NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2006-0223-3029
Cincinnati Police Canine Unit
Cincinnati, Ohio

November 2006

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). 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 the Cincinnati Police Headquarters, the Cincinnati Police Canine Unit, 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 April 2006, the National Institute for Occupational Safety and Health (NIOSH) received a management request from the Cincinnati Police Department to evaluate noise exposures and potential hearing loss experienced by police officers in the Cincinnati Police Canine Unit (CPCU). Between April and September 2006, noise exposure assessments and hearing tests were conducted on nine police officers assigned to CPCU.

What NIOSH Did

- We tested CPCU officers' hearing.
- We measured personal noise exposures on CPCU officers during their work shift.
- We reviewed officers' pre-employment hearing tests obtained from the City of Cincinnati.

What NIOSH Found

- Most officers had normal hearing patterns.
- Three officers showed hearing loss.
- Pre-employment hearing test results showed inconsistencies in tests and poor quality control.
- Noise levels exceeded the NIOSH criterion six times and approached the OSHA AL once.

What CPCU Managers Can Do

- The police department should provide officers radio earpieces with compression circuits.
- The police department should work with the City of Cincinnati to begin a hearing loss prevention program with annual hearing tests.
- Hearing tests should be administered by trained technicians.
- The police department should work with the City of Cincinnati on how to improve the quality of test data collected on police officers.

What the CPCU Officers Can Do

- Officers should wear hearing protection whenever they are at the firing ranges, during training, before throwing flash-bangs, and whenever loud noise is expected.
- Officers should train their dogs to be quiet during routine patrols.

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 #2006-0223-3029

Health Hazard Evaluation Report 2006-0223-3029
Cincinnati Police Canine Unit
Cincinnati, Ohio
November 2006

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SUMMARY

On April 1, 2006, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation (HHE) from the Cincinnati Police Department. The HHE request asked NIOSH to assess the noise exposure levels and the hearing profiles of police officers assigned to the Cincinnati Police Canine Unit (CPCU). Between April 21 and September 8, 2006, NIOSH investigators conducted personal dosimetry and hearing tests on the nine CPCU police officers. In addition, pre-employment audiograms for these officers were obtained from the City of Cincinnati to calculate any threshold shifts that had occurred since they were hired.

Six of the 22 personal dosimetry measurements exceeded the daily allowable dose of 100% as calculated by the NIOSH recommended exposure limit criterion. Three of the police officers showed some degree of hearing loss (defined as exceeding 25 decibels) on the NIOSH-administered audiogram. One of the officers had a physician-diagnosed non-occupational hearing decrement. Another officer showed moderate hearing loss in both ears, while the third showed mild hearing loss in his left ear. Another officer who still had normal hearing showed a worsening of his hearing when data collected as part of this evaluation was compared to pre-employment audiograms from the City of Cincinnati. Pre-employment audiograms from the City of Cincinnati revealed testing inconsistencies and a lack of quality control of the data.

Police officers with CPCU have the potential for exposure to excessive noise levels. Some of the police officers have some hearing loss but it is not possible to determine the exact cause of the loss. Recommendations are provided to reduce noise exposures and prevent further hearing loss. These recommendations include establishing a hearing loss prevention program, wearing ear protection when loud noises are anticipated, and training canine partners to be quiet during routine patrols.

Keywords: NAICS 922120 (Police Protection), canine, police, noise, dose, audiometric testing, hearing loss

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INTRODUCTION

On April 1, 2006, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation (HHE) from the Cincinnati Police Department, Cincinnati, Ohio. The HHE request asked NIOSH to assess the noise levels and the hearing profiles of police officers assigned to the Cincinnati Police Canine Unit (CPCU). Due to the varied schedules of the police officers, informal meetings were held over several days between management and individual police officers to explain the HHE process and to discuss the logistics of the study. Between April 21 and September 8, 2006, NIOSH investigators conducted personal dosimetry and hearing tests on nine police officers. In addition, the officers' pre-employment audiograms were obtained from the City of Cincinnati to calculate threshold shifts that occurred since they were hired.

BACKGROUND

The CPCU is one of seven units within the Special Services Section of the Cincinnati Police Department. All police officers, including those assigned to the CPCU, are employees of the City of Cincinnati. The primary responsibility of the CPCU officers is to serve as a back up to the rest of the Cincinnati police force when assistance from a canine is needed to track or corner suspected criminals. Currently, there are nine officers (eight males and one female). They work four shifts: morning (6:00 a.m. to 2:00 p.m. or 10:00 a.m. to 6:00 p.m.), afternoon (1:00 p.m. to 9:00 p.m.), power (7:00 p.m. to 3:00 a.m.), and third (10:00 p.m. to 6:00 a.m.). Because only one officer works each of the two morning shifts, the identity of the officers will be protected in this report by referring to the morning and afternoon shifts as the "Day" shift, and the power and third shifts as the "Night" shift.

The dogs, often referred to as the officers' canine partners, are purebred Alsatians obtained from the Czech Republic. The dogs are trained with the officers and ride in the back of the police car. The back of the car is separated from the front by metal bars. Some dogs bark constantly when in the car. Others bark intermittently when people approach the car or when the siren is on. The dogs are trained to bark on cue as well. According to the police officers, younger dogs are usually quieter than older dogs because they lack the awareness of the potential dangers when in the patrol car. The dogs live with the officers to promote emotional bonding. The officers get an hour credit every day (usually the first hour) for taking care of their dogs. So, they only work for 7 hours on the streets. Once every 2 weeks, the officers participate in a 9-hour refresher training session with their dogs.

METHODS

Noise Assessment

Between April 21, 2006, and July 25, 2006, nine police officers contributed 22 full-shift, personal noise measures. Eight officers contributed two or three measures each; one of the officers contributed one measure.

Quest® Electronics (Oconomowoc, Wisconsin) Model Q-300 Noise Dosimeters were worn by the police officers 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 employee's 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.

Threshold Shifts and Hearing Loss

All police officers of the CPCU were eligible for the hearing tests. Officers reported to the NIOSH facility on Ridge Avenue in Cincinnati, Ohio, when they were available during their work shift. Informed consent was obtained from each participant before they completed a short questionnaire about work history and self assessment of their hearing ability. Study participants also completed a release of information form that allowed NIOSH investigators to obtain their pre-employment audiograms from the City of Cincinnati.

A Tremetric (Eden Prairie, Minnesota) Model AR 901 hearing booth and OSCAR 7 Electro-Acoustic Ear and Octave Monitor provided an acoustic environment for hearing testing. The booth was set up in an enclosed high-bay area at the NIOSH facility. The area was controlled for conversations and other extraneous noises. 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 worker. In addition, each participant was sent a letter summarizing the individual's results along with a copy of the audiometric test.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[1] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[2] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[3] Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91–596, sec. 5(a)(1)]. Thus, employers should understand that not all hazardous agents have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

Noise-induced loss of hearing 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.[4] 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.[5]

The A-weighted decibel [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) 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,[6] and the ACGIH, propose exposure criteria of 85 dBA as a TWA for 8 hours, 5 dB less than the OSHA standard. The criteria also use 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 a 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.[7] 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 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 baseline audiogram. 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. 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 is persistent 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.[8] 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).

RESULTS AND DISCUSSION

Hearing tests were given to nine CPCU police officers over a 2-month period. The median hearing test results and the inter-quartile range are shown in Figure 1. The median hearing levels for the left and right ears appear to be similar at most frequencies, with the right ear performing slightly better at 1000, 2000, and 8000 Hz. The data show a high level of inter-individual variability. The mean age for the nine officers is 40.8 years (range = 33-47 years). These officers have been in law enforcement for a mean of 16 years with a mean time of 7 years as a canine officer.

Three of the nine officers showed some hearing loss as determined by the "single frequency impairment" of 25 dB. When their current audiograms were compared to their pre-employment audiograms, all three showed a worsening of their condition. One officer showed worsening of his hearing levels at 4000, 6000, and 8000 Hz in both ears. His pre-employment audiogram administered in May 1989 showed normal hearing at 4000, 6000, and 8000 Hz. The pre-employment audiogram indicated that the frequency at 3000 Hz was not tested. In November 2001, the officer's hearing was tested again after he complained of earaches following an ear injury during a chase through the woods. The hearing tests showed moderate hearing loss at 3000, 4000, 6000, and 8000 Hz, and threshold shifts (25-35 dB) in each ear at 4000, 6000, and 8000 Hz when compared to the 1989 audiogram. Between November 2001 and July 2006, this officer's hearing continued to deteriorate (5-20 dB shift at 3000, 4000, 6000, and 8000 Hz).

Another officer with mild hearing loss at 3000 Hz and 4000 Hz in his left ear, as shown on the July 2006 audiogram, showed a threshold shift of 30 dB at 4000 Hz. The shift at 3000 Hz could not be determined because this frequency was not tested in the pre-employment audiogram. In addition, this employee's hearing in his left ear worsened at 6000 and 8000 Hz (20 and 25 dB shifts respectively), although the hearing levels were in the normal range.

The third officer's hearing loss is a result of a medical disorder. This officer had mild to profound hearing loss at all frequencies in both ears on the July 2006 audiogram. According to

the officer, this disorder was diagnosed 2-3 years before this evaluation. His pre-employment audiogram taken approximately 20 years ago showed that he had excellent hearing. It is not possible to conclude that the deterioration of his hearing was due solely to the medical disorder or to the medical condition combined with high noise exposure.

One of the police officers who still had normal hearing on the current audiogram, had a 20-dB shift in his right ear at 6000 Hz and a 25-dB shift in the left ear at 8000 Hz. This officer was advised by the NIOSH investigators to protect his hearing to the extent possible by wearing hearing protectors. The remaining five officers had normal hearing on the NIOSH audiograms with no substantial change from their pre-employment audiograms.

This evaluation discovered inconsistent data collection and inadequate quality control of the audiometric testing program by the City of Cincinnati Employee Health Services. In some audiograms reviewed by NIOSH investigators, 3000 Hz was not tested. In other instances, 6000 and 8000 Hz were not tested. Sounds at 3000, 6000, and 8000 Hz are within the human hearing range and employees should be tested at these frequencies to determine if their hearing has deteriorated. In one pre-employment audiogram, multiple hearing levels (10, 20, 30, 40, and 50 dB HL) were marked, as opposed to the conventional method of marking the lowest hearing level that the employee was able to hear. As a result of these inconsistencies, threshold shifts for most of the officers could not be fully determined. The City now uses a microprocessor audiometer similar to the one used in this evaluation. Many of the quality control issues should be resolved with this computerized system. It is important that the technician administering hearing tests be certified by CAOHC and that the audiometer be calibrated on an annual basis.

The success of the hearing test program can be assessed through audits, tabulating hearing shifts, and through audiometric database analysis. These approaches have been compared in the literature[9]; one approach is the audiometric database analysis procedure as defined in a technical report issued by the American National Standards Institute (ANSI) in S12.13 TR-2002, Section 14.[10] The method is practical, can be applied to small worker populations such as the CPCU, and can provide useful feedback.

This evaluation cannot establish an association between officers' hearing loss and the loudness of their canine partners 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 CPCU officers are relatively young, and 3) police officers are exposed to noise from various sources that will confound the effect. However, continued exposure to excessive noise over a working lifetime can potentially result in noise-induced hearing loss.

Of the three officers with hearing loss, only one officer who worked the day shift reported that his dog barks all the time in the car. This officer had a maximum noise exposure of 145% of his daily dose as calculated by the NIOSH criterion. His noise exposure level exceeded the NIOSH REL twice out of three measures. The other two officers with hearing loss mentioned that their dogs bark intermittently, for example when people approach the police vehicle. Both of these officers worked the night shift. Two officers with normal hearing responded that their dogs bark all the time when inside the car. The noise exposures for one of them exceeded the REL's daily allowable dose by more than 5 times (552%). The other officer had daily allowable doses of 110% and 162% as calculated by the NIOSH criterion. Both of these officers worked the day shift. The data (Table 1) show that noise exposures from the canines were higher during the day shift than during the night shift. The median daily allowable dose for the day shift was 110% as opposed to 30% for the median daily allowable dose for the night shift. This could be due to increased stimulation during the day (more traffic, people) that made the dogs excitable and thus bark more often. Regardless, the sample size is insufficient to

draw definite conclusions about noise levels as a function of which shift the officer worked or to what extent dog barking contributed to their hearing loss.

When asked to rate their hearing, three officers (including one with moderate hearing loss) said that they have perfect hearing. Four officers said they have very minor hearing loss (one of these officers had hearing loss), and one each said that they have moderate hearing loss and severe hearing loss. Five of the nine officers (including two with hearing loss) said that they rarely have trouble hearing. Three of the officers, including one with hearing loss, reported occasional difficulty in hearing. One officer with normal hearing reported that he has trouble hearing on a daily basis. Police officers' perception of their hearing was influenced by how their family, friends, and colleagues sometimes responded to them. Table 2 summarizes noise levels, police perception of their hearing, conclusions from the quantitative hearing tests, and shifts worked by each officer.

Previous research has documented a potential for high occupational noise levels to law enforcement officers while conducting traffic stops[11] and from weapons training.[12] Eight of the nine officers in this evaluation said that they have been exposed to weapons fire without hearing protection. Some of the CPCU officers use radio earpieces for communication. These earpieces can generate high noise levels if the radio volume is turned up, potentially damaging the officers' hearing.[13,14] Commercially-available earpieces with compression circuits can compress excessive noise to a safe level before it enters the ear.[15,16] Other occupational noise sources that the officers identified include flash-bangs (also called stun grenades, these are non-lethal devices that create a blinding, deafening explosion when thrown into a room to surprise its occupants), police vehicle sirens, and audible alarms during building searches.

CONCLUSIONS

This evaluation showed that police officers with CPCU are sometimes exposed to hazardous noise levels. Some police officers who participated in this evaluation showed signs of hearing loss; an officer who had normal hearing on his most recent audiogram showed worsening of his hearing when compared to his pre-employment audiogram. However, because of the small sample size, inability to control for other sources of noise, and the relative youth of the officers with respect to time needed to develop hearing loss, it is not possible to draw a definitive conclusion about the association between onset of hearing loss and exposure to noise from canines.

RECOMMENDATIONS

Based on the observations and findings of this evaluation, the following recommendations are offered to better protect the hearing of the police officers with CPCU.

1. Establish a hearing loss prevention program for CPCU officers. The basic elements of the program should, at a minimum, meet the requirements of the OSHA hearing conservation amendment (29 CFR 1910.95). Other sources for defining effective hearing conservation programs are also available.[17,18,19]
2. Work with the City of Cincinnati management on how to improve the quality of the hearing test program for police officers. Hearing tests should be administered by CAOHC-trained technicians and interpreted by audiologists or physicians with expertise in hearing loss. Use the audiometric database analysis procedure such as defined in ANSI S12.13 TR-2002.
3. Ensure that officers wear proper hearing protection devices when training, firing weapons in the range, before throwing flash-bangs, or whenever loud noise is anticipated.
4. Train dogs to be quiet when patrolling.
5. Use radio earpieces with compression circuits to prevent sudden fluctuations in noise levels.

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TABLES

Table 1
Range and (Median) Values of Full-Shift Personal Dosimetry Results Expressed as Percent Dose

Shift*	Number of Measures	Percent Dose**		
		OSHA AL	OSHA PEL	NIOSH REL
Day	9	3.4-46.7 (13.1)	1.7-41.7 (8.4)	21.7-552.5 (109.9)
Night	13	0.3-6.4 (3.1)	0-6.4 (2.0)	3.8-70.4 (29.9)

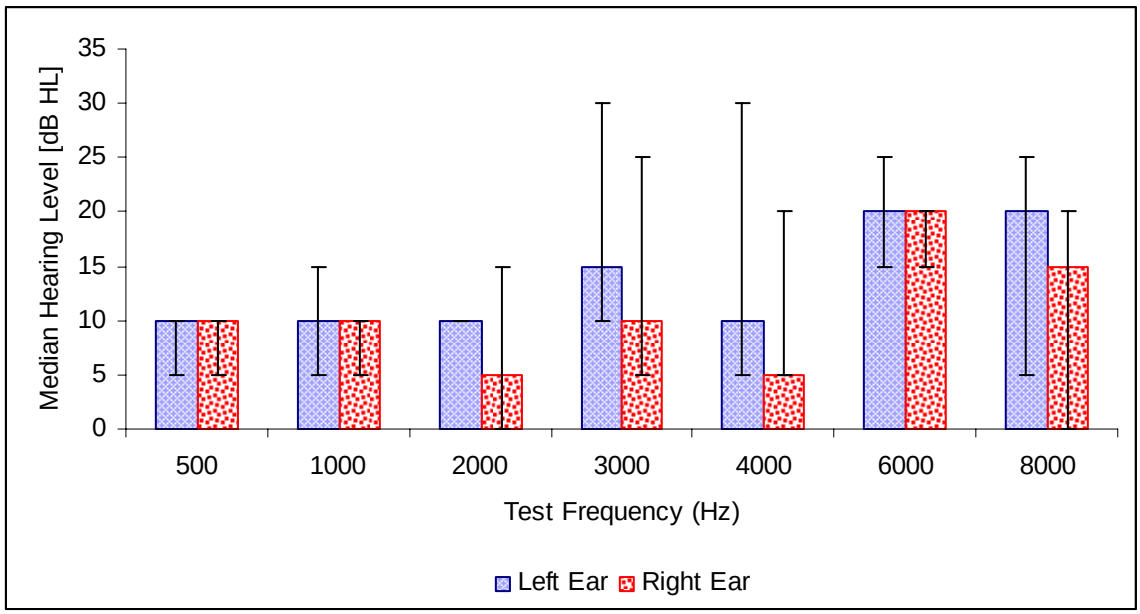
*Day shift includes morning and afternoon shifts (6:00 a.m. to 2:00 p.m.; 10:00 a.m. to 6:00 p.m.; 1:00 p.m. to 9:00 p.m.). Night shift includes power and third shifts (7:00 p.m. to 3:00 a.m.; 10:00 p.m. to 6:00 a.m.)
** The various dose percentages are the amounts of noise accumulated during a work 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

Table 2
Relationship between Noise Levels, Hearing Test Results, and Perception of Hearing Loss
Among Cincinnati Police Canine Unit Officers

Officer ID	Noise Levels	Hearing Test Results	Personal Rating of Hearing	Shift
Officer-A	Low	Mild hearing loss	Minor hearing loss	Night
Officer-B	Low	Moderate hearing loss	Perfect hearing	Night
Officer-C	High	Normal hearing	Perfect hearing	Day
Officer-D	Low	Normal hearing	Perfect hearing	Night
Officer-E	Low	Normal hearing	Minor hearing loss	Night
Officer-F	Low	Normal hearing	Moderate hearing loss	Night
Officer-G	High	Mild-profound hearing loss	Severe hearing loss	Day
Officer-H	High	Normal hearing	Minor hearing loss	Day
Officer-I	Low	Normal hearing	Minor hearing loss	Day

FIGURE

Figure 1
Median Hearing Levels and Inter-Quartile Ranges for Nine Cincinnati Police Canine Unit Officers



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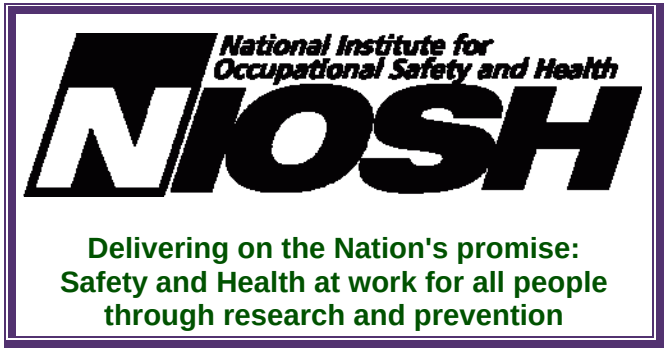

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