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Editorial

The contribution of focus groups in the evaluation of hearing conservation program (HCP) effectiveness

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Abstract

Problem: Exclusive reliance on such practices as policy review, audiometric testing audits, and noise surveillance to evaluate the effectiveness of workplace hearing conservation programs (HCP) fails to capture the impact of these programs as experienced by workers at the ''shop floor'' and offers little insight into the reasons and potential remedies for noted deficiencies. *Methods*: A qualitative approach for evaluating industrial HCPs (and their various components) is discussed using three industrial populations as case studies. For each study population, this paper illustrates how focus groups, comprised of line workers and supervisors, were used to clarify and augment information gathered through more traditional program assessments to provide a more enriched picture of hearing conservation practices. Descriptive data on plant hearing conservation program practices at each plant are presented with a comparison of proactive elements of each program relative to the Occupational Safety and Health Administration (OSHA) Hearing Conservation Amendment (HCA) requirement and to internal plant policy. *Results*: Yearly program evaluation with input from all end-users is important in the process of hearing loss prevention. The qualitative assessment outlined in this paper serves as a basis for future quantitative assessments of HCP effectiveness using hearing threshold data and noise exposure assessments to examine changes in hearing levels as a function of noise exposure and other risk factors for hearing loss.

Keywords: Program evaluation; Hearing conservation; Noise; Hearing loss

1. Introduction

The U.S. Occupational Safety and Health Administration (OSHA) Hearing Conservation Amendment (HCA) has mandated that general industry employers must establish hearing conservation programs for workers exposed to noise levels having a time-weighted average (TWA) of 85 dBA or higher (OSHA, 1983). The standard further specifies that such programs shall consist of five components: (a) workplace noise monitoring; (b) audiometric testing; (c) the provision of hearing protection; (d) training; and (e) record keeping. Although specific with respect to program structure, the regulation leaves employers some latitude with respect to program design, implementation, and administration. For example, the training provision requires annual refresher training for all affected employees and describes the general content, but does not specify delivery method, duration, evaluation, or trainer qualifications. In addition, aspects of audiometric testing procedures are not explicitly specified, such as how baseline audiogram revisions for standard threshold shifts are to be revised and timing of annual audiometric testing (mid-shift vs. before or after the shift).

In an attempt to provide further guidance on the implementation of successful noise-induced hearing loss protection programs, the National Institute for Occupational Safety and Health (NIOSH), has produced a number of supporting publications (NIOSH, 1996, 1998). One NIOSH recommendation has been to replace the term ''hearing conservation program,'' which implies a goal of minimizing hearing loss, with the more proactive term ''hearing loss prevention

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program (HLPP)'' to describe programs aimed at eliminating hearing loss (NIOSH, 1998). NIOSH (1998) has also suggested a more comprehensive set of ''best practice'' elements for hearing loss prevention programs than what was described in the original OSHA standard. These would include: (a) initial and annual audits of procedures, (b) routine noise exposure assessment, (c) engineering and administrative control of noise exposures as the primary mechanism of reducing worker exposures (rather than reliance on hearing protection devices (HPD)), (d) annual audiometric surveillance and evaluation (feedback on testing results and training on HPD fit and use are provided immediately, testing is done mid-shift to detect possible temporary threshold shift (TTS)), (e) use of hearing protectors (for exposures $\geq$ 85 dBA, regardless of duration), (f) education and motivation guidelines, (g) record keeping, and (h) program evaluation. These additional components, with the exception of program evaluation and routine plant audits, were also contained (with less specification in some areas) in OSHA's HCA of 1983.

It should be recognized that the noise standard (DOL, 1969) and amendment (OSHA, 1983), as originally written, describes the minimum framework or structure of a hearing loss prevention program. Equally important, but perhaps more difficult to capture, is the manner in which these program elements get adapted and implemented in different workplace settings. Recent research indicates that the key to developing any successful workplace safety and health program involves the coordinated efforts and involvement of all levels of the organization including executive managers, line supervisors, workers, and safety and health professionals (NIOSH, 1996; Royster & Royster, 1990; Smith, Cohen, Cohen, & Cleveland, 1978; Cohen, 1976; Schmidek, Layne, Lempert, & Fleming, 1975; Zohar, Cohen, & Azar, 1980). In terms of conducting a program evaluation, this suggests that one must get beyond a ''paper'' audit, which focuses primarily on the program's description and structure, to a more ''grass roots'' assessment of its actual ''process,'' the manner in which the program involves and influences all members of the organization. At issue here are such factors as the organization's credibility and perceived commitment to the program, employee acceptance and ownership of the program, allocation of resources and organizational priorities with respect to the program, and other such indices of a supportive organizational climate. Such hands-on evaluations allow for a more dynamic picture of how the program is actually working and send a message throughout the organization that the program is sufficiently valued by the company to warrant systematic monitoring, reexamination, and fine-tuning. In addition to the direct benefits of preventing hearing loss, an effective program may also provide secondary gain to the participants. Research studies suggest that chronic noise exposure also results in significant non-auditory effects, thus HLPP participants may experience less fatigue, lower absenteeism, and better overall health (Cohen, 1976; Cohen, 1977; Evans, Hygge, & Bullinger, 1995). The present paper describes how focus groups were used, in conjunction with traditional audit measures, to assess the extent to which formal hearing loss protection policies became integrated into day-to-day work practices across three organizations.

2. Study methods

2.1. Description of study populations

The study included three unionized manufacturing plants located in the Midwest. Herein, the three plants will be referred to as Plant 1 (basically compliant on paper with the OSHA HCA Standard), Plant 2 (a step above basic compliance), and Plant 3 (the most proactive program). Table 1 shows the demographic and noise exposure characteristics of each plant. Plant 1 is the oldest plant site, opening in 1947. Employees in the plant HCP were predominately white males, with Plants 2 and 3 having similar gender and race distributions. Duration of employment is higher in Plants 1 and 3 and the mean age of workers at these plants is somewhat older compared to Plant 2. The higher proportion of hourly workers enrolled in the company HCP reflect their higher overall noise levels relative to salaried workers. Salaried workers enrolled in the HCP typically include first line supervisors assigned to departments with high noise levels ($\geq$ 85dBA). All three plants had similar distributions of 8-hour time-weighted average (TWA) exposures, but differed with respect to the types of industry, noise exposure sources, HPD requirements, and how they implemented their hearing conservation program.

2.2. Overview and conceptual framework

The activity reported in the present paper was part of a larger NIOSH study to examine organizational practices in the implementation of the OSHA Noise/Hearing Conservation Standard and the impact of these practices on workers' perception of program effectiveness. Three organizations were selected which, based on program description, appeared to vary in their approach to hearing loss prevention, ranging from basic compliance to more proactive commitment. The initial criteria used to rate the three plants were based on site visits at each of the plants and discussions with plant personnel responsible for implementing the program at both the corporate and/or plant site level. This included a review of written procedures, audiometric testing records, booth background noise levels, and plant walk-through of each facility. Elements of each plant's program were compared to OSHA requirements as well as to the internal corporate policy, if available.

Table 1
Demographics and noise exposure characteristics by plant site

Characteristics	PLANT SITE		
	Plant 1 (N = 1879 people)	Plant 2 (N = 4952 people)	Plant 3 (N = 4683 people)
Year Plant Opened	1947	1965	1957
Number of Workers Ever Enrolled in HCP[a]	1300	3130	2891
Years of Audiometric Testing	1981–1999	1978–1999	1967–1999
Hourly/Salaried Workers[b]			
% Hourly	74.1%	90.9%	89.9%
% Salaried	25.9%	9.1%	10.1%
Age at first audiogram			
Mean ± standard deviation	37.7 ± 9.52	35.5 ± 9.7	41.0 ± 10.7
[range]	[19–69]	[16–67]	[17–69]
Gender (% male)	74.5%	87.8%	88.0%
Race (% white)	97.6%	80.4%	81.7%
Duration employed (years)[a]			
Mean ± standard deviation	21.7 ± 11.4	18.0 ± 12.5	20.00 ± 13.36
[range]	[0.1–50.0]	[0.1–51.7]	[0.1–45.5]
Sources of Noise Exposure	Canning, press motors, blowers, cutting blades, mill and grinding, packaging	Press operations, including blankers, transfer presses, tool die and set operations	Cutter/grinder, tooling and motor operations, assembly of pistons, rack and pinion, and gear repair
Range of Noise Levels (dBA)[c]	75–101 dBA	75–111 dBA	75–106 dBA
HPD requirements per company policy	In areas with noise levels ≥ 85 dBA	Wall-to-wall (required at all times and all areas)	In areas with noise levels ≥ 85 dBA

[a] Enrollment through 12/31/1998, (study end date) or last known employment data.
[b] The percentage of hourly and salaried workers was computed based on the job each person held at the time of the last test.
[c] 8-hour TWA, calculated with 3-dB exchange rate using OSHA Appendix G calculations with a 80-dB threshold. For Plants 2 and 3, noise measurement data are from the periods of 1971–1998 and 1984–1998 for Plant 1.

Within each organization, the data routinely collected as part of the OSHA HCA to the noise standard (OSHA, 1983) were obtained. This involved an audit of company audiometric records, noise surveys, training records as well as interviews with plant HCP administrators regarding training and education, and relevant policy documents for a period of time extending from before 1981 (the anniversary date of the draft OSHA HCA Standard) until the end of 2000 (end date for data collection). In addition to these traditional program evaluation measures, the present study also used focus groups of employees, supervisors, and managers in each plant to: (a) gain a historical perspective of hearing protective practices and policies in the plant over the time period of interest; (b) better understand how the various program elements (e.g., training, audiometric testing, provision of hearing protection) were actually implemented; (c) gauge employee acceptance of the program; and (d) identify ongoing employee training/informational needs relative to noise induced hearing loss.

2.3. Data analysis

The small sample size of the focus groups precludes conducting inferential analyses. The primary intent of gathering information from interview and focus groups on hearing conservation program practices over time was to gain insight into actual practice versus written policies or standards. Hence, the findings reported in this paper are descriptive and serve to supplement the quantitative data on hearing and noise levels and provide useful insights necessary to interpret the impact of changes in program implementation over time. The results of the comprehensive evaluation of the three programs using audiometric and noise surveillance data will be reported elsewhere.

The present paper reports the findings of the focus group discussions, and more specifically, how these sessions provided insights into the employees' perceptions of the hearing conservation program. This is illustrated with examples where the insights from focus group and administrators' interviews can augment traditional paper audit methods.

2.4. Program evaluation instruments

The study collected historical and the most current information regarding how these plants implemented their HCPs. This information was provided through (a) focus groups with hourly employees and first line supervisors working in noisy areas (presumably enrolled in the company HCP); (b) structured interviews with the HCP administrators; and (c) structured audits of company records and written policies. The HCP administrators for all sites were the plant nurse and/or the plant safety manager.

2.4.1. Focus groups

The focus groups were conducted by a trained moderator (NIOSH contractor) with extensive experience. The moderator was kept blind to the judged quality of the hearing loss prevention programs of the three companies. The focus groups, lasting approximately 2 hours, took place after work hours and off-site. A total of four focus groups (two for first line supervisors and two for line employees) per company were initially planned with anticipated 10–12 participants per group (Krueger & Casey, 2000). Recruiting at the three sites was conducted in collaboration with the local union and human resource department. To qualify for inclusion in the focus groups, individuals had to have worked for the company for at least 10 years in an area covered by the OSHA noise standard (i.e. noise exposures $\geq$85 dBA (decibels, A-weighted, 5-dB exchange rate)). Specific recruitment strategies were tailored for each of the facilities following negotiations with key plant representatives (Table 2).

Table 2
Method of recruitment by study site

Recruitment Strategy[1]	Plant 1	Plant 2	Plant 3
Identification of Employees			
• List of workers with $\geq$10 years employment	×	×	
• On-site recruitment-sign-up sheets (self-selected)			×
Plant Personnel Recruit Subjects		×	×
• On-site recruitment	×		×
– By e-mail, face-to face recruitment on shop floor and break times		×	×
– Phone calls and face-to-face recruitment on shop floor.		×	
• Off-site recruitment, union retirees groups	×		×
NIOSH Recruit Subjects			×
• On-site recruitment			×
• Off-site recruitment-phone calls/e-mail	×	× (supervisors)	×

[1] For all three plant sites, brochures, flyers and posters were provided for distribution to employees and in break rooms at least three weeks before recruitment began. On-site recruitment indicates that recruitment took place at the plant site whereas off-site recruitment indicates that subjects were recruited by e-mail or phone calls with no on-site recruiter.

Recruitment approaches were quite varied and included making presentations at union meetings, posting flyers and setting up information tables in the plant, relying on phone solicitations by the human resource office, and contacting recent retirees through an "alumni association." In general, the more directly involved the principal investigators and employee representatives were in the recruiting effort, and the more personal the contact with potential participants, the more favorable the response. Workers representing a variety of job classifications were asked to participate. As much as possible, efforts were made to assure that the demographic profile and departmental distribution of recruited workers approximated that of the criterion population. In a few instances, recent retirees who met the selection criteria were included in the study sample. All participants were paid US$50 to cover travel costs and time. As is customary for focus groups, food and refreshments were provided at the sessions.

For Plant 1, personnel and HCP records were used to identify eligible workers and supervisors. Individuals invited to participate in the focus group sessions were randomly selected from a roster of 155 hourly and supervisory employees working for at least 10 years in noisy departments that require the use of hearing protection devices. Among the eligible 2nd and 3rd shift hourly employees (N = 895) at Plant 2, NIOSH randomly selected 27–40 employees per group (ensuring a balanced distribution of employees from each department by race and gender) for possible participation in focus groups. Salaried employees meeting the inclusion criteria were identified by the Human Resources Department, but the number of eligible employees was much more limited (12 from second shift and 14 from third shift). At the time of the focus groups at Plant 3, there were a total of 2,891 employees (2,623 hourly and 268 salaried). However, the pool of eligible 2nd and 3rd shift hourly employees and supervisors was much lower (500 hourly and 25 first line supervisors).

A sample of the questions and topic areas from the discussion guide for the focus groups is presented in Table 3. The guide covered a wide array of topics relating to the hearing protection program at the plant.

Specific issues included characterizing the organization's hearing conservation policies and practices: (a) employees' perceptions of company commitment to the program; (b) the managerial practices that contribute to these perceptions; (c) the nature, quality, and frequency of HCP training; (d) availability of, and satisfaction with, the hearing protectors provided by the facility; and (e) the workers' views about the strengths and weaknesses of the HCP. In addition, participants were asked to provide a historical perspective of hearing conservation activities within the facility over the past 10–20 years, noting any significant or sentinel changes in practices or policies. The group facilitator assisted with this activity by con-

Table 3
Focus group discussion guide topic areas

Topics	Type of Information	How used in Evaluation
Susceptibility and Seriousness of NIHL	a) Gauge employee awareness of hearing loss; b) Introduction to topic area for further discussion	Not directly used in evaluation.
History of Hearing Loss Prevention Activities (pre-OSHA HCA) *If no program prior to OSHA HCA, used time period reflecting a known change in plant program procedures).*	–When did program start? –How is/was testing done? (onsite vs. mobile unit; Audiometer or procedural changes). –HPD use and compliance –Noise monitoring and engineering controls.	a) Provides overview of changes in the program over time and insights into why these changes may have occurred. b) Useful in comparing concordance of this information with company records and other data sources.
Current Hearing Loss Prevention Activities *(Post-OSHA HCA or since last change in program).*		c) Provides possible explanatory variables when examining audiometry data over time in relation to changes in testing procedures, HPD use, and noise levels.
Communication/Training	–Types of training material used (Past and present) –Employee suggestions for improving training	a) Evaluation of effectiveness of training: information retention and impact on standard threshold shift (STS) and hearing impairment rates. b) May be used by plant for targeted training interventions to improve training and to increase employee involvement.
Hearing Protection Devices	When first used at plant, types of devices available, employee preferences, employee concerns regarding comfort, fit, choice, barriers to use, and general knowledge.	Compare concordance with company records. May be used to evaluate compliance, use, and type of protector in relation to hearing loss.
Perceived Commitment	What are indicators of commitment from employee viewpoint? Has it changed over time? If so, what factors may have been related to these changes.	Provide possible explanatory variables for analysis of hearing loss trends over time.

structing a visual time line on a flip chart based on participants' recollections and dialogue.

2.4.2. Audit forms and structured interviews with HCP administrators

In addition to focus group discussions with workers and front line supervisors, structured interviews were conducted with those individuals responsible for the implementation of the hearing protection program. A program evaluation checklist was used which included a series of questions related to training. Supporting documentation from the company (training materials, program policies) was also collected. The structured interview was based on a template previously developed by NIOSH to describe individual company training practices relative to the OSHA guidelines for model training programs (Goldenhar, Moran, & Colligan, 2001). Information was collected on such topics as curriculum development and content, record keeping, trainer qualifications, evaluation, training delivery mechanisms, and supervisor involvement. The structured interviews were conducted concurrently with the detailed written program audit and background noise level checks of existing audiometric test booths. Any historical information on background levels and all current and historical procedures manuals and training information related to hearing loss prevention were gathered at that time.

The audit forms were organized into seven sections corresponding to different requirements under the HCA (Table 4). Administration of the audit forms was conducted two ways to check for concordance in response to questions: (a) administrators first self-administered the forms and (b) NIOSH investigators then re-administered the audit through face-to-face interviews. Inconsistencies between self-administered and direct interview were followed up with additional interviews during subsequent sites visits.

Each section of the audit checklist form was scored for each item, which allowed for four possible responses: *Always*, *Often*, *Infrequently*, or *Never* (scored from 3 to 0). A score of three (3) denoted the maximum compliance level possible. For each section, the maximum possible score (3 multiplied by the total number of questions in that section) and respondents' total score was calculated. The percent total scored, denoted as percent compliance, was then calculated by taking the respondent's total score for that section divided by the maximum possible score for that section multiplied by 100. Similarly, percent compliance for the entire program was calculated using the sum of the section scores divided by maximum score over each section. In this way, the three plants could be compared by HCP element and as a whole. For example, 100% would denote consistent, full compliance with the OSHA HCA. Using a similar procedure, scores were computed

Table 4
Items from program evaluation checklist items related to OSHA HCA standard

Program Component[1]	Checklist Item by Program Component
Training and Education	• Provide training to employees exposed to ≥ 85 dBA. • Repeat training annually and update material • Training includes: (a) noise effects on hearing, (b) purpose of HPD's, advantages/disadvantages, noise reduction ratings, instructions on selection, use fit and care, (c) purpose and procedures of audiometric testing (yes/no). • Copies of OSHA standard available to employees or their representatives and posted in workplace. • Information provided by OSHA available to employees. • All records provided on request to employees, former employees, representatives, and OSHA.
Noise Monitoring	• Conduct noise monitoring when ≥ 85-dBA TWA with 5-dB exchange rate. • Use representative personal monitoring for highly mobile workers, significantly varying sound levels, and impulse noise exposure. • Include all continuous, intermittent, and impulsive sound levels from 80–130 dBA. • Calibrate noise monitoring equipment. • Repeat monitoring when noise exposure increases significantly. • Notify employees of noise monitoring results when exposure is >85 dBA TWA, with 5-dB exchange rate. • Employees or their representatives may observe noise monitoring.
Engineering/Noise Controls	• Feasible controls for employees when sound levels exceed 90 dBA. • Impulse or impact noise do not exceed 140 dB peak sound pressure level.
Hearing Protectors	• All employees exposed to ≥ 85 dB TWA with 3-db exchange rate use HPD's. • Available to all employees exposed ≥ 85 dBA TWA and replaced as necessary. • Worn by employees when exposed to 90 dBA TWA or above or exposed to 85 dBA TWA or above when a) no baseline after 6 months or b) STS occurs. • Employees select from a variety of suitable HPD's. • Employees trained in care and use. • Employer ensures proper initial fitting and supervises correct use. • Evaluate attenuation for specific noise environments according to Appendix B. • Attenuate to at least 90 dBA or 85 dBA if STS experienced. • Re-evaluate attenuation as necessary.
Audiometric Testing and Follow-up Program	• Audiometric testing available to employees exposed >85 dBA TWA. • Provide annual audiogram for all employees exposed ≥ 85 dBA TWA with 5-dB exchange rate. • Tests performed by professional or by competent technician (certification recommended).
Audiometric Testing and Follow-up Program	• Audiograms meet 1910.95 Appendix C requirements. • Establish baseline audiogram within 6 months or within 1 year if using mobile test van. • 14-hour period without workplace noise before baseline (HPD can be substituted). • Notify employees to avoid high non-occupational noise levels before baseline. • Compare each annual test to baseline for validity and to see if standard threshold shift (STS) exists (10-dB, average, 2, 3, and 4 kHz). • If STS occurs, retest within 30 days. • Audiologist, otolaryngologist or physician reviews problem audiograms and determines need for further follow-up. • Notify employees with STS in writing within 21 days. • Actions to be taken (unless Physician determines STS not work-related): (a) Provide employees with HPD's (if not already wearing), train in care and use, and require them to be worn. (b) Refit and retrain employees already using HPD's. (c) Refer (as necessary) for clinical evaluations or additional testing. (d) Inform employees with non-work related ear problems for need for otologic exam. • Annual audiogram may become baseline as per OSHA criteria. • STS is evaluated as change relative to baseline of 10 dB or more in average hearing level at 2, 3, and 4 kHz, either ear. Allowance of aging optional per Appendix F. • Testing Procedures: (a) Each ear tested at frequencies 0.5, 1, 2, 3, 4 and 6 kHz. (b) Audiometers meet ANSI S3.6-1969 (c) Pulse-toned and self-recording audiometers meet Appendix C requirements (d) Test rooms meet Appendix D requirements; (e) Audiometer calibration includes: functional tests before each day's use, acoustical check annually according to Appendix E, and exhaustive calibration every 2 years.
Record keeping	• Maintain accurate records of noise exposure measurements. • Maintain audiometric records with the following information: (1) employee name and job classification, (2) date of audiogram, examiner's name, (3) date of last acoustic or exhaustive calibration, (4) employee's most recent noise exposure assessment, (5) background noise levels in audiometric test rooms. • Retain all noise exposure records for at least 2 years. • Retain all audiometric test records at least for duration of employment. • Transfer all records to successor employer.

[1] High compliance was usually scored at a 3 but descriptors could be reversed (3 = never, etc.) for items where a non-occurrence of an event indicated good compliance.

for selected program elements using information from employee-centered focus groups.

3. Results

3.1. Qualitative program evaluation: training and audit checklist

The structured interview and audit checklist provided supplemental data documenting how the HCP program was implemented from the perspective of the key administrators of the program. Table 5 presents a summary of results from structured interviews regarding training aspects of the program.

For Plant 1, the main person involved with hearing conservation was the plant nurse. For Plants 2 and 3, these duties were shared with the medical department (audiometric testing and evaluation, HPD evaluation and dissemination) and the safety department working with the engineering and human resources departments (purchase of HPD's, enforcement of HPD compliance, noise monitoring and engineering controls). Plants 2 and 3 have had in-house programs from the time the programs started (1965 and 1973, respectively), while Plant 1 more recently (1997) converted to an in-house audiometric test program. Prior to this, Plant 1 contracted with a provider of mobile audiometry to test employee's hearing. Length of safety training depended on the type of training. For HPD fit and use, which was in the purview of the plant medical departments, time for training ranged from 3–5 minutes (Plant 2 and 3) up to 10 minutes (Plant 1) to reduce time off the production line. Brochures with topic areas on hearing loss and noise were available in the health unit of all plants. Plants 2 and 3 also had weekly safety talks on specific topic areas, conducted by supervisors with input from the safety department. In the past, the safety department had bulletins and videos on a broad range of safety issues. Although Plant 3 indicated that they used printed booklets, none of the information was specific to noise or hearing loss. Administrators indicated that formal refresher courses on training were given and that there was only limited customization of training to fit workers' needs (the exception was HPD fit during audiometric testing). Administrators at Plants 2 and 3 stated that they used corporate audits to evaluate effectiveness of the program, but Plant 3 had no formal or consistent evaluation mechanism. Supervisory involvement in training was limited across the three plants to safety talks (Plants 2 and 3) and enforcement of HPD use (Plant 1). Administrators in Plants 1 and 3 indicated that hourly workers felt proper use of HPD's was important; however, workers viewed HPD's as burdensome.

Table 6 presents the scoring of each program component relative to the OSHA HCA elements based on the written audits and on data provided by HCP administrators at each of the three plants.

The highest compliance areas based on input from HCP administrators were audiometric testing and medical referral for all three plants. Administrative controls were not used as a mechanism to control noise exposure at any of the three plants. Engineering controls was rated high for both Plants 2 and 3 but not Plant 1, which relied on HPD's as the primary method of noise control. Training efforts were rated highest at Plant 3 (94%) and lowest at Plant 2 (78%). Plant 1 was rated as having 83% training compliance based primarily on training on HPD use conducted at the time of testing.

Noise monitoring compliance scores at Plants 2 and 3 scored were similar (81–84%) but Plant 1 was lower (74%) because there was no routine noise monitoring program. For all three plants, administrators indicated that noise exposure results were either never directly provided to workers or were done so infrequently. However, all three plant administrators indicated that maps and group information were often or always posted to indicate areas where HPD should be worn. Compliance with the HPD component of the OSHA HCA was at about 75–78% at Plants 1 and 3 and somewhat higher (85%) at Plant 2 which required wall-to-wall use of HPD and had more high level impulsive noise exposures than the other two plants. Administrative and record keeping compliance ranged from 74% (Plant 1) to 89% (Plant 3), even though most elements of the standard were in compliance. The lower than expected scores for the recordkeeping component of the standard for all three plants was affected by lack of compliance for an item in the standard requiring that the most recent noise exposure be part of the medical record. Overall program compliance with the OSHA standard ranged from 82–92%.

It should be noted that the corporate policies covering Plants 2 and 3 were proactive in the following areas: (a) noise exposure monitoring, (b) engineering controls, (c) audiometric testing, and (d) HPD use. Noise monitoring and inclusion of a worker into the HCP was based on 8-hour TWA sound levels using a 3-dB exchange rate (as recommended by NIOSH, 1998). Biennial sound surveys were also required (plant policy required more frequent monitoring if there had been significant changes in plant processes). A buy quiet program is also incorporated into company policy at Plants 2 and 3 with noise level specifications of less than 85 dB when purchasing new equipment or modifying existing equipment. Additionally, at Plants 2 and 3, HPD's are to be provided and worn by all employees exposed to $>$ 85 dBA regardless of exposure duration. With respect to annual audiometric testing, policies for Plants 2 and 3 expect that workers are to be administered testing during their shift to detect early noise-induced temporary hearing shifts (e.g., Temporary threshold shift or TTS).

3.2. Focus group results

To be eligible to participate in the focus groups, employees had to be employed for at least 10 years at

Table 5
Results of structured interviews with administrator

ITEM (Year Data Collected):	PLANT 1 (1998)	PLANT 2 (1999)	PLANT 3 (2000)
Length of time HCP in place	HCP program since 1984; In-house program Since 1997	1965 (year plant opened).	1973
Overall responsibility for HCP	Medical-RN supervisor	Medical and Safety Departments	Medical-head nurse
Main responsibility for training	Medical-nurses	Safety training refreshers for new employees Medical at time of audiograms	Medical-nurses
Description of HCP	• In-house audiometry. • 1/1 training at time of testing. • group training for new employees only.	• In-house audiometry • 1/1 training at time of testing • Group training-safety talks by department – Company TV, bulletins, videos	– In-house audiometry – 1/1 training at time of testing – Group training-safety talks by department – Company TV, bulletins, videos
Length of time for training	About 10 minutes/employee Audiometry tests take ~ 15 minutes (employee off-production line for 1/2 hour).	About 5 minutes/employee	2–3 minutes per employee at time of annual audiometry. Safety talks-10 minutes/week.
Training content	Limited to topics specified in noise standard; One-on-one HPD fitting, immediate feedback on audiometric test results.	Includes information specified in OSHA standard-material in refresher booklets given in Medical at time of annual test.	Includes information specified in OSHA standard with major focus on problems, special issues identified by Health and Safety Noise Committee.
Formal record keeping procedures for initial and refresher courses	Entered in computer audiometric testing program.	Refresher training taken upon completion of audiometry is documented in the employee's record. Supervisors document all safety talks.	None for training provided by Medical. The corporate audit and safety training talks have sign-in sheets. No refresher courses given outside annual testing regiment.
Training materials used	Booklets (printed text), discussion/ demonstrations on HPD use.	Videos, hands-on demos on use of HPD's, lectures, Q&A sessions at safety meetings.	Videos, hands-on demos on use of HPD's, lectures, Q&A sessions at safety meetings.
Differences in content for initial and refresher courses?	Initial training is more detailed. Later training does not include ear anatomy.	Initial training increases employee awareness of hazard. Refresher is a reminder of the dangers of not wearing HPD's.	Refreshers are rarely given (not routinely conducted). Some is done for new workers when they start.
Customization of training to fit needs of individual worker?	For some workers as needed to explain ear exam and HPD use and fit.	No	Yes, medical department provides HPD fit demos. Sometimes custom HPD's are made for employees and those with unique physical problems are given special training.
How is effectiveness of training measured?	No formal mechanism. May ask for feedback from employees informally at time of testing.	Audits of the HPD use are performed and the annual audiometry tests are administered to measure effectiveness of the HCP.	Corporate audits are sometimes conducted to get feedback from employees.
Who reviews evaluation of effectiveness?	Not applicable	Evaluation of audiometry by Medical; HPD compliance by Safety.	Corporate-union committee oversight, with reports provided to plant sites, highlighting areas of improvement or where program is effective.
Do you think hearing loss prevention program has any real benefits?	Reduced liability and insurance costs.	It increases employee awareness of hazard. Program falls short in convincing workers that not protecting themselves against these hazards can have serious consequences later in life.	Yes, particularly the sound surveys.
How do you think your employees/supervisors feel about the HCP?	Employees not very interested, but supervisors recognize its importance.	Both hourly and supervisors feel the program is important.	The workers think it's important but wearing HPD's is a burden. Supervisors think it's important but it's hard to keep track of HPD use and other safety issues with changing production schedules.
How are supervisors involved in hearing protection training?	Enforce of HPD use on plant floor and coordinate with union floor relief for audiometric testing.	Supervisors present the videos and give safety talks.	Not directly involved. They attend HCP committee meetings; all engineers must attend if there is an issue in their area, because they have input into safety decisions.

Table 5 (*continued*)

ITEM (Year Data Collected):	PLANT 1 (1998)	PLANT 2 (1999)	PLANT 3 (2000)
How do you ensure what is taught in training is put in place on the jobsite?	Nothing except try to ensure employees abide by company policy.	We review the workers and supervisor's compliance with wearing HPD's.	We don't know for sure. What gets done gets measured. The audits tell us if we're making a difference.
Does your company do anything to demonstrate that HC is a priority?	Bulletin boards post various H&S themes. Handbooks on mandatory HPD use, permit use of company time for hearing tests and training during exams.	There are written policies, including noise monitoring, HPDS provisions and on-site training.	Yes, we have a buy quiet program, allocate company time for training, and have noise surveys every other year.
Has your approach to safety training changed since you initiated it?	Not since the inception a year ago when we moved to in-house testing of employees and one-on-one training on HDP use.	Not significantly.	Yes, it is always changing. Safety is not separate from the manufacturing process or quality. This is a recent focus of the new management.
Ambient sound levels in test rooms	Meet OSHA specifications but not ANSI standards.	Booth within OSHA specifications but 2.5 dB higher for 500 Hz relative to ANSI S3.1, 1991 and ANSI S3.1, 1999; Work activities adjacent to test booth may increase noise levels.	2 booths below ANSI S3.1, 1991 and ANSI S3.1, 1999 (ANSI, 1991) and (ANSI, 1999) specifications for all test frequencies. Therefore, also meet OSHA specifications.

each of the plant sites and must have worked in noisy departments that require the use of HPD's. The 10-year inclusion criterion assured that focus group participants would be able to discuss the hearing conservation program from a historical perspective. The study targeted at least 10 hourly and 10 first line supervisors for each of four focus groups per plant. For Plant 1, of the eligible 155 employees originally identified, 88 employees were contacted by phone. Of the eligible workers contacted, 55% agreed to participate (n = 47). Although a third of the eligible hourly Plant 2 employees were contacted, about 55% of these hourly employees declined to participate. Among the smaller number of eligible salaried employees (12 from 2nd shift and 14 from 3rd shift), there were no volunteers from 2nd shift and only five 3rd shift supervisors who agreed to participate. As with Plant 2, the eligible population of supervisors meeting the inclusion criteria was also small at Plant 3. Scheduling conflicts, under staffing, and long work hours among the supervisors at two of the facilities resulted in low enrollments. This necessitated a change from the original sampling plan. At Plant 2, a third worker group was substituted for one of the supervisor groups. At Plant 3, only three groups were held, two consisting of hourly workers (n = 15) and one comprised of supervisors (n = 9). The number of workers and supervisors in the focus groups conducted at each of the facilities is presented in Table 7.

Table 6
Program component scores by plant site: on-paper review by HCP administrator

HCP Administrators' Input Relative to OSHA Requirements (%Total Score)			
Program Component	Plant 1	Plant 2	Plant 3
Training/Education	83%	78%	94%
Noise exposure monitoring	74%	88%	81%
Engineering/Admin Controls	67%	100%	100%
Audiometric Testing and Follow-up	96%	100%	100%
Medical Referral	92%	100%	100%
HPD's	75%	85%	78%
Administrative/Record keeping	74%	89%	83%
TOTAL PROGRAM	82%	91%	92%

A total of 93 hourly and salaried employees participated in focus groups in the three plants (n = 39 in Plant 1; n = 30 in Plant 2; n = 24 in Plant 3). For purposes of the present paper, we will focus on four of the areas in the discussion guide, which provided the most useful information with respect to accessing workers' perception of, and compliance with, the hearing loss prevention program in their facilities. These were: HPD usage, training, audiometric testing, and perceived organizational commitment.

3.2.1. Hearing protection devices

At the time of the focus groups, hearing protection devices were provided "free-of-charge" by all three companies and workers were generally satisfied with the availability and variety of devices available. Rankings of the various devices provided at the three plants indicated that muffs were generally the least preferred, relative to plugs, because they were perceived as hot, cumbersome, and uncomfortable. Similarly, all three companies had mandatory HPD usage policies in the designated "high noise" (e.g., $\geq$ 85 dBA) areas, but there was considerable variability in site enforcement. Worker and supervisor groups at Plant 1 (the most "basic" program) reported that hearing protection was regularly worn by 95%–100% of the workers in the plant and that employees were routinely "written-up" if they were found in non-compliance. However, group estimates of the number of workers who wore them properly

ranged from 30%–75%. Independent observations by one of the authors (Stephenson) during four site visits over 2-years confirmed that while 100% of workers wore hearing protectors in required areas, less than one-third were wearing them in a manner assuring effective attenuation (Merry & Staller, 1999). Workers commented that although they were happy with the variety of HPD's available free-of-charge, they had no information about the relative advantages/disadvantages of the various devices or which one might be best suited for them or their noise exposures.

Surprisingly, the lowest level of reported HPD usage was at Plant 3 (the most "proactive" plant), where focus group members estimated that approximately 30% of the workers and 15% of supervisors plant-wide wore hearing protection. It should be noted that "wall-to-wall" hearing protection in Plant 3 was not required so that one should not expect a 100% user rate. Nevertheless, participants in Plant 3 tended to use their own departments (i.e., departments where noise levels were 85 dBA or higher) as a frame of reference in reaching these estimates. They consistently commented on the lack of enforcement of HPD policy within the plant, and agreed across all three focus groups that the use of HPD's was poor, with the lowest compliance occurring among the supervisors. The supervisors agreed with this assessment and offered a variety of reasons for not enforcing HPD usage. Among the reasons cited were a perceived inability to listen to the functioning of the machines, difficulty in visually monitoring usage and proper fit of HPD's, reluctance to jeopardize management/union relations, and lack of incentive to enforce company policy. Reasons for not wearing hearing protection reported by workers included: (a) that they were hot and uncomfortable; (b) that they believed them to cause ear infections; (c) that they got dirty from their hands when they were inserted or adjusted during use; (d) that they moved around during use and forced wax into the ear; (e) and that they made it difficult to communicate. Both supervisors and workers commented that adherence to the mandatory HPD policy had been much higher prior to the mid-1990's at which time the plant went through a downsizing and the supervisor/employee ratio was reduced.

Hearing protection usage in Plant 2 was intermediate to Plants 1 and 3, with participants estimating that about 75% of all plant employees used them, ranging from about 90% usage in high noise areas to about 20% in the less noisy assembly, welding, and shipping areas. Employees commented that there were no organizational incentives for wearing hearing protection. Both worker groups commented that supervisors don't wear hearing protection (presumably so that they can use radios for communication) and that management should be encouraged to routinely use HPD's as an example to shop-floor employees.

3.2.2. Training

All three plants reported that they provided training with respect to noise-induced hearing loss and the use of HPD's through a variety of mechanisms including videos, pamphlets, private tutorials conducted in concert with audiometric testing, poster displays, and safety talks. Discussions with supervisors and workers at the three plants indicated that training was much less formalized and structured than the program description indicated. For Plant 1, participants remembered a training session conducted in 1992 in which supervisors explained the importance of hearing protection within the context of a more general safety training program dealing with protective clothing and equipment. Group members also mentioned that hearing loss prevention pamphlets were on display in the dispensary, although none of the participants in the four groups had ever taken one. Participants said that they learned how to fit HPD's through trial and error and through reading the printed instructions on the packages. A number of workers commented that they had heard new workers might receive some training as part of their initial orientation. Other workers, however, were unclear as to the nature of the training or whether training of new workers occurred at orientation. Workers at Plant 2 also reported no formal instruction on hearing loss prevention, HPD selection, or proper fitting techniques. A "hearing conservation" booklet was made available by the nurse in conjunction with the audiometric testing, and the nurse would respond to requests for information, but participants felt that younger workers and new hires were more likely to get unsolicited instruction than more senior workers.

The situation was similar at Plant 3. Some employees reported having seen hearing loss prevention and other safety-related booklets displayed in the Medical Office. Still others had vague recollections of having seen a video on hearing protection at some time in the past, but they could not be more specific about the content or date of the viewing.

Table 7
Demographics and number of focus group subjects by plant site[a]

Characteristics	Plant 1			Plant 2			Plant 3		
	Total	Supervisors	Hourly	Total	Supervisors	Hourly	Total	Supervisors	Hourly
Number of employees	39	20	19	30	4	26	24	9	15
Gender, % male	87%	90%	84%	77%	25%	87%	75%	11%	20%
Mean Years Employed	17.5	12.2	26.2	17.5	10.2	18.9	23	21	23.9

[a] Racial composition of focus group participants was not collected. The racial composition across the three plants for participants was predominately white.

Thus for all three plants, educational materials and instruction were available on a request basis, usually in conjunction with audiometric testing, but there was no structured training plan. Typical of the sentiments expressed by employees at all three plants was the comment of a worker at Plant 1 who described his training in the use of hearing protection devices as being "like your first date, you have to learn on your own." Participants at all three plants indicated some common informational needs. Among these were questions regarding: (a) the relationship between aging and hearing loss; (b) the relationship between continuous noise, impact noise, and hearing loss; (c) the relationship between the use of HPD's and ear infections; (d) the use life of HPD's; (e) proper HPD fit testing and fit checking; and (f) the results of in-plant noise surveys.

3.2.3. Audiometric testing

In accordance with the OSHA HCA standard, all three companies had established audiometric testing programs. The focus group discussions indicated that employees were very sensitive to the quality and consistency of these programs and tended to use them as a bellwether of the company's continuing commitment to hearing loss prevention. In Plant 1, workers reported that earlier (i.e., mid 1980's) attempts at audiometric testing appeared to be disorganized and produced inconsistent testing results. The testing was conducted annually for the entire plant by a contractor in portable booths housed in a mobile van parked beside the loading dock. A number of participants recalled the tests being administered under conditions with high background noise from various internal and external sources (e.g., van engine running during tests, vibrational noise caused by activity on the loading dock, workers entering and leaving test booths, and doors closing/opening from the nearby cafeteria door). Employees reported receiving their test results in their pay envelopes three months later.

Around 1997, the testing was moved in-house, using a computerized system administered by the plant nurse during the month of the employee's birthday, and a computer printout generated the results immediately. The nurse reviewed the results with the individual relative to previous year's results and helped with the interpretation. Both workers and supervisors reported that the company conscientiously attempted to follow each individual's annual testing schedule and felt that the improved procedures reflected on the organization's attempt to reduce noise-induced hearing loss.

Plant 2 showed a similar evolution in testing technology over the years. Employees remembered mandatory hearing tests of all new hires as far back as they could remember. Sometime in the 1980's the plant began to test workers in the noisy departments on an annual basis. Although the tests had always been conducted by the medical department, earlier tests were given manually by the nurse in a booth that was not very soundproof. The nurse provided the results immediately, but employees doubted the credibility of the findings due to the poor testing conditions and confusing feedback. One employee commented "one week they said I was almost deaf and the next week (after retesting) my hearing was perfect." The testing had since become automated and the quality of the soundproof chamber improved. The nurse provided an immediate interpretation of results based on a computer-generated printout and volunteered to answer any questions. Employees were uncertain of the testing dates, however, with some feeling it was conducted around their birthday with others feeling it was conducted during the last months of the year. Employees were aware of the improvements in the testing procedures and were consequently more attentive to the results.

Surprisingly, the audiometric testing program at Plant 3 (the plant initially identified as the most proactive of the three) was the most sporadic. While employees were generally complimentary of the quality of the testing, which was handled by a local contractor under automated conditions with feedback procedures similar to those currently used in Plants 1 and 2, there were numerous comments about inconsistent test scheduling. One especially salient finding was that employees had been scheduled to take their tests prior to beginning the shift, which is inconsistent with company policy. Workers and supervisors have since been instructed that they may now take their test during their scheduled shift as long as they have been wearing their hearing protection. An additional scheduling problem was identified by the supervisors who reported that until recently (January 2000) there had been no enforcement of the company policy for annual employee audiometric testing. This was confirmed by the worker groups who said that if a worker didn't want to be tested, he/she didn't pursue it. They were under the impression that up through 2000, testing was voluntary. There was now increased pressure from upper management and the medical department to ensure that workers get tested on any annual basis. However, employees commented that there did appear to be some slippage in testing supervisors. The supervisors agreed that there has been much more emphasis on getting the hourly workers tested than on ensuring that the supervisory staff working in the same areas are also tested. One supervisor stated "salaried people are exposed to the same noise for 65%–70% of the time, but we don't get hearing tests" (routinely).

3.2.4. Perceived organizational commitment

Assessing employee perception of the organization's commitment to hearing loss prevention was accomplished with two primary discussion items: (a) "What does your company do overall to demonstrate to you that protecting your hearing is an important priority for the company?"; and (b) What more could the company do to demonstrate its commitment?"

Plant 1 workers commented on the company's willingness to provide an unlimited supply of HPD's, improved audiometric testing, and the emphasis on HPD usage as signs of the company's commitment to hearing loss pre-

vention. However, both supervisors and workers attributed the company's motivation to regulatory pressures and insurance considerations as opposed to genuine concern for the workers. The company's ambivalence in covering the costs of hearing aids for hearing-disabled workers was cited by a number of participants as supportive of this attribution. Three of the four focus groups felt that the company should do more in the way of engineering controls and noise abatement. They provided a number of feasible and inexpensive suggestions such as better machine maintenance, substitution of rubber for steel chain drive mechanisms, and use of quieter air valves on steam machines. Improved worker education/training was also cited by three of the four groups as a step the company could take to demonstrate their investment in the hearing loss prevention program.

Focus group participants at Plant 2 recognized that the company had made some capital investments to reduce noise exposures and were also aware of improvements in the audiometric testing program and in the availability and variety of free HPD's provided by the company. Participants were critical of the company's enforcement of the HPD policy. They felt that there should be definite consequences associated with the use/misuse/disuse of HPD's on the shop floor and that more could have been done in the area of training. They specifically mentioned a ''safety talk'' format, which would allow for question and answer sessions. As with Plant 1, all focus groups had suggestions for site-specific engineering controls and noise abatement strategies that could be employed in the plant.

Plant 3 had made a significant number of physical changes in the plants in an attempt to reduce noise exposure. In addition, the company had instituted a ''buy quiet'' policy whereby all new equipment purchases had to meet the best existing standards for noise emissions. Both workers and supervisors were aware of these practices and agreed that the company had invested heavily in capital improvements. They also acknowledged that the company generously supplied them with an array of HPD's on request. Improvements in the quality of the audiometric testing equipment and feedback procedures were also taken as a sign of company investment in the hearing protection program. Regarding areas of improvement, both supervisors and workers felt that the company should more proactively enforce the policy for HPD usage in specified areas and standardize the annual audiometric testing schedule for individual employees. In agreement with employees at Plants 1 and 2, employees at Plant 3 also felt that the company should provide more training and education, in some kind of interactive framework, on the various facets of the hearing loss protection program.

4. Qualitative program evaluation summary: administrators' and employee viewpoints compared to written program audits and on site observations

Results in this section pull together information from the focus groups, structured interviews, review of paper policies (for Plant 2 and 3), written audits, and other available documentation to provide an overview of differences in program implementation across the threes studies and variability in compliance.

To compare program elements based on audit information and interviews with actual implementation as described by the workforce, the focus group information was used to score elements of the OSHA compliance checklist. Specifically, we evaluated elements related to HPD use, training, and audiometric testing (Table 8).

It is readily apparent that percent compliance scores on these three elements of the program are lower across all three plant sites when focus group information is considered. Scores were 19%–26% lower on training and education, which reflects workers' views that all three companies' training and education programs were not being implemented routinely and that more information on basic concepts was needed, particularly with respect to HPD use, fit, and care. For example, an insight that would have been difficult to detect from only the paper audit was the observation from employees' at Plant 3 that audiometric testing was routinely conducted at the beginning of the shift (rather than during mid-shift per company policy). Additionally,

Table 8
Revised compliance scores based on input from focus groups

Program Component	(% Total Score)						Difference in % Total Score[1] by Plant:		
	Focus Group Input on OSHA Requirements			HCP Administrators' Input on OSHA Requirements					
	Plant 1	Plant 2	Plant 3	Plant 1	Plant 2	Plant 3	1	2	3
Training and Education	63%	59%	68%	83%	78%	94%	20	19	26
Audiometric Testing and Follow-up	88%	91%	83%	96%	100%	100%	8	9	17
HPD use	67%	59%	63%	75%	85%	78%	8	26	15

[1] This represents difference in percent (%) total scores for OSHA HCA requirements based on input from HCP Administrators' versus employee-centered focus group responses.

routine annual scheduling of audiometry for noise-exposed workers was not being consistently completed. For Plant 1, audiometric testing and follow-up scores were somewhat different (96% vs. 88%) because the focus groups consistently reported high background noise levels during audiometry and workers' perception that refit and retraining for HPD use was done inconsistently during audiometric testing.

For Plants 2 and 3, HPD use was another area where relatively large discordance (15%–26%) was observed between administrators' compliance scores and scores based on focus group input. This was reflected in elements related to the employer ensuring proper fit and correct use of HPD's, evaluation and re-evaluation on attenuation, and training on care and use.

5. Discussion

This paper provides a structured qualitative approach to evaluating HCP effectiveness using three well-developed industrial programs as illustration of the methods. In addition to an audit checklist and review of available relevant plant historical records, information from employee-centered focus groups was used to develop a clearer historical picture of the evolution of the program over time. The use of focus groups to supplement a more traditional protocol for evaluating the quality and effectiveness of three hearing loss prevention programs in the present study provided explanation for some interesting findings. Paper audits of programs completed by the HCP managers were insufficient by themselves to provide a realistic picture of actual implementation of and compliance with various program components, as evidenced by the discordance between focus group reports, onsite observations, and the audit checklists.

For example, employees at all three plants expressed a desire for more training regarding noise-induced hearing loss, in general, and the proper use and fitting of HPD's in particular. Although fitting instructions are generally provided on the HP packages (perhaps leading providers to assume that no further instruction is necessary), employees had a variety of questions relating to such issues as selection, testing, hygiene, and replacement. Brochures and pamphlets, which were relied on by the organizations as the primary educational tools, were not routinely read by employees. They preferred a more interactive, engaging form of instruction whereby they can ask specific questions about the plant or their life situations. This finding adds to a considerable body of training research that emphasizes the value of providing small group activities with hands-on training in which peers and supervisors share experiences relevant to the specific workplace (Stephens, Lippen, & Mc Quisten, 1999).

There also seemed to be a consistent perception, expressed across groups and plants, that more experienced workers and supervisors are less likely to receive annual training than new hires, presumably due to the assumption that seniority assures expertise. This suggests that organizations may be overlooking the informational needs of the very employees who act as role models and reference resources within the plant. These same individuals may be inhibited from seeking out information on their own initiative because of the prevailing culture that they should already know the answers. Thus, cultivating well trained senior workers as peer safety leaders may be a valuable strategy to ensure their self-efficiency with regard to hearing loss prevention and proper HPD use which has been shown to result in improved implementation of safety programs (Stephens, Lippin, & McQuisten, 1999).

Employees at the three plants were sensitive to the quality of the company's audiometric testing program and used it as an indicator of the company's commitment to hearing loss prevention. Deficiencies in the testing procedures, scheduling, and feedback policies were seen as symptomatic of company apathy. As testing improved (driven by technologic changes) in the three plants, employees paid more attention to their test results and also attributed a greater sense of commitment to the organization. Slipped or neglected scheduling of the hearing tests was perceived by the employees as a sign that the company values production over employee protection and that the testing was being performed merely to avoid OSHA penalties. To illustrate this, consider the situation at Plant 3 (the most proactive plant). Although the OSHA standard does not specifically state when tests are to be performed, best practice (NIOSH, 1998) and corporate policy indicated that tests were to be administered during the work shift to "catch" any temporary hearing losses caused by insufficient HPD use. Hence, this plant's current practice of scheduling annual testing of their employees at the beginning of the work shift was counter to the company's written policy, eliminates the possibility of detecting temporary hearing loss, and may result in artificially lower STS rates when compared to other HCPs that test workers in the middle of their shift. Moreover, the opportunity to intervene for those suffering TTS with improved training and education during annual audiometric testing is thus lost and workers' hearing may progress to permanent hearing loss faster.

The effects of capital improvement or engineering controls on employee perception of company commitment were interesting and complex. Not surprisingly, the heaviest investments were made in Plant 3, the organization rated most proactive at the start of the study. Yet this was the plant that showed the least compliance with company mandated HPD usage and audiometric testing policies. One possible explanation is that as the company introduced engineering designs as a means of controlling noise within the plant, staff emphasis on the use of administrative controls and personal protection devices may have lessened. This was unfortunate because, despite the overall reduction in noise levels within the plant, exposure levels still exceed the 85 dBA level in a number of departments. Increased use of engineering controls over time was confirmed by the com-

pany's noise surveillance data, which shows that the proportion of workers exposed to greater than 85 dBA, has decreased over time. Increased reliance on engineering controls and changes in manufacturing processes, which reduced noise levels in several very loud areas, may have lulled the organization into a sense of complacency in ensuring proper HPD use. Thus, while the traditional public health model (e.g., Levy & Wegman, 1988) emphasizes engineering design over personal protective devices, it presupposes that these designs have successfully eliminated the hazard. In the absence of such evidence, it is important to use all the tools in the arsenal (e.g., hearing protection) where still needed.

The focus group reports from employees also corroborated the available paper records collected at all three plants on noise exposure changes, providing further insight into reasons for changes in compliance. For instance, even though noise monitoring and engineering controls were proactive program elements at Plants 2 and 3, changes in business products, economic downturns, and high employee turnover or layoffs can have an impact on compliance with even the most proactive HCPs. For Plant 2, focus group reports and noise survey records indicate that biennial surveys were not always conducted during the 1990s, despite company policy calling for such monitoring. Similarly, focus group participants revealed that reductions in noise exposure as a result of engineering controls (specified in the buy quiet programs at each plant) were driven primarily by the need to change process lines at Plant 3 and the replacement of older equipment at Plant 2 during the mid-1980s and 1990s. Decreases in the ratio of supervisory employees relative to hourly employees introduced staffing and compliance challenges leading to minimal enforcement of HPD plant requirements and perhaps slippages in scheduling annual audiometric testing.

5.1. Advantages and limitations of focus groups

Focus groups are an accepted method for collecting qualitative data (Krueger & Casey, 2000). Like many other qualitative methods (e.g., structured interviews, ethnography), they are appropriate when assessing needs or processes, or evaluating programs. In contrast to a survey in which individuals are directed to respond to a pre-determined set of questions having fixed response options, a focus group is much more fluid and participant-directed. The focus group facilitator begins with a general script or discussion guideline of issues to be covered in the session. Individuals are encouraged not only to respond directly to the issues as they are presented, but also to react to comments and insights provided by other group members. The focus group moderator guides the discussion and probes participants when answers are unclear or need amplification. Focus groups have the advantage of providing data from a setting of social interaction and allow the participants to clarify or elaborate on their perspectives.

The drawback to focus groups is that their data are less generalized than are survey data. Usually, no statistical tests are performed on focus group data because samples are small and often not randomized. However, by foregoing representativeness, focus groups gain the capability to generate rich cultural understandings about the workplace that are not accessible by quantitative means. In some cases, focus groups may be used as a prelude to a survey and serve to identify the major content areas to be covered in the questionnaire. The value of focus groups in this study was to provide additional information regarding areas where documentation was sparse or where onsite observations contradicted initial paper audits (e.g., HPD compliance and fit, training, education and motivation, and company commitment).

5.2. Focus group population relative to target population

A comparison of demographic characteristics of the entire HCP population (Table 1) relative to those of the focus group participants (Table 7) provide some information on how representative the focus groups were in relation to the target population. The original design for this study was to include workers with similar characteristics of the target HCP population, with particular focus on workers with longer durations of employment in noisy areas. Recruitment efforts targeted workers who worked in high noise areas, who were required to wear HPDs, and who had at least 10 or more years with the company. Duration employed for the entire HCP population versus the focus group population was similar for Plants 2 (18 years vs. 17.5 years) and 3 (20 years vs. 23 years). For Plant 1, the mean years employed is skewed by the shorter duration of employment of first line supervisors. The mean duration employed for Plant 1 hourly is slightly higher for those who participated in the focus groups (26 years) compared to the total HCP population (22 years). With regard to the gender, Plant 3 had more women focus group participants than the overall HCP population. For Plant 2, there were slightly more men participating in focus groups than the overall HCP population.

The distribution of salaried and hourly workers for the overall HCP population is not a good representation of the actual target population available for focus group participation because supervisory staff are likely to be underrepresented in the HCP program, particularly for Plants 1 and 3. Plant 1 focus group participants are drawn from a random sample of eligible hourly and first line supervisory employees and are more likely to be representative of the target population. In Plant 2, where wall-to-wall HPD use was required, the distribution of hourly employees participating in the focus groups (87%) was similar to the percentage of hourly enrolled in the HCP program. It is Plant 3, where participation was the worst, that focus group results may not be representative of the opinions from the eligible plant population. Despite the small

sample sizes of the focus groups, a few observations are noteworthy. First, other data sources generally corroborate the focus group results. Secondly, for all three plants, the most important factor for assessing historical changes in HCP implementation, length of employment, was similar to that of the target HPC population.

Based on this study, recommendations include:

1. Annual training of employees in small groups or one-on-one, incorporating HPD fit training and explanations of audiometric results and noise monitoring.
2. Cultivate senior employees as role models. These data suggest these workers should be the most highly trained and can serve as role models for the hearing loss prevention program. This may be especially valuable in this time of downsizing when senior peer workers can champion hearing loss prevention activities to newer employees.
3. A quality audiometric program, conducted on schedule is perceived to correspond with positive company attitudes toward worker safety and health. The implications for both in-house and contracted programs are significant. Workers recognized that testing hearing during the work shift was a best practice that facilitated identifying TTS. When companies deviated from this policy, it had negative effects on morale and trust.
4. While engineering controls must be first in the hierarchy of controls, it is not prudent to neglect HPD use until noise monitoring assures the absence of hazardous noise. Partial engineering controls may have led to complacency, decreased HPD use where still needed, thus, more hearing loss than predicted.

Evaluation is a process of continuous learning. Continuous and yearly program evaluation should be an ongoing process to ensure a quality hearing loss prevention program. It provides important mechanisms by which management and employees can measure and document program successes, identify areas for further improvement, and guide new interventions. Focus groups can provide rich data to this process. When used together, qualitative and quantitative methods provide a check and a complement for each other.

This study suggests that all end-users of the program (employees, supervisors, and health and safety professionals) should be involved in this evaluation process. While audits by management of records, policies, procedures, and examination of hearing loss trends through audiometric database analysis are critical to program evaluation, companies who enrich this data with periodic focus group discussions may uncover a richer understanding of both problem areas or successful strategies that can be shared within or between industries. In addition, the input of workers in the evaluation process provides considerable value to the program in the form of increased awareness of hazards and more active participation of workers, in collaboration with management, in maintaining a positive health and safety culture.

The qualitative program assessment presented in this paper provides a structure for further quantitative evaluation of HCP effectiveness using data on hearing threshold levels, noise exposure data, and other risk factors for hearing loss. Future work from this study will focus on evaluating the impact of the OSHA HCA on trends in noise exposure and hearing loss. In addition, various reference populations for evaluating the significance of observed trends in noise-induced hearing loss will be addressed for the three industrial case studies discussed in this paper (see Prince, 2002; Prince, Gilbert, Smith, & Stayner, 2003, for further discussion of this issue).

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