Nighttime Care Routine Interaction and Sleep Disruption in Adult Cardiac Surgery

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Authors' Qualifications

Dr. Casida is nationally known for his clinical expertise and research in adult cardiac surgery. He served as a founding member of the American Association of Critical-Care Nurses Adult Cardiac Surgery Nursing Certification Exam Development Committee. Dr. Casida is also known for his pioneering work on self-management and symptom science in mechanical circulatory support.

Dr. Davis has a long-standing program of research and scholarship on biobehavioral and physiological nursing. Much of her work has been centered on sleep and sleep outcomes in vulnerable populations.

Mr. Zalewski, a former Hillman Scholar, worked with Dr. Casida as his research assistant at the University of Michigan. He is currently working as a staff RN in the cardiac surgery step-down unit at the University of Wisconsin Hospital in Madison, Wisconsin.

Dr. Yang is a statistician who specializes in statistical consulting and genetic data analysis. He has published his methodological work in high impact journals of statistical science such as Bioinformatics and Genetic Epidemiology.

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Article type : Original Article

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Aims and Objectives: To explore the context and the influence of nighttime care routine interactions (NCRIs) on nighttime sleep effectiveness (NSE) and daytime sleepiness (DSS) of patients in the cardiac surgery critical-and progressive-care units of a hospital.
Background: There exists a paucity of empirical data regarding the influence of NCRIs on sleep and associated outcomes in hospitalized adult cardiac surgery patients.
Methods: An exploratory repeated measures research design was employed on the data provided by 38 elective cardiac surgery patients (mean age 60.0 ± 15.9 years). NCRI forms were completed by the bedside nurses and patients completed a 9-item Visual Analog Sleep Scale (100 mm horizontal lines measuring NSE and DSS variables). All data were collected during post-operative nights/days (PON/POD) 1 through 5, and analyzed with IBM SPSS software.
Results: Patient assessment, medication administration, and laboratory/diagnostic procedures were the top 3 NCRIs reported between midnight and 6:00 am. During PON/POD 1 through 5, the respective mean NSE and DSS scores ranged from 52.9 ± 17.2 to 57.8 ± 13.5 and 27.0 ± 22.6 to 45.6 ± 16.5. Repeated measures ANOVA showed significant changes in DSS scores ($p < .05$). NSE and DSS were negatively correlated ($r = -.44$, $p < .05$), but changes in NSE scores

were not significant ($p > .05$). Finally, out of 8 NCRIs, only 1 (post-operative exercises) was significantly related to sleep variables ($r > .40$, $p < .05$).

Conclusion and Relevance to Clinical Practice: Frequent NCRIs are a common occurrence in cardiac surgery units of a hospital. Further research is needed to make a definitive conclusion about the impact of NCRIs on sleep/sleep disruptions and daytime sleepiness in adult cardiac surgery. Worldwide, acute and critical-care nurses are well positioned to lead initiatives aimed at improving sleep and clinical outcomes in cardiac surgery.

Keywords: Acute Care, Adult Nursing, Cardiovascular, Care Activities, Critical Care, Sleep Disturbance, Sleep Quality, Surgical Nursing

BACKGROUND

Sufficient sleep is a basic human need essential for restoring the body's homeostatic function altered by illness, injury, or surgery (Friese, 2008; Buysee, 2014). However, insufficient sleep is common in patients who have undergone cardiac surgery, despite the remarkable advancements in surgical techniques (Bojar, 2011) and the availability of private rooms in the cardiac surgery critical- and progressive-care units of hospitals (Thompson et al., 2012). In fact, sleep disruption remains a major problem reported by patients and is highly prevalent in adult cardiac surgery. Studies show that over 80% of adults, 30 years and older, had sleep disruptions during the first week after cardiac surgery. In these studies, nearly 70% of adults who had coronary artery bypass and/or heart valve surgery continued to be sleep deprived up to 6 months after hospitalization (Liao, Huang, Huang, & Hwang, 2011; Propper, van Domburg, Brunott, & Bogers, 2015; Yang, Huang, Tsai, & Lou, 2015).

In cardiac surgery, sleep disruption is characterized by the patient's inability to initiate and maintain sleep (Liao et al., 2011; Propper et al., 2015; Yang et al., 2015). Sleep disruption is a multidimensional phenomenon stimulated by a myriad of factors including, but not limited to, pain, anxiety, stress, and inflammatory response post cardiopulmonary bypass (Casida & Nowak, 2011; Casida, Davis, Spakoff, & Yarandi, 2014). Additionally, noise level and bright lighting practices are common environmental factors known to disrupt the sleep of patients recovering from cardiac surgery (Casida & Nowak, 2011). Within the environments of care, however, the context of care provider interactions during patients' sleeping hours and the impact of such interactions on sleep and sleep outcomes in cardiac surgery are still understudied (Casida & Nowak, 2011).

While nighttime routine care interactions (NCRIs) have been proposed as a major environmental factor affecting the sleep of patients confined in acute and critical-care units

(Tamburri, DiBrienza, Zozulla, & Redeker, 2004; Bihari et al., 2012), there exists a paucity of this information in the adult cardiac surgery unit. Through an extensive literature search, we found three studies that specifically addressed the influence of care interactions on sleep disturbances in cardiac surgery. Investigators in these studies, which were published from 1996 to 2012, had employed either retrospective (Simpson, Lee, & Cameron, 1996) or cross-sectional research designs (Makic, Rauen, Watson, & Poteet, 2014; Le et al., 2012) focusing on care interactions in critical-care units. These studies found significant relationships among procedures on patients, sleep effectiveness, and sleep length. Although two studies (Simpson et al., 1996; Let et al., 2012) did not provide sleep data, investigators found care interactions were more frequent at midnight and less frequent at 3:00 AM. Additionally, the frequency of care interactions in cardiac surgery critical-care was significantly higher than the frequency of care interactions occurring in the general surgical, medical, pediatric, and neonatal critical-care units (Let et al., 2012).

The objective of this study was to address the dearth of information about the context and the influence of the care environment on the patients' sleep in cardiac surgery units of hospitals. The specific aims of this study were the following: (a) describe the type and frequency of NCRI during patients' sleeping hours (12 MN to 6:00 AM); (b) determine if the frequency of NCRI changes over the first postoperative week; (c) describe the patients' perceptions of nighttime sleep effectiveness (NSE) and daytime sleepiness/sleep supplementation (DSS) during the first postoperative week; (d) examine the changes in the patients' perceptions of NSE and DSS over the first postoperative week; and (e) identify the relationships among NCRIs, NSE, and DSS variables.

METHODS

Design, Sample, and Setting

To address the objective of the study, we employed an exploratory repeated measures design. Study patients were recruited and screened in an outpatient clinic using the following inclusion criteria: (a) first-time elective cardiac surgery using a cardiopulmonary bypass machine; (b) male or female 18 years of age or older; (c) able to read, write, and understand written and verbal instructions in English; and (d) provide informed consent. Patients were excluded from the study if they had a pre-operative history or a diagnosis of a sleep disorder (e.g., sleep apnea), substance abuse, neurologic or psychiatric disorders, and used sleep medications, narcotics, anxiolytics and/or antidepressants. Out of 215 patients screened, 38 provided an informed consent and completed the study. Recruitment and implementation of the study were conducted in the out-patient clinic and in-patient care units (critical-and progressive-care) of a large tertiary (urban) hospital in the Midwestern region of the United States. The study was approved by the affiliated university and hospital institutional review boards.

Data Collection

The patient demographics and clinical profiles were collected through interviews and reviews of medical records. The NCRI, NSE, and DSS were collected in the critical and progressive care units. NCRIs were collected every night from the postoperative night (PON) 1 through PON 5. Patients' self-reported NSE and DSS collected upon awakening during postoperative days (POD) 1 through POD 5.

NCRIs were operationally defined as any type of patient care-related activity (e.g., assessment, medication administration) implemented by the bedside RN or another healthcare provider (e.g., respiratory therapist, physician) during sleeping hours, from 12:00 MN to 6:00 AM. During this time, no visitors are allowed, and the scheduled diagnostic tests (e.g.,12 lead ECG, chest radiograph) are not typically performed. Within this time-frame, bedside RNs completed a *Care Report Form* on which the type of nighttime care and frequency of care interactions were recorded.

The Verran Snyder-Halpern (VSH, 1990) Visual Analogue Sleep Scale (9 out of 16 items) was used to measure nighttime sleep and daytime sleepiness variables. Each item on this self-administered instrument consists of a 100 mm horizontal straight line where the ends of each line define the extreme limits of response being measured (e.g., "awoke exhausted" at the left end and "awoke refreshed" at the right end). The VSH scale has shown adequate reliability (α = .70 to .93) and is sufficiently valid in measuring adult patients' perceptions of sleep and outcomes of sleep in hospitals and community settings (Casida, et al., 2013; Synder-Halpern & Verran, 1987). The reliability coefficient derived from the sample of the present study was .80.

Sleep effectiveness is defined as the patient's perception of the effectiveness of his/her nighttime sleep from the previous 24-hour period. Sleep effectiveness was measured by five scale items, including *total sleep length* (TSL) and *sleep quality* (SQ) variables. TSL is defined as the patient's perception of the total time spent in bed attempting to sleep and actually sleeping (i.e., bulk of sleep period). SQ is defined as the patient's perception about the adequacy of his/her rest upon awakening and amount of sleep. Total mean TSL and SQ scores provide *nighttime sleep effectiveness* (NSE) mean score. A higher NSE score implies sufficient sleep while a lower score implies sleep disruptions (i.e., insufficient or poor nighttime sleep). In normal or "healthy" sleepers, the mean and standard deviation (SD, ±) scores were as follows: TSL (*M*= 80.4,*SD* =19.2), SQ (*M*= 66.5, *SD* = 28.4), and NSE (*M*= 73.4, *SD* = 23.8 (Synder-Halpern & Verran, 1987; Verran & Synder-Halpern, 1990).

Daytime sleepiness is defined as the patient's perception of his/her daytime functioning manifested by the need for taking frequent naps during waking hours of the day to supplement the previous night's sleep loss. Daytime sleepiness was measured by four scale items from VSH, which assessed the temporal pattern of the patient's sleepiness throughout the day. The variables comprising this measure were as follows: (a) *wake after final arousal* (WAFA) –the initial morning awakening; (b) *morning sleep* (AMS) –the amount of supplemental sleep during the morning hours; (c) *afternoon sleep* (PMS) –the amount of sleep during afternoon hours; and (d) *daytime sleep* (DTS) –the duration or time asleep outside of the primary (nighttime) sleep period. The combined WAFA, AMS, PMS, and DTS scores provide an overall *daytime sleepiness or sleep supplementation score* (DSS). A higher DSS score implies excessive daytime sleepiness while a lower score implies alertness sustained during the day. In normal or "healthy" sleepers, the mean and SD scores were as follows: WAFA (M = 20.5, SD = 28.7), AMS (M = 8.8, SD = 20.5), PMS (M = 10.9, SD = 22.9), DTS (M = 5.9, SD =13.6), and DSS (M = 11.5, SD = 21.4) (Synder-Halpern & Verran, 1987; Verran & Synder-Halpern, 1990).

Data Analyses

We used SPSS IBM version 22.0 (IBM Corporation, 2013) for data management and analyses. NRCIs were analyzed by coding the patient care-related activity recorded by the RN on the *Care Report Form,* followed by applying descriptive analytics. Care activities were clustered into categories and coded as one type of NCRI (eg, assessment). We used summary statistics (mean, SD, or frequency distributions) to characterize the sample distribution of the study patients, and to summarize the trend of NCRIs, NSE, and DSS during the study period. Upon determining the normality of data (-1.0 to 1.0 SD units) using the skewness coefficient formula (Munro, 2001), we inferred the changes over time in the mean scores of care interactions, nighttime sleep, and daytime sleepiness variables with repeated measures analysis of variance (ANOVA) method. Furthermore, we used Pearson's correlations to estimate and test the relationships among the continuous variables of NCRIs, nighttime sleep, and daytime sleepiness. Type I error was set at 0.05 for all tests and derived *p*-values were presented as the variable for the strength of evidence without multiple testing adjustment.

RESULTS

Patient Characteristics

The patient demographics and pertinent clinical characteristics are summarized in Table 1. Patients' mean age was 60 with *SD of*15.9 years. Patients were predominantly male (60%), married (66%), and Caucasian (63%). Most were educated beyond high school (45%) and retired (37%). The majority of the patients had a history of coronary artery disease (68%), hypertension (68%), and/or coronary artery bypass graft surgery (53%). All patients had undergone standard operative procedures with the following intra-operative data: anesthesia time (*M* = 359, *SD* =105 min); cross-clamp time (*M* = 109.5, *SD* = 69 min); and bypass time (*M* = 139.2, *SD* = 67 min). Postoperative management included the administration of narcotic analgesics (97%), beta-blockers (89%) and vasoactive agents (71%). The mean hospital length of stay was 7.1, *SD* = 6.3 days.

Type and Frequency of NRCI

The most frequent type of NCRIs occurring between midnight and 6:00 AM were a patient assessment (92%), medication administration (87%), laboratory/diagnostic procedures (78%), and postoperative exercises (55%). The least frequent NCRIs during this time frame were multidisciplinary care rounds (14%) and performing a procedure, such as intravenous catheter insertion (8%) [Table 2]. The frequency of NCRI ranged from 1 to 16 interactions every night, with the highest NCRI occurring on PON 1 (*M* = 4.5, *SD* = 3.6). On PON 2 to 4, the NCRIs were *M* = 2.8, *SD* =1.8,*M* = 2.3,*SD* =1.6, and M = 2.3, *SD* =1.4, respectively (Table 3). The lowest NCRI was noted on PON 5 (*M* = 1.9, *SD* =0.9). Although there was a 62% decrease in NCRI between PON 1 and 2, and a gradual decrease between PON 3 to 5, these reductions and changes in care frequencies over time were not statistically significant by repeated measures ANOVA (p = .72).

Sleep Effectiveness

Table 4 is a summary of the patients' perceptions of their sleep effectiveness during the postoperative period. TSL scores ranged from *M* = 49.4, *SD* = 12.1 to *M* = 54.1, *SD* = 14 with lowest and highest scores on POD 3 and 5, respectively. The respective lowest and highest scores of SQ were on POD 4 and POD 2. SQ scores ranged from *M* 52.9, *SD* = 31.8 to *M* = 65.6, *SD* = 21.3. The trend in the patients' perceptions of their NSE was different from TSL and SQ. At POD 1, 2 and 5, NSE scores were somewhat the same, ranging from *M* = 57.7, SD =12.1 to M = 57.8, *SD* =13.5. The similarity of NSE scores, although lower, was also noted on POD 4 and 3 (*M* = 52.9, *SD* =17.2 and *M* = 53.0, *SD* = 14.4) than POD 2, 3, and 6. Regardless of the variability in mean TSL, SQ, and NSE scores, the changes in scores over time were not statistically significant by repeated measures ANOVA; respective p values were .36, .81, and .79 (Table 4).

Daytime Sleepiness

A summary of the temporal pattern of daytime sleepiness among study patients is shown in Table 5. The lowest WAFA score was at POD 1 (*M* = 20.8, *SD* = 25.5), and the highest was at POD 3 (*M* = 44.4, *SD* = 34.9), but these changes over time were not statistically significant by repeated measures ANOVA (*p* =.365). A distinct pattern and statistically significant changes in AMS, PMS, and DTS scores were found throughout the postoperative period; respective *p* values were .004, .005, and .003 . AMS scores ranged from *M* = 34.9, *SD* = 32.4 to *M* = 46.7, *SD* = 36.4 with the lowest score on POD 1 and highest score on POD 3. Most notably, the pattern of PMS, DTS, and DSS scores was identical during POD 1 and 2. Respective lowest PMS and DTS scores were found during POD 1 (*M* = 28.3, *SD* =30.1 and *M* = 24, *SD* = 26.0), and the highest scores were during POD 2 (*M* = 64.4, *SD* = 32.9 and *M* = 41.3, *SD* = 41.3). The DSS scores ranged from *M* = 27, *SD* = 22.6 (POD 1) to M = 45.6, *SD* = 16.5 (POD 2), *p* value <.0001 (Table 5).

Relationship Between NCRI, Sleep Effectiveness, and Daytime Sleepiness

Results of the pairwise association tests showed that only one NCRI (post-operative exercise) was significantly related to sleep variables: TSL (r = .45, *p* = .042) and NSE (r = .46, *p* = .035). No significant relationship between NCRI and daytime sleepiness variables were found. Using the same approach, we also found that there was no significant relationship between TSL and daytime sleep variables. However, we found that SQ was negatively related to DTS (r = -.42, *p*=.008) and DSS (r = -.41, *p* = .010). Also, NSE was negatively related to DTS (r = -.49, *p* = .002) and DSS (r = -.44, *p* = .006).

DISCUSSION

We found eight types of NCRIs commonly occurring during the sleeping hours of patients in cardiac surgery units of a hospital. The findings suggested that patients were awakened by the RN or other health care provider at least once every hour on PON 1, and every 2 to 2.5 hours on PON 2 to 5, between the hours of 12 MN and 6:00 AM. This assertion was based on the data on the *Care Report Form* documenting the reasons of “purposely waking patients” during these hours. Major reasons for waking patients were to perform assessments, medication administration, and laboratory tests, which were consistent with previous research (Let et al., 2012). However, the reduction in the frequency of NCRIs over time (albeit not statistically significant) is a new finding that merits close attention and future investigation. This non-significant finding may be explained by clinical stability, as the majority of the patients were transferred out of the critical-care into the progressive care units between POD 3 and 5.

Despite the reduction in NCRIs, patients’ sleep was disrupted throughout the first postoperative week. Their sleep disruptions are shown by the non-statistically significant change in their TSL, SQ, and NSE mean scores (Table 3). These scores are lower than the scores of “healthy sleepers” in previous VSH studies (Verran & Snyder-Halpern, 1990), which suggest ineffective or insufficient sleep (i.e., disrupted sleep) when compared to norms. This assertion, however, requires further investigation as the mean age (*M* = 60.0, *SD* = 15.9 years) of our sample is older than the mean age (*M* = 39.5, *SD* = 10.4 years) of the comparative healthy sleepers. Sleep is expected to change with aging. As the person ages, sleep becomes more shallow with much less deep sleep (Verster et al., 2008). Because of the non-significant changes in NCRI frequencies, TSL, SQ, and NSE mean scores (Tables 2a to 4), we *speculated* that NCRIs might have also contributed to a myriad of factors (e.g., pain and anxiety) that are known to disrupt sleep in cardiac surgery (Casida & Nowak, 2011). However, the degree to which NCRIs and these factors influence sleep, specifically the intensity and the frequency of post-operative exercises on sleep and sleep outcomes (e.g., daytime sleepiness), warrants further research.

The significant associations among post-operative exercise, TSL and NSE infer that frequent post-operative exercises during the defined sleeping hours contribute to the decrease in TSL and NSE scores. This assertion is supported by the fact that patients' in the present study had lower TSL and NSE scores than normative sample (Verran & Snyder-Halpern, 1990). Nonetheless, NCRIs are amenable to intervention. Le and colleagues (2012) reported that critical-care RNs were comfortable omitting some NCRIs without compromising patient outcomes. According to the RNs, 16% of routine assessment, 14% of routine care activities, and 10% of nighttime interventions can be safely omitted between 10:00 PM and 6:00 AM (Let et al., 2012). Thus, routine post-operative exercises (e.g., use of incentive spirometry) could be deferred from 10:00 PM until 6:00 AM to promote patient's nighttime sleep in cardiac surgery units.

While the practice of clustering NCRIs (e.g., bed bath) has been implemented in some critical-care units as a sleep promotion intervention (Bihari et al., 2012), the extent of this practice in cardiac surgery units remains unknown. To fill this knowledge gap, research should include mapping and match the necessity and frequency of NCRIs with the patient's clinical stability and physiologic integrity. This research can be accomplished by clinical assessments or perhaps risk stratifications, similar to what has been proposed for non-surgical patients. For example, in a study involving 54,096 hospitalized patients, Yoder and colleagues (2013) suggested that nighttime vital sign monitoring may be safely omitted in medically stable patients (low risk) based on the Modified Early Warning Score (MEWS). With the goal of promoting sleep and facilitating physiological repair during recovery and rehabilitative periods, investigators should attempt to examine the feasibility and usability of MEWS (a risk stratification model)[22] in adult cardiac surgery by starting with select "stable patients" in progressive care units. This can be a starting point to challenge the traditional 24-hour regimen of routine vital signs monitoring and administration of medications.

Although only one NCRI was associated with sleep variables, the extent of the patients' daytime sleepiness throughout the waking hours of the day was uncovered by the present study. Mean scores presented in Table 4 are far higher than the normal/healthy sleepers (Verran & Snyder-Halpern, 1990) suggesting excessive sleepiness throughout the day. The data also inferred that during POD 2, daytime sleepiness was far more excessive than PODs 1, 3, 4 and 5. Excessive daytime sleepiness is a common consequence of insufficient sleep among adults with various illnesses and conditions. It can impair physical and mental function, as well as the quality of life (Verster, Pandi-Perumal, & Streiner, 2008; Buysee, 2014). Notably, the significant associations among SQ, NSE, DTS, and DSS suggest that patients required frequent naps beyond sleeping hours to compensate for sleep loss. Naps occurred in the early morning until late afternoon hours. Though daytime sleepiness is understudied in cardiac surgery, excessive naps during the day can further impair daytime functioning. Potential hazards of excessive daytime sleepiness may include, but are not limited to, increased risks for postoperative complications prevented by frequent ambulation (e.g., deep vein thrombosis, pressure ulcers) and pulmonary exercises (e.g., atelectasis, pneumonia) (Casida & Nowak, 2011).

Limitations and Future Directions

The main limitations of this study include the omission of sleep fragmentation items of the VSH scale, which may have further explained the patients' perceptions of sleep disruptions. The use of self-report measures and nonrandom sampling procedures were additional limitations. Thus, the interpretation of the results should be confined within the limits of the study aims and use of self-report measures that can be influenced by several factors leading to underestimation or overestimation of the results (Casida et al., 2014). We acknowledged that patients who had taken anxiolytics, beta-blockers, and/or sleep medications (Table 1) might have biased perceptions of their sleep quality as these medications are known to disrupt or promote sleep (Vallerand & Sanoski, 2014). Also, our sample from a single center may not be an accurate representation of adult cardiac surgery population in the United States and the world, thus limit the generalizability of the results. However, despite the limitations, we hope our data encourage researchers and clinicians to continually investigate the traditional care delivered at night in adult cardiac surgery.

Future research is needed to address the study limitations to form a definitive conclusion, particularly the effect of NCRIs on sleep disruptions in adult cardiac surgery.

Demographics (e.g., age) and other variables that are known to disrupt (e.g., pain and anxiety, beta-blockers) or promote (e.g., sleep medications) should be collected and considered as confounding variables in future research designs. Research should be implemented in multiple centers including a diverse, random sample of cardiac surgery procedures (e.g., reoperations, ventricular assist devices, and heart/lung transplants) in community, tertiary, and quaternary heart centers. While there have been studies in other patient care units regarding NCRIs and sleep research in cardiac surgery is still warranted due to the differences in clinical trajectory (i.e., exposure to cardiopulmonary bypass) and outcomes that are possibly sensitive to excessive daytime sleepiness resulting in delayed ambulation-related complications described previously. Also needed is a rigorous research design using an objective measure of sleep (e.g., polysomnogram) (Verster et al., 2008) and a camera to capture NCRIs and patients' clinical or physiological needs in "real-time." These future studies would expand our knowledge of the context and the need for challenging the traditions of care routinely implemented during sleeping hours in cardiac surgery units. By objectively matching NCRIs with physiological and clinical states, as well as assessing the risks and benefits associated with the omission of some NCRIs during sleeping hours, we could produce mechanistic data needed for developing and testing sleep promotion interventions.

CONCLUSION & RELEVANCE TO CLINICAL PRACTICE

NCRIs appeared to decrease over the first post-operative week. However, patients still experienced sleep disruptions and excessive daytime sleepiness. Research is needed to explicate the cause and effect of NCRI on sleep disruption, daytime function, and clinical outcomes. This would guide the development and testing of interventions aimed at improving both health and healthcare outcomes in diverse patient populations in various types of hospitals. Acute and critical-care nurses in the world are well positioned to lead the advancement of sleep promotion science and to transform the nighttime care delivery processes in adult cardiac surgery.

Summary Box: What does this paper contribute to the wider global clinical community?

- This study is the first empirical description of the type and frequency of NCRIs occurring during the first week following cardiac surgery.
- The study findings offer investigators a basis for examining the mechanism of the potential adverse effects of NCRIs on sleep and sleep outcomes following cardiac surgery. The knowledge that will be generated is crucial for designing an intervention research aimed at optimizing patient's health and health care outcomes, post-operatively.

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Table 1: Patient Demographics and Clinical Characteristics (*N* = 38)

Features	Mean and SD *n* (%)*
Age (*mean in years*)	60 ± 15.9
Gender:	
Male	23 (60.0)
Female	15 (40.0)
Marital Status:	
Single	5 (13.2)
Married	25 (66.0)
Domestic Partner	1 (3.0)
Divorced	1 (3.0)
Widow	5 (13.2)
Race/Ethnic Background:	
African American	12 (32.0)
Asian	2 (5.3)
Caucasian	24 (63.2)
Education:	
Some education	3 (8.0)
High School	5 (13.2)
Some College	7 (18.4)
College	7 (18.4)
Beyond College	3 (8.0)
Employment Status:	
Full-Time	11 (30.0)
Part-Time	2 (5.3)
Retired	14 (37.0)
Unemployed	2 (5.3)

On Disability	2 (5.3)
Medical History:	
Coronary Artery Disease/Myocardial Infarction	26 (68.4)
Hypertension	26 (68.4)
Hypercholesterolemia	19 (50.0)
Diabetes	14 (37.0)
Valvular Disease	7 (18.4)
Heart Failure	6 (15.8)
Pulmonary Disease	6 (15.8)
Other	13 (34.2)
Surgical History:	
Yes	20 (53.0)
No	18 (47.0)
Surgical Procedure:	
Coronary Artery Bypass Graft (CABG)	20 (53)
Valve Replacement/Repair	16 (42.1)
CABG + Valve Repair	2 (5.3)
Anesthesia Time (*mean in min*)	359.0 ± 105.0
Cross-Clamp Time (*mean in min*)	109.5 ± 69.0
Bypass Time (*mean in min*)	139.2 ± 67.0
Post-operative Medications:	
Anxiolytics	4 (10.5)
Beta-blockers	34 (89.5)
Inotropic agents	5 (13.2)
Narcotic analgesics	37 (97.4)
Non-Narcotic analgesics	20 (53.0)
Sleep medications	1(3.0)
Vasoactive agents	27 (71.0)

Note. *Because of rounding, missing or "not applicable" data, or multiple responses, not all percentages total 100; SD (Standard Deviation)

Table 2: Type of NCRI occurred between 12:00 MN and 6:00 AM

Nighttime Routine	*n* (%)
Assessment (eg, vital signs, hemodynamics)	35 (92.1)
Medication administration	33 (87.0)
Lab/diagnostic procedure (eg, blood test)	28 (74.0)
Post-operative exercises (eg, use of an incentive spirometer)	21 (55.3)
Multidisciplinary care rounds	5 (14.3)
Patient condition (eg, arrhythmia)	5 (14.3)
Equipment related (eg, troubleshooting infusion pumps)	4 (10.5)
Nursing procedure (eg, intravenous catheter insertion)	3 (8.0)

Table 3: Frequency of NCRI between 12:00 MN and 6:00 AM

Postoperative Nights	Range	Mean	Standard Deviation (±)
1	1-16	4.5	3.6
2	2-11	2.8	1.8
3	1-11	2.3	1.6
4	1-10	2.3	1.4

Table 4: Repeated Measures ANOVA of Patients Perceptions of Nighttime Sleep (*N* = 38)

Variables	Mean Scores and Standard Deviations (±)					
	POD 1	POD 2	POD 3	POD 4	POD 5	*p-value*
Total Sleep Length (TSL)	50.8 (17.8)	51.7 (11.4)	49.4 (12.1)	52.9 (31.8)	54.1 (14.0)	.36
Sleep Quality (SQ)	64.0 (24.2)	65.6 (21.3)	56.0 (25.6)	52.9 (31.8)	61.4 (22.8)	.81
Nighttime Sleep Effectiveness (NSE)	57.7 (17.5	57.7 (12.1)	53.0 (14.4)	52.9 (17.2)	57.8 (13.5)	.79

Note. Normal values (TSL = 80.4 ± 19.2, SQ = 66.5 ± 28.4, and NSE = 73.4 ± 23.8)

Table 5: Repeated Measures ANOVA of Patients Perceptions of Daytime Sleepiness (*N* = 38)

Variables	Mean Scores and Standard Deviations (±)					
	POD 1	POD 2	POD 3	POD 4	POD 5	*p-value*
Wake After Final Arousal (WAFA)	20.8 (25.5)	31.6 (29.0)	44.4 (34.9)	39.9 (36.1)	35.8 (33.2)	.365
Morning Sleep (AMS)	34.9 (32.4)	45.1 (33.5)	46.7 (36.4)	39.2 (35.4)	42.7 (33.8)	**.004**
Afternoon Sleep (PMS)	28.3 (30.1)	64.4 (32.9)	49.5 (34.9)	47.7 (36.6)	48.0 (33.6)	**.005**
Daytime Sleep (DTS)	24.0 (26.0)	41.3 (23.6)	39.1 (24.6)	24.1 (22.9)	31.2 (24.5)	**.003**

Daytime Sleepiness/Sleep Supplementation (DSS)	27.0 (22.6)	45.6 (16.5)	44.8 (22.1)	37.7 (21.4)	39.7 (24.9)	**<.0001**

Note. Normal values (WAFA = 20.5 ± 28.7, AMS = 8.8 ± 20.5, PMS = 10.9 ± 22.9, DTS = 5.9 ± 13.6, and DSS = 11.5 ± 21.4)