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“Subarachnoid Precautions” and Sound Levels

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Abstract

Background / Objective.—Patients with aneurysmal subarachnoid hemorrhage (aSAH) may be at risk for complications related to excessive environmental noise. Our ICU utilizes a variety of universal interventions to minimize ambient noise levels, but patients with aSAH additionally have specific orders intended to further minimize physiologic stress and noise exposure. It is unknown whether such orders can have a supplementary reductive effect on noise exposure.

Methods.—Sound levels were measured for at least three consecutive days in the rooms of 17 patients with aSAH and implemented “subarachnoid precautions” orders. Sound levels were similarly recorded in the rooms of 11 geographically-proximate, critically-ill control patients without aSAH.

Results.—Linear mixed models were used to assess the difference in measurements between groups. Observations were combined into fifteen-minute windows, then group means and their differences were calculated and plotted to help identify what times of the day had significant differences. aSAH patients consistently experienced lower sound levels than control patients, with a statistically significant difference ($p < 0.05$) in mean sound levels at 62 of 96 intervals throughout the day. Overall, the mean sound level for aSAH patients was always between 62–63dBA, while the mean sound level experienced by control patients ranged between 64–66dBA.

Conclusions.—Implementation of patient-specific orders can have a supplementary reductive effect on noise exposure for aSAH patients in an intensive care unit that already utilizes universal noise abatement interventions.

Keywords

critical care; critical illness; noise; subarachnoid precautions; subarachnoid hemorrhage

Introduction

It has long been recognized that excessive noise exposure may have adverse effects on the health of hospitalized patients(1). This may in part be due to increased levels of serum cortisol(2) and potentially adrenal catecholamines(3), leading to small-vessel vasoconstriction(4, 5).

Spontaneous aneurysmal subarachnoid hemorrhage (aSAH) is a type of stroke that is associated with a unique delayed cause of morbidity: cerebral vasospasm, a type of inflammatory intracerebral vasoconstriction which can contribute to delayed cerebral ischemia (DCI) and worsened clinical outcomes(6). Early rebleeding from the aneurysm site is another major cause of death or neurologic decline among patients with aSAH(7). The risk of rebleeding from an unsecured (unclipped or uncoiled) aneurysm has been proposed to be at least partially related to systemic blood pressure (and thus trans-luminal pressure at the aneurysm site), and the later risk of vasospasm has been proposed to be at least partially related to a hyperinflammatory state due to physiologic stress. Serum cortisol levels may be associated with and contribute to the risk of vasospasm(8–10).

Many neurosurgical centers therefore routinely institute so-called “aneurysm precautions” or “subarachnoid precautions” after a patient is admitted with a diagnosis of aSAH (11). Such precautions typically include a defined period of bedrest and limitations on the amount of activity, noise, light, and the number of visitors a patient may receive. Noise restrictions are implemented based on the theory that greater amounts of noise and aural stimulation may raise blood pressure (12) (13) and increase physiologic stress, thereby potentially increasing the risk of re-bleeding or later vasospasm. Data demonstrating the effectiveness of such patient-level precautions is lacking, however.

Given the recognized potential adverse effects of excessive noise levels on patient physiology and health, a variety of centers have implemented strategies intended to reduce overall noise levels and published their results (14) (15) (16) (17). Although some centers have specifically examined sound levels in reference to neuroscience patients (18, 19) – including those with traumatic or hemorrhagic brain injury (20) – to our knowledge, no-one has yet studied the potential for a supplementary reductive effect on noise level from “subarachnoid precautions” or other patient-specific orders in care units that *already* implement global noise abatement strategies.

To evaluate the effectiveness of our “subarachnoid precautions” in limiting noise levels experienced by patients admitted with spontaneous aneurysmal subarachnoid hemorrhage, we undertook a quality improvement project to measure sound levels in aSAH patient rooms with active “subarachnoid precautions” orders, and compared these to the sound levels in geographically-proximate intensive care unit rooms without aSAH patients. Results are reported according to Standards for Quality Improvement Reporting Excellence (STROBE 2.0) criteria(21). The aim of this study was to determine whether implementation of patient-specific orders can have a supplementary reductive effect on noise exposure for patients in an intensive care unit that already utilizes universal noise abatement interventions.

Methods

All observations were undertaken as a quality improvement project, and no identifiable patient data was collected. The project was therefore deemed to be exempt from IRB approval. Using a Larson Davis Spark 703+ noise dosimeter (PCB Piezotronics, Provo, UT; Figure 1), we measured sound levels in the rooms of a randomly-selected set of patients admitted with aSAH (n=17) as well as in the rooms of control patients without aSAH (n=11) in the surgical and neurosciences ICU of a large academic medical center in the Midwest. All aSAH patients had orders for our typical “subarachnoid precautions” to be employed. These precautions include maintaining patients in private rooms when possible; closing doors to try to minimize ambient sound from the unit and nursing station; strictly denying access to television, radios, or other sound-producing devices; limiting visitors to patient rooms; discouraging extensive in-room conversations; and placing placards on the patient’s door and in the room announcing the importance of maintaining low ambient noise levels. Control patients had none of these specific precautions, but did benefit from the general noise-limiting provisions standard to our ICU. These universal noise abatement strategies include posted signage encouraging quiet conversation, closure of hallway doors, architectural changes to distance physician and nursing work areas from close proximity to patient rooms, mandated “quiet time / lights off” periods, dispensation of earplugs at night, and, when necessary, active person-to-person reminders to limit excessively noisy activity.

Sound level meters were introduced to patient rooms within 24 hours of admission, although there was no standardization or protocolization to the time of day or clinical condition of patients when the meters were initiated. Microphones were placed within 12 inches of the patient’s head and the sound meter was secured to the bedframe. The sound meter measured the decibel levels in the room every 5 seconds and stayed in place for at least 72 hours. Leaving the sound meter in place for this length of time provided us tens of thousands of data points per patient. A-weighting of decibel measurements (dBA) was used because this type of sound level weighting helps to approximate sounds heard by the human ear, is used widely in practice, and is recommended by the World Health Organization (WHO)(22).

Linear mixed models were used to assess the difference in measurements between the aSAH and control groups while accounting for repeated measurements on all subjects.

Observations were combined into 96 fifteen-minute windows to be used as a categorical predictor in our model. Group, time, and their interaction were included as model covariates to allow for group comparisons at every time window. Group means and their differences were calculated and plotted to help identify what times of the day have significant differences. We conclude a significant group difference for comparisons with two-tailed p-values below 0.05.

Results

The differences, confidence intervals, and p-values at each fifteen-minute interval are listed in Table 1 (morning) and Table 2 (afternoon / evening), with significant differences ($p < 0.05$) highlighted. Repeated measures made over the course of the three days are averaged to yield a representative 24 hr period of time. A statistically significant difference in noise

levels is noted over most (62 of 96) time intervals in a representative day, except in the early morning between 02:00 and 06:00. A plot of mean measurements and 95% confidence intervals (CI), by time of day, are shown in Figure 2.

The 95% CI for the lower level of sound exposure was never less than 59dBA among aSAH patients, and never less than 60dBA in control patients. The highest recorded sound level deemed non-artifactual that lasted greater than five seconds was 109.5 dBA, and this was presumed to be due to infusion pump alarm. In a few patients, noise levels >90dBA lasted >30sec. Overall, the mean sound level for aSAH patients was between 62–63dBA for aSAH patients at all time points, while the mean sound level experienced by control patients ranged between 64–66dBA. At least one patient was exposed to sustained noise levels >85dBA for multiple periods in an hour. In both aSAH and control groups, 0.02% of all noise measurements exceeded 85dBA, with a p-value of 0.242 based on a Pearson's chi-square test of independence.

Discussion

Our examination of sound levels shows that patient-level “subarachnoid precautions” orders can have a supplementary reductive effect on noise exposure for aSAH patients in an intensive care unit that already utilizes universal noise abatement interventions, with a statistically significant difference seen in mean sound levels at most times of day. The largest time window without significance is from 02:00 and 06:00. This loss of significance seems to be driven by a decrease in mean sound levels among control patients, rather than an increase in sound levels among aSAH patients.

Most critically ill patients in our combined surgical and neurosciences ICU are placed in “shared” rooms with open doors and only a curtain separating roommates. This is in distinction to aSAH patients, who, per our policy and “subarachnoid precautions” order sets, are consistently housed in private, darkened rooms. Regardless of neurologic status, aSAH patients under our “subarachnoid precautions” are not allowed to read, watch TV, talk on the phone, or listen to music. They are placed on complete bedrest and the number of visitors is strictly limited. Complete neurologic exams are performed by nursing staff every 2 hours in aSAH patients, and routine neurologic exams are performed daily by physicians usually before 6am, whereas neurologic exams are performed less frequently among critically ill patients without neurologic disease. Daily labs are drawn around 04:00 in all patients. Shift change, when the unit is “busiest” with conversation in or outside patient rooms, is at 07:00 and 19:00. In other words, our data suggest that “subarachnoid precautions” have the *least* benefit relative to our standard noise-abatement strategies during times of day when there is likely to be active bedside patient care or evaluation – although not because sound levels are higher in aSAH patient rooms during these time periods, but rather because sound levels are *lower* in control patient rooms. It has been previously noted that there is no significant reduction in overnight activity in ICUs(23), and bedside monitor and syringe pump alarms are unlikely to have a circadian pattern of when they go off or be associated with the degree of active bedside patient care. Therefore, we can hypothesize that noise levels in non-aSAH patients decrease to levels seen in patients with active “subarachnoid precautions” in the early morning hours because their rooms “look” like SAH rooms during those hours:

televisions are also off, visitors are unlikely to be present, doors may be closed to facilitate sleep, nurses may be trying not to disturb sleeping patients even while drawing labs, etc. This finding also suggests, however, that there is a “floor” to achievable noise levels in our ICU: the noise levels experienced by patients with active “subarachnoid precautions” orders (which so aggressively limit potential sources of stimulation and sound in patient care rooms) may be as low as are technically possible in the context of necessary bedside alarms and patient care. Previous studies have also provided evidence for such a supposition, with one study noting that the majority of loud sounds in ICUs probably come from either appropriate communication between caregivers and patients or from equipment alarms(24).

Noise is measured on a logarithmic scale of decibels. A 10-dBA increase in noise perceived as a doubling of volume, a 5-dBA increase in noise considered clearly discernible, and a 3-dB change in noise level considered just barely discernible (25). Our data shows that the mean sound level for aSAH patients tends to consistently be only about 2.5–3dBA below the control group throughout all time periods of the day, with the 95% lower confidence interval of mean differences never greater than 6dBA. This means that the noise difference between an aSAH and control critically-ill patient in our unit would most likely be considered somewhere between “just barely” and “clearly” discernible. It is not clear whether this difference should be considered clinically meaningful.

The original rationale behind “subarachnoid precautions” was to try to decrease the risk of complications associated with hypertension and adrenergic stimulation(11), but the data supporting such practices are not strong. Indeed, interventions potentially antithetical to classic “subarachnoid precautions” – such as increased mobility and daytime stimulation (26) and ensuring the availability of personal sensory equipment such as hearing aids (27) – have been demonstrated to have a beneficial effect on patient outcomes in a variety of critical and non-critical illnesses. Although early mobility and sensory stimulation have not been studied specifically in the context of aSAH, national guidelines for the critical care management of aSAH no longer make recommendations to limit activity or sensory stimulation(28, 29). Our data show that while patient-level “subarachnoid precaution” orders can be effective in further lowering noise exposure among aSAH patients, the magnitude of decrease is disappointing and may be barely discernible. In this context, it may be worth reassessing the expected value in maintaining “subarachnoid precautions” despite the presumed benefits in decreasing the risk of vasospasm. We did not record data on patient outcomes, and do not know whether aSAH patients with lower mean volume exposures had a lower rate of vasospasm or other complications.

The main focus of this observational study was to evaluate our capacity to further minimize ICU sound levels experienced by aSAH patients with the implementation of patient-level “subarachnoid precaution” orders. However, it is worth noting that our data – like many published reports prior to ours – documented both that sound levels in the ICU consistently greatly exceeded recommended average levels for hospitals, and that several of our patients experienced potentially dangerous sound exposure. Since 1999, the WHO has recommended that average hospital noise levels not exceed 35 dB (30). For comparison purposes, a sound level of 60 dBA is equivalent to normal conversation while a level of 110 dBA is equivalent to shouting. Sustained occupational and recreational exposure to sounds in excess of 85dBA

is associated with the risk of permanent hearing changes, and this relationship exhibits a dose-response relationship (31). For example, for listeners exposed to a time-weighted average of 85 dBA, the maximum allowable daily dose under National Institute of Occupational Safety and Health (NIOSH) recommendations is 8 hours. For every 3dBA increase, the allowable dose is cut in half (32). While the windows of intense sound levels in our sample were brief and rarely contiguous in time, the safe exchange rate suggests that several patients (in both the aSAH and control groups) experienced potentially dangerous sound exposure. Figure 3 shows the count of sound measurements in excess of 85dBA and 100dBA per hour in our dataset.

ICU sources of intense sounds include audible alarms, mechanical ventilation equipment, overhead communication systems, and staff talking(33). Aside from their acoustic intensity, the frequency of intense alarm signals in the ICU has previously been identified as problematic due to the risk of misidentification by the acoustic signal alone(34), and that ICU staff habituate to alarm signals due to false alarms(35). Several noise sources can be addressed through behavior and environmental modification strategies such as choosing optimized and patient-specific alarm settings on monitors and positioning staff work areas outside patient rooms(33, 36). For older patients who come into the ICU environment with pre-existing hearing loss, providing consistent access to an individual patient's hearing technology (i.e., hearing aids) may reduce the need for raised voices among family and staff during care.

There are several limitations to our study. Because we left the sound level meters in place for several days and did not monitor them constantly, it is possible that some data may have been erroneous due to artifact from patient care (unintentional movement or contact with the microphone for instance). We did our best to avoid this by educating unit nurses on the microphone position and the reason for data collection. Secondly, although our institution is a high volume center, our study is still limited to a small sample size due to the rare incidence of aSAH. Strengths of our study include robust statistical sampling of near-continuous data points, and the ability to obtain sound levels at a patient level – as opposed to intermittent sampling from central common areas, as most previous studies have done.

Conclusion

Our results demonstrate that patient-level “subarachnoid precautions” orders can have a supplementary reductive effect on noise exposure for aSAH patients in an intensive care unit that already utilizes universal noise abatement interventions. However, the magnitude of change is relatively low – only slightly above a level considered to be a “barely perceptible” difference in volume – and the clinical significance of this change is unclear. Further, even with aggressive measures to limit noise exposure at both the global unit and patient-specific level, average sound levels greatly exceeded guideline-recommended levels for hospitals.

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Figure 1:

A Larson Davis Spark 703+ noise dosimeter (PCB Piezotronics, Provo, UT) was attached to the bedframe of randomly selected patients with aneurysmal subarachnoid hemorrhage and active “subarachnoid precautions” orders, and of control critically ill patients in the same critical care unit who did not have specific noise- and activity-limiting orders.

Figure 2:

Thousands of noise level observations were combined into 96 fifteen-minute windows. Repeated measures made over the course of multiple days were averaged by time of day to yield a representative 24 hour period of time. Mean A-weighted decibels (dBA) in each 15 minute windows throughout this representative time period are represented by the upper and lower thick black lines for control and subarachnoid hemorrhage patients, respectively. The sum of the two darkest gray shaded areas represents the 95% confidence area for control patients, and the sum of the darkest and lightest shaded area represents the 95% confidence interval for patients with subarachnoid hemorrhage. The darkest shaded area represents overlap between the noise levels experienced by control and subarachnoid hemorrhage patients.

Figure 3:

Average number of times per hour (from measurements obtained every 5 seconds) when peak values above 85 A-weighted decibels (dBA) and above 100 dBA were recorded in patient rooms.

Table 1:

Group means and confidence intervals of A-weighted decibel (dBA) levels are shown for each 15 minute window during the first 12 hours of a 24 hour day. The differences, confidence intervals, and p-values are also included with significant differences ($p < 0.05$) highlighted.

Time (AM)		SAH dbA levels			Control dBA levels			Difference (SAH - Control)			
Start	End	Mean	95% CI Lower	95% CI Upper	Mean	95% CI Lower	95% CI Upper	Mean	95% CI Lower	95% CI Upper	p-value
0:00	0:15	62.42	59.94	64.89	65.03	63.11	66.96	-2.61	-5.34	0.11	0.0601
0:15	0:30	62.76	60.47	65.06	64.68	62.23	67.13	-1.91	-4.73	0.90	0.1824
0:30	0:45	62.65	60.29	65.00	64.72	62.58	66.87	-2.08	-4.85	0.69	0.1419
0:45	1:00	62.56	60.31	64.81	65.18	63.53	66.83	-2.62	-5.21	-0.02	0.0480
1:00	1:15	62.57	60.30	64.83	65.23	63.67	66.78	-2.66	-5.22	-0.11	0.0411
1:15	1:30	62.51	60.18	64.84	65.22	63.66	66.79	-2.72	-5.31	-0.13	0.0398
1:30	1:45	62.42	60.05	64.79	65.18	63.62	66.74	-2.77	-5.40	-0.13	0.0395
1:45	2:00	62.45	60.15	64.76	65.21	63.60	66.83	-2.76	-5.36	-0.16	0.0371
2:00	2:15	62.53	60.27	64.80	65.05	63.15	66.95	-2.52	-5.13	0.09	0.0587
2:15	2:30	62.60	60.36	64.83	64.26	61.34	67.18	-1.67	-4.90	1.56	0.3116
2:30	2:45	62.45	60.05	64.85	64.11	60.94	67.28	-1.66	-5.10	1.79	0.3454
2:45	3:00	62.44	60.13	64.75	64.35	61.64	67.07	-1.92	-5.05	1.21	0.2302
3:00	3:15	62.54	60.28	64.80	64.66	62.40	66.92	-2.12	-4.94	0.71	0.1426
3:15	3:30	62.63	60.42	64.84	64.08	60.84	67.31	-1.45	-4.87	1.96	0.4048
3:30	3:45	62.48	60.18	64.77	64.42	61.65	67.18	-1.94	-5.03	1.15	0.2179
3:45	4:00	62.56	60.29	64.84	64.92	62.90	66.95	-2.36	-5.01	0.28	0.0801
4:00	4:15	62.52	60.29	64.75	64.91	62.37	67.46	-2.39	-5.25	0.47	0.1009
4:15	4:30	62.66	60.49	64.83	64.56	61.90	67.23	-1.90	-4.85	1.05	0.2058
4:30	4:45	62.69	60.47	64.90	64.39	61.54	67.24	-1.71	-4.87	1.46	0.2903
4:45	5:00	62.75	60.57	64.94	65.24	63.64	66.83	-2.48	-4.97	0.01	0.0507
5:00	5:15	62.58	60.38	64.77	65.06	63.27	66.86	-2.49	-5.08	0.10	0.0600
5:15	5:30	62.68	60.51	64.85	64.58	62.12	67.05	-1.91	-4.83	1.02	0.2023
5:30	5:45	62.84	60.76	64.92	64.80	62.72	66.89	-1.97	-4.63	0.70	0.1488
5:45	6:00	62.82	60.68	64.95	64.98	62.98	66.98	-2.16	-4.78	0.45	0.1049
6:00	6:15	62.72	60.58	64.85	65.17	63.69	66.66	-2.46	-4.84	-0.07	0.0439
6:15	6:30	62.58	60.41	64.75	65.23	63.81	66.66	-2.65	-5.07	-0.24	0.0315
6:30	6:45	62.55	60.32	64.78	65.53	64.21	66.84	-2.98	-5.42	-0.54	0.0168
6:45	7:00	62.57	60.45	64.69	65.52	64.27	66.77	-2.95	-5.26	-0.64	0.0123
7:00	7:15	62.36	60.21	64.52	65.56	64.22	66.91	-3.20	-5.46	-0.94	0.0055
7:15	7:30	62.57	60.52	64.63	65.40	64.02	66.78	-2.83	-5.09	-0.56	0.0145
7:30	7:45	62.72	60.75	64.69	65.55	64.25	66.85	-2.83	-5.03	-0.63	0.0119
7:45	8:00	62.55	60.49	64.61	65.02	63.04	67.00	-2.47	-4.94	0.01	0.0506
8:00	8:15	62.63	60.54	64.71	65.44	63.96	66.91	-2.81	-5.10	-0.52	0.0162
8:15	8:30	62.50	60.29	64.71	65.52	63.87	67.17	-3.02	-5.60	-0.43	0.0221
8:30	8:45	62.41	60.22	64.60	65.68	64.14	67.23	-3.27	-5.77	-0.78	0.0101
8:45	9:00	62.44	60.20	64.68	65.65	64.18	67.12	-3.21	-5.60	-0.82	0.0085

Time (AM)		SAH dbA levels			Control dbA levels			Difference (SAH - Control)			
Start	End	Mean	95% CI Lower	95% CI Upper	Mean	95% CI Lower	95% CI Upper	Mean	95% CI Lower	95% CI Upper	p-value
9:00	9:15	62.77	60.56	64.99	65.95	64.99	66.92	-3.18	-5.48	-0.88	0.0067
9:15	9:30	62.72	60.40	65.05	65.78	64.54	67.02	-3.06	-5.54	-0.57	0.0159
9:30	9:45	62.62	60.27	64.97	65.60	64.03	67.17	-2.98	-5.78	-0.19	0.0362
9:45	10:00	62.78	60.50	65.07	65.52	64.21	66.83	-2.74	-5.29	-0.19	0.0351
10:00	10:15	62.67	60.47	64.87	65.46	64.08	66.84	-2.79	-5.24	-0.34	0.0255
10:15	10:30	62.62	60.34	64.90	65.51	64.03	66.98	-2.88	-5.39	-0.37	0.0245
10:30	10:45	62.64	60.33	64.95	65.65	64.42	66.88	-3.01	-5.56	-0.45	0.0211
10:45	11:00	62.77	60.49	65.04	65.24	63.74	66.75	-2.48	-5.10	0.14	0.0638
11:00	11:15	62.55	60.19	64.92	65.47	64.31	66.62	-2.91	-5.45	-0.37	0.0247
11:15	11:30	62.66	60.36	64.96	65.35	63.96	66.73	-2.69	-5.37	-0.01	0.0493
11:30	11:45	62.75	60.43	65.08	65.41	64.02	66.80	-2.66	-5.27	-0.05	0.0460
11:45	12:00	62.91	60.74	65.08	65.47	64.15	66.79	-2.56	-4.98	-0.13	0.0386

Table 2:

Group means and confidence intervals of A-weighted decibel (dBA) levels are shown for each 15 minute window during the afternoon and evening 12 hours of a 24 hour day. The differences, confidence intervals, and p-values are also included with significant differences ($p < 0.05$) highlighted.

Time (PM)		SAH dBA levels			Control dBA levels			Difference (SAH - Control)			
Start	End	Mean	95% CI Lower	95% CI Upper	Mean	95% CI Lower	95% CI Upper	Mean	95% CI Lower	95% CI Upper	p-value
12:00	12:15	63.00	60.87	65.13	65.45	64.19	66.70	-2.45	-4.78	-0.11	0.0401
12:15	12:30	63.04	60.87	65.20	65.38	64.28	66.49	-2.35	-4.70	0.00	0.0502
12:30	12:45	62.74	60.50	64.99	65.64	64.52	66.76	-2.90	-5.23	-0.57	0.0147
12:45	13:00	63.00	60.89	65.11	65.47	64.23	66.72	-2.48	-4.77	-0.18	0.0344
13:00	13:15	62.87	60.68	65.05	65.23	63.71	66.75	-2.36	-4.77	0.05	0.0551
13:15	13:30	62.92	60.75	65.09	65.25	63.55	66.95	-2.34	-4.74	0.07	0.0565
13:30	13:45	62.87	60.62	65.12	65.43	64.01	66.85	-2.56	-4.95	-0.16	0.0363
13:45	14:00	62.56	60.28	64.84	65.55	64.37	66.74	-3.00	-5.36	-0.63	0.0129
14:00	14:15	62.53	60.24	64.82	65.57	64.18	66.96	-3.04	-5.51	-0.57	0.0160
14:15	14:30	62.56	60.20	64.92	65.59	64.40	66.78	-3.03	-5.54	-0.52	0.0181
14:30	14:45	62.64	60.40	64.87	65.37	63.69	67.04	-2.73	-5.28	-0.18	0.0361
14:45	15:00	62.61	60.42	64.79	65.22	63.66	66.79	-2.62	-5.06	-0.18	0.0356
15:00	15:15	62.64	60.47	64.80	65.05	63.39	66.72	-2.42	-5.10	0.27	0.0774
15:15	15:30	62.42	60.25	64.59	65.21	63.88	66.55	-2.79	-5.26	-0.33	0.0265
15:30	15:45	62.20	59.87	64.53	65.32	63.84	66.80	-3.12	-5.65	-0.60	0.0154
15:45	16:00	62.18	59.84	64.51	65.36	63.98	66.74	-3.18	-5.62	-0.75	0.0104
16:00	16:15	62.58	60.45	64.71	64.87	63.31	66.43	-2.29	-4.65	0.06	0.0566
16:15	16:30	62.45	60.35	64.55	64.69	63.05	66.34	-2.24	-4.65	0.16	0.0673
16:30	16:45	62.38	60.16	64.59	65.00	63.42	66.58	-2.62	-5.04	-0.20	0.0340
16:45	17:00	62.28	60.09	64.48	65.06	63.55	66.56	-2.77	-5.22	-0.33	0.0263
17:00	17:15	62.36	60.18	64.54	65.14	63.62	66.66	-2.78	-5.16	-0.40	0.0220
17:15	17:30	62.30	60.06	64.54	64.68	63.02	66.35	-2.38	-4.93	0.16	0.0666
17:30	17:45	62.19	59.84	64.54	64.65	63.04	66.26	-2.46	-5.08	0.16	0.0653
17:45	18:00	62.40	60.06	64.73	64.64	62.66	66.61	-2.24	-4.95	0.46	0.1039
18:00	18:15	62.08	59.66	64.51	64.85	63.10	66.60	-2.77	-5.48	-0.05	0.0458
18:15	18:30	61.97	59.62	64.33	65.13	63.73	66.52	-3.15	-5.67	-0.64	0.0140
18:30	18:45	62.19	59.87	64.51	64.94	63.33	66.54	-2.75	-5.47	-0.03	0.0477
18:45	19:00	62.33	60.06	64.59	64.89	63.22	66.55	-2.56	-5.30	0.18	0.0673
19:00	19:15	62.26	60.10	64.43	64.81	63.46	66.16	-2.55	-4.83	-0.27	0.0284
19:15	19:30	62.41	60.25	64.57	65.12	63.68	66.56	-2.71	-4.98	-0.43	0.0196
19:30	19:45	62.41	60.23	64.60	65.00	63.42	66.58	-2.59	-5.04	-0.13	0.0387
19:45	20:00	62.34	60.10	64.58	64.89	63.32	66.45	-2.55	-5.02	-0.08	0.0431
20:00	20:15	62.69	60.64	64.75	64.90	63.05	66.75	-2.21	-4.55	0.14	0.0655
20:15	20:30	62.91	60.84	64.97	65.10	63.21	67.00	-2.20	-4.65	0.26	0.0796
20:30	20:45	62.91	60.83	64.98	65.30	63.82	66.78	-2.39	-4.68	-0.11	0.0402
20:45	21:00	62.72	60.53	64.91	65.11	63.60	66.62	-2.39	-4.81	0.03	0.0530

Time (PM)		SAH dBA levels			Control dBA levels			Difference (SAH - Control)			
Start	End	Mean	95% CI Lower	95% CI Upper	Mean	95% CI Lower	95% CI Upper	Mean	95% CI Lower	95% CI Upper	p-value
21:00	21:15	62.47	60.24	64.69	65.06	63.48	66.65	-2.60	-5.01	-0.18	0.0350
21:15	21:30	62.28	60.05	64.52	65.35	64.05	66.65	-3.07	-5.44	-0.69	0.0114
21:30	21:45	62.28	60.01	64.56	65.31	63.97	66.65	-3.02	-5.43	-0.61	0.0141
21:45	22:00	62.53	60.41	64.65	65.35	63.88	66.82	-2.82	-5.02	-0.63	0.0118
22:00	22:15	62.46	60.28	64.64	65.00	63.23	66.77	-2.54	-4.88	-0.21	0.0329
22:15	22:30	62.52	60.44	64.60	65.04	63.41	66.66	-2.51	-4.82	-0.21	0.0328
22:30	22:45	62.15	59.85	64.44	65.07	63.41	66.72	-2.92	-5.51	-0.34	0.0268
22:45	23:00	62.00	59.60	64.40	65.10	63.49	66.72	-3.11	-5.78	-0.44	0.0226
23:00	23:15	61.98	59.56	64.40	65.01	63.22	66.80	-3.03	-5.78	-0.28	0.0306
23:15	23:30	61.90	59.41	64.40	64.95	63.11	66.78	-3.04	-5.84	-0.24	0.0334
23:30	23:45	62.14	59.64	64.64	65.38	63.89	66.87	-3.24	-5.92	-0.57	0.0176
23:45	0:00	62.23	59.75	64.71	65.32	63.83	66.81	-3.09	-5.73	-0.46	0.0215