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NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2006-0196-3036
Liberty Veterinary Hospital
Liberty Township, Ohio

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 and Scott Brueck. Desktop publishing was performed by Robin Smith. Editorial assistance was provided by Ellen Galloway.

Copies of this report have been sent to employee and management representatives at Liberty Veterinary Hospital and the OSHA Regional Office. This report is not copyrighted and may be freely reproduced. The report may be viewed and printed from the following internet address: http://www.cdc.gov/niosh/hhe. Copies may be purchased from the National Technical Information Service (NTIS) at 5825 Port Royal Road, Springfield, Virginia 22161.

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 March 2006, NIOSH investigators received a management request from the Liberty Veterinary Hospital (LVH) to evaluate noise exposures experienced by kennel workers and veterinary staff at LVH in Liberty Township, Ohio. Between April and October 2006, noise assessments were conducted on 13 employees and hearing tests were conducted on 14 employees.

What NIOSH Did

- We measured personal noise exposures for kennel workers.
- We tested hearing levels of LVH employees.

What NIOSH Found

- Noise levels exceeded the NIOSH recommended exposure limit on ten occasions and exceeded the OSHA criteria on six.
- Eleven of the workers have normal hearing patterns.
- Three employees showed hearing loss.

- Enroll kennel workers in a hearing conservation program.
- Require the use of hearing protectors (ear muffs or ear plugs) in the kennels.
- Maintain ear muffs by making sure they are clean and not bent, and replacing the cushions every 6 months or sooner if necessary.
- 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.
- Make sure that the vacuum on laser equipment is functioning as designed.

What LVH Employees Can Do

- Wear hearing protectors when working in the kennels.
- Follow proper health and safety guidelines when treating sick animals such as wearing gloves and washing hands frequently.
- Make sure that electrical appliances do not come into contact with water and spills are promptly cleaned up.

CDC Workplace Safety and Health

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 #2006-0196-3036

NIOSH

Health Hazard Evaluation Report 2006-0196-3036
Liberty Veterinary Hospital
Liberty Township, Ohio
February 2007

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SUMMARY

On March 27, 2006, the National Institute for Occupational Safety and Health (NIOSH) received a management request to conduct a health hazard evaluation (HHE) at Liberty Veterinary Hospital in Liberty Township, Ohio. The requestor was interested in knowing the noise levels at the facility from barking dogs in boarding kennels or at the hospital.

Thirteen kennel workers contributed 18 full-shift personal noise dosimetry measures over two days. In addition, hearing tests were performed on 14 employees. Ten of the 18 full-shift personal noise dosimetry measures collected on kennel workers exceeded the NIOSH Recommended Exposure Limit. Six of these measures exceeded the Occupational Safety and Health Administration (OSHA) Action Level and one exceeded the OSHA Permissible Exposure Limit. For kennel workers, noise exposures during the morning shift were slightly higher than those during the afternoon shift workers, which is consistent with the activity level of the dogs.

Three of the 14 employees showed some degree of hearing loss (> 25 decibels hearing loss). Of the three, one was a veterinary staff member, one was a kennel worker, and one was an office worker. Five employees with normal hearing showed "notches" (frequency at which there is a dip in the audiogram followed by an increase) in their audiograms at 6000 Hertz (Hz). Notches occurring between 3000 to 6000 Hz may be indicative of the early stages of noise-induced hearing loss (NIHL). In addition, two employees with hearing loss had notches at 2000 Hz and 6000 Hz. The notch at 2000 Hz is not consistent with NIHL.

Kennel workers at LVH are exposed to excessive noise levels. Some LVH employees have hearing loss but it is not possible to determine whether this is related to noise exposures in the kennel. Recommendations are provided to reduce noise exposures and prevent further hearing loss. These recommendations include establishing a hearing conservation program, installing sound-absorbing materials in kennels, and wearing hearing protection devices when entering the kennel area.

Keywords: NAICS 54190 (Veterinary Services), noise, dose, notch, hearing loss, audiometric testing, dog

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INTRODUCTION

On March 27, 2006, the National Institute for Occupational Safety and Health (NIOSH) received a management request to conduct a health hazard evaluation (HHE) at Liberty Veterinary Hospital (LVH) in Liberty Township, Ohio. The requestor was interested in knowing the noise levels at the facility from barking dogs in boarding kennels or at the hospital.

On April 4, 2006, NIOSH representatives briefed LVH management and employee representatives about NIOSH, the HHE program, and the scope of the NIOSH evaluation. This was followed by a tour of the facility. On April 10 and 14, 2006, NIOSH investigators measured noise exposure for employees working throughout the facility. On October 13, 2006, NIOSH investigators returned to the facility to conduct hearing tests for the employees.

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 hearing loss among police officers in the 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.

Liberty Veterinary Hospital

Established in 1998, Liberty Veterinary Hospital provides medical care to small pets, primarily cats and dogs. The practice offers outpatient treatment, routine surgery such as spaying and neutering of animals, and boarding. The main work areas are an office/waiting area, hospital area, kennel area, and a dog grooming area.

Pet owners check their pets in at the front office. The office staff members notify the kennel-area staff that an animal has arrived for boarding in the kennel or the veterinary staff that an animal is ready for its examination. Sometimes, office workers go to the kennels to collect an animal.

The veterinary staff includes three veterinarians, two veterinary assistants, four veterinary technicians, and a laboratory assistant. They start work between 7:30 a.m. and 10:30 a.m. and end between 4:00 p.m. and 7:00 p.m. The veterinary assistants and technicians assist the veterinarians by performing initial examinations, dressing wounds, tracking animals as they are brought in and out of surgery, and restraining animals undergoing treatment.

Depending on how busy the practice is, there are between five and seven part-time kennel workers. The kennel workers work the morning shift (7:00 a.m. to 12:45 p.m.) or the afternoon shift (1:15 p.m. to 7:00 p.m.) The kennel area is divided into a small animal area and a large animal area. During the NIOSH evaluation there were about 27 large dogs and 18 small dogs; the facility was at full capacity. The main responsibilities of the kennel workers are to feed and walk the animals, and to clean their cages. The workers prepare food for the animals in a kitchen adjacent to the kennels. The kennel area leads to an outside play area for the dogs. Most

animals are taken out to play or for a walk at least once a day. In a grooming area next to the kennels, dogs are bathed in a bath tub, dried initially with a wet vacuum and then with a blower attached to their cage, and groomed. The clinic also has a groomer on staff.

METHODS

Noise Exposure Assessments

Thirteen kennel workers contributed 18 personal noise dosimetry measures over a 2-day period. Quest® Electronics Model Q-300 Noise Dosimeters (Oconomowoc, Wisconsin) were worn by the employees while they performed their daily activities. Samples were collected throughout work shifts that ranged from 2 to 8 hours. The noise dosimeters were placed in the pocket of the employees' scrubs 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 sampling period, 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® Professional computer software. The dosimeters were calibrated before and after the measurement periods according to the manufacturer's instructions.

Real-time noise monitoring was done with a Quest Electronics Model 2400 Sound Level Meter (SLM). The instrument was set to measure noise levels between 70 and 140 dB, on an A-weighted slow-response scale. The SLM was calibrated before and after the measurement periods according to the manufacturer's instructions. Real-time spectral analysis was done with a Larson-Davis Laboratory Model 2800 Real-Time Analyzer and a Larson-Davis Laboratory Model 2559 ½-inch random incidence response microphone (Provo, Utah). The analyzer allows for the analysis of noise into its spectral components in a real-time mode. The ½-inch diameter microphone has a frequency response range (± 2 dB) from 4 Hertz (Hz) to 21 kilohertz (kHz) that allows for the analysis of sounds in the region of concern. One-third octave bands consisting of center frequencies from 25 Hz to 20 kHz were integrated for 5–30 seconds and stored in the analyzer.

Hearing Loss Assessments

All employees were invited to take the hearing tests. Workers reported to the NIOSH mobile test facility parked at the LVH property. Most employees were tested prior to starting their shift; others were asked to wear ear muffs until they had their hearing tested. Informed consent was obtained from each participant before they completed a short questionnaire about work history and self assessment of their hearing ability.

A Tremetrics (Eden Prairie, Minnesota) Model AR 901 hearing booth and OSCAR 7 Electro-Acoustic Ear and Octave Monitor (Eden Prairie, Minnesota) provided an acoustic environment for hearing testing. The area was controlled for conversations and other extraneous noises. Hearing tests were administered with a Tremetrics Model HT Wizard Audiometer that had received a routine calibration check 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 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.

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, NIHL 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). 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

Noise Exposure Assessments

The length of the workday at LVH may vary depending on the number of dogs and cats being boarded in the kennel, number of part-time workers, and the veterinarians' surgery schedule. The noise exposure evaluation was conducted during spring break and thus represented a "worst-case" scenario because of the large number of animals being boarded.

Thirteen employees contributed 18 full-shift personal dosimetry measures over the 2-day evaluation. Ten of the 18 measures exceeded the NIOSH REL. Six of these measures also exceeded the OSHA AL while one exceeded the OSHA PEL (Table 1). TWA noise levels for the kennel workers ranged from 91 to 95 dBA as calculated by the NIOSH criterion. Noise exposures for the morning shift kennel workers were slightly higher than those for the afternoon shift workers. This is probably because the dogs are excitable first thing in the morning when the lights are turned on and the workers make their rounds. By the time the afternoon shift starts, the dogs have been fed; during the evaluation they were observed resting. One of the morning shift kennel workers who spent about 1–2 hours doing administrative work had a lower noise exposure than that of the worker who spent all the time in the kennel area or the kennel's kitchen area. The TWA noise exposures for workers in the hospital area ranged from 70 to 84 dBA as calculated by the NIOSH criterion. One of the veterinary assistants who stood in for the groomer had an exposure of 88.5 dBA (225% dose) for the 2 hours that she worked on the day of the evaluation. This job function is not typical for veterinary staff.

Spot noise measurements and real time noise exposure profiles for employees and spectral noise data are presented in Table 2 and Figures 1–7 respectively. Figure 1 shows that employees who primarily work in the hospital area (veterinarians, veterinary assistants, and veterinary technicians) have relatively low noise exposures (below 85 dBA). Their main source of noise exposure is the occasional barking dog in the hospital area, depicted in peaks in Figure 1. Some of these dogs are brought in for outpatient treatment; others are temporarily placed in cages pending surgery and during post-surgery recovery. The veterinary staff described potential excessive noise from surgical equipment. Figure 2 shows spectral noise data from a vacuum system used for laser surgery and ultrasonic dental equipment. The noise contributions from these sources were well below 70 dBA and are not a significant noise source. Figure 3 shows the noise exposures of a veterinary assistant who primarily bathed dogs for the 2 hours that she worked on the day of the assessment. The high exposures are a result of the barking of a couple of dogs in the grooming area, as well as a wet vacuum and a blower used to dry the dogs. The wet vacuum had noise levels as high as 91 dBA when measured using a sound level meter. Figure 4 shows spectral data from the blower and the wet vacuum. Kennel workers consistently sustained noise levels as high as 105 dBA, as depicted in Figure 5. One of the kennel workers reached 71% of the NIOSH REL after the first 17 minutes in the kennel. If similar exposures occur throughout the day, this worker would exceed the NIOSH REL in a short time. Another kennel worker exceeded the daily allowable dose (116%) in 8 minutes. These calculations, based on the more protective NIOSH criterion, show that administrative controls such as job rotation will not be effective for kennel workers. Noise exposures were slightly higher in the morning when workers cleaned cages, and fed and walked the dogs, compared to the afternoon, when some of the dogs napped briefly. Regardless, levels for all kennel workers were found to exceed the NIOSH REL (Table 1). Figure 6 depicts typical spectral noise data in the kennel area. The loudest noise exposures (in excess of 85 dBA) occurred between 400 and 2000 Hz. The maximum noise level was 98 dBA. The kennel workers power wash the kennels as frequently as needed. Spectral noise data taken during power washing (Figure 7) showed high noise levels in the range where NIHL can occur (2000 to 6000 Hz). However, these data were collected with the dogs present, so the barking of the dogs added to the noise from the power washing.

All but one of the kennel workers reported headaches that they attributed to occupational noise exposure. One kennel worker mentioned having ringing in the ears in the past.

Hearing Loss Assessments

Hearing tests were offered to all LVH employees. Fourteen LVH employees were available to take the test. Of the 14, eight workers were veterinary staff (veterinarians, veterinary technicians and assistants, and

laboratory assistants), two were office workers (receptionist, manager) and four were kennel workers. Two of the veterinary staff had worked as kennel workers in previous jobs. The mean age of the 14 employees was 32 years (range = 19–55). They had worked at LVH from 3 months to 8 years (mean = 3 years). Nine employees had worked with dogs (as groomer, groomer's assistants, kennel workers, veterinary office worker) in previous other jobs (mean = 7 years). The median hearing test results and the inter-quartile ranges (a measure of variability) are shown in Figure 8.

Three of the 14 employees showed some degree of hearing loss. Of the three, one was a veterinary staff member, one was a kennel worker, and one was an office worker. Five employees with normal hearing showed notches in their audiograms at 6000 Hz. Notches occurring between 3000 to 6000 Hz may be indicative of the early stages of NIHL. In addition, two employees with hearing loss had notches at 2000 Hz and 6000 Hz. The notch at 2000 Hz is not consistent with NIHL. Table 3 shows the relationship between hearing loss and notch formation for LVH employees.

This evaluation cannot establish an association between animal shelter workers with hearing loss and the loudness of the dogs 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 LVH 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 they are difficult to clean while maintaining dryness in order to avoid mold and mildew. 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.[21] 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, but do not eliminate the direct noise path from the dog to the worker. A noise survey should be conducted after these 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.

Other Observations

NIOSH investigators noticed veterinary staff not wearing gloves when handling syringes or holding wounded animals near their wounds. Zoonotic agents such as viruses, bacteria, and parasites can transmit diseases from animals to humans.[22,23] The vacuum attached to the laser device used for surgery was not capturing all of the emission produced by the procedure. A pungent odor and smoke plume were evident in the surgical suite. In the grooming area, the electrical blower was in close proximity to puddles of water. This can pose an electrical hazard if electrical circuits are not protected by ground fault interrupters, and pose a slip hazard if the water is not dried promptly.

CONCLUSIONS

This evaluation showed that kennel workers at LVH are exposed to hazardous noise levels. Some of the workers who participated in this evaluation showed signs of hearing loss. However, because of the small sample size, inability to control for other sources of noise, and the relative youth of the workers with respect to time needed to develop hearing loss, it is not possible to determine whether the

observed hearing loss is related to noise exposure at the kennel.

RECOMMENDATIONS

Based on the observations and findings of this evaluation, the following recommendations are offered to better protect the hearing of the kennel workers with LVH and to address other health and safety issues noted during the evaluation:

1. Establish a hearing loss prevention program for the kennel workers. The basic elements of the program should, at a minimum, meet the requirements for a hearing conservation program as outlined in the OSHA hearing conservation amendment (29 CFR 1910.95). 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 kennel areas. 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 anyone entering these areas for extended periods to wear hearing protectors.
4. Consider using sound-absorbing materials that are easy to keep clean on ceilings and floors of dog kennels.
5. Follow health and safety precautions recommended by the National Association of State Public Health Veterinarians such as hand washing and use of gloves with respect to touching blood, body fluids, secretions, excretions, mucous membranes, and non-intact skin.[22]
6. Consult an acoustical engineer when considering any future design changes to the facilities to determine whether noise exposures can be reduced.
7. Contact the manufacturer of the laser equipment to make sure the vacuum is functioning as designed to effectively remove surgical smoke.
8. Make sure that puddles of water are promptly dried and that electrical appliances do not come in contact with water.

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TABLES

Table 1
Full-Shift Personal Dosimetry for 18* LVH Employees

	Number of Samples	Shift**	Noise Levels (Percent Dose)		
			OSHA AL	OSHA PEL	NIOSH REL
Kennel Workers	6	Morning	47.0 – 118.2	44.5 – 114.8	509.3 – 1442.5
	3	Afternoon	24.2 – 74.4	22.5 – 68.7	262.5 – 797.0
Veterinary Staff†	8	Morning	1.0 – 26.1	0.2 – 24.7	8.0 – 225.2
	1	Afternoon	1.9	1.1	15.1

*A sample collected on a veterinary technician was voided because of equipment malfunction, and is not reported.
**Morning shifts start between 7:00 a.m. and 10:30 a.m. and end between 12:45 p.m. and 4:00 p.m., evening shifts start at 1:15 p.m. and end at 7:00 p.m.
The various dose percentages are the amounts of noise accumulated during a work day, with 100% representing the maximum allowable daily dose.
†Veterinary staff includes veterinarians, veterinary assistants, veterinary technicians and a lab assistant
LVH: Liberty Veterinary Hospital
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

Table 2
Spot Area Noise Measurements (dBA) in the Laboratory, Kennel, and Grooming Areas

Area	Day 1	Day 2
Large-dog kennel (morning)	93.7 – 107.1	100.7 – 103.9
Large-dog kennel (afternoon)	105.8	100.0 – 112.0
Small-dog kennel (morning)	97.2 – 105.4	92.7
Small-dog kennel (afternoon)	102.6	86.1 – 103.0
Laboratory	< 60	60.0 – 70.0
Grooming (blower on cage)	< 78	75.9
Grooming (wet vacuum at tub)	No Exposure	90.9
Grooming (wet vacuum and blower)	No Exposure	90.3
Ultrasonic dental	No Exposure	66.6 – 67.5
Vacuum on laser	No Exposure	65.3 – 67.1
Kennel kitchen (door closed)	69.0 – 76.0	78.0-81.4
Kennel kitchen (door fully opened)	88.0	91.0
Kennel kitchen (door partially open)	78.0	75.0 – 86.0

dBA: decibels on an A-weighted scale

Table 3
Relationship between Hearing Loss (> 25 decibels), and Notch Formation among LVH Employees

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

LVH: Liberty Veterinary Hospital

FIGURES

Figure 1
Profile of Noise Exposure for Veterinary Staff

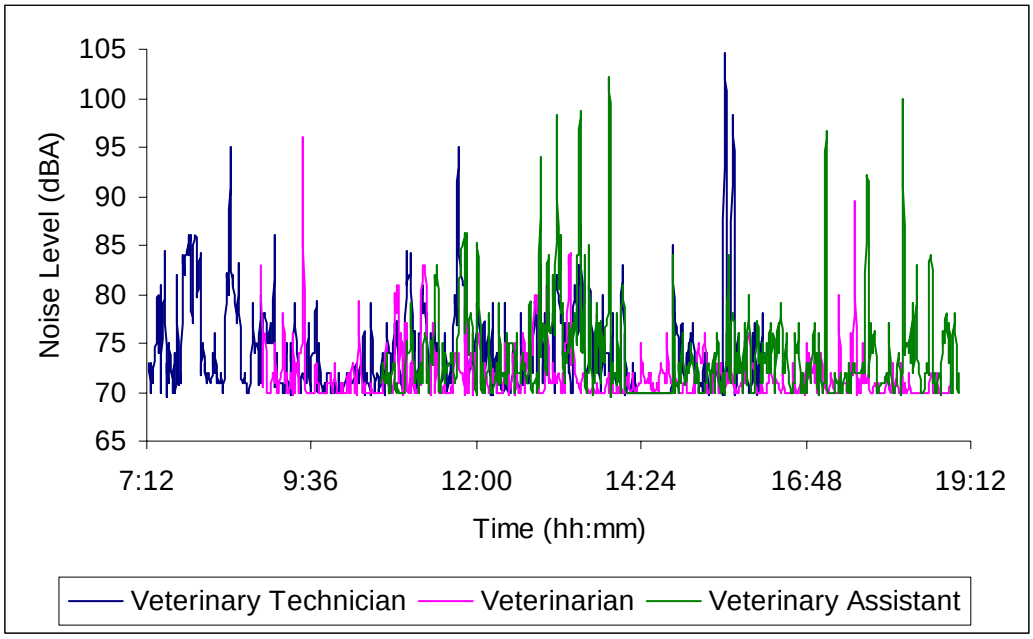


Figure 2
Spectral Noise from Laser Vacuum and Ultrasonic Dental Equipment

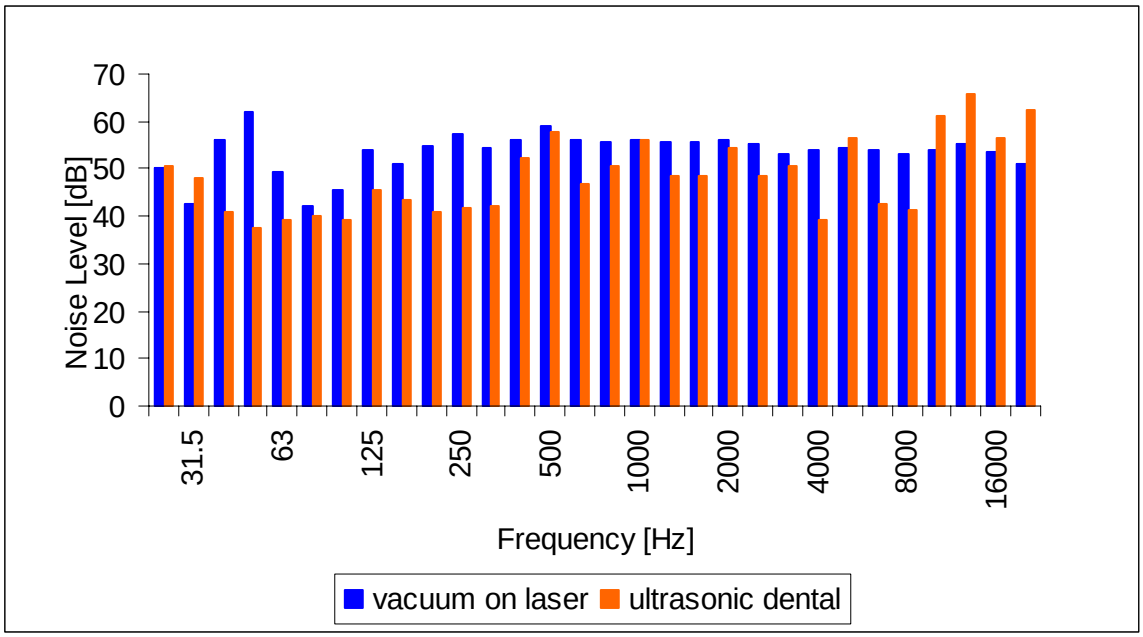


Figure 3
Profile of Noise Exposure during Bathing of Dogs

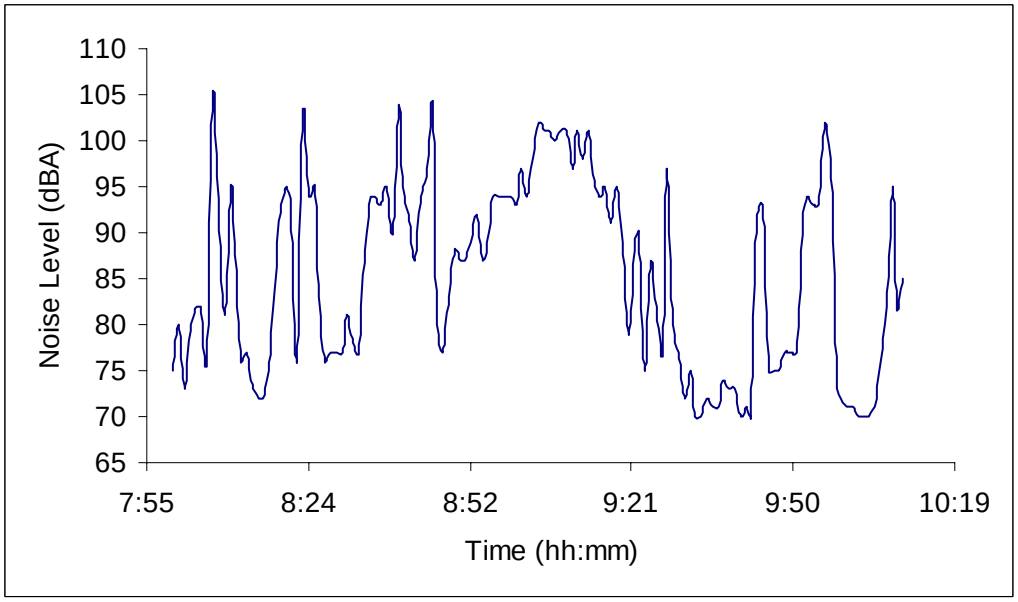


Figure 4
Spectral Noise Data from Vacuum and Blower in the Grooming Area

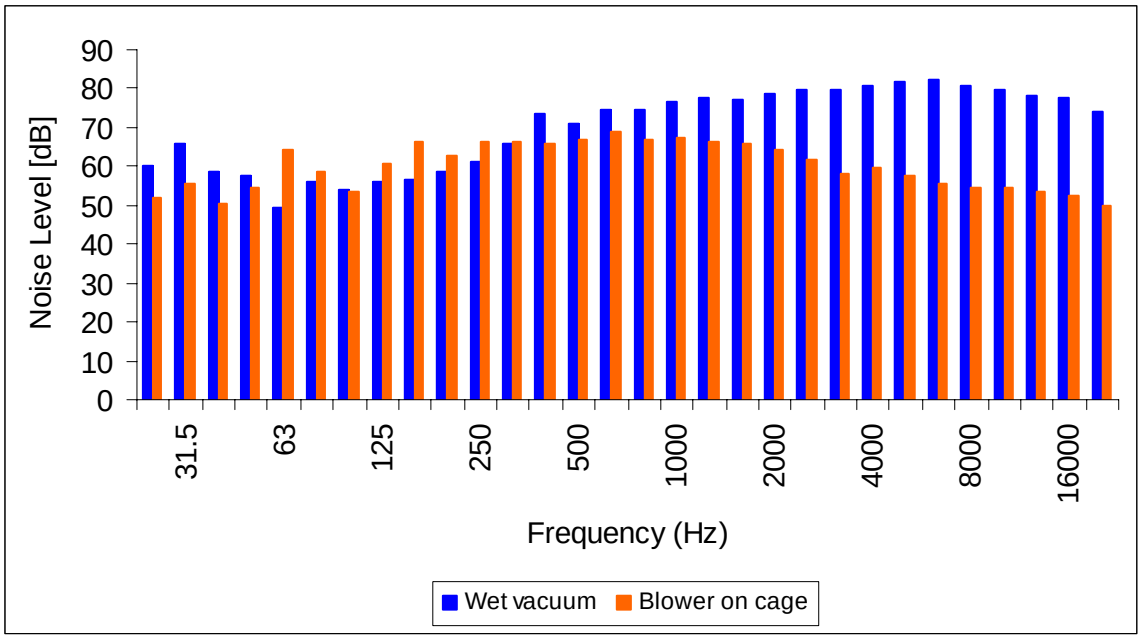


Figure 5
Typical Noise Profile for a Kennel Worker

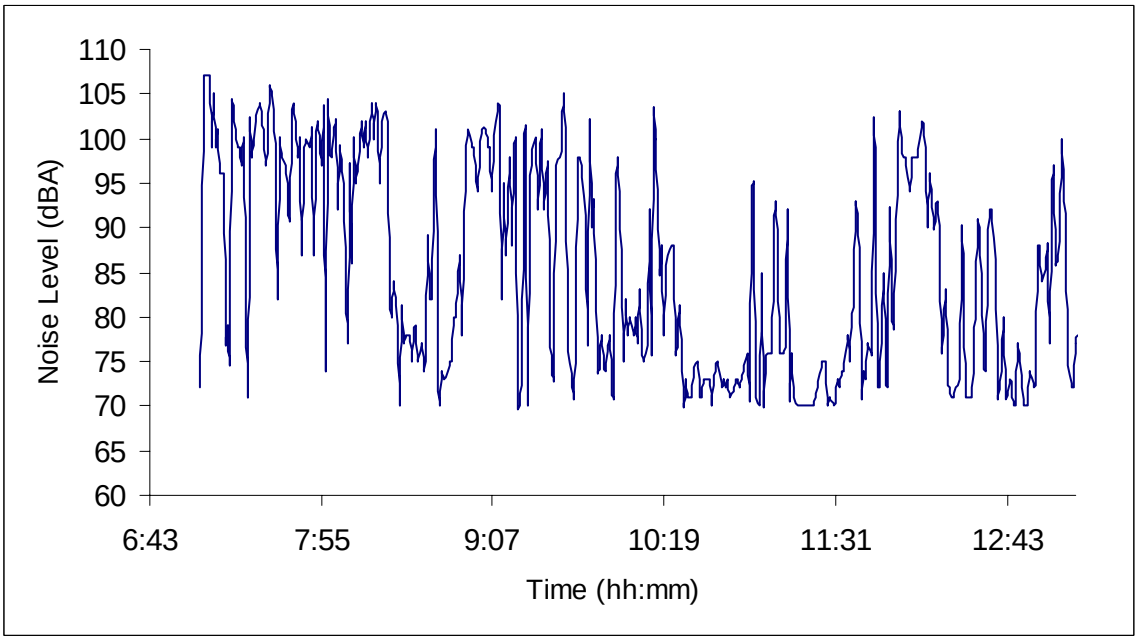


Figure 6
Typical Spectral Noise Data in the Kennel Area

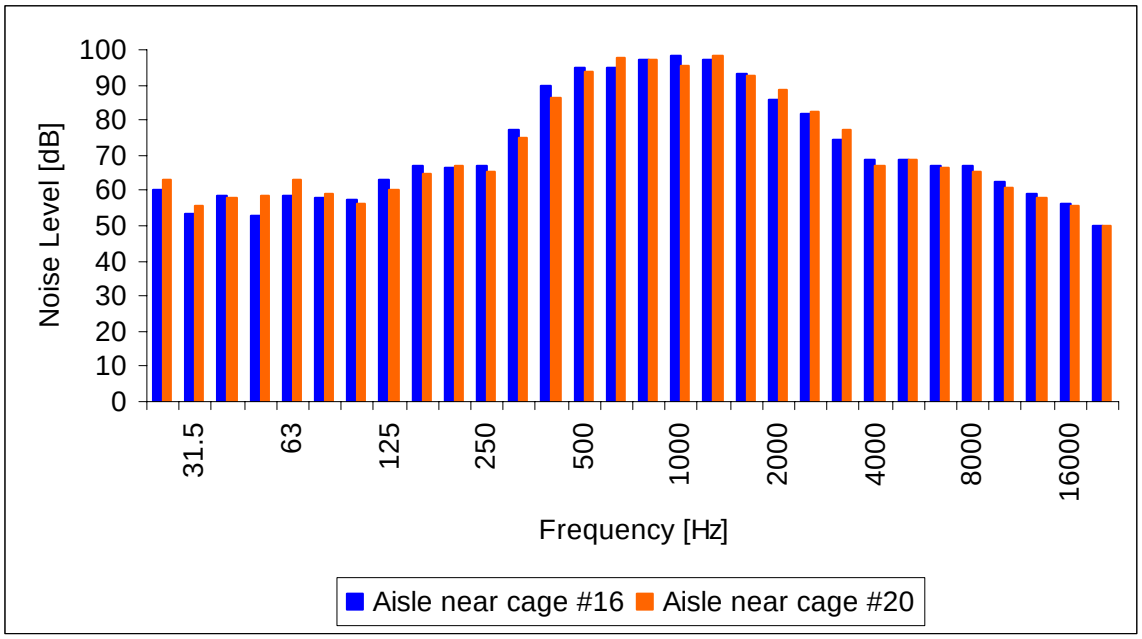


Figure 7
Spectral Noise Data when Power Washing Cages and with Dogs Barking Simultaneously

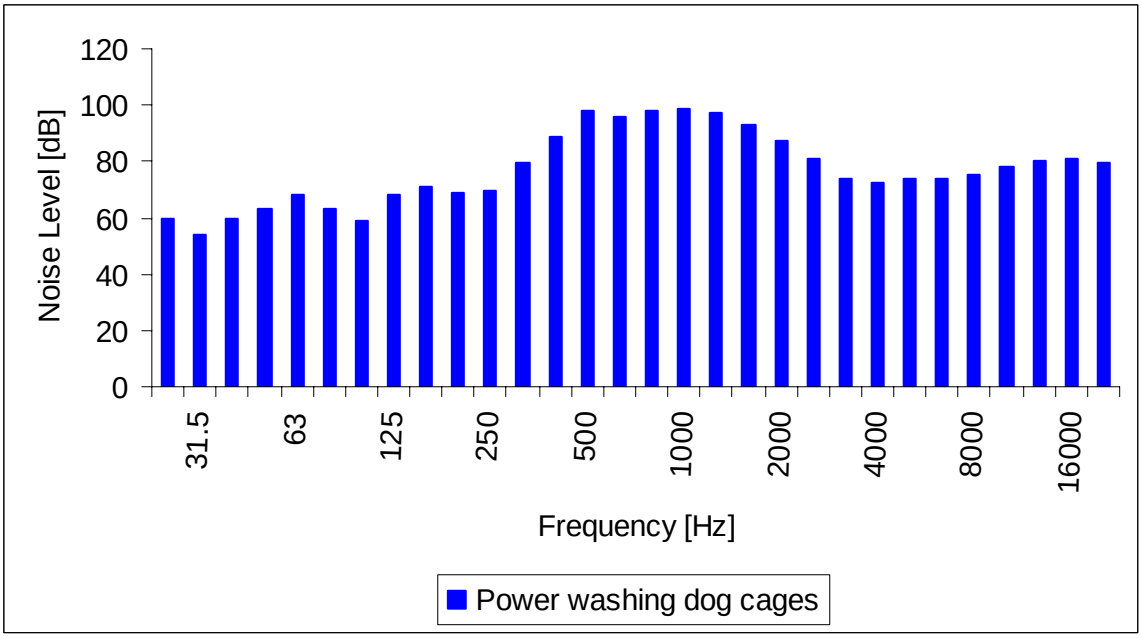
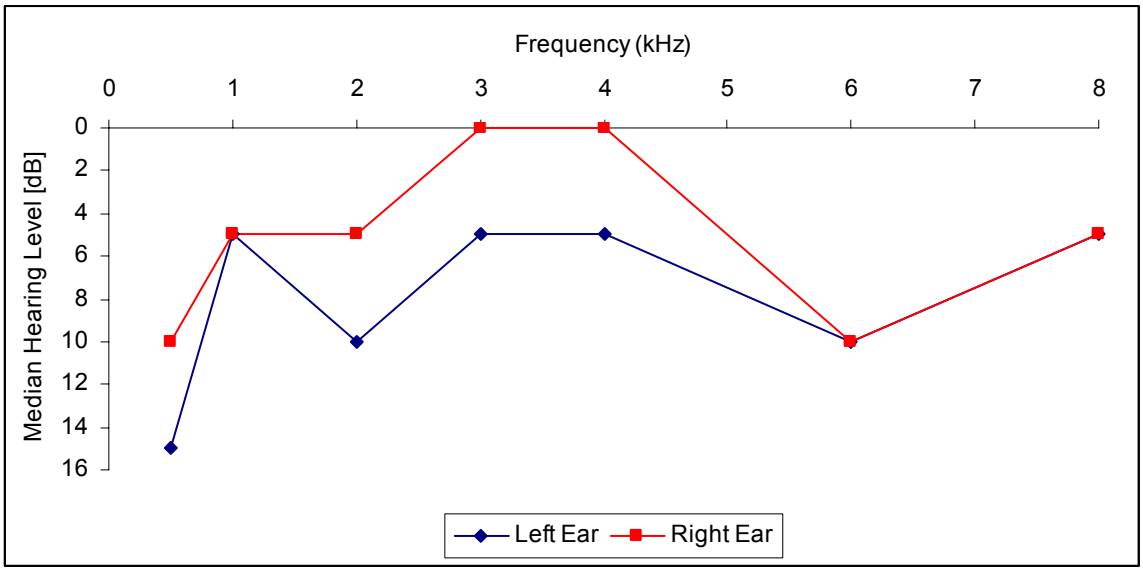


Figure 8
Median Hearing Levels and Inter-Quartile Ranges for LVH Employees



Frequency (kHz)	Left Ear		Right Ear	
	25th percentile	75th percentile	25th percentile	75th percentile
0.5	10	20	5	15
1	5	15	5	10
2	5	10	5	10
3	-5	10	0	10
4	0	15	0	10
6	5	25	0	20
8	0	10	0	15

LVH: Liberty Veterinary Hospital

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