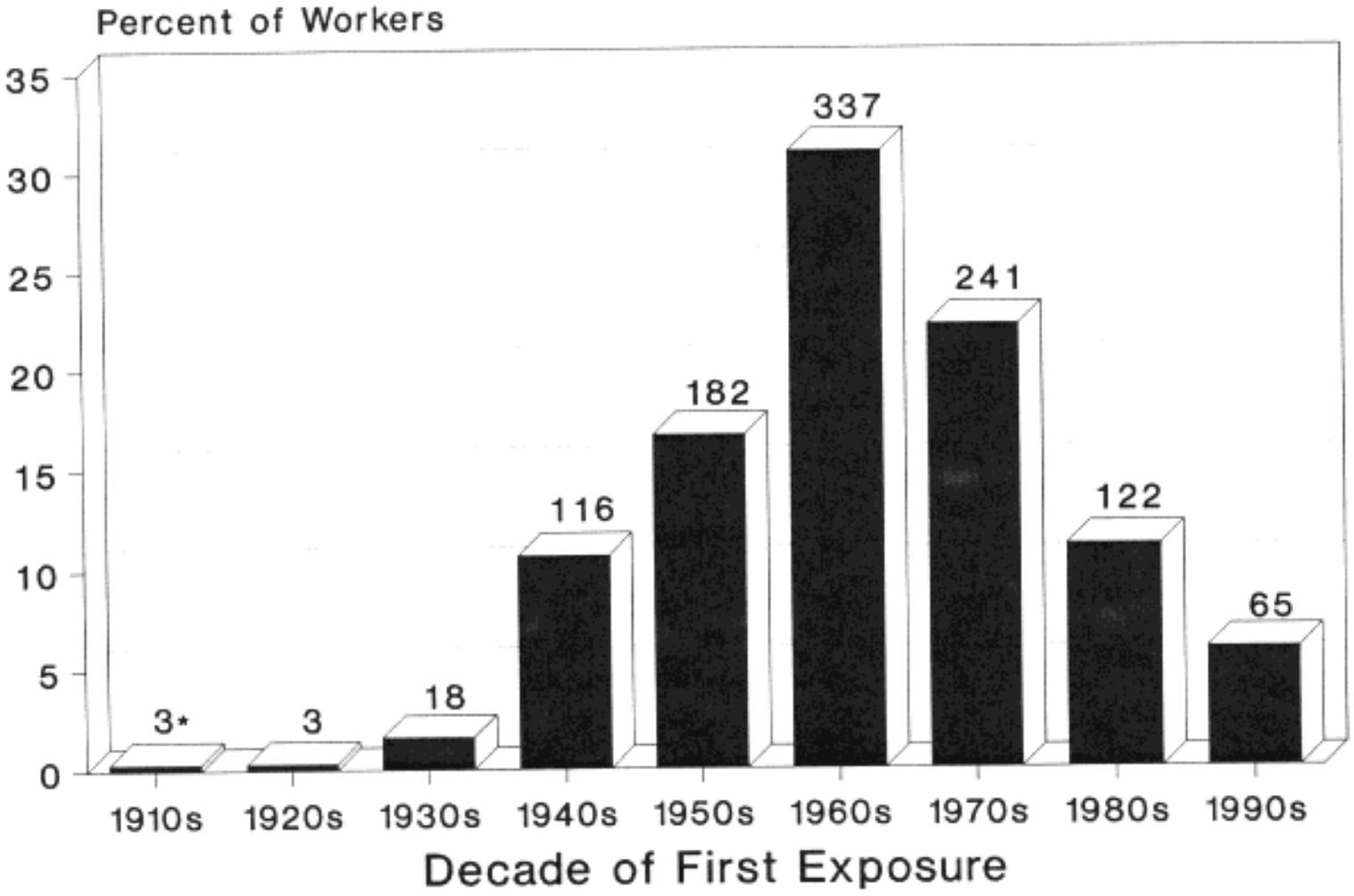
* Number of patients. Decade of birth was unknown for 9 patients.

Figure 6. Duration of Years Worked at Each Noisy Company
for Hearing Loss Patients with a Fixed Loss:
Michigan 1992-1997



* Number of patients. Duration was unknown for 259 companies.

Figure 7. Decade of First Exposure to Noise Among Hearing Loss Patients with a Fixed Loss: Michigan 1992-1997



* Number of workers. Decade of first exposure was unknown for 291 individuals.

Table 1. 1997 Occupational Disease Reports of Noise-Induced Hearing Loss: Number of Non-Company Based Health Professionals Reporting Patients in Michigan

Number of Patients Reported	Health Professionals Number	Percent	Total Number of Patients Reported
1	27	(55.1)	27
2-10	17	(34.7)	56
11-50	3	(6.1)	43
51+	2	(4.1)	305
Total	49*	(100.0)	431**

*Includes 7 group practices.

**Fifty-three of the 484 non-company audiologist and otolaryngologist reports were from 1995 hospital discharge data that was received in 1997; these 53 reports are not included in this table.

Table 2. 1997 Occupational Disease Reports of Noise-Induced Hearing Loss: Number of Employees at the Company Where Exposure to Noise Occurred

	Total		Company Medical Department		Non Company Audiologist/ENT	
Number of Employees	Number	Percent	Number	Percent	Number	Percent
<25	7	(0.5)	--	--	7	(4.7)
25-100	23	(1.6)	7	(0.5)	16	(10.8)
100-500	35	(2.4)	18	(1.4)	17	(11.5)
500+	1366	(95.5)	1258	(98.1)	108	(73.0)
Total*	1431	(100.0)	1283	(100.0)	148	(100.0)

*Number of employees was unknown for 30 company reports and for 336 companies from private practice health professionals.

Table 3.1997 Occupational Disease Reports of Noise-Induced Hearing Loss: Industry of Patients Reported

Standard Industrial Classification (SIC)*	Total Number of Patients	Percent	Company Medical Department Number of Patients	Percent	Non Company Audiologist/ENT Number of Patients	Percent
Agriculture (01-07)	5	(0.3)	--		5	(1.9)
Mining (10)	1	(0.1)	--		1	(0.4)
Construction (15-17)	17	(1.1)	--		17	(6.4)
Manufacturing (20-39)						
Food (20)	5	(0.3)	3	(0.2)	2	(0.8)
Textile Mill Products (22)	1	(0.1)	--		1	(0.4)
Apparel (23)	1	(0.1)	--		1	(0.4)
Paper (26)	3	(0.2)	--		3	(1.1)
Printing (27)	5	(0.3)	--		5	(1.9)
Chemicals (28)	8	(0.5)	3	(0.2)	5	(1.9)
Petroleum (29)	2	(0.1)	--		2	(0.8)
Rubber (30)	79	(5.0)	78	(5.9)	1	(0.4)
Leather (31)	1	(0.1)	--		1	(0.4)
Stone/Clay/Glass (32)	15	(1.0)	13	(1.0)	2	(0.8)
Primary Metals (33)	81	(5.1)	67	(5.1)	14	(5.3)
Metal Fabrication (34)	354	(22.4)	337	(25.7)	17	(6.4)
Machinery (35)	23	(1.5)	10	(0.8)	13	(4.9)
Electronics (36)	56	(3.6)	56	(4.3)	--	
Transportation (37)	789	(50.0)	707	(53.9)	82	(30.8)
Measuring Instruments (38)	1	(0.1)	--		1	(0.4)
Miscellaneous Mfg Industries (39)	3	(0.2)	--		3	(1.1)
Transport./Comm. Svcs. (40-49)	22	(1.4)	1	(0.1)	21	(7.9)
Wholesale Trade (50-51)	33	(2.1)	27	(2.1)	6	(2.3)
Retail Trade (52-59)	3	(0.2)	--		3	(1.1)
Finance,Insurance & Real Estate (60-67)	2	(0.1)	--		2	(0.8)
Services (70-89)						
Hotels (70)	1	(0.1)	--		1	(0.4)
Automotive Repair (75)	1	(0.1)	--		1	(0.4)
Repair (76)	1	(0.1)	--		1	(0.4)
Recreation (79)	1	(0.1)	--		1	(0.4)
Health (80)	14	(0.9)	--		14	(5.3)
Education (82)	22	(1.4)	5	(0.4)	17	(6.4)
Engr./Mgt. (87)	5	(0.3)	1	(0.1)	4	(1.5)
Public Admin. (91-97)						
Police (92)	10	(0.6)	--		10	(3.8)
Human Resources (94)	1	(0.1)	--		1	(0.4)
Environmental Quality (95)	1	(0.1)	--		1	(0.4)
Admin. of Economic Programs (96)	2	(0.1)	2	(0.2)	--	
Military (97)	8	(0.5)	1	(0.1)	7	(2.6)
Total	1577	(100.3)**	1311	(100.1)**	266***	(100.6)**

*Standard Industrial Classification (1987 Manual).

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

***SIC was unknown for 2 patients reported by companies and 218 patients reported by private practice health professionals.

Table 4. Type of Industry at Any Company Where Hearing Loss Patients with a Fixed Loss Were Exposed to Noise: Michigan 1992-1997

Standard Industrial Classification (SIC)*	Companies Number	Percent
Agricultural Production & Services (01-07)	54	(2.9)
Mining (10-14)	10	(0.5)
Construction (15-17)	170	(9.1)
Manufacturing (20-39)		
Food (20)	31	(1.7)
Apparel (23)	5	(0.3)
Wood (24)	18	(1.0)
Furniture (25)	10	(0.5)
Paper (26)	21	(1.1)
Printing (27)	14	(0.8)
Chemicals (28)	24	(1.3)
Petroleum Refining (29)	2	(0.1)
Rubber (30)	32	(1.7)
Leather (31)	3	(0.2)
Stone/Clay/Glass (32)	27	(1.5)
Primary Metals (33)	92	(4.9)
Metal Fabrication (34)	136	(7.3)
Machinery (35)	103	(5.5)
Electronics (36)	16	(0.9)
Transportation (37)	556	(29.9)
Measuring Instruments (38)	6	(0.3)
Miscellaneous Manufacturing (39)	26	(1.4)
Transport./Comm. Svcs. (40-49)	142	(7.6)
Trade (50-59)	53	(2.8)
Finance, Insurance & Real Estate (60-67)	8	(0.4)
Services (70-89)		
Personal Services (72)	2	(0.1)
Telemarketing (73)	5	(0.3)
Automotive Repair (75)	48	(2.6)
Repair (76)	4	(0.2)
Amusement/Recreation (79)	7	(0.4)
Health (80)	21	(1.1)
Education (82)	62	(3.3)
Social Services (83)	4	(0.2)
Parks (84)	1	(0.1)
Engr./Mgt. (87)	2	(0.1)
Geology (89)	2	(0.1)
Public Admin. (91-97)	145	(7.8)
Total	1862**	(100.0)

*Standard Industrial Classification (1987 Manual).

**SIC was unknown for 84 companies.

Table 5. Type of Industry and Performance of Regular Hearing Testing at Most Recent Company Where Hearing Loss Patients with a Fixed Loss Were Exposed to Noise: Michigan 1992-1997

Standard Industrial Classification (SIC)*	Companies Number	No Hearing Test Number	Percent
Agricultural Production & Services (01-07)	37	20	(54)
Mining (14)	5	3	(60)
Construction (15-17)	92	69	(75)
Manufacturing (20-39)			
Food (20)	20	9	(45)
Apparel (23)	3	2	(67)
Wood (24)	11	7	(64)
Furniture (25)	6	5	(83)
Paper (26)	15	7	(47)
Printing (27)	8	6	(75)
Chemicals (28)	16	5	(31)
Rubber (30)	22	10	(45)
Leather (31)	2	1	(50)
Stone/Clay/Glass (32)	23	17	(74)
Primary Metals (33)	56	21	(38)
Metal Fabrication (34)	86	32	(37)
Machinery (35)	62	30	(48)
Electronics (36)	7	4	(57)
Transportation (37)	430	147	(34)
Measuring Instruments (38)	4	2	(50)
Miscellaneous Manufacturing (39)	14	4	(29)
Transport./Comm. Svcs. (40-49)	104	34	(33)
Trade (50-59)	39	27	(69)
Finance, Insurance & Real Estate (60-67)	7	4	(57)
Services (70-89)			
Personal Services (72)	1	1	(100)
Telemarketing (73)	2	0	--
Automotive Repair (75)	25	16	(64)
Repair (76)	3	3	(100)
Amusement/Recreation (79)	6	4	(67)
Health (80)	19	8	(42)
Education (82)	57	37	(65)
Social Services (83)	4	3	(75)
Parks (84)	1	0	--
Engr./Mgt. (87)	1	1	(100)
Geology (89)	2	1	(50)
Public Admin. (91-97)	104	59	(57)
Total	1294**	599	(46)

*Standard Industrial Classification (1987 Manual).
**There were 84 companies with an unknown SIC.

Table 6. Number of Employees in Most Recent Company Where Hearing Loss Patients with a Fixed Loss Were Exposed to Noise, by Status of Hearing Testing: Michigan 1992-1997

Company Size: Number of Employees	Number of Patients	No Hearing Test Number	Percent
<25	169	122	(72)
25-100	161	123	(76)
100-500	213	105	(49)
500+	554	203	(37)
Total	1097*	553	(50)

*There were 281 companies with an unknown number of employees.

Table 7. Decade Last Worked and Status of Regular Hearing Testing at Most Recent Company Where Hearing Loss Patients* With a Fixed Loss Were Exposed to Noise, by Industry Type: Michigan 1992-1997

	Decade Last Exposed to Noise and Hearing Testing Status													
	1940's		1950's		1960's		1970's		1980's		1990's		Total	
Industry Type (SIC)**	No. of Pts.	% no HCP***	No. of Pts.	% no HCP	No. of Pts.	% no HCP	No. of Pts.	% no HCP	No. of Pts.	% no HCP	No. of Pts.	% no HCP	No. of Pts.	% no HCP
Agriculture (01-07)	1	100	1	100	2	50	0	--	3	100	15	87	22	86
Mining (14)	0	--	0	--	0	--	0	--	1	100	3	67	4	75
Construction (15-17)	0	--	1	100	1	100	1	--	9	89	59	92	71	90
Manufacturing (20-39)	7	86	13	77	15	93	59	78	148	48	440	33	682	43
Transportation (40-49)	0	--	0	--	1	--	5	40	10	60	75	35	91	37
Trade (50-59)	0	--	1	100	1	--	0	--	2	50	29	86	33	82
Finance (60-67)	0	--	0	--	0	--	1	100	0	--	3	100	4	100
Services (70-89)	0	--	0	--	1	100	0	--	12	83	87	72	100	74
Public Administration (91-97)	2	--	3	100	3	100	4	50	10	60	65	65	87	64
Total	10	70	19	84	24	83	70	73	195	54	776	48	1094	52

*For 284 Patients, either industry type or decade last exposed to noise was unknown.
**Standard Industrial Classification (1987 Manual).
***Hearing Conservation Program.

Table 8. Decade Last Worked and Status of Hearing Protection Availability at Most Recent Company Where Hearing Loss Patients* With a Fixed Loss Were Exposed to Noise, by Industry Type: Michigan 1992-1997

	Decade Last Exposed to Noise and Percent with No Hearing Protection											
	1940's		1950's		1960's		1970's		1980's		1990's	
Industry Type (SIC)**	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	0	--	3	33	15	47
Mining (14)	0	--	0	--	0	--	0	--	1	--	3	--
Construction (15-17)	0	--	1	100	1	100	1	100	9	33	59	17
Manufacturing (20-39)	7	86	13	69	15	60	59	42	148	19	440	7
Transportation (40-49)	0	--	0	--	1	--	5	60	10	40	75	29
Trade (50-59)	0	--	1	100	1	100	0	--	2	50	29	41
Finance (60-67)	0	--	0	--	0	--	1	100	0	--	3	33
Services (70-89)	0	--	0	--	1	--	0	--	12	67	87	23
Public Administration (91-97)	2	--	3	--	3	--	4	50	10	10	65	20

*For 284 Patients, either industry type or decade last exposed to noise was unknown.
**Standard Industrial Classification (1987 Manual).
***Hearing Protection Device (ear plugs or muffs).

Table 9. Decade Last Worked and Status of Regular Hearing Testing at Most Recent Company Where Hearing Loss Patients* With a Fixed Loss Were Exposed to Noise, by Industry Size: Michigan 1992-1997

	Company Size (Number of Employees)							
	<25		25-100		100-500		500+	
	No. of Pts.	% with no HCP**	No. of Pts.	% with no HCP	No. of Pts.	% with no HCP	No. of Pts.	% with no HCP
1940's	1	100	1	100	0	--	3	100
1950's	3	100	3	100	3	67	7	86
1960's	2	50	5	60	2	50	12	100
1970's	6	100	10	80	14	86	31	71
1980's	20	75	22	77	24	58	110	45
1990's	126	74	113	76	159	47	333	30
Total	158	75	154	77	202	51	496	39

*For 368 patients, either company size or decade last exposed to noise was unknown.
**Hearing Conservation Program.

Table 10. Status of Hearing Testing for the Most Recent Company Where Hearing Loss Patients with a Fixed Loss Were Exposed to Noise: Michigan 1992-1997

Regular Hearing Tests Conducted	Baseline Hearing Test Conducted			
	Yes	No	Unknown	Total
Yes	242	130	59	431 (33.7)
No	88	461	52	601 (47.0)
Unknown	10	11	225	246 (19.2)
Total	340 (26.6)	602 (47.1)	336 (26.3)	1278*

*For 100 patients, either baseline hearing testing status or regular hearing testing status was unknown.

Table 11. Forty-Three Companies Inspected Where Patient Reported They Had Not Received Audiometric Testing: Michigan 1992-1997

Industry (SIC)*	Above MIOSHA Noise Standard**	HCP***	Number of Employees Total #	Range
Construction (15-17)	No (1)	No (1)	30	
Manufacturing (20-39)	Yes (8)	No (8)	244	2-75
	Yes (10)	Yes (10) 5 were deficient	2324	1-1250
	No (4)	Yes (4) 2 were deficient	1417	19-1000
	No (9)	No (9)	1021	3-400
Transportation (40-49)	No (1)	Yes (1) deficient	2	
Trade (50-59)	Yes (1)	No (1)	3	
	No (3)	No (3)	728	1-477
Services (70-89)	Yes (2)	No (2)	17	7-10
	No (2)	No (2)	23	8-15
Government (91-97)	Yes (2)	Yes (2) 1 was deficient	18	2-16

*Standard Industrial Classification (1987 Manual).
**Number of companies in parentheses.
***Hearing Conservation Program.

Table 12. Size of Companies Cited for Violations of the Noise Standard in Michigan: l/l/97 to 12/31/97

Number of Employees	Companies Number	Percent
0 - 50	28	(51.8)
51 - 250	23	(42.6)
251 +	3	(5.5)
Total	54	99.9*

*Percentage does not add to 100 due to rounding.

Table 13. Violations of the Noise Standard in Michigan: l/l/97 to 12/31/97

Standard Violated	Number of Citations	Percent *	Percent **
No hearing conservation program	43	(79.6)	(52.4)
Exceeded noise level	10	(18.5)	(12.2)
Access to medical records	3	(5.5)	(3.6)
Training	7	(13.0)	(8.5)
Provide hearing protection	4	(7.4)	(4.9)
Any audiometric testing	4	(7.4)	(4.9)
Noise monitoring	4	(7.4)	(4.9)
Follow-up on annual audiometric testing	4	(7.4)	(4.9)
Audiometry on an annual basis	2	(3.7)	(2.4)
Baseline audiometric testing	1	(1.8)	(1.2)

*A company may be cited for more than one type of violation, therefore these percentages are based on a total of 54 companies cited.
**Percentage based on a total of 82 violations.

Table 14. Type of Industry Cited for Violations of the Noise Standard in Michigan: 1/1/97 to 12/31/97

Industry (SIC Code) *	Companies Number	Percent
Manufacture of:		
Fabricated Metal Products (34)	23	(42.6)
Transportation Equipment (37)	6	(11.1)
Primary Metal (33)	6	(11.1)
Food and Kindred Products (20)	1	(1.8)
Industrial and Commercial Machinery (35)	5	(9.2)
Rubber/Plastics (30)	5	(9.2)
Lumber and Wood Products (24)	2	(3.7)
Chemicals (28)	1	(1.8)
Stone, Clay, Glass (32)	2	(3.7)
Furniture (25)	2	(3.7)
Trade:		
Wholesale Trade (50)	1	(1.8)
Total	54	99.7**

*Standard Industrial Classification (1987 Manual).
**Percentage does not add to 100 due to rounding.

Table 15. Demographic Characteristics of 132 Patients with Noise-Induced Hearing Loss, with Noise Exposure in Construction: Michigan 1992-1997

Gender

	Number	Percent
Male	131	(99.2)
Female	1	(0.8)
Total	132	(100)

Race

	Number	Percent
White	121	(96.0)
African American	3	(2.4)
Hispanic	1	(0.8)
Other	1	(0.8)
Total	126	(100)

Race was unknown for 6 individuals.

Decade of Birth

Decade	Number	Percent
1910-1919	4	(3.1)
1920-1929	12	(9.2)
1930-1939	27	(20.6)
1940-1949	32	(24.4)
1950-1959	36	(27.5)
1960-1969	18	(13.7)
1970-1979	2	(1.5)
Total	131	(100)

Decade was unknown for 1 individual.

Table 16. Status of Regular Hearing Testing and Use of Hearing Protection at Most Recent Construction Job Where 132 Patients with Noise-Induced Hearing Loss were Exposed to Noise: Michigan 1992-1997

Regular Hearing Tests*

	Number	Percent
Yes	4	(3.7)
No	104	(96.3)
Total	108	(100)

*Status of testing was unknown for 24 individuals.

Given Hearing Protection*

	Number	Percent
Yes	38	(48.1)
No	41	(51.9)
Total	79	(100)

*Status of hearing protection was unknown for 53 individuals.

Table 17. Most Recent Decade Where 132 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 1992-1997

			Regular Hearing Tests					Given Hearing Protection				
	Total Patients		No		Yes		Unk.	No		Yes		Unk.
Decade*	Number	Percent	Number	Percent	Number	Percent	Number	Number	Percent	Number	Percent	Number
1950-1959	2	(2.0)	2	(100)	--	--	--	1	(100)	--	--	1
1960-1969	6	(6.0)	5	(100)	--	--	1	4	(100)	--	--	2
1970-1979	10	(10.0)	9	(100)	--	--	1	5	(100)	--	--	5
1980-1989	15	(15.0)	12	(92)	1	(8)	2	5	(63)	3	(37)	7
1990-1997	67	(67.0)	62	(97)	2	(3)	3	15	(33)	30	(67)	22
Total			90	(97)	3	(3)	7	30	(48)	33	(52)	37

*Decade was unknown for 32 individuals.

Table 18. Status of Regular Hearing Testing and Use of Hearing Protection for 69 Patients with Noise-Induced Hearing Loss Who were Exposed to Noise Only in Construction Jobs: Michigan 1992-1997

Regular Hearing Tests*

	Number	Percent
Yes	2	(3.9)
No	49	(96.1)
Total	51	(100)

*Status of testing was unknown for 18 individuals.

Given Hearing Protection*

	Number	Percent
Yes	23	(57.5)
No	17	(42.5)
Total	40	(100)

*Hearing protection was unknown for 29 individuals.

Table 19. Most Recent Decade Exposed to Noise for 69 Patients with Noise-Induced Hearing Loss Who Were Only Exposed to Noise in the Construction Industry, and Status of Regular Hearing Tests and Use of Hearing Protection: Michigan 1992-1997

			Regular Hearing Tests					Given Hearing Protection				
	Total Patients		No		Yes		Unk.	No		Yes		Unk.
Decade*	Number	Percent	Number	Percent	Number	Percent	Number	Number	Percent	Number	Percent	Number
1950-1959	1	(2.0)	1	(100)	--	--	--	1	(100)	--	--	--
1960-1969	1	(2.0)	1	(100)	--	--	--	1	(100)	--	--	--
1970-1979	0	--	--	--	--	--	--	--	--	--	--	--
1980-1989	7	(14.0)	7	(100)	--	--	--	3	(60)	2	(40)	2
1990-1997	41	(82.0)	37	(97)	1	(3)	3	9	(32)	19	(68)	13
Total			46	(98)	1	(2)	3	14	(40)	21	(60)	15

*Decade was unknown for 19 individuals.

Table 20. Duration of Years Worked for 69 Patients with Noise-Induced Hearing Loss Who Were Only Exposed to Noise in Construction Jobs: Michigan 1992-1997

Duration *	Number	Percent
1-5	14	(25.0)
6-10	7	(12.5)
11-15	1	(1.8)
16-20	9	(16.1)
21-25	7	(12.5)
26-30	7	(12.5)
31-35	6	(10.7)
36-40	2	(3.6)
41-45	3	(5.3)
Total	56	(100)

*Duration was unknown for 13 individuals.

Table 21. Estimates of the Number of Blue-Collar Workers in Michigan Exposed to Excessive Levels of Noise, by Industry Type

Industry (SIC)*	Total No. of Workers**	% Exposed to Noise***	No. Workers Noise-Expose
MINING			
Mining (10-12, 14)	7900	66.74	5272
Oil and Gas Extraction (13)	2100	91.25	1916
CONSTRUCTION			
General Building Contractors (15)	26100	87.37	22803
Heavy Construction (16)	11700	81.21	9501
Special Trade Contractors (17)	88700	88.02	78073
MANUFACTURING			
Food (20)	32300	30.86	9968
Textiles (22)	400	40.94	164
Apparel (23)	16400	16.16	2650
Lumber and Wood (24)	13700	38.38	5258
Furniture (25)	25900	35.77	9264
Paper (26)	15600	33.37	5206
Printing (27)	24900	22.58	5622
Chemicals (28)	22000	17.81	3918
Petroleum and Coal (29)	900	27.12	244
Rubber and Plastics (30)	50700	24.86	12604
Leather (31)	3300	6.48	214
Stone, Clay and Glass (32)	12400	23.76	2946
Primary Metals (33)	28400	44.13	12533
Fabricated Metals (34)	101600	36.89	37480
Machinery, except Electrical (35)	86200	21.32	18378
Electrical Machinery (36)	24500	8.82	2161
Transportation Equipment (37)	198600	22.63	44943
Instruments (38)	10500	12.95	1360
Miscellaneous Manufacturing (39)	5100	17.71	903
TRANSPORTATION			
Freight (42)	38800	3.86	1498
TRADE			
Wholesale (50,51)	169200	23.60	39931
Retail (53-58)	822400	21.09	173444
SERVICES			
Financial (60-67)	188000	0.33	620
Other (70-79 except 75)	573500	21.56	123647
Automotive (75)	49600	50.43	25013
Health (80)	581800	3.40	19781

*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 1996. August 12, 1996, DHHS (NIOSH) Publication No. 96-XXX, Table 2-1. Percentages are estimates based on data collected in the National Occupational Exposure Survey NOES).