

INTRODUCTION

- In the United States (US), the mass transit infrastructure provides affordable transportation for over 33 million riders each weekday.
- There are 15 different subway transit systems in the US, 95 systems worldwide.
- In New York City (NYC) alone, more than 4 million riders use the subway each day; seven worldwide subway systems report over 1 billion riders per year.
- There are roughly 300,000 subway transit workers in the US- 67,000 in NYC.
- Ridership reliance on mass transit may have led to a lack of interest regarding potential health hazards for riders and transit workers.
- One potential health hazard for subway workers, as well as riders, is subway-related noise.
- Excessive exposure to noise can result in noise-induced hearing loss (NIHL), a serious condition affecting >10 million Americans, and an estimated 200 million people worldwide.
- NIHL is one of the top ten priorities for targeted intervention by the US Public Health Service and one of the Key Healthy People Objectives of the US.

STUDY DESIGN

- A protocol to sample environmental noise on NYC subway platforms and inside subway cars was developed. Bus stops near subway systems were also sampled for comparison.
- Noise measurements were made using a Quest 2700 (Type II) sound level meter.
- 57 average sound pressure levels encompassing 377 5-second interval samples were made on platforms in 17 different subway stations. Maximum levels were identified from among the 5-second interval samples comprising each of the 57 measurements.
- Mean maximum levels were also calculated for subway platforms, inside cars and at bus stops.

RESULTS

PLATFORMS

- Mean maximum noise levels ranged from 83 decibels (dB) to 106 dB
- The mean maximum noise level on platforms was 94 dB
- The length of time for the sampling ranged from 20 seconds to 90 seconds, with a mean of 34 seconds

INSIDE SUBWAY CARS

- Mean maximum noise levels ranged from 84 dB to 112 dB
- The mean maximum noise level inside cars was 95 dB
- 20% exceeded 100 dB

BUS STOPS

- The mean maximum noise levels ranged from 76 dB to 89 dB
- The mean maximum noise level of bus stops was 84 dB

Conditions Affecting Levels

PLATFORMS

- Multiple trains entering and leaving the station at the same time
- Squeaking brakes
- Curvature of the tracks
- Air brakes, train horn
- Music in the station (with or without amplifiers, especially saxophone and drums)

INSIDE CARS

- Express trains passing

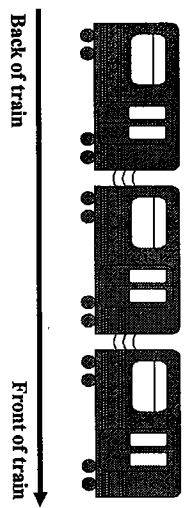
STREET LEVEL (Bus stop noise)

- Emergency sirens
- Garbage trucks idling
- Buses stopping

PLATFORMLOCATION

- Back of the train had the highest mean noise level, although this was not statistically significantly for the other two locations

Figure 1. Direction of Train Movement and Noise



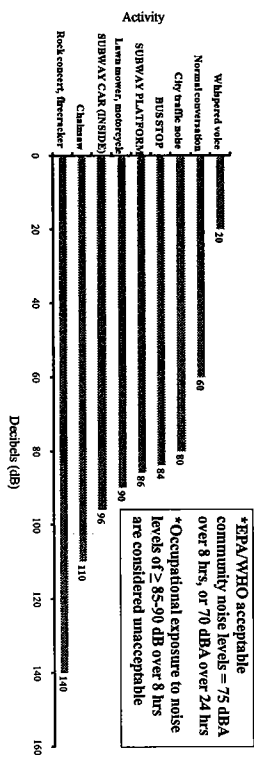
DISCUSSION

- NIHL can result from even a single exposure of very high levels of noise (125-150 dB)
- However, NIHL typically results from long-term repeated exposure to noise levels in excess of 85 dB

- Noise exposure is measured logarithmically; each increase is 10 times higher than the lower bound (e.g., A 90 dB noise is 10 times greater than a 80 dB noise and 100 times greater than a 70 dB noise)

- The mean maximum noise level from subway platform measurements in this study has an allowable exposure duration of about 45 minutes under EPA/WHO limits. Nearly 60% of platform measurements exceeded this level.
- Approximately 20% of subway car measurements exceeded 100 dB, which has a 1.5 min allowable exposure duration under EPA/WHO limits.

Figure 2. Common Noises and Decibel Levels



*EPA/WHO acceptable community noise levels = 75 dBA over 8 hrs, or 70 dBA over 24 hrs
*Occupational exposure to noise levels of 2-85-90 dB over 8 hrs are considered unacceptable

Signs of Hearing Loss*

- Do you have a problem hearing over the telephone?
- Do people complain that you turn the TV volume up too high?
- Do you have to strain to understand conversation?
- Do you have trouble hearing in a noisy background?
- Do you find yourself asking people to repeat themselves?

*Sample questions from The American Speech-Language-Hearing Association (ASHA) Self-Trial.
If you answered yes to more than 2 of these questions, you should have your hearing tested.

- Because NIHL can be incremental, people are often unaware of early hearing loss
- Sensitive hearing tests (audiometric testing) are needed to diagnose hearing loss
- Research on excessive noise exposure has noted adverse impacts to the cardiovascular system and mental health
- Hearing loss has also been associated with adverse effects on interpersonal communication and quality of life and work life

CONCLUSIONS

- Subway transit systems should assess noise levels and implement noise reduction measures (e.g., sound dampening acoustic materials, rubberized rails, improved braking mechanisms etc., where feasible).
- Riders and workers can use personal hearing protection (ear plugs) to reduce noise exposure.
- Personal listening devices- increasingly popular to use are not effective in blocking noise and may increase the risk of noise exposure if played at loud levels.