NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2006-0212-3035
Kenton County Animal Shelter
Covington, Kentucky

February 2007

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

PREFACE

The Hazard Evaluation and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health (OSHA) Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employers or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HETAB also provides, upon request, technical and consultative assistance to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Chandran Achutan and Randy L. Tubbs of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Donnie Booher, Srinivas Durgam, Judith Eisenberg, and Lynda Ewers. Desktop publishing was performed by Robin Smith. Editorial assistance was provided by Ellen Galloway.

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For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Highlights of the NIOSH Health Hazard Evaluation

In April 2006, NIOSH investigators received a management request from the Kenton County Animal Shelter (KCAS) in Covington, Kentucky to evaluate noise exposures and potential hearing loss experienced by animal shelter workers at KCAS. Between April and October 2006, noise assessments were conducted on nine animal shelter workers, and hearing tests were performed on 10 workers.

What NIOSH Did

- We measured personal noise exposures for animal shelter workers.
- We tested hearing levels of animal shelter workers.

What NIOSH Found

- Noise levels exceeded the NIOSH recommended exposure limit six times. The OSHA criteria were not exceeded.
- Six of the ten workers who got tested have normal hearing.
- Four employees showed some hearing loss.

What KCAS Managers Can Do

- Enroll employees in a hearing loss prevention program.
- Require the use of hearing protectors in the kennel areas.
- Maintain ear muffs by making sure they are clean and the head bands are not sprung.
- Post signs to show areas with loud noise, and have hearing protectors available to employees entering these areas.
- Cover the floors and ceilings with sound absorbing materials that are easy to clean and disinfect.

What KCAS Employees Can Do

- Wear hearing protectors when working in the kennel areas.

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report #2006-0212-3035

Health Hazard Evaluation Report 2006-0212-3035
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SUMMARY

On April 13, 2006, the National Institute for Occupational Safety and Health (NIOSH) received a management request for a health hazard evaluation (HHE) from the Kenton County Animal Shelter (KCAS) in Covington, Kentucky. The HHE request asked NIOSH to assess the noise levels experienced by the animal shelter workers from barking dogs. On April 18 and 19, 2006, NIOSH investigators measured noise exposure levels for animal shelter workers. NIOSH investigators returned to the facility on October 12, 2006, to conduct hearing tests for all animal shelter workers.

Nine animal shelter workers contributed 18 full-shift personal dosimetry measures over 2 days. Hearing tests were performed on 10 workers. Six of the 18 (33%) of the personal noise dosimetry measures exceeded the NIOSH recommended exposure limit. The Occupational Safety and Health Administration (OSHA) action level and the OSHA permissible exposure limit were not exceeded. Exposures were highest for workers who cleaned the dog kennels in the morning. Exposures were lower for employees who rotated between cleaning cat cages, providing food to the animals, and staffing the front desk.

Four of the 10 workers tested showed some degree of hearing loss. Five employees with normal hearing showed "notches" (frequency at which there is a dip in the audiogram followed by an increase) at 4000 Hertz (Hz) and 6000 Hz in one or both ears. Notches occurring between 3000 to 6000 Hz may be indicative of the early stages of noise-induced hearing loss (NIHL). In addition, one employee with hearing loss had notches at 2000 Hz, 4000 Hz, and 6000 Hz. The notch at 2000 Hz is not consistent with NIHL.

Some of the animal shelter workers at KCAS are exposed to excessive noise levels. Some of the workers have some hearing loss but it is not possible to assess whether it is related to noise exposure at the kennel. Recommendations are provided to reduce noise exposures and prevent further hearing loss. These recommendations include establishing a hearing loss prevention program, installing sound-absorbing materials in kennels, and wearing hearing protection devices when entering the kennel area.

Keywords: NAICS 813310 (Environment, Conservation and Wildlife Organizations), noise, dose, animal shelter, audiometric testing, hearing loss, dog

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INTRODUCTION

On April 13, 2006, the National Institute for Occupational Safety and Health (NIOSH) received a management request for a health hazard evaluation (HHE) from the Kenton County Animal Shelter (KCAS) in Covington, Kentucky. The HHE request asked NIOSH to assess employee exposure to noise from barking dogs. On April 18 and 19, 2006, NIOSH investigators measured noise exposure levels for all animal shelter workers. NIOSH investigators returned to the facility on October 12, 2006, to conduct hearing tests for all animal shelter workers.

BACKGROUND

Noise Exposures to Domestic Animal Handlers

Veterinary hospital workers, animal shelter employees, workers at facilities that board animals and police officers with canine partners are potentially exposed to excessive occupational noise levels from barking dogs. However, few studies have examined noise exposures and the potential for hearing loss among these workers. One study measured noise levels as high as 108 decibels on an A-weighted scale (dBA) in veterinary establishments.[1] Another study looking at noise exposures to veterinary staff in an outdoor animal shelter showed noise exposures in excess of the NIOSH recommended exposure limit (REL) for occupational noise.[2] This evaluation was conducted in the aftermath of Hurricane Katrina in St. Bernard Parish, Louisiana, and is not representative of typical veterinary staff work activity. Two studies examined noise exposures and the risk of hearing loss among police officers assigned to their canine unit.[3,4] Both studies found that police officers were exposed to excessive noise from canines, and some officers had hearing loss. The design of these studies did not enable investigators to determine whether observed hearing loss was associated with occupational noise exposures.

Kenton County Animal Shelter

Founded in 1985, the KCAS serves 19 cities in Kenton County, Kentucky. The shelter receives approximately 500 cats and dogs a month. The animals are initially observed for diseases and temperament before being put up for adoption. There are six full-time employees at this facility. Additionally, inmates from the Kenton County Department of Corrections work at the facility as part of their community service.

Visitors to the facility and animals being brought in are processed in the lobby. Across from the lobby is a room that holds animals for temperament observation. A short corridor from the main lobby leads to the dog kennel area with 30 cages. Along the corridor that connects the main lobby and the dog kennels are two rooms. One is the kitchen area where the animal feeding and drinking bowls are washed; the other is a cat and puppy area. Next to the main facility is a small building where adoptions take place. Animals and their potential owners are given an opportunity to bond in this area before the adoption is finalized.

Most employees work between 8:30 a.m. and 6:00 p.m. The facility director and the inmates arrive between 6:30 and 7:00 a.m. The inmates begin cleaning dog cages and feeding dishes. They also clean the bathrooms and keep other parts of the facility clean. The inmates leave at 3:00 p.m. while the director stays until closing. The employees perform a variety of tasks including laundering soiled cloths, feeding cats and dogs, cleaning cat and puppy cages, giving shots to animals, taking animals from the kennels to the adoption area and back, cleaning the facility, and staffing the front desk. Prior to inmates from the Kenton County Department of Corrections working at the kennels, KCAS employees cleaned dog cages as well.

METHODS

Noise Assessment

On April 18 and 19, 2006, nine animal shelter workers (six employees and three inmates)

contributed 18 full-shift, personal noise measures. Quest® Electronics (Oconomowoc, Wisconsin) Model Q-300 Noise Dosimeters were worn by the kennel workers while they performed their daily activities. The noise dosimeters were attached to the wearer's belt and a small remote microphone was fastened to the wearer's shirt at a point midway between the ear and the outside of the shoulder. A windscreen provided by the dosimeter manufacturer was placed over the microphone during recordings. At the end of the workday, the dosimeter was removed and paused to stop data collection. The information stored in the dosimeters was downloaded to a personal computer for interpretation with QuestSuite for Windows® computer software. The dosimeters were calibrated before and after the measurement periods according to the manufacturer's instructions.

Hearing Loss Assessment

All KCAS workers were eligible for the hearing tests. Workers reported to an onsite NIOSH mobile test facility, prior to starting their shift. Informed consent was obtained from each participant before they completed a short questionnaire about work history.

A Tremetrics (Eden Prairie, Minnesota) Model AR 901 Hearing Booth and OSCAR 7 Electro-Acoustic Ear and Octave Monitor (Eden Prairie, Minnesota) provided an appropriate acoustic environment for testing. The booth was located inside the mobile test facility. The area was controlled for conversations and other extraneous noises during the tests. Hearing tests were collected with a Tremetrics Model HT Wizard Audiometer that was calibrated within the past year. Hearing tests were conducted by one of the investigators, who has current certification from the Council for Accreditation in Occupational Hearing Conservation (CAOHC). The audiometer tested the pure-tone frequencies of 500, 1000, 2000, 3000, 4000, 6000, and 8000 Hertz (Hz) in the computerized mode in each ear, left ear first.

Test results for each participant were interpreted immediately after testing and explained to the participant. In addition, each participant was sent a letter summarizing his or her results along with a copy of the audiometric test result.

EVALUATION CRITERIA

The primary sources of evaluation criteria for noise in the workplace are: (1) the NIOSH REL,[5] and (2) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL).[6] Employers are encouraged to follow the more protective NIOSH REL, although they are required to adhere to the OSHA limits for compliance purposes.

Noise-induced hearing loss (NIHL) is an irreversible, sensorineural condition that progresses with exposure. Although hearing ability declines with age (presbycusis) in all populations, exposure to noise produces hearing loss greater than that resulting from the natural aging process. This noise-induced loss is caused by damage to nerve cells of the inner ear (cochlea) and, unlike some conductive hearing disorders, cannot be treated medically.[7] While loss of hearing may result from a single exposure to a very brief impulse noise or explosion, such traumatic losses are rare. In most cases, noise-induced hearing loss is insidious. Typically, it begins to develop at 4000 or 6000 Hz (the hearing range is 20 Hz to 20000 Hz) and spreads to lower and higher frequencies. Often, material impairment has occurred before the condition is clearly recognized. Such impairment is usually severe enough to permanently affect a person's ability to hear and understand speech under everyday conditions. Although the primary frequencies of human speech range from 200 Hz to 2000 Hz, research has shown that the consonant sounds, which enable people to distinguish words such as "fish" from "fist," have still higher frequency components.[8]

The dBA is the preferred unit for measuring sound levels to assess worker noise exposures. The dBA scale is weighted to approximate the sensory response of the human ear to sound frequencies near the threshold of hearing. The

decibel unit is dimensionless, and represents the logarithmic relationship of the measured sound pressure level to an arbitrary reference sound pressure (20 micropascals, the normal threshold of human hearing at a frequency of 1000 Hz). Decibel units are used because of the very large range of sound pressure levels which are audible to the human ear. Because the dBA scale is logarithmic, increases of 3 dBA, 10 dBA, and 20 dBA represent a doubling, tenfold increase, and hundred-fold increase of sound energy, respectively. It should be noted that noise exposures expressed in decibels cannot be averaged by taking the simple arithmetic mean.

The OSHA standard for occupational exposure to noise (29 CFR 1910.95)[6] specifies a maximum PEL of 90 dBA for a duration of 8 hours per day. The regulation, in calculating the PEL, uses a 5 dB time/intensity trading relationship, or exchange rate. This means that a person may be exposed to noise levels of 95 dBA for no more than 4 hours, to 100 dBA for 2 hours, etc. Conversely, up to 16 hours exposure to 85 dBA is allowed by this exchange rate. The duration and sound level intensities can be combined in order to calculate a worker's daily noise dose according to the formula:

$$\text{Dose} = 100 \text{ X } (C_1/T_1 + C_2/T_2 + ... + C_n/T_n),$$

where C_n indicates the total time of exposure at a specific noise level and T_n indicates the reference duration for that level as given in Table G-16a of the OSHA noise regulation. During any 24-hour period, a worker is allowed up to 100% of his daily noise dose. Doses greater than 100% exceed the OSHA PEL.

The OSHA regulation has an additional action level (AL) of 85 dBA; an employer shall administer a continuing, effective hearing conservation program when the 8-hour time-weighted average (TWA) value exceeds the AL. The program must include monitoring, employee notification, observation, audiometric testing, hearing protection devices (HPDs), training, and record keeping. All of these requirements are included in 29 CFR 1910.95, paragraphs (c) through (o). Finally, the OSHA noise standard states that when workers are exposed to noise levels in excess of the OSHA PEL of 90 dBA, feasible engineering or administrative controls shall be implemented to reduce the workers' exposure levels.

NIOSH, in its Criteria for a Recommended Standard, proposes exposure criteria of 85 dBA as a TWA for 8 hours, 5 dB less than the OSHA standard.[9] The criterion also uses a more conservative 3 dB time/intensity trading relationship in calculating exposure limits. Thus, a worker can be exposed to 85 dBA for 8 hours, but to no more than 88 dBA for 4 hours or 91 dBA for 2 hours. The NIOSH REL for 12-hour exposure is 83 dBA or less.

Audiometric evaluations of workers are conducted in quiet locations, preferably in a sound-attenuating chamber, by presenting pure tones of varying frequencies at threshold levels (i.e., the level of a sound that the person can just barely hear). Audiograms are displayed and stored as tables or charts of the hearing levels (HL) at specified test frequencies.[10] Zero dB HL represents the hearing level of an average, young, normal hearing individual. In OSHA-mandated hearing conservation programs, thresholds must be measured for pure-tone signals at the test frequencies of 500, 1000, 2000, 3000, 4000, and 6000 Hz. Individual employee's annual audiograms are compared to their own baseline audiogram to determine the amount of standard threshold shift (STS) that might have occurred between the two tests. Specifically, OSHA states that an STS has occurred if the average threshold values at 2000, 3000, and 4000 Hz have increased by 10 dB or more in either ear when comparing the annual audiogram to the baseline audiogram.[6] The NIOSH recommended threshold shift criterion is a 15-dB shift at any frequency in either ear from 500-6000 Hz measured twice in succession.[9] Practically, the criterion is met by immediately retesting an employee who exhibits a 15-dB shift from baseline on an annual test. If the 15-dB shift persists on the second test, a confirmatory follow-up test should be given within 30 days of the initial annual examination. Both of these threshold shift criteria require at least two

audiometric tests. In cases where only one audiogram is available, a criterion has been proposed for single-frequency impairment determinations.[11] It employs a lower fence (the amount of hearing loss necessary before a hearing handicap is said to exist) of 25 dB HL. With this criterion, any person who has a hearing level of 26 dB HL or greater at any single frequency is classified as having some degree of hearing loss. The degree of loss can range from mild (26–40 dB HL) to profound (>90 dB HL).

The audiogram profile is a plot of the hearing test frequencies (x-axis) versus the hearing threshold levels (y-axis). Hearing threshold levels are plotted in reverse (the highest hearing level up to 0 or -10 dB). For many workers, the audiogram profile tends to slope downward toward the high frequencies with an improvement at the audiogram's highest frequencies, forming a "notch."[12] A notch in an individual with normal hearing may indicate the early onset of hearing loss. Although there is no universal criterion to define what constitutes a notch, several mathematical models that attempt to identify notches are presented in the scientific literature.[13,14,15] The relative strength and weaknesses of these models have also been reviewed.[16] For this evaluation, a notch is defined as the frequency where the hearing level is preceded by an improvement of at least 10 dB and followed by an improvement of at least 5 dB. The notch from occupational noise can occur between 3000 and 6000 Hz, depending on the frequency spectrum of the noise, and the anatomy of the individual's ear.[17,18] It is generally accepted that a notch at 4000 Hz indicates occupational hearing loss.[19] On the other hand, some researchers have argued that the notch at 6000 Hz may not be a good marker for occupational hearing loss because it is widely seen in young adults and others with little documented occupational noise exposure.[20] An individual may have notches at different frequencies in one or both ears.[12]

RESULTS AND DISCUSSION

One third of the personal noise dosimetry measures (6 of 18) exceeded the NIOSH daily allowable dose of 100% (Table 1). The full-shift TWA values for the NIOSH REL ranged from 79 to 87 dBA. The TWA values for the OSHA criteria ranged from 63 to 82 dBA. Exposures were highest for the inmates who cleaned the dog kennels in the morning. Most of the full-time employees had little direct contact with dogs; they rotated between cleaning cat cages, providing food to the animals, taking dogs to the adoption area, and staffing the lobby. Their exposures were lower than those of the inmates and lower than those measured at two other animal shelters.[21,22] In addition, on the second day of the survey, the facility closed for a staff meeting for a few hours in the afternoon, further reducing employee contact with the dogs. Despite the limited contact with dogs, even short term exposure to barking dogs can vastly affect the full-shift noise exposures. An employee accumulated 20% dose (or one fifth the daily allowable dose) during a 10-minute period trying to get a dog back into its cage. The noise levels during this short period ranged from 88.4 to 100.3 dBA. Noise exposures for the KCAS employees were higher towards the latter part of the day when they took over tasks in the dog kennels after the inmates left the shelter (Figure 1). Job rotation among the full-time employees reduced their overall noise exposures.

Hearing tests were given to 10 KCAS animal shelter workers (eight employees and two inmates). The median hearing test results and the inter-quartile range (a measure of variability) are shown in Figure 2. The data showed a high level of inter-individual variability. The mean age for the 10 workers was 37 years (range = 25–60 years). They had worked at KCAS from 1 month to 20 years.

Four of the 10 workers showed some hearing loss defined as exceeding the lower fence of 25 dB HL. Five employees with normal hearing showed "notches" (frequency at which there is a

dip in the audiogram followed by an increase) at 4000 Hz and 6000 Hz in one or both ears. Notches occurring between 3000 to 6000 Hz may be indicative of the early stages of NIHL. In addition, one employee with hearing loss had notches at 2000 Hz, 4000 Hz, and 6000 Hz. The notch at 2000 Hz is not consistent with NIHL. Table 2 shows the relationship between hearing test results and notch formation.

This evaluation cannot establish an association between animal shelter workers with hearing loss and exposure to noise at the shelter because (1) the sample size is too small to make definitive conclusions, (2) hearing loss typically develops over a relatively long period of time, and most of the KCAS employees are relatively young, and (3) exposure to noise from hobbies and factors such as genetics and illnesses that affect hearing may affect the results. However, continued exposure to excessive noise over a working lifetime can potentially result in NIHL.[9]

Noise control strategies in dog kennels are complicated. Sound-absorbing materials such as spray-on foam and fibrous mineral wool, which are usually used in industry and other indoor settings to reduce noise exposures, are not appropriate in kennels because these materials are difficult to clean. One approach may be to use sound-absorbing material on surfaces that do not need to be cleaned routinely, such as ceilings. Acoustical ceiling tiles that are waterproof and washable can be installed to reduce noise.[23] In addition, floors can be covered with rubber mats to absorb sound from the barking dogs and to reduce noise from feeding and drinking dishes hitting on hard (concrete and tile) surfaces. These approaches may offer some reduction in noise levels. Such approaches, however, does not eliminate the direct noise path from the dog to the worker. Hearing protectors, if worn properly all of the time, offer adequate protection. However, as far as possible, the preferred ways of controlling for noise are engineering controls, followed by administrative controls. Personal protective equipment such as hearing protectors should be considered after all feasible engineering and administrative controls are in place.

A noise survey should be conducted after any controls are in place to determine if personal noise exposures to workers are reduced. If there are plans for building a new facility or expanding the current facility, an acoustical engineer can assist in designing dog confinement areas that may reduce noise exposures.

CONCLUSIONS

This evaluation showed that workers at the KCAS are potentially exposed to hazardous noise levels particularly when working with dogs. Four of the animal shelter workers who participated in this evaluation showed some hearing loss greater than 25 dB HL. However, because of the small sample size, inability to control for confounders, and the relative youth of most of the employees with respect to time needed to develop hearing loss, it is not possible to say whether the observed hearing loss is related to noise exposure at the shelter.

RECOMMENDATIONS

Based on the observations and findings of this evaluation, the following recommendations are offered to better protect the hearing of the animal shelter workers at KCAS:

1. Establish a hearing loss prevention program for KCAS animal shelter workers. The basic elements of the program should, at a minimum, meet the requirements of the OSHA hearing conservation amendment (29 CFR 1910.95).[6] Other sources for defining effective hearing conservation programs are also available.[12,24,25]
2. Wear hearing protection devices (ear muffs or ear plugs) when working in the dog kennels. Employees should be trained on the proper fit, selection, and maintenance of hearing protectors. For example, ear plugs should be deeply inserted into ear canals, and cushions on ear muffs should not be cracked or creased, and the head bands not sprung.

3. Place warning signs that identify loud noise areas on doors, and require employees entering these areas to wear hearing protectors.
4. Consider using sound-absorbing materials that are not compromised by water and other cleaning solutions on ceilings and floors of dog kennels. Conduct noise exposure monitoring after controls are in place.
5. Consult an acoustical engineer when considering any future design changes to the facilities to determine whether noise exposures can be reduced.

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TABLES

Table 1
Full-Shift Personal Dosimetry Results for 18 Animal Shelter Workers at KCAS

Job Responsibilities	Number of Measures	Percent Dose		
		OSHA AL	OSHA PEL	NIOSH REL
*Clean dog cages, wash dishes, and clean bathrooms	6	15.1 – 32.5	6.3 – 24.1	63.2 – 145.4
**Laundry, clean cat and puppy cages, provide shots to animals, respond to the public, arrange adoptions	12	4.2 – 29.3	2.3 – 18.2	24.9 – 171.2

* NIOSH REL exceeded five times
** NIOSH REL exceeded once
The various dose percentages are the amounts of noise accumulated during a work day, with 100% representing the maximum allowable daily dose
OSHA: Occupational Safety and Health Administration
NIOSH: National Institute for Occupational Safety and Health
AL: Action Level
PEL: Permissible Exposure Limit
REL: Recommended Exposure Limit
KCAS: Kenton County Animal Shelter

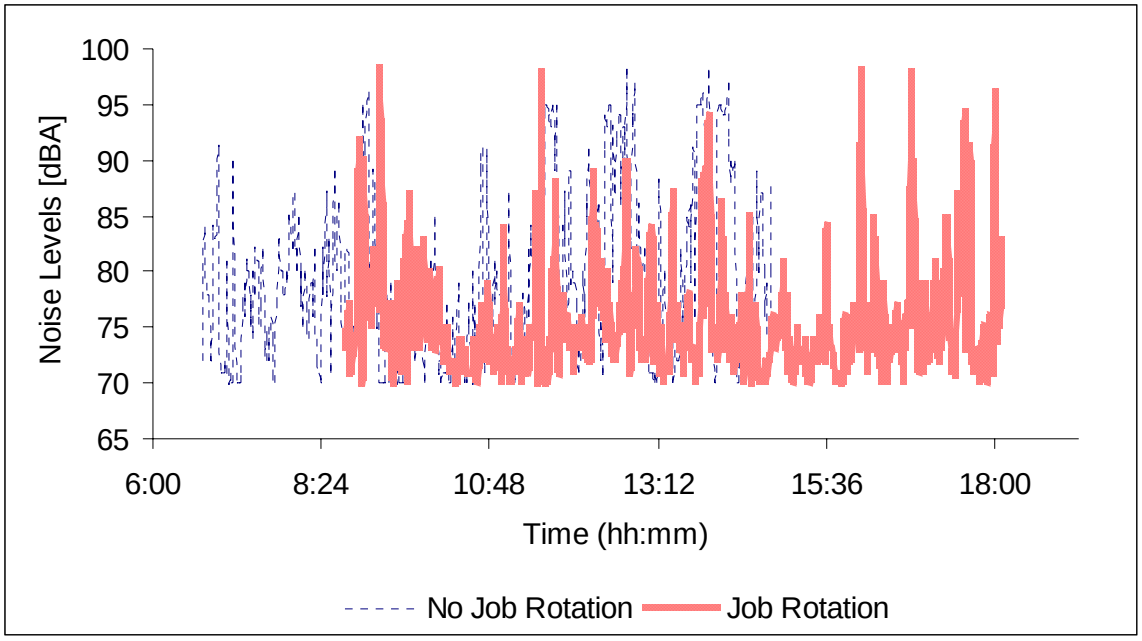
Table 2
Relationship between Hearing Loss (> 25 decibels), and Notch Formation
among KCAS Employees

Employee ID	Hearing Loss		Notch (Hertz)	
	Left Ear	Right Ear	Left Ear	Right Ear
A	Mild to Moderate	Mild to Moderate	No	No
B	No	No	6000	6000
C	No	No	4000	4000
D	No	Mild	2000, 4000	6000
E	Moderate	Mild	No	No
F	Mild	Mild	No	No
G	No	No	6000	6000
H	No	No	No	No
I	No	No	6000	No
J	No	No	No	6000

KCAS: Kenton County Animal Shelter

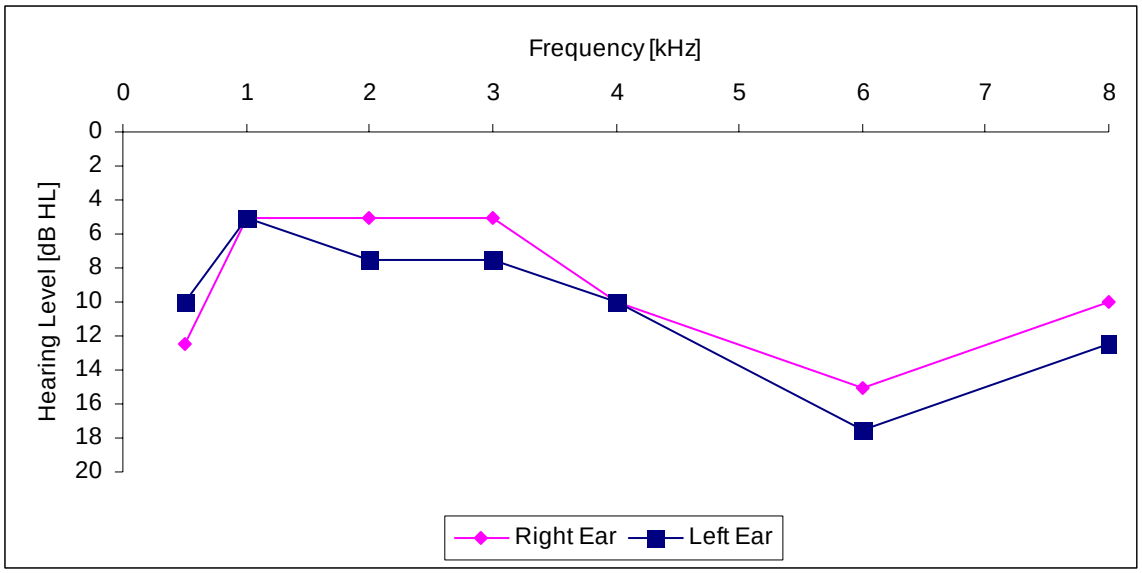
FIGURES

Figure 1
Comparison between Noise Exposures between KCAS Worker
who Spends Most of the Time in Dog Kennels and KCAS Worker who has Job Rotation



KCAS: Kenton County Animal Shelter

Figure 2
Median Levels and Inter-Quartile Ranges for Ten KCAS Employees



Frequency (kHz)	Left Ear		Right Ear	
	25th percentile	75th percentile	25th percentile	75th percentile
0.5	10	14	5	15
1	5	15	5	10
2	0	10	1	18
3	0	10	0	15
4	6	21	5	20
6	11	25	10	25
8	6	25	6	23

KCAS: Kenton County Animal Shelter

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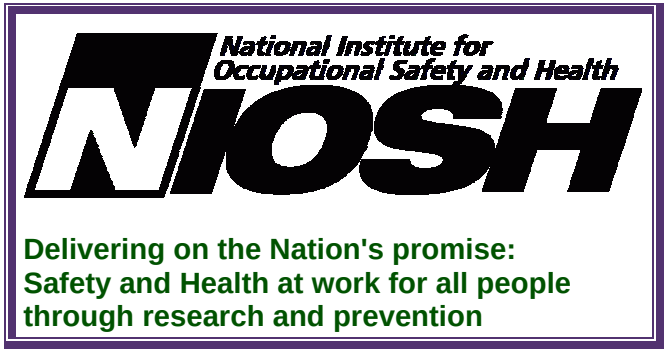
Cincinnati, OH 45226-1998

OFFICIAL BUSINESS
Penalty for private use $300



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