Working in Noise with a Hearing Loss: Perceptions from Workers, Supervisors, and Hearing Conservation Program Managers

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Objective: **Workers with hearing loss face special problems, especially when working in noise. However, conventional hearing conservation practices do not distinguish between workers with normal hearing versus impaired hearing. This study collected information from workers with self-reported noise exposure and hearing loss, supervisors of such workers, and hearing conservation program managers through focus groups and in-depth interviews to evaluate their perspectives on the impact of hearing loss on safety and job performance, the use of hearing protection, and information needed to appropriately manage hearing-impaired workers who work in noisy environments.**

Results: **Concerns about working in noise with a hearing loss could be grouped into the following 10 categories: impact on job performance, impact on job safety, impaired ability to hear warning signals, impaired ability to monitor equipment, interference with communication, stress and/or fatigue, impaired communication caused by hearing protector use, reduced ability to monitor the environment as the result of hearing protector use, concerns about future quality of life, and concerns about future employability. Mostly, there was an agreement between the perceptions of workers, supervisors, and hearing conservation program managers regarding difficulties associated with hearing loss and consequent needs. These findings suggest that noise-exposed workers with hearing loss face many of the same problems reported in the literature by noise-exposed workers with normal hearing, with additional concerns primarily about job safety as the result of a reduced ability to hear environmental sounds, warning signals, and so forth.**

Conclusions: **The study outlines potential challenges regarding job safety and hearing conservation practices for noise-exposed, hearing-impaired workers. Awareness of these issues is a necessary first step toward providing appropriate protective measures for noise-exposed, hearing-impaired workers.**

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Of the 19 million adults in the United States with some degree of hearing trouble, nearly half are currently employed in the workforce (NCHS, 1994). More than 30 million US workers are exposed to hazardous noise levels, and noise-induced hearing loss is the most common occupational disease in the United States (NIOSH, 1996). Many workers incur their hearing losses during the first 5 to 10 yrs of employment (Rosler, 1994; Ward et al., 2000) and subsequently work the rest of their careers in an environment where noise and hearing loss interact to impair their ability to hear communication and other important signals.

Workers with hearing loss who are exposed to hazardous noise levels present a dilemma to hearing loss preventionists. On the one hand, it is of great importance to ensure that their residual hearing is protected from the damaging effects of the noise to which they are exposed. On the other hand, however, traditional hearing protectors serve to further "deafen" such workers, making communication more difficult and impairing the detection of environmental sounds and warning signals. These workers have special needs that must be addressed. However, conventional hearing conservation practices do not distinguish between workers with normal versus impaired hearing; and, to date, no governmental or professional organization has developed specific guidelines or policies concerning the accommodation of noise-exposed, hearing-impaired workers.

Some research regarding noise-exposed, hearing-impaired workers has been completed. These studies have primarily focused on three areas: (a) speech intelligibility in noise versus quiet, with and without various types of hearing protection devices (Abel et al., 1982; Abel et al., 1993; Abel & Spencer, 1997; Rink, 1979; Suter, 1989); (b) signal detection and localization under similar conditions (Abel et al., 1993; Abel et al., 1985; Abel & Hay, 1996); and (c) the use of hearing aids as hearing protectors (Berger, 1986; Dolan & Maurer, 1996; Hétu et al., 1992; Hétu et al., 1993). Research in these three areas has provided an initial framework for development of a management paradigm for these workers. However, each of these studies addressed a very specific research question, examining

a single aspect of the problem. In addition, these prior laboratory studies relied on the investigators to formulate research questions based on assumptions regarding the problems hearing-impaired workers might face working in high noise environments. The studies then evaluated these research questions by using standardized listening tasks with the hope that performance on those tasks would generalize to real-world settings. The science has not been translated into practical guidance to employers and hearing health professionals so that they might make appropriate recommendations for individual hearing-impaired workers.

Other studies have used surveys or focus groups of hard-of-hearing or deaf workers to identify obstacles to work integration. Laroche, Garcia, & Barrette (2000) drew attention to barriers including the necessity of telephone use, background noise in the workplace, and the use of auditory rather than visual alerting signals. The most challenging workplace situations reported by deaf and hard-of-hearing people, however, involved group situations such as departmental and staff meetings, training sessions, and work-related social functions—situations recognized as important for career maintenance or advancement (Laroche, Garcia, & Barrette, 2000; Scherich, 1996; Scherich & Mowry, 1997). Detaille et al. (2003) asked a group of hearing-impaired workers to complete the sentence, "What a person with hearing loss needs to be able to keep on working is..." Participants generated 59 statements that could be clustered into nine categories, including awareness of hearing aids and methods to finance them; support of occupational health physicians, management, and colleagues; and accessibility of assistive listening devices. However, in all of these studies, workers were not necessarily working in high noise levels that might exacerbate or alter the difficulties posed by the hearing loss; their needs may therefore have been different from those of noise-exposed, hearing-impaired workers.

The objective of the present study was to investigate, through focus groups, the perspective of workers with self-reported hearing impairment and occupational noise exposure, on hearing loss prevention at work and the impact that hearing loss and noise exposure have on safety, communication, and their ability to perform their jobs. In addition, hearing conservation program managers and supervisors of noise-exposed, hearing-impaired workers were interviewed to obtain their insights on problems faced by these workers and difficulties they may have encountered or information they need to effectively accommodate hearing-impaired employees who work in noise. Participants were given an open forum to express the challenges and problems that exist in their own work settings. The intent was to identify any previously overlooked issues that might need to be addressed in the formulation of specific recommendations for accommodating these workers.

Methods

Focus Groups and Interviews

Four focus groups were conducted with a total of 31 workers who self-reported hearing trouble and occupational noise exposure to examine the difficulties they encounter working in noise with a hearing loss. Participants were recruited to represent different age categories in an attempt to sample workers with various years of exposure and degrees of hearing impairment. Eight supervisors of noise-exposed, hearing-impaired workers and five hearing conservation program (HCP) managers were interviewed regarding the problems and questions they face in managing these employees. Two supervisors were dropped from the analysis—one because she indicated that she had no employees with hearing loss under her supervision and the other because he could not provide coherent answers to the questions—leaving six supervisor interviews for analysis.

Focus groups have been used previously to evaluate hearing conservation programs (Prince et al., 2004). Based on research done using focus groups with hearing-impaired participants (Hétu et al., 1994; Laroche, Garcia, & Barrette, 2000), it was expected that focus groups would make the expression of negative perceptions and prejudices easier for the participants. The interview format rather than focus group format was chosen for supervisors and hearing conservation program managers because the expression of negative perceptions was less of a concern and because they comprise a smaller population and were more difficult to recruit.

The focus groups and interviews took place in two cities (Cincinnati and Pittsburgh) selected to provide a range of industries and occupational noise environments.

Representative industries included manufacturing, mining, construction, and others. Participants of one group did not have any relationship with the other groups. The content of the focus groups and interviews was identical regardless of location or industry. Participants had no knowledge of the number or location of other groups being conducted. Focus group meetings took place for a period of up to 2 hrs; interviews lasted up to 30 minutes. Table 1 and Table 2 summarize the characteristics of the study participants.

The focus groups and interviews were conducted

TABLE 1. Demographic and employment characteristics of the focus group participants

Group No./location	Group size	Work environments	Age groups (yr)	Gender	Ethnicity
Group I Cincinnati	8 participants	5 manufacturing 1 meatpacking 1 printing 1 construction	2 persons (24–34) 3 persons (35–44) 3 persons (45–54)	7 male 1 female	7 white 1 other
Group II Cincinnati	7 participants	5 manufacturing 1 printing 1 unknown	4 persons (35–44) 2 persons (45–54) 1 person 55–64	6 male 1 female	5 white 2 black
Group I Pittsburgh	8 participants	1 manufacturing 3 construction 3 heavy equipment 1 mechanic	1 person (24–34) 3 persons (35–44) 4 persons (45–54)	8 male	8 white
Group II Pittsburgh	8 participants	8 mining	5 persons (45–54) 3 persons (55–64)	8 males	8 white

by a trained moderator from a market research company with extensive experience contracted by the National Institute for Occupational Safety and Health (NIOSH). Study participants were recruited by the contractor through newspaper ads and were reimbursed for their participation. Focus group participants were required to meet three eligibility criteria: currently working in "loud" noise, having earplugs or earmuffs provided where they worked, and reporting that their hearing was "not as good as it used to be." The moderator verified that each participant met these criteria at the beginning of each session by a series of questions (see discussion guide in the Appendix). Supervisors and managers of hearing conservation programs were eligible if they reported that they managed noise-exposed, hearing-impaired workers. No information was gathered to confirm if the places of employment of focus groups participants were required to have hearing conservation programs. Information on the availability of hearing protection at work was used as a surrogate indicator for the need for these programs.

The supervisors and hearing conservation program managers did not work for the same companies as the recruited employees, and participants of one group did not have any relationships with the other groups. As a consequence, it was not possible to compare the groups' responses for accuracy. This design, however, allowed a wider range of perceptions and more honest, candid testimonials to be obtained than if data collection had been restricted to one company. The study design was approved by the NIOSH Human Subjects Review Board, and all participants gave informed consent.

NIOSH collaborated with the contractor in developing the discussion guide for the focus groups and interviews. The focus group discussions were employee-centered and attempted to describe the difficulties in job performance caused by a hearing impairment from the workers' perspective. Issues covered included (a) current/future impact of hearing loss; (b) hearing protection devices and other protective equipment; (c) important environmental sounds; and (d) management practices regarding safety issues. Interviews with supervisors and hearing conservation program managers were face-to-face and covered similar content areas, with the addition of the following topics to gain insights into the difficulties encountered by hearing-impaired

TABLE 2. Demographic and employment characteristics of supervisors and hearing conservation program (HCP) managers interviewed for the study

Location	Job title	Work environment	Gender	Ethnicity
Cincinnati	Supervisor	Manufacturing plant	Male	Black
Cincinnati	Supervisor	Manufacturing plant	Female	Black
Cincinnati	Supervisor	Manufacturing plant	Male	Black
Cincinnati	Supervisor	Manufacturing plant	Female	White
Pittsburgh	Supervisor	Coal mine	Male	White
Pittsburgh	Supervisor	Limestone mine	Male	White
Pittsburgh	HCP manager	Manufacturing plant	Male	White
Pittsburgh	HCP manager	Manufacturing plant	Male	White
Pittsburgh	HCP manager	Coal mine	Male	White
Pittsburgh	HCP manager	Coal mine	Male	White
Pittsburgh	HCP manager	Mine/gravel processing	Male	White

workers from the managerial perspective: (a) methods used (if any) to recommend appropriate hearing protection for a hearing-impaired worker; (b) problems that hearing-impaired workers report in the use of hearing protection devices; (c) knowledge of special hearing protectors and/or other accommodations that may be helpful to hearing-impaired, noise-exposed workers; and (d) information required to manage the unique needs of hearing-impaired workers. The discussion guides used to conduct the focus groups and interviews are provided as an appendix.

The meetings were audiotaped and transcribed verbatim. A NIOSH researcher observed each focus group and interview. NIOSH received reports of the focus groups and interviews, which were stripped of the participants' identifying information.

Data Analysis

The analysis of data was based on steps described by Dahlgren & Fallsberg (1991). Initially, the transcripts were read and the most significant statements made by each subject were identified as determined by their extensiveness, intensity, specificity, and frequency (Kruger, 1998). These statements were then compared across participants for agreement or variation. Similar statements were grouped together, the essence of their similarity was described, and each category was given an appropriate label. Finally, the categories obtained were compared and contrasted. The transcripts were analyzed in this manner by the contractors and by the NIOSH investigators separately to provide a measure of validity. Differences were resolved by continued review of the transcripts until consensus was reached.

Results

Results are summarized below by category. A brief description of the statements and their range is given, followed by verbatim quotes on that theme. The quotes were selected to illustrate insights that were typical of participants' responses.

Focus Groups: The Workers' Perspective

Focus group participants in all four sessions engaged in frank, candid conversation throughout the discussion. One group included four participants who worked at the same location and had been friends for years; this made the group dynamic somewhat unusual but did not prevent the other members of the group from participating meaningfully in the dialogue. Demographically, the participants from Pittsburgh differed somewhat from participants in Cincinnati in that the Pittsburgh participants were all white men.

All of the focus group participants reported hearing trouble of various degrees, all described their workplace as noisy, and all indicated that hearing protection was at least offered where they work. In addition to hearing loss, more than half of the participants reported tinnitus, at least periodically and often at the end of the work day. Audiological or medical care received for these conditions varied between the participants from none to some limited diagnostic or periodic testing. None of the focus groups participants had hearing aids.

Analysis of the transcripts revealed experiences and concerns about working in noise with a hearing loss that could be grouped into the following 10 categories: impact on job performance, impact on job safety, impaired ability to hear warning signals, impaired ability to monitor equipment, interference with communication, stress and/or fatigue, impaired communication due to hearing protector use, reduced ability to monitor the environment due to hearing protector use, concerns about future quality of life, and concerns about future employability. Figure 1 displays the frequency of expression by focus group participants for each of these categories. Specific points in each category are discussed in detail below.

Job Performance

Although the moderator specifically inquired, none of the participants believed that hearing impairment decreased productivity or compromised job performance. Most participants answered the moderator's question by simply replying "No," but a few elaborated:

- "Not with mine... it's all hands on, reading the paper, moving toggle switches, you don't have a lot of conversation that you have to do."
- "No, not me. I work by myself... inside a machine."
- "I've been doing it for so long; I don't even think when I'm working. Pretty much just routine."

It appeared from comments such as these that the workers believed there was little impact on their performance due to the nature of their occupations (involving little interaction or communication with others) and the repetitive nature of their tasks. There was, however, one participant who stated "To me, it doesn't make a difference because my hearing loss isn't great enough," implying that there might be a level of hearing impairment that would affect his work.

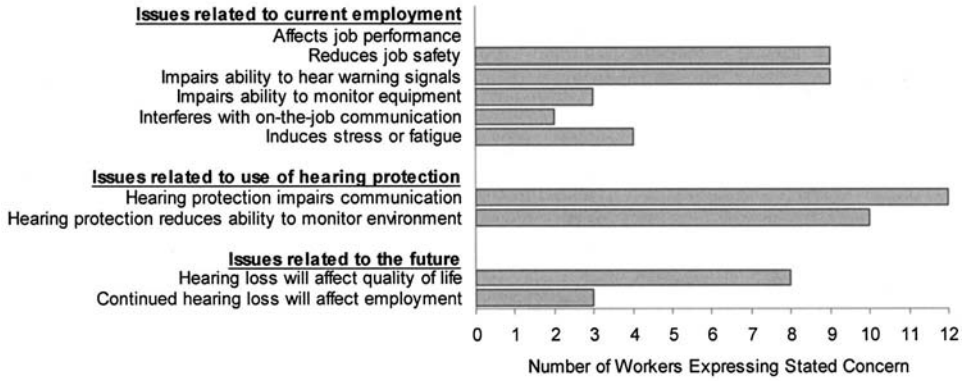

Fig. 1. Difficulties and concerns expressed by noise-exposed, hearing-impaired workers and frequency of their expression during the focus group sessions.

Job Safety

Just as participants were unanimous that their hearing impairment did not affect job performance, they were equally unanimous that working in loud noise with a hearing loss did pose a safety risk. Remarks such as the following were common:

- "You need to be able to hear pretty well where I work to be safe."
- "Loss of hearing could put you or maybe your buddy in jeopardy, if you don't see something or hear something."
- "There's a tremendous amount of hazards running around where I work, so it [hearing loss] could definitely affect it [safety]."

Workers expressed particular concern about new employees who might not have enough on-the-job experience to rely on senses other than hearing in order to recognize and avoid dangerous situations.

- "It seems like new people, their first few months on the job, typically, they're the ones that might get hurt. If they had a problem with their hearing, that would make it a lot easier for them to get hurt because they couldn't hear somebody say 'watch out' or something happened."

Participants described three particular types of scenarios in which hearing loss would pose a safety risk: impaired ability to hear warning signals, impaired ability to monitor equipment or environmental sounds, and difficulty to communicate. These situations are discussed in more detail in the following sections.

Impaired Audibility of Warning Signals

The inability to hear auditory warning signals was the most frequently mentioned scenario described by participants as examples of the safety risk posed by hearing loss on the job. They indicated that most warning signals at their jobs are auditory, and described a number of situations in which the inability to hear these warnings would endanger the worker with hearing loss. For example:

- "Or... another machine backing up, beeping with the safety alarm or something, you might not hear. It increases your odds, I'd say."
- "You might have your back turned or something. A piece of equipment is coming at you and you just don't hear it."

Workers most often cited back-up alarms on forklifts as an example of a warning signal that could be easily missed; other necessary warnings included buzzers or other indicators on machinery, fire alarms, CO monitors, and start-up horns. Most workers thought that buzzer sounds were more easily heard than other types of warning signals. Some participants indicated that there were not many warning signals at their workplace; one reported "Our warning system is 'Look out!'" Participants found warning lights that supplemented audible alarms helpful, but several reported that the lights were not appropriately placed, eliminating any potential benefit.

Impaired Ability to Monitor Equipment

Participants also described a number of situations in which hearing loss and noise could interfere with the ability to monitor essential equipment sounds. For example:

- "A lot of times you'll just be in the area by yourself and if you can't hear that little whistling noise, something that's a little bit out of the ordinary, it could be very dangerous."
- "They've got vacuum machines they use to lift parts with. By hearing the sounds you can tell if they're working like they're supposed to or not. If there's a vacuum loss and you go to lift something

up, it could break loose and drop. Somebody could get hurt that way."

Several workers indicated that they compensated for this inability to monitor equipment by removing their hearing protectors. This is discussed more specifically later, as an issue related to hearing protection.

Interference With On-the-Job Communication

Some workers indicated that their hearing loss did interfere with their ability to communicate in the noisy environment at work. Statements included the following:

- "It's hard to communicate, that's the only thing I can think where our job would have a problem with the hearing."
- "Rather than trying to talk, you'd just whack him and point with your leg or finger or something. Rather than say "Hey, I see this." And "Huh, what did you say?" So we'd just smack each other."

Again, many workers indicated that communication difficulties were exacerbated by the use of hearing protection. This is discussed further in a subsequent section.

Stress and Fatigue

There were several comments made indicating that having to work in noise with a hearing loss was stressful and/or tiring. For example:

- "As the shift goes on, it aggravates on... It gets me angry and I can't wait to get out of there. It just gets frustrating after a while."
- "It does put a lot of fatigue on you"
- "It's almost like you're mad at yourself because why can he hear? He works in the same atmosphere; why can he hear and I can't?... that makes you frustrated."

One participant commented that when he works in a quiet area for a little while, he is not as tired. And another voiced frustration at equipment that was kept running even while it was not being used. But some comments, such as the third example cited above, clearly indicated that stress or fatigue was exacerbated by the effect of their hearing loss.

Hearing Protection and Interference With Communication

Approximately half of the focus group participants indicated that hearing protector use was mandatory where they worked, though very few reported strict enforcement of this requirement. Most of the focus group participants reported wearing hearing protection a majority of the time. A few of the focus group participants said they never wore hearing protection. Lack of use was most frequent among Pittsburgh participants who worked outside, driving heavy equipment or working construction. Conventional ear muffs and various types of ear plugs were identified as the only known hearing protection devices; no one was aware of more sophisticated options, such as flat-attenuation devices or communication headsets.

The most common problem associated with hearing protector use among the participants was interference with communication. For example, participants stated:

- "That's why I never wore them [hearing protectors]. I had them, I put them in and yeah, it made it quiet but then every time somebody wants to talk to you I can't hear. I've seen guys wear them, they keep them on, they're carrying on a conversation, I'm thinking, am I deaf? Because I can't do that, I never could, maybe I am deaf."
- "I've got the ear plugs in, we're standing by the fan, and he has something to tell me. Well, I just can't hear him with the ear plugs in. I have a hard enough time hearing him with them out because of the fan. But if they're in, I can't comprehend what he's saying."
- "I would wear them [hearing protectors] but it comes back to the point like everybody was saying, then I can't hear anything. Like if somebody would be calling me for help I couldn't hear nothing and then I'd have to be taking them out every five minutes."

Manufacturing and construction workers generally indicated that they removed their hearing protectors when they needed to communicate with someone. This constant "taking them in and out" was a major deterrent to wearing hearing protectors; this was particularly the case in environments where people would have to reinsert the plugs with grit or grease on their hands. Miners said they usually did not remove their ear plugs when communicating with coworkers because of the dusty, dirty environment underground and their expertise in communicating nonverbally.

Hearing Protection and Reduced Ability to Monitor Important Sounds

An inability to monitor important environmental or equipment sounds was another major problem caused by hearing protector use among the hearing-impaired workers. For example, workers related the following difficulties:

- "We got a lot of fork lifts coming and if you have a hearing loss plus your plugs are in your ear, they could be coming up behind you and you wouldn't know it..."
- "You just have to be very careful, you will get run over if you don't really watch yourself. You have to use some of the other senses because you don't have time to be putting them [hearing protectors] in, taking them out, putting them in, taking them out all the time."
- "In retreat work [a mining job] I never wore any kind of hearing protection because I wanted to be able to really hear the ribs. I just wanted that extra that I could hear it for sure."

In addition to reduced audibility, some workers reported that hearing protection made it impossible to determine the directionality of a signal:

- "I can hear a train right here... But I can't tell you if that train is coming in that direction or from this direction... and they're loud."
- [Re: back-up alarms] "You don't know which direction it's coming from."

One person described working in a noisy, enclosed area with hearing protection and not hearing the bell or seeing the visual signals for a fire drill. This person and three coworkers continued at their jobs, even after the rest of the plant had been evacuated. This event illustrates not only the difficulty hearing-impaired workers may have in perceiving audible warning signals, but also the importance of ensuring that supplemental signals such as lights are placed in appropriate locations.

Quality of Life

Respondents consistently expressed concern that their hearing will deteriorate further in the future. They were fatalistic that, given their workplace environments, they would continue to lose hearing over time. Participants were unanimously more concerned about the impact continued hearing loss would have on interactions with family and friends than the potential impact on the jobs. For example, participants said:

- "Our quality of life would definitely be affected by it [continued hearing loss]; it wouldn't be good..."
- "It could be a real handicap if you go to ball games or go to sports bars and places like that and you have friends sitting around the table like this and like Gene's trying to talk to me and I can't hear him because the noise is already loud."
- "My dad worked at [Company] for thirty-something years and I hope I don't end up like him. You got to scream for him to hear you. It's gone."

Some workers talked about "turning up the TV" and other indicators that their hearing loss already impacts their personal lives. None of the focus group participants had hearing aids. A few knew coworkers who wore hearing aids in the workplace. Some respondents described hearing aids as a "last resort." Others implied that simply purchasing a hearing aid would "magically" restore their hearing to normal levels with little inconvenience.

Future Employability

Although the impact of further hearing loss on their work was clearly less important than its impact on their personal life, some participants did express concern that their jobs would be affected if their hearing continued to decline. For example:

- "Yes, it would be a problem in mine... I have to communicate with a lot of people when we're working out on the floor, so if I can't hear we've got to go to another conference room or something to talk and get off the floor and that's going to slow us down."
- "I've got to be able to talk to somebody about as far away from me as Albert with orders... I'd say if your hearing decreases over time... that would affect my job."

It is unclear from the discussion whether or not these concerns about the impact of further hearing loss on quality of life or future employability is translated by the workers into preventive actions, such as consistent use of hearing protection devices.

Other Comments

Consistently, manufacturing and construction workers said management "couldn't care less" if workers lost their hearing. They described workplaces where even minimal safety standards were not always followed. They did not identify any innovations or other types of support from management. These reactions were somewhat more intense in Cincinnati than in Pittsburgh. Conversely, miners had considerably more respect for upper management than the members of the manufacturing and construction sectors. They reported that while many of the miners were "a dying breed," management was consistently interested in the health and safety of their workers. Some said they were proud to have worked for these types of employers. Miners who said equipment was outdated or safety training was inept quickly added that they worked for "mom and pop operations" whose profit margins did not allow them to do more.

Several manufacturing workers reported that annual hearing tests were offered or mandated at their

TABLE 3. Features of the ideal workplace for hearing-impaired workers, as identified by focus group participants

- Bright, clean environment
- Some new equipment
- Baffles or enclosures on the noisiest machinery
- Custom-made ear plugs provided by employer
- Ear muffs offered "with no hassle"
- Upper management wearing hearing protection while in the plant
- A "caring" work environment—management truly interested in employees and the workplace issues that affect them
- High-quality public address system
- Lights to indicate start-up of noisy equipment
- Signs indicating all high-noise areas
- Quiet areas around the shop floor
- All equipment well-maintained, defective parts replaced immediately

work site. In many cases, however, the workers never saw the results of the testing. None indicated that they received information comparing recent results with a baseline audiogram. Focus group participants recommended that they receive a written report following each test and indicated that a chart tracking hearing levels over time would get their attention. On the other hand, few of the miners had their hearing tested at work, and most were unaware of the specific amount of hearing loss they had sustained.

Participants from all groups said training about hearing loss or hearing conservation was typically non-existent. When it did exist, it was cursory and ineffective. Some people recommended that training programs be converted to CD-ROM, with questions at the end of each section to make sure each learner had absorbed the content.

Ideal Work Environment

Towards the end of each focus group, the moderator asked the participants to visualize their own company and imagine that they had the power to make it an ideal workplace for employees with hearing impairment. Features identified by the participants are summarized in Table 3.

Throughout the discussions, workers mentioned a number of ways in which they thought noise could be reduced at their workplace. However, during this exercise, one participant described a particularly innovative way to ensure workers protected their hearing in an ideal job site. He stated:

- "I saw a lot of equipment not being able to operate unless you had hearing equipment on, similar to the safety belt and your forklift—doesn't start unless you've got your seat belt latched."

Single Most Important Change

As each session was drawing to a close, the moderator asked the participants to discuss among themselves and determine the single most important change that ought to be made in their workplaces to make it better for people with hearing loss. Despite difficulties that had been reported with the use of hearing protection, three of the four focus groups determined that making hearing protector use mandatory for workers was the most important change that would benefit those who have hearing loss. One of the groups added as a corollary that it would be equally necessary to implement good educational programs explaining why hearing protection is important. In a similar vein, the remaining focus group recommended providing the workers with their audiometric results as the most important change. They thought this would be the strongest tool for educating workers regarding the effects of noise on their hearing and the necessity of taking preventive action.

Interviews: Management's Perspective

All of the persons interviewed indicated that they worked in environments where noise was a hazard. Almost all of the supervisors indicated that they had some level of hearing loss themselves. Demographically, participants in the Cincinnati interviews differed from the Pittsburgh participants in that a number of the respondents were female and a majority of participants were black; in Pittsburgh, all respondents were white men.

Supervisors consistently reported that at least a third of the workers in their plants had some type of hearing loss. Supervisors felt confident that they had identified the workers with hearing loss. "Having to repeat yourself" was the indicator mentioned most often. Other ways that supervisors used to identify hearing-impaired workers included noticing that hearing-impaired workers were "cocking their heads" to maximize use of "the good ear," being told by coworkers about a person's hearing loss, and being aware that there was greater interference with communication in the presence of background noise. None of the supervisors said that they identified hearing-impaired workers on the basis of audiometric tests. More significantly, only three of the HCP managers reported that they identified workers with hearing loss through review of audiometric test results; the remaining two stated that they identified such workers by noticing communication difficulties.

Analysis of the transcripts revealed concerns and difficulties associated with workers who have a hearing loss and who are exposed to noise that could be grouped into the following five categories: impact on job performance, impact on job safety, problems

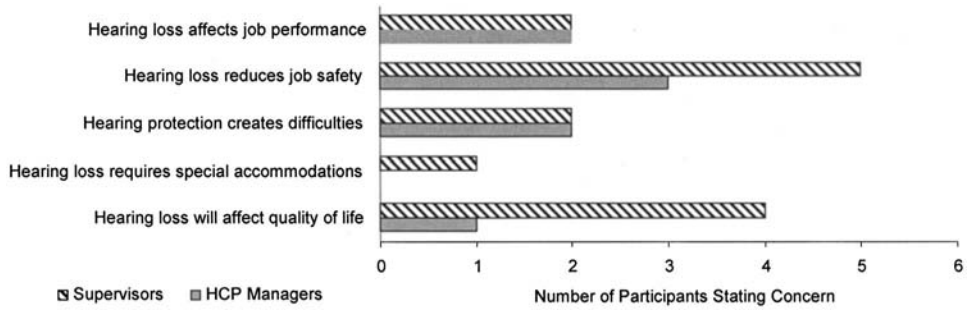

Fig. 2. Frequency of expression of concerns regarding the effects that hearing loss has on employees who work in noise by supervisors of noise-exposed, hearing-impaired workers ($N = 6$) and hearing conservation program (HCP) managers ($N = 5$).

caused by hearing protection, need for special accommodations, and effect on future quality of life. These are very similar to the categories gleaned from the transcripts of the focus groups; some of the earlier categories have been collapsed due to the smaller number of interview participants. Figure 2 displays the frequency of expression by supervisors and HCP managers for each category. Specific points are discussed in detail below.

Job Performance

Just as among the workers who participated in the focus groups, there was little indication that the supervisors or HCP managers believed that hearing loss impaired the ability of the workers to perform their jobs efficiently and effectively. Any affirmative remarks were qualified by saying that such an effect was "possible" or might occur "ultimately" or that the effect would be very small. For example:

- "The degree of hearing loss... ultimately can affect productivity." (supervisor)
- "I would say maybe it [hearing loss] affects their job performance." (supervisor)
- "You do have some glitches in that [productivity]. But they're pretty miniscule, really...communicating in noisy areas." (HCP manager)

One supervisor did suggest that hearing loss might affect a worker's chances of promotion, due to the fact that workers with hearing loss tend to talk louder than workers with normal hearing, which can cause annoyance among other workers. This supervisor observed that some of her employees with hearing loss did not seem to get the same job assignments as other employees with the same seniority.

Job Safety

Supervisors and HCP managers did indicate that hearing loss increased a worker's safety risks, though the perception that hearing loss caused safety problems was not as universal among this group as it was among the workers themselves. Similar to the risks noted by the workers, the safety problems cited most often were inability to hear approaching fork lifts or tow trucks and inability to hear fire alarms or other audible warning systems. Comments included these:

- "There's been a few near misses, fork trucks... Each part of the line has an audible alarm on it if the oven shuts down or there's a problem with the line and all those buzzers are well above 105 decibels so they're much louder than all the other pieces of equipment and machinery and extrusion; those are quite audible. I'd say the fork truck would be the big thing." (HCP manager)
- "I think it could be a problem when it comes to safety because if they can't hear when the loudspeaker... we've got an intercom speaker and if they can't hear well enough in order to get out of the building for example or whatever, then yes, that's a definite problem." (supervisor)

One HCP manager attributed the safety risk more to an attitude that accompanies refusal to wear hearing protection than to the resulting hearing loss:

- "From the standpoint of the person who fights you tooth and nail in wearing their ear plugs, they're probably the same person who cuts corners in safety in other areas... I would say there is probably some connection there."

Supervisors said their employers were genuinely concerned about some safety issues—wearing safety glasses and steel-toed shoes—but not very interested in hearing. When asked to speculate on the discrepancy, some people suggested that eye injuries or crushed feet were acute and obvious, whereas hearing loss was subtle and not easily noticed.

Difficulties Associated With Hearing Protection

Most supervisors indicated that wearing hearing protection was mandatory at their workplace. Four

of the five HCP managers reported a mandatory hearing protection requirement; the fifth indicated that protector use was "strongly encouraged" and reported a 95% compliance rate. None of the companies had different hearing protection requirements for hearing-impaired workers. Most participants believed that wearing hearing protection should be mandatory. Some stated that it was hard to get workers (with or without hearing loss) to wear hearing protection. Although many supervisors indicated that workers could be disciplined if they did not wear hearing protection, some stated that it would be "too much of a hassle" for employers to enforce or that employers were concerned about reduced productivity should hearing protection rules be fully enforced. No one reported that workers with known hearing loss were monitored more closely than those without an obvious hearing deficit. Several supervisors and even two HCP managers indicated that they sometimes failed to wear hearing protection. The most frequent reason given was that "I was only going to be there for a minute."

Respondents had inconsistent opinions about whether hearing-impaired workers were more or less likely to wear hearing protection. At least one supervisor stated "It's hard to get the people who do have hearing loss to wear hearing protection." When asked why workers did not wear hearing protection, supervisors were most likely to cite "inconvenience" in having to remove and reinsert ear plugs, particularly when communicating. There was an impression among some respondents that use of hearing protection can interfere with communication and potentially pose a hazard for the worker:

- "I think there are situations where it [wearing hearing protection] can be dangerous... when people wear hearing protection sometimes it's difficult to communicate." (supervisor)

One HCP manager explained workers removing their hearing protection to communicate as more an issue of politeness than necessity:

- "The plugs, they usually take them out; the muffs they flip up because they're attached to hard hats... Kind of a more respectful thing to do... Like when I'm wearing sunglasses and I'm talking to somebody I'll try to usually take them off so they can see my eyes." (HCP manager)

None of the people interviewed had any personal experience with communication head sets or other special types of hearing protection. One supervisor speculated that it would "be nice" to have a microphone connected to a traditional ear muff, but said she had never seen such a device.

Special Accommodations

Very few participants were able to identify any special accommodations available for workers with hearing loss. One supervisor reported:

- "There's a lady that's in my department and also a gentleman who works downstairs, they ask for the volume phones, the ones you can increase the volume on."

In addition, one HCP manager reported that a flashing light was installed as a back-up warning on a fork lift to accommodate a former employee who had a severe hearing loss. No other accommodations were mentioned by supervisors or HCP managers.

None of the participants had hearing aids, but over half the participants were aware of workers who wore hearing aids. Among these workers, it was most common for the employee not to wear the hearing aid at work. However, there were other workers who wore their hearing aids under conventional earmuffs, workers who wore their hearing aids turned off in lieu of standard hearing protection, and one worker who wore his hearing aid turned on even in the noisy work environment.

Quality of Life

As with the focus group participants, supervisors and HCP managers were concerned about the impact of further hearing loss among these workers in the future. The concern was again primarily regarding the impact this would have on their quality of life away from work.

- "What are these guys going to be like when they're retired, late sixties or early seventies? Are they going to have any hearing at all left?" (supervisor)
- "How would you like to have your grandkids come up to you and you not be able to hear a word they say?" (HCP manager)

No supervisor or HCP manager made any remark expressing apprehension about the future employment prospects of workers with hearing impairment. In fact, at least one respondent indicated that noise was a great equalizer—no one can hear well.

Other Comments

Although it was clear from some participants that an audiometric monitoring program was well-established at their work site, there were others who reported that their employer did not offer annual hearing tests. The supervisors and HCP managers corroborated the opinion expressed by the focus group participants that these tests are valuable in motivating workers to wear hearing protection.

A few participants reported that there was no hear-

TABLE 4. Features of the ideal workplace for hearing-impaired workers, as identified by supervisors of such workers and hearing conservation program managers

- Clean facility, bright lights, uncluttered work areas
- Noise abatement
- Improved public address system
- A "light thermometer" (vertical series of lights) that light up and alert workers to the amount of noise expected when a machine starts up
- Mandatory hearing protection
- Annual hearing examinations—results and comparison to baseline reported to employees
- Trend analysis of audiograms to identify the loudest areas in the plant
- Key person to assist the hearing-impaired worker
- Mentoring—new employees matched with experienced workers
- Job-switching every few hours to reduce individual noise exposures
- Support for hearing protection from company management—personally encouraging use of hearing protection, modeling behavior when management is in noisy areas

ing conservation training at all in their plant. Most participants indicated that there was at least some minimal level of training conducted as part of new employee orientation; however, several people reported that the training was very cursory and ineffective and they doubted whether new workers truly knew how to insert ear plugs properly. Some persons interviewed stated that hearing conservation was covered at least annually and sometimes more frequently as part of safety meetings. Training seldom lasted more than a few minutes and sometimes involved merely watching a video. A number of participants stated that bringing in outside "experts" would result in higher-quality programs.

Few participants realized the impact of short-term exposure to noise. Even some HCP managers admitted that they did not use hearing protection if they would only be in a noisy area of the plant for a few minutes. However, most of those interviewed did recognize that noise abatement was the best way to protect employee hearing. The universal difficulty mentioned was the price of this investment. Although some believed the cost would be offset by savings in workers' compensation claims, few were optimistic that upper management would invest in noise control.

Ideal Work Environment

As for the focus groups, the moderator asked each participant to visualize the ideal working environment for hearing-impaired workers. Participants identified the features listed in Table 4. One HCP manager had a particularly insightful comment: "I saw a plant nurse who is also a key person to assist the hearing-impaired person."

Single Most Important Change

At the conclusion of each interview, the moderator asked each individual what one recommendation he would make to the CEO of his company regarding workers with hearing loss. Once again, mandatory hearing protection was the most common response. Several also indicated that management should make more types of hearing protection available, including "more modern" devices and the best available protectors, instead of being "cheap on the supplies." Other suggestions included better training programs, especially geared toward younger workers to convince them early on that hearing conservation is important; investments in noise reduction and quiet equipment; visible support from upper management; and audiometry both as a means to identify hearing-impaired workers and to monitor employee hearing. One supervisor remarked, "We need to take hearing protection as serious as we take eye protection and clothing or body protection."

Discussion

Hearing-impaired workers face special problems, especially when working in hazardous noise environments. These problems may include communication difficulty, diminished ability to monitor environmental sounds (e.g., warning signals), increased risk of accidents resulting from impaired hearing and communication, and possibly even reduced productivity and compromised opportunities for workplace advancement. Standard hearing conservation practices do not accommodate these special problems. Although it is particularly important to protect the residual hearing of such workers, traditional hearing protectors can further reduce such workers' ability to communicate and monitor important background sounds.

The workers in this study verified the assumptions drawn from earlier studies that also used qualitative methods to examine the problems hearing-impaired workers might face working in high-noise environments (Hétu et al., 1994; Laroche, Garcia, & Barrette, 2000; Scherich & Mowry, 1997; Stika, 1997). Workers, supervisors, and hearing conservation program administrators all confirmed that working in noise with a hearing loss does not have much, if any, effect on worker productivity but does present a concern for employee safety, particularly as regards communication and the ability to hear important environmental sounds. Workers expressed a greater level of concern about hearing environmental sounds than verbal communication. Many of them described elaborate nonverbal com-

munication techniques that rendered speech intelligibility less important. Because these techniques must be learned, new workers may be at a disadvantage and possibly at increased risk for accidents. Training them in the nonverbal communication techniques in place at their work site should be a high priority. Also, future laboratory research on audibility for workers should include a significant number of warning sounds, approaching equipment noises, and other environmental sounds that workers have said they need to hear. These stimuli are at least as important as speech sounds for maintaining safe environmental awareness.

Previous focus group studies have indicated that noise in the workplace and the consequent need for hearing protection were the most evident barriers to communication among workers who have a hearing loss (Hétu et al., 1994; Laroche, Garcia, & Barrette, 2000; Stika, 1997). In the present study, focus group and interview participants verified that hearing-impaired workers have more difficulties hearing communication and other important signals under conventional hearing protection devices than workers with normal hearing. Because of the severe audibility problems that result when persons with hearing loss put on traditional hearing protectors, workers in this study indicated that they remove their protectors often, which can increase the risk of further hearing loss (Franks, Stephenson, & Merry, 1996).

Results of this study indicated that supervisors of noise-exposed, hearing-impaired workers were more frequently concerned than hearing conservation program managers about the impact of hearing loss on job safety and quality of life. Furthermore, no program manager indicated that noise-exposed, hearing impaired workers might need special accommodations. In most instances, supervisors are in closer contact to the worker and might therefore be more aware of the problems experienced by workers than program managers. Moreover, sometimes supervisors have hearing loss themselves and thus have first-hand knowledge of the unique difficulties faced when working in high noise levels with impaired hearing. This study indicates that remarkably, hearing conservation program managers may need more training than line supervisors regarding the special needs of hearing-impaired workers.

The Americans with Disabilities Act of 1990 (ADA) requires employers to make reasonable accommodation for disabled workers. Employers are obligated to change the work environment or process as necessary to provide an equal employment opportunity for workers with hearing loss, as long as such accommodations do not place undue hardship on business operations. Although the ADA has specific guidance on communication issues for the deaf, the ADA provides no guidance for occupational management of hearing-impaired workers who continue to be exposed to an agent responsible for loss of hearing.

The research conducted to date has not been translated into practical recommendations to guide employers and hearing health professionals when trying to accommodate individual noise-exposed, hearing-impaired workers. The issue of accommodating workers with hearing loss is therefore very timely.

Earlier studies have indicated that one important reason for lack of accommodations is the lack of information regarding what the ADA requires and what technical resources exist (Geyer & Schroedel, 1999; NRC, 2005; Scherich, 1996). Neither the supervisors nor the HCP managers interviewed in this study evidenced much knowledge of the special accommodations and hearing protection options already available that could be of assistance to noise-exposed, hearing-impaired workers. Devices such as flat-attenuation or electronic earmuffs might address some of the needs of hearing-impaired workers, yet they were largely unknown to participants. Employees who have hearing aids are handled in a number of different ways, which may or may not be appropriate. It is clear that guidance and education regarding these nonstandard hearing conservation approaches is needed.

The lack of initiative to ask for special accommodation has also been linked with apprehension and anxiety about the potential consequences of having one's hearing difficulties known to others (Hétu et al., 1994; Stika, 1997). Missing out on promotions was another concern that was raised in both previous studies and the present investigation. Moreover, the present study confirmed that stress and fatigue are associated with a hearing loss, and that social norms play an important role. It was suggested that workers may be encouraged to wear hearing protection by learning about the experiences of other workers whose hearing is impaired. Incorporating hearing-impaired workers as role models into the training program can be a powerful endorsement for the use of hearing protection. People respond most strongly to personal anecdotes about hearing loss. When discussing the effects of hearing impairment during the focus groups and interviews, participants regularly told stories about other workers and their own family members. Promoting the concept that using hearing protection improves later quality of life may be powerful, especially when associated with a message such as "be able to hear your grandchildren." Although it is important to include problems experi-

enced by the hearing-impaired workers on-the-job, emphasizing communication problems outside of work was overwhelmingly considered to be the more compelling argument by those who participated in this study.

It was evident from this study that front-line supervisors are much more likely than administrators of hearing conservation programs to admit that workers do not always wear hearing protection and that they remove their hearing protection from time to time. In contrast, administrators of hearing conservation programs know much more about federal regulations and are less likely to say that employees at their plants do not follow workplace rules. In future studies, it will be important to gather data from both perspectives.

The findings of this study verify that accommodations for noise-exposed, hearing-impaired workers are needed, and especially concerning hearing protection and warning signals, so that they can perform their jobs safely and be protected from further hearing loss. It made evident that multiple factors play a role in determining the best management strategy for individual hearing-impaired workers. These factors include the type, degree, and configuration of the hearing loss; the worker's need for and/or use of hearing aids; the noise to which the worker is exposed; the auditory requirements and communication needs of the employee's job; and the worker's own perceived needs and difficulties (Geyer & Schroedel, 1999; Hétu et al., 1994; Laroche, Garcia, & Barrette, 2000; Scherich, 1996).

Although some important information can be taken from this study, readers should be aware that the findings have limitations. Focus group participants' noise exposure and hearing status were both self-reported, so it is possible that some of the participants had normal hearing or worked at places where noise exposure was not excessive. Previous studies have indicated that questions about hearing and noise exposure appear to be sufficiently sensitive and specific indicators of hearing status and noise levels (Noble, 1998; NRC, 2005; Svensson et al., 2004), but in this case there was an inherent conflict of interest—that is, interest in being eligible to participate in the study. However, this possibility was accounted for in the study. Questions before and during the focus groups helped get some understanding of participants' hearing status. Those who may not have had much difficulty with hearing still contributed valuable information regarding their peers with hearing loss.

Hearing status has an impact on the availability of various accommodations. The more serious the hearing loss, the more likely that accommodations are in place. The studies of Scherich & Mowry (1997) and Geyer & Schroedel (1999) found that employers recognized the needs of hard-of-hearing workers less than those of deaf workers, and that hard-of-hearing workers may have been reluctant to ask for necessary accommodations. The main interest in the present study was to better understand the difficulties of workers with mild to moderate hearing losses, which are more prevalent in the workforce and more likely to be overlooked than more severe conditions.

Previous research has indicated that requests for reasonable accommodations are most likely to be approved when employers and workers collaborate to determine how to best accommodate a worker's needs (Anderson & Watson, 1995; Scherich, 1996). Our results indicate that supervisors and hearing conservation program managers should also be involved in decision-making and need to be better informed regarding potential accommodations.

Professional hearing healthcare providers, particularly audiologists, occupational physicians, and otolaryngologists, could be instrumental in the resolution of communication issues, safety issues, and prevention of noise-induced hearing loss. They offer professional supervision of the audiometric testing component of hearing conservation programs and sometimes do or could expand their contribution.

The information obtained in this study will serve as a basis for the development of a standard evaluation and intervention technique that will provide hearing conservationists and others with the necessary tools to manage hearing-impaired, noise-exposed workers so that they can continue to perform their jobs safely while still preventing additional hearing loss (NIOSH project number 39277451). This evaluation and intervention technique will be designed to be incorporated into existing hearing conservations programs. A framework for determining the accommodations best suited for a particular worker will include at least:

1. a questionnaire to gather information from the individual worker regarding the unique difficulties caused by working in a noisy environment with a hearing loss;
2. an evaluation of the worker's particular noise exposure;
3. audiometric testing, with an emphasis on evaluating the worker's ability to hear speech and other important signals in noise; and
4. audibility using different hearing protection options.

The qualitative data obtained in study have implications not only to hearing-impaired workers

but also to normal-hearing workers. Unfortunately, the scenarios described by the participants of the focus groups and interviews paint a rather bleak picture of current hearing conservation efforts in the United States, suggesting that not even the current regulatory standards are being implemented. Successful hearing loss prevention initiatives benefit both the company and employees. Employees benefit with the prevention of disabling hearing impairments and a less stressful work environment. Companies benefit from reduced medical expenses, fewer worker compensation claims, and improved employee morale.

The existence of a hearing loss prevention program (even one that complies with government standards) does not guarantee the prevention of occupational hearing loss. Experiences with successful hearing loss prevention programs show that management needs to develop and adhere to certain policies from the start. NIOSH has published *Preventing Occupational Hearing Loss—A Practical Guide* (Franks, Stephenson, & Merry, 1996) to summarize some of the important attributes of successful hearing loss prevention programs (http://www.cdc.gov/niosh/96-110.html). The fourth edition of the Council for Accreditation in Occupational Hearing Conservation (CAOHC) Hearing Conservation Manual (Suter, 2003) also covers all facets of developing a successful hearing loss prevention program. Both NIOSH and CAOHC discuss program evaluation alternatives and indicate that to achieve success in a hearing loss prevention program one should not be limited by legislative requirements. Similarly, mere adherence to existing regulations may not provide appropriate accommodation for noise-exposed, hearing-impaired workers.

APPENDIX

Discussion Guide for the Focus Groups

Purpose: To understand the problems experienced by hearing-impaired workers and to identify ways to minimize or eliminate those problems.

0:00

I. Warm-Up

- Purpose of the study
- Participants introduce themselves
- Describe current type of work
- Rate current ability to hear—good hearing, a little trouble hearing, a lot of trouble hearing
- Have ringing/buzzing/roaring? If so—not bothersome, slightly distracting (gets my attention), moderately distracting (affects ability to concentrate), severe (problems falling asleep, problems doing daily tasks)

0:15

II. Current/Future Impact of Hearing Loss

- Does your current hearing loss prevent you from doing your job as well as you could if you had normal hearing?
- Do you think you are more likely to have an accident or injury on the job because of your hearing loss?
- Are there any job tasks you feel uncomfortable about performing because of your hearing loss?
- When do you have the most trouble hearing or communicating with other workers on the job?
- Do you worry that you will lose more of your ability to hear in the future?
- If you had additional hearing loss, how would that affect you on the job?

0:35

III. Hearing Protection Devices/Protective Equipment

- Are you asked to wear some type of hearing protector at work? If so, do you usually wear hearing protection?
- What type of hearing protection do you use most often?
- Have you ever used anything other than the standard ear plugs or earmuffs for hearing protection? [probe for use of electronic hearing protection or communication headsets]
- If you have used other types of hearing protection, how did you like them? Why did you like or dislike them?
- Is there anything about your job or work environment that makes it hard to wear hearing protection?
- Have you had any problems that were caused by your hearing protection?
- Do you use any other type of protective equipment on the job? If so, do any of these pieces of equipment affect your ability to hear?
- Have you ever worn a hearing aid? Do you wear it/them at work? If not, what keeps you from wearing it/them at work? Do hearing aids interfere with your work in any way?

1:00

IV. Environmental Sounds

- What types of warning signals (bells, buzzers, alarms) do you need to be able to hear at work?

Which ones are easy to hear? Which ones are hard to hear?
- Have you ever been unable to hear a warning signal?
- Can you think of any ways to change the warning signals where you work to make them easier to hear?
- Do you need to talk to other people while you are working? If so, what do you do if you can't hear what someone is saying?
- Are there sounds where you work that make it even more difficult for you to hear a warning signal or talk to someone nearby?

1:20

V. Management Practices

- Do the bosses or supervisors where you work do anything to make it easier for you to hear and communicate? If so, what do they do?
- Have you had any training about hearing loss or hearing health? If so, describe the training.

1:30

VI. Visualization Exercise

Close your eyes and imagine that you now run the company where you work. You have the power to make this workplace the ideal situation for a hearing-impaired worker.

- What do you do to make things easier for hearing-impaired workers?
- What kinds of training do you give them? [probe for lecture versus one-on-one versus video]
- What type of hearing protection do you provide?
- What assistance or support do supervisors offer to hearing-impaired workers?
- How does this ideal company make the work environment as safe as possible?

1:50

VII. Wrap-Up/Conclusion

Interview Guide for Supervisors and Hearing Conservation Program Managers

In this project, we are interviewing people who supervise hearing-impaired workers and hearing conservation program managers. We want to learn about the types of noise you have in your workplace, the problems experienced by hearing-impaired workers in your organization, and what you are doing now to protect your workers' hearing. We do not intend to ask you any questions that would pry into confidential or proprietary information about your company.

Background Information

1. Specifically what does your company do?
2. How many employees do you have?
3. What percentage of your employees are hearing-impaired?
4. At your job site, what aspects of the work environment are most likely to cause hearing loss?

Current Practices: Protecting Workers' Hearing

5. Do you require your workers who do not have current hearing loss to wear hearing protectors? If so, what type?
6. Is it hard to get your workers who do not have current hearing loss to wear hearing protectors? What do you do to maximize compliance?
7. Is it hard to get your workers who have current hearing loss to wear hearing protectors? What do you do to maximize compliance?
8. Do you use any kind of hearing protectors other than the "standard" ear plugs or ear muffs?
9. Have your workers ever tried any type of electronic hearing protector or communication headset? If so, what was their opinion of this type of hearing protection? [probe for ease of use, effectiveness versus "standard" hearing protection]
10. Do workers seem to prefer nontraditional hearing protectors to the typical ear plugs or ear muffs?
11. Does your company offer any type of training about hearing loss or hearing health? If so, describe this training briefly. Is the program effective? How do you know?
12. Do you wear hearing protectors yourself? Why or why not? If yes, what type?

Hearing-Impaired Workers

13. Do you know specifically which of your employees have hearing loss? How do you identify workers with hearing problems?
14. What difficulties do you have when communicating with workers who have hearing loss?
15. How does the hearing loss of these workers impair their on-the-job performance?
16. What problems, if any, do your hearing-impaired workers report, when they wear hearing protectors?
17. Do you think hearing-impaired workers are more accident-prone or injury-prone when they are wearing hearing protection?
18. Do hearing-impaired workers ask for or need any special accommodations on your job site?
19. Do any of your hearing-impaired workers wear hearing aids? If so, do they wear them on the job site? Do they turn them on and off while working? Do they still wear them under hearing protectors?

Ideal Situation: Visualization Exercise

Close your eyes and imagine a company that does an amazingly good job of helping noise-exposed, hearing-impaired workers.

20. How does this work site look different from other companies?
21. What types of hearing protection is available through this ideal company?
22. What does this ideal company do to make sure hearing-impaired workers use this protection in situations where they are exposed to noise?
23. What does this ideal company do to make it as easy as possible for hearing- impaired workers to hear and to communicate with other people?
24. What types of training does this ideal company offer for hearing-impaired workers and those who do not have hearing impairment?
25. What special services or accommodations does this ideal company offer for hearing-impaired workers?

Summary Comments

26. Based on your experience, what is the most important thing for company presidents/ CEOs to know about noise-exposed, hearing-impaired workers?
27. Are there any other issues we need to discuss?

Thank you for your time today/this evening!

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REFERENCES

Abel, S. M., Alberti, P. W., Haythornthwaite, C., & Riko, K. (1982). Speech intelligibility in noise: Effects of fluency and hearing protector type. *Journal of the Acoustical Society of America*, *71*, 708–715.

Abel, S. M., Armstrong, S. M, & Giguere, C. (1993). Auditory-perception with level dependent hearing protectors: The effects of age and hearing loss. *Scandinavian Audiology*, *22*, 71–85.

Abel, S. M, & Hay, V. H. (1996). Sound localization: The interaction of aging, hearing loss, and hearing protection. *Scandinavian Audiology*, *25*, 3–12.

Abel, S. M., Kunov, H., Pichora-Fuller, K, & Alberti, P. W. (1985) Signal detection in industrial noise: Effects of noise exposure history, hearing loss, and the use of ear protection. *Scandinavian Audiology*, *14*, 161–173.

Abel, S. M, & Spencer, D. L. (1997). Active noise reduction versus conventional hearing protection: Relative benefits for normal hearing and impaired listeners. *Scandinavian Audiology*, *26*, 155–167.

Anderson, G., & Watson, D. (eds.) (1995). *Partnerships 2000: Achieving a Barrier-Free Workplace.* Little Rock, AR: University of Arkansas Rehabilitation Research and Training Center for Persons who are Deaf or Hard of Hearing.

Berger, E. H. (1986). *EAR Log 18: Can hearing aids provide hearing protection?* Indianapolis, IN: Aearo Company (formerly Cabot Safety Corporation).

Dahlgren, L. O, & Fallsberg, M. (1991). Phenomenography as a qualitative approach in social pharmacy research. *Journal of Social and Administrative Pharmacy*, *8*, 150–156.

Detaille, S. I., Haafkens, J. A, & van Dijk, F. J. H. (2003). What employees with rheumatoid arthritis, diabetes mellitus, and hearing loss need to cope at work. *Scandinavian Journal of Work Environment and Health*, *29*, 134–142.

Dolan, T. G, & Maurer, J. F. (1996). Noise exposure associated with hearing aid use in industry. *Journal of Speech and Hearing Research*, *39*, 251–260.

Franks, J. R., Stephenson, M. R., & Merry, C. J. (1996). *Preventing Occupational Hearing Loss: A Practical Guide.* DHHS (NIOSH) Publication No. 96–110. Cincinnati, OH: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

Geyer, P, & Schroedel, J. (1999). Conditions influencing the availability of accommodations for workers who are deaf or hard-of-hearing. *Journal of Rehabilitation*, *65*, 42–50.

Hétu, R., Getty, L., & Waridel, S. (1994). Attitudes towards co-workers affected by occupational hearing loss, II: Focus groups interviews. *British Journal of Audiology*, *28* , 313–325.

Hétu, R., Tran Quoc, H., & Tougas, Y. (1992). Can an inactivated hearing aid act as a hearing protector? *Canadian Acoustics*, *20*, 35–36.

Hétu, R., Tran Quoc, H., & Tougas, Y. (1993). The hearing aid as warning signal receiver in noisy workplaces. *Canadian Acoustics*, *21*, 27–28.

Kruger, R. A. (1998). *Analyzing and Reporting Focus Groups Results.* Thousand Oaks, CA: Sage Publications, Inc.

Laroche, C., Garcia, L. J, & Barrette, J. (2000). Perceptions by persons with hearing impairment, audiologists, and employers of the obstacles to work integration. *Journal of the Academy of Rehabilitative Audiology*, *23*, 63–90.

NCHS, National Center for Health Statistics. (1994). *Prevalence and Characteristics of Persons with Hearing Trouble: United States, 1990–1991.* Series 10, Publication No. 188. Hyattsville, MD. US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Health Statistics.

NIOSH, National Institute for Occupational Safety and Health. (1996). *National Occupational Research Agenda.* DHHS (NIOSH) Publication No. 96–115. Cincinnati, OH: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

Noble, W. (1998). *Self-assessment of Hearing and Related Functions.* London, England: Whurr.

National Research Council. (2005). *Hearing Loss: Determining Eligibility for Social Security Benefits.* Committee on Dis-

ability Determination for Individuals with Hearing Impairments. Dobie, R.A. and Van Hemel, S. (Editors). Board on Behavioral, Cognitive, and Sensory Sciences, Division of Behavioral and Social Sciences and Education. Washington DC: The National Academies Press.

Prince, M. M., Colligan, M. J., Stephenson, C. M., & Bischoff, B. J. (2004) The contribution of focus groups in the evaluation of hearing conservation program (HCP) effectiveness. *Journal of Safety Research*, *35*, 91–106.

Rink, T. L. (1979). Hearing protection and speech discrimination in hearing-impaired persons. *Sound and Vibration*, *13*, 22–25.

Rosler, G. (1994). Progression of hearing loss caused by occupational noise. *Scandinavian Audiology 23*, 13–37.

Scherich, D. (1996). Job accommodations in the workplace for persons who are deaf or hard-of-hearing: Current practices and recommendations. *Journal of Rehabilitation*, *62*, 27–53.

Scherich, D, & Mowry, R. L. (1997). Accommodations in the workplace for people who are deaf or hard of hearing: Perceptions of employees. *Journal of the American Deafness and Rehabilitation Association*, *31*, 31–43.

Stika, F. C. (1997). Living with hearing loss: focus groups results, II: Career development and vocational experiences. *Hearing Loss*, *18*, 29–32.

Suter, A. H. (1989). *The Effects of Hearing Protectors on Speech Communication and the Perception of Warning Signals.* Technical Memorandum 2–89. Aberdeen Proving Ground, MD: US Army Human Engineering Laboratory.

Suter,A. H. (2003). *Hearing Conservation Manual.* 4th edition. Council for Accreditation in Occupational Hearing Conservation, CAOHC. Milwaukee, WI: CAOHC.

Svensson, E. B., Morata, T. C., Nylen, P., Krieg, E. F, & Johnson, A. C. (2004). Beliefs and attitudes among Swedish workers regarding the risk of hearing loss. *International Journal of Audiology*, *18*, 585–593.

Ward, W. D., Royster, J. D., & Royster, L. H. (2000). *Auditory and Nonauditory Effects of Noise.* In: Berger, E. H, Royster L. H., Royster, J. D., Driscoll, D. P., & Layne M., (Eds). *The Noise Manual.* 5th edition. Fairfax, VA: American Industrial Hygiene Association, pp.123–147.