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# Background Noise Levels in Medical ICU vs. Sleep Polysomnography Examining Room

## **Cover Page Footnote**

Praneet Iyer, M.D.<sup>1</sup>, Amado X. Freire, M.D., M.P.H., D-ABSM, ATS-F,<sup>1,2</sup>, Erica Miller, R. RT.<sup>2</sup>, Elizabeth Burnette, R.N., F-NP.<sup>2</sup>, Regina Laws, R.N., A-NP.<sup>2</sup> Institutions: <sup>1</sup>Division of Pulmonary, Critical Care, and Sleep Medicine, Department of Medicine, University of Tennessee Health Science Center, Memphis, TN; <sup>2</sup>Sleep Disorders Center, Memphis-Veterans Administration Medical Center. Key Words: Background Noise, Medical ICU, Sleep Polysomnography, MSLT

**Background Noise Levels in Medical ICU vs. Sleep Polysomnography Examining Room at the Memphis VAMC.**

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## **Abstract**

**Introduction:** Sleep Centers located in-hospital may produce environmental challenges that can be associated with sleep disruption (i.e. noise) that may threaten MSLT exam accuracy of sleep onset (SO); parameter which quantifies tendency to fall asleep.

**Population and Methods:** Study aims to compare environmental background noise (decibels) from unoccupied rooms in the medical ICU with those in a sleep laboratory suite at times at which daytime sleep studies are usually performed.

**Settings and Data Collection:** Data collected included date, time of measurement of background noise, decibel readings in both the ICU and sleep laboratory examination room. An I-phone application "sound meter" was used to measure noise.

**Statistical Analysis:** The primary outcome data was the decibel measurements in the two environments. Paired t-tests were used to compare noise data. Statview version 5.01 software was used.

**Results:** Measured mean noise level in ICU was 47.14 decibels (SD  $\pm 5.02$ ) compared to the sleep laboratory room 39.6 decibels (SD  $\pm 1.08$ ). Noise levels Mean Difference was 7.54 decibels with a p value of  $<0.0001$ .

**Discussion:** We found a statistically significant difference in noise levels between both hospital environments. Noise levels were measured in the ICU and sleep laboratory during the day in rooms that were unoccupied by patients and neither had any functioning equipment capable of producing noise.

**Conclusion:** Our study showed that in-hospital sleep laboratory polysomnography room noise levels were within the acceptable levels for daytime sleep testing.

**Introduction:**

Objective evaluation of physiological sleepiness is an essential core element of the evaluation of patients with sleep disorders presenting with daytime hypersomnia. This clinical evaluation is performed using the Multiple Sleep Latency Test (MSLT).[1] During this test the staff invites a patient to fall asleep during five 20 minutes daytime naps (separated by two-hour periods) for which environmental noise control is necessary to avoid or limit any stimuli affecting sleep initiation.

Sleep Centers (laboratories) located in-hospital may produce environmental challenges that can be associated with sleep disruption (i.e. noise).[2] Such conditions may threaten the quality and accuracy of the MSLT exam in determining Sleep Onset (SO) that is the parameter which quantifies the tendency to fall asleep.

The World Health Organization (WHO) has provided noise levels acceptable for different scenarios and environments including a quiet room for sleep.[3] In this study we compared noise levels in an in-hospital sleep center PSNG/MSLT examining room with levels encountered in an unoccupied Intensive Care Unit (ICU) room (ICU-background noise load).[4] The goal was to determine if acceptable noise levels are seen in the in-hospital sleep laboratory at times when MSLT naps are usually performed and to find differences, if any, between noise levels in the two hospital environments.

**Population and Methods:**

This study aims to compare the levels of environmental background noise (decibel readings) from unoccupied rooms in the medical ICU with those in an in-hospital sleep laboratory suite. None of the rooms used for decibel recordings were occupied by patients at the time of data collection. The times at which data was collected simulated those at which Multiple Sleep Latency Test (MSLT) or Maintenance of Wakefulness Test (MWT) are usually performed. This study was done as a quality improvement project in the VAMC at Memphis where IRB approval is waived for such projects.

**Settings and Data Collection:** The study area was a patient room in the medical ICU at the VAMC in Memphis. The comparison environment was a suite at the in-hospital sleep laboratory polysomnography examining room. Data collected included date, time of measurement of background noise, decibel readings (primary outcome measurement) in both the ICU and sleep laboratory examination room. An I-phone application "sound meter" was used to measure the background noise.[5] Decibel readings were collected at 8 am, 10 am, Noon, 2 pm and 4 pm for five consecutive days. For the most accurate estimate of what a patient would perceive, the sound meter was placed at the expected patient's head level when lying in bed. To provide precise data on noise levels within this clinical area, a calibrated sound meter was used to assess noise in ICU and the sleep laboratory.

**Statistical Analysis:** The primary outcome data was the decibel measurements in the ICU room and sleep laboratory polysomnography examination rooms. We intended to compare: 1) Overall noise levels between the two environments and 2) establish the

magnitude of difference in decibel measurements in both hospital areas. Paired t-tests were used to compare noise data in both medical ICU and the sleep laboratory. Statview version 5.01 (SAS Institute, Cary, NC) software was used for the statistical analysis.

### **Results:**

We found that the measured mean noise level in ICU was higher at 47.14 decibels (Standard Deviation 5.02) compared to the sleep laboratory polysomnography room which was 39.6 decibels (Standard Deviation 1.08) as shown in table 1. Additionally, the mean difference of noise levels was noted to be 7.54 decibel. This difference was statistically significant with p-value of <0.0001.

Figures 1 and 2 show histograms depicting noise levels in medical ICU and sleep laboratory examination suite respectively.

### **Discussion:**

We compared noise levels in an empty room of our Medical ICU with the hospital Sleep Laboratory Polysomnography room. Our study found a statistically significant difference in noise levels between both hospital environments. The background noise in the ICU was noted to be higher than the Environmental Protection Agency (EPA) recommended levels for hospitals during daytime hours (45 db).[6] Previous published studies have shown noise levels in the ICU to be between 55-65 db (above EPA recommended noise levels).[7-9] In our study we noted that background noise levels in the ICU were lower; compared to published decibels found in manuscripts elsewhere.

Our study has several limitations. Noise levels were measured in the ICU and sleep laboratory during the day as the study was designed to capture background noise data at times during which MSLT/MWT are usually performed. Additionally, noise levels were only measured in rooms that were unoccupied by patients; neither rooms had any functioning equipment (working/active) capable of producing noise. This could have lowered encountered noise levels in our ICU as compared to previous studies elsewhere.[7, 8, 10] The various sources of higher noise in the ICU environment were not determined in our study. Previously, it has been shown that nursing staff conversations/rounds, noise from support equipment and emergencies were the primary cause of higher noise levels in the ICU.

Unfortunately, no specific guidelines exist for noise levels in the Sleep Laboratory Polysomnography rooms which could have been used as reference. We considered WHO guidelines for hospital wards and other rooms to be the norm (daytime noise up-to 40db).[3] Our sleep laboratory room noise levels performed at an acceptable range. Furthermore, the use of earplugs devices may improve the performance of daytime sleep studies by further reducing noise disruptions.[11-13]

Furthermore, sleep deprivation in ICU is associated with poor outcomes and has been extensively reported in the past.[14] It was also noted that when noise levels were measured in rooms with patients and functioning equipment it has far exceeded the levels noted in this study.[10, 15, 16] We believe that adequate measures should be defined and

implemented for hospitals in the United States to reduce noise levels and protect our patients. Additionally, our study shows that other hospital wards are not free of noise and control measures need to be implemented hospital-wide to ensure a healthy noise free environment for patients to avoid sleep/rest disruptions.[17]

**Conclusion:**

Our study showed mean background noise levels in the ICU to be slightly higher than the levels recommended by the EPA and WHO but the in-hospital Sleep Laboratory Polysomnography room noise levels were within the acceptable levels for daytime sleep testing (i.e. MSLT). Further studies are needed to evaluate noise in other areas of hospital and at different times of the day to be used as a benchmark for noise reduction strategies in the hospital environment.

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**Table 1: Noise level difference between ICU and Sleep Laboratory Environment**

	ICU (n=25)	Sleep Laboratory (n=25)	Difference (db)	p value
Mean $\pm$ SD	47.14 ( $\pm$ 5.02)	39.6 ( $\pm$ 1.08)	7.54	< 0.0001

db = Decibels; SD = Standard Deviation

**Figure Captures:**

**Figure 1: Noise levels (db) in the Medical ICU**

**Figure 2: Noise levels (db) in the Sleep polysomnography room**