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# How to Improve Patients' Perceived Quality of Sleep During Hospitalization Through a Multicomponent "Good Sleep Bundle": A Prospective Before and After Controlled Study

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## ABSTRACT

**Introduction:** Despite sound evidence on the importance of sleep for human beings and its role in healing, hospitalized patients still experience sleep disruption with deleterious effects. Many factors affecting patients' sleep can be removed or minimized. We evaluated the efficacy of a multicomponent Good Sleep Bundle (GSB) developed to improve patients' perceived quality of sleep, through which we modified environmental factors, timing of nighttime clinical interventions, and actively involved patients in order to positively influence their experience during hospitalization. **Methods:** In a prospective, before and after controlled study, two different groups of 65 patients each were admitted to a cardiothoracic unit in two different periods, receiving the usual care (control group) and the GSB (GSB group), respectively. Sleep quality was evaluated by the Pittsburgh Sleep Quality Index (PSQI) at the admission, discharge, and 30 days after discharge in all patients enrolled. Comparisons between the two groups evaluated changes in PSQI score from admission to discharge (primary endpoint), and from admission to 30 days after discharge (secondary endpoint). **Results:** The mean PSQI score difference between admission and discharge was 4.54 (SD 4.11) in the control group, and 2.05 (SD 4.25) in the GSB group. The mean difference in PSQI score change between the two groups, which was the primary endpoint, was 2.49 (SD 4.19). This difference was highly significant ($p = 0.0009$). **Conclusion:** The GSB was associated with a highly significant reduction of the negative effects that hospitalization produces on patients' perceived quality of sleep compared with the usual care group.

**Keywords:** sleep, patient centered care, quality of care, patient experience

## INTRODUCTION

The need for sleep in human beings is universal because sleep serves a restorative function for the body and mind. Sleep deprivation adversely affects health and quality of life.[1–6] Hospitalized patients often experience disturbances of sleep that are caused by environmental factors and personal factors.[7]

Environmental factors include noise, excessive heat or cold, bright lights, and frequent awakening for treatment. Personal factors include anxiety, pain, itching, fever, patient's underlying illness, and medications. In addition, the prescription of medications, such as benzodiazepine and opiates, alters the quality of sleep.[8–16] Sleep fragmentation has a negative impact on metabolism, cognitive performance, physical functioning, coordination, immune function, coagulation cascade, and cardiac function.[17–22] Sleep impairment has been shown to increase stress responses, thereby delaying healing.[23–25] Sleep deprivation during hospitalization contributes to "post-hospital syndrome," an acquired, transient period of vulnerability.[26] Moreover, it has been observed that there is an incidence of chronic insomnia following hospitalization.[27] Despite sound evidence supporting the need to adopt strategies to protect patients' sleep while in the hospital setting, and the World Health Organization recommendations regarding noise levels to be kept in hospital settings, noise is still a major source of environmental stimuli, including staff conversation, medical equipment alarms, telephones, televisions, and caregiving activities,[28] with levels of 72 decibels during daytime hours and 60 decibels at night having been identified.[29] Several studies have shown that interventions to reduce noise levels are possible,[30–35] and the need to focus on improving patients' sleep during hospitalization has been recognized among the top 10 opportunities to improve quality of care in hospitals.[36] Our study aimed to evaluate the efficacy of a set of multimodal, nonpharmacological interventions called GSB (Good Sleep Bundle), which target modifiable environmental and behavioral factors affecting sleep quality, by measuring the difference in the two groups of the difference in sleep quality between admission and discharge assessed using a Pittsburgh Sleep Quality Index (PSQI) questionnaire.

## METHODS

The study is a prospective before and after controlled study (Figure 1). Hospital leadership promoted the project and our institutional research review board approved the study (IRRB/00/16). Informed consent was obtained from all the patients included in the study.

### Study Setting

The study was conducted at IRCCS-ISMETT (Mediterranean Institute for Transplantation and Advanced Specialized Therapies) from November 2015 to January 2017. IRCCS-ISMETT in Palermo is a multiorgan transplant center that performs transplants and highly specialized procedures for adult and pediatric patients. The GSB was applied in the cardiothoracic unit (CTU).

### Study Design and Participants

Before conducting our study, to measure the quality of sleep in the patients admitted in our hospital, an internal preliminary anonymous survey was administered to 84 patients discharged from our CTU and to nurses working in the same unit from November to December 2015 (Phase 1). Eighty-four patients and 67 nurses completed the survey. We selected the CTU to administer the survey, as we assumed it was the noisiest ward, outside the intensive care unit (ICU), because of the presence of monitors and other alarm-generating equipment. Results from the survey enabled us to identify sleep disturbance factors specific to our unit (Table 1) and to develop a multicomponent bundle, the GSB, with the goal of decreasing sleep disruptions (Table 2.).

The bundle development, which also took into account findings from a literature review,[30–36] was led by the quality department through the collaboration of multiple hospital departments, including nursing, cardiothoracic medical department, laboratory, neurology, and clinical psychology participating in a Sleep Improvement Task Force, and providing input to the analysis and the identification of the improvement.

The GSB required planning for the provisions of several educational interventions for both nursing and medical staff to introduce behavioral and environmental modifications, such as reducing the volume of staff conversations, turning off patient televisions at 11:00 PM, dimming hallway lights, and providing nurses with a pocket light when entering patient rooms, and modifying range and volumes of alarms. Furthermore, agreement on modification of timing of routine clinical procedures was reached, and changes in nursing nighttime activities planned accordingly. Based on these modifications, procedures such as blood drawings, electrocardiography, and vital signs assessment were avoided during the night to limit unnecessary clinical interventions from 11 PM to 7 AM unless necessary. However, nurses continued to round every 4 hours at the patient's bedside without interrupting the patient's sleep, unless necessary. Patient education material was developed to highlight the importance of sleep, the need to prevent excessive daytime napping, and to avoid caffeine in the afternoon and evening. A "good sleep kit," which included a patient educational brochure on sleep, earplugs, eye mask, and information regarding availability of a relaxation music channel on the television was developed to be given to patients on admission. The program was written as the organization's protocol.

Actions included in the bundle were progressively implemented between July and September 2016, during

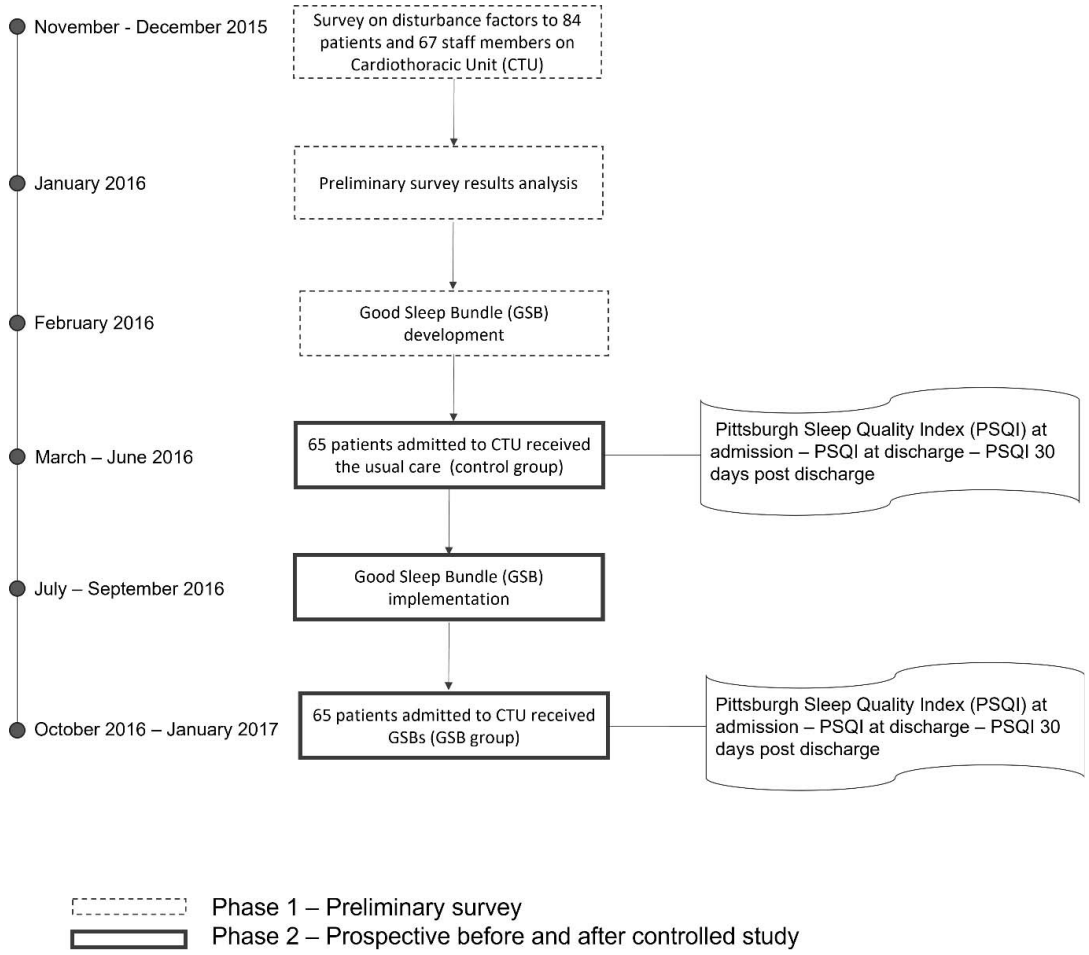


**Figure 1.** Study design process diagram.

the second phase of the project, which consisted of a prospective before and after controlled study.

Phase 2 of the study included a total of 130 cardiothoracic medical and surgical patients divided into two groups. Randomization was not possible because of the nature of the study. The two groups were homogeneous for age, diagnosis, main procedures, and comorbidities. Inclusion criteria were age 18 years or older, length of stay (LOS) of 2–50 days, and acceptance to receive a PSQI questionnaire to assess sleep quality at admission, discharge, and at 30 days after discharge.

**Table 1.** Distribution of environmental sleep disturbance factors into the cardiothoracic unit, resulting from the internal preliminary survey

| Disturbance Factors | 84 Cardiothoracic Unit Patients, *n* (%) | 67 Cardiothoracic Unit Nurses, *n* (%) |
|---|---|---|
| Alarms | 33 (39.3) | 65 (97) |
| Blood drawings | 15 (17.9) | 56 (83.58) |
| Lights | 13 (15.5) | 38 (56.72) |
| Staff conversation | 8 (9.5) | 31 (46.27) |
| Television noise | 3 (3.6) | 8 (11.94) |
| Room temperature | 12 (14.3) | 30 (44.78) |
| Nocturnal therapies | 12 (14.3) | 55 (82.1) |

**Table 2.** Good sleep bundle protocol

**Intervention for patients**
- Provide patients with a Good Night Kit composed of eye mask, earplugs, and educational brochure on sleep improvement measures

**Modifications on nighttime clinical routine to reduce sleep interruptions**
- Modify timing of blood drawings, electrocardiogram, and vital signs time (not from 11 PM to 7 AM, unless necessary)
- When possible, avoiding intravenous fluids overnight and diuretics administration after 4 PM

**Introduce a "Quiet Nighttime" during which noises and lights are minimized**
- Adjust alarm settings to minimize unnecessary equipment alarms
- Turn off patient televisions at 11 PM
- Dim hallway lights
- Use pocket lights when entering a patient's room
- Make relaxing music available on demand
- Optimize room temperature
- Remind patients to use earplugs and eye mask if they wish

**Interventions for providers**
- Educate medical and nursing staff on sleep medication guidelines
- Sleep-promoting education for nurses
- Communication material developed (posters and pocket cards) reminding the importance of patients' sleep
- Adopt a noise control policy, especially during night-shift handover

**Table 3.** Patient characteristics for control group and GSB group

| | Control Group ($n$ = 65) | GSB Group ($n$ = 65) | $p$-values for difference |
|---|---|---|---|
| Age (y), mean (SD) | 65.3 (15.2) | 62.3 (15.8) | 0.1158 § |
| Female, $n$ (%) | 18 (27.7) | 29 (44.6) | 0.0674 ‡ |
| Diagnosis at admission, $n$ (%) | | | 0.2028 ‡ |
| Aortic aneurysm | 8 (12.3) | 7 (10.8) | |
| Ischemic cardiomyopathy | 4 (6.2) | 12 (18.5) | |
| Lung cancer | 6 (9.2) | 7 (10.8) | |
| Cardiac valvulopathy | 28 (43.0) | 19 (29.2) | |
| Status post lung transplant | 7 (10.8) | 4 (6.1) | |
| Other | 12 (18.5) | 16 (24.6) | |
| Comorbidities and risk factors, $n$ (%) | | | 0.5080 ‡ |
| Smoking habit | 4 (12.5) | 11(25.0) | |
| Diabetes | 13 (40.6) | 15 (34.1) | |
| Obesity | 9 (28.1) | 7 (15.9) | |
| COPD | 4 (12.5) | 8 (18.2) | |
| Others | 2 (6.3) | 3 (6.8) | |
| Main procedure, $n$ (%) | | | 0.2076 ‡ |
| Coronary artery bypass grafting | 3 (4.9) | 7 (11.6) | |
| Transplant | 0 (0.0) | 2 (3.3) | |
| Valve intervention | 28 (45.9) | 19 (31.7) | |
| Diagnostic procedure | 10 (16.4) | 10 (16.7) | |
| Thoracic surgical intervention | 18 (29.5) | 16 (26.7) | |
| Other | 2 (3.3) | 6 (10.0) | |
| DRG weight, mean (SD) | 3.4 (3.8) | 3.2 (4.8) | 0.5084 § |
| LOS (d), mean (SD) | 9 (3.0) | 11 (10.0) | 0.0626 § |
| Monitored patients, $n$ (%) | 54 (83.1) | 47 (72.3) | 0.2058 ‡ |
| Time on monitor (h), mean (SD) | 74.5 (68.8) | 95.5 (164.7) | 0.7711 § |
| Admissions to ICU, $n$ (%) | 37 (56.9) | 35 (53.8) | 0.8600 ‡ |
| LOS in ICU (d), mean (SD) | 1.0 (2.0) | 1.0 (2.0) | 0.7817 § |
| ICU sedated patients, $n$ (%) | 26 (40.0) | 20 (30.8) | 0.3592 ‡ |
| ICU sedation time (h), mean (SD) | 2.8 (3.5) | 3 (12.3) | 0.7609 § |
| Diuretics after 4 PM, $n$ (%) | 26 (40.0) | 32 (49.2) | 0.3778 ‡ |

§Median Two-Sample Test; ‡ Fisher exact test.
COPD: chronic obstructive pulmonary disease; DRG: diagnosis related group; GSB: Good Sleep Bundle; ICU: intensive care unit; LOS: length of stay.

Exclusion criteria were patients with secondary insomnia, psychotic patients, patients taking sleep-altering medications (benzodiazepine), patients with visual or hearing impairment, and patients with preexisting cognitive impairment. Patients in this study were mostly postoperative patients. Patient characteristics and distribution are shown in Table 3.

The first group (control group) of 65 patients consecutively admitted between March and June 2016 received the usual care. From July throughout September 2016 (implementation period), the GSB was implemented and put into effect. During the implementation period, every staff member involved in the program received one-to-one education on the importance of sleep for patients' well-being and instructions for complying with the GSB program. The training was provided by the CTU nurse educator for nursing staff. The neurologist and clinical psychologist trained medical staff on the sleep medication guidelines. Several posters reminding staff of the importance of the patient's sleep and the need to limit sleep interruptions were affixed in the unit. To limit noise during changes of shift, a shielded location was identified as the "Nursing Report Zone." In addition, to ensure compliance with the GSB bundle, the following measures were undertaken: a daily checklist reminded staff to perform sleep-promoting interventions, a GSB team leader for every CTU shift was appointed to monitor compliance in the common areas and to conduct regular spot checks to monitor GSB application; and one weekly meeting was conducted to supervise the project.

Following full deployment of the GSB, a second group (GSB group) of 65 patients consecutively admitted between October 2016 and January 2017 receiving the GSB program was observed.

## Sleep Quality Evaluation Criteria

To evaluate the quality of sleep in the patients included in the study, the PSQI questionnaire[37] was used. PSQI is a 19-item self-rated questionnaire for evaluating subjective sleep quality over the previous month and is an effective instrument that can be used in clinical research to identify groups that differ in the quality of sleep.[38–41]

The PSQI has a sensitivity of 98.7% and specificity of 84.4% for identifying cases with sleep disorder, using a cutoff score of 5.[38] The questions are combined into seven clinically derived component scores (sleep quality, sleep-onset latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medications, daytime dysfunc-

tions), each weighted equally from 0–3. The scores are added to obtain a global score ranging from 0–21, with higher scores indicating worse sleep quality. A score of 5 or greater indicates a "poor" sleeper, and as the score obtained from the scale increases, sleep quality worsens. In our study, we used the Italian version of the instrument, which has been previously tested for validity.[42]

The PSQI questionnaire, in soft copy form, was submitted in a face-to-face meeting by one trained nurse at the time of admission and discharge. The PSQI questionnaire was submitted by telephone from the same trained nurse 30 days after discharge. For the questionnaire submitted at the time of discharge, patients were made aware that the PSQI would investigate exclusively the hospitalization time. PSQI questionnaire responses were aggregated by the quality department. In our study, we evaluated the quality of sleep in two groups before and after the implementation of the GSB and assessed the difference between the two groups of the mean change in the PSQI score from admission to discharge. This was set as the primary endpoint. In addition, to evaluate the possible effect of the GSB program in the post-hospitalization period (30 days), the difference between the two groups of the mean change in the PSQI score from admission to 30 days after discharge was set as the secondary endpoint. Other secondary endpoints included explorative comparisons of the mean change in the PSQI score between the control group and GSB group from admission to discharge, adjusting for all variables, listed in Table 3.

### Statistical Analysis

The study was planned to evaluate the mean PSQI score change from admission to discharge, between the control group and GSB group, with one control patient for each GSB patient. A two-sided *t* test for two independent samples was used to assess the efficacy of the GSB program, comparing the mean PSQI score changes between the two groups. We determined the sample size using data from a previous study assessing the quality of sleep in hospitalized neurosurgical patients, showing a mean PSQI score at admission of approximately 8 with an SD of approximately 5 points.[43] We considered relevant a mean reduction from admission to discharge between the two groups of at least 2.5 points. To assess a true mean score difference of 2.5 points between control and GSB groups with the two-sided two-sample *t* test, a sample size of 130 patients (65 per group) was estimated to reject the null hypothesis, for which the population means of the GSB groups and control groups are equal. The probability (power) and the type I error probability associated with this null hypothesis were 0.8 and 0.05, respectively.

Continuous variables are expressed as mean and SD or median and IQR when appropriate, and categorical variables are reported as counts and proportions. The mean PSQI score change from admission to 30 days after discharge was assessed by the two-sided two-sample *t* test. Any differences between the two groups' variables were assessed by *t* test for continuous variables and the Fisher exact test for categorical variables. Homoscedasticity of variance and normal distribution assumptions were also assessed before applying the *t* test.

The multiple linear regression analyses were explorative in nature, and the *p*-values had to be intended as nominal values. The stepwise selection method was adopted with significance level for entry and staying in the model of 0.05 and 0.2, respectively, and standard errors (SE) were also reported.

For all analyses, a value of $p < 0.05$ was considered statistically significant. All statistical analyses were carried out with Statistical Analysis Software (SAS) 9.4 (2017 SAS Institute Inc., Cary, NC).

## RESULTS

A total of 159 patients were initially enrolled in the two groups (81 in the control group and 78 in the GSB group) giving consent and thus receiving the PSQI questionnaire at admission. In 65 patients of 81 in the control group and in 65 patients of 78 in the GSB group, the PSQI questionnaire at discharge was completed. Reasons for excluding 29 patients included LOS <2 days and withdrawing consent to completing the PSQI questionnaire at discharge. The comparison of the mean change in the PSQI score from admission to discharge between the two groups was the primary endpoint of the study. The mean difference of the PSQI score from admission to discharge in the two groups was significantly statistically different, confirming the GSB program was effective in reducing the negative effect of the hospitalization on the patients' quality of sleep. Indeed, mean PSQI score (SD) at admission was 6.14 (3.21) in the control group, and 6.58 (3.61), in the GSB group, and the PSQI at discharge was, respectively 10.68 (4.02) and 8.63 (4.21).

The mean PSQI score difference between admission and discharge was 4.54 (4.11) in the control group, and 2.05 (4.25) in the GSB group. The mean difference of PSQI score change between the two groups, which was the primary endpoint, was 2.49 (SD 4.19). This difference was highly significant ($p = 0.0009$), with a computed power of 0.917 (Figure 2). Given that an increase in the PSQI score indicates a decrease of quality of sleep, a less reduced quality of sleep was observed in the GSB group.

Comparing the PSQI scores between admission and discharge in the control group, 55 patients (84.6%) had a worsening in score, 6 (9.2%) had an unmodified score, and 4 (6.2%) had a better score.

In addition, the secondary endpoint was reached, as shown by a significant mean difference of 1.38 (SD 3.41) in PSQI score change from admission to 30 days after discharge between the two groups ($p = 0.0248$).

Other secondary endpoints included explorative comparisons of the mean PSQI score change from admission

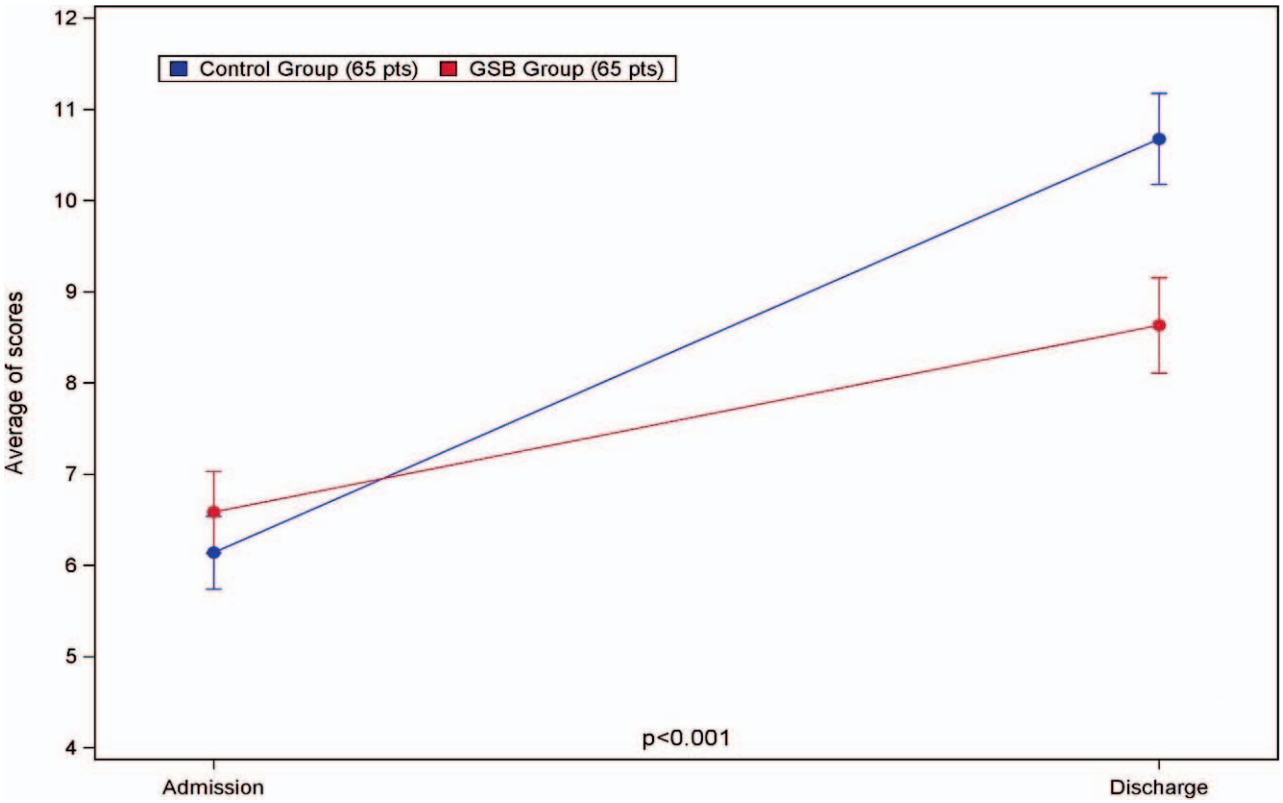


**Figure 2.** Mean difference of PSQI score from admission to discharge. PSQI, Pittsburgh Sleep Quality Index. pts, patients.

to discharge between the two groups adjusting for age, gender, diagnosis at admission, comorbidities, main procedures, diagnosis related group weight, LOS, monitoring (yes or no), time on monitor, admission to ICU (yes or no), ICU LOS, ICU sedation (yes or no), time of sedation, and diuretics.

Median LOS was 11 days (IQR 10.0) for the GSB group and 9 days (IQR 3.0) for the control group. The comparison of the mean PSQI score change adjusted for LOS was significant, showing the efficacy of GSB application regardless of LOS. The same comparison adjusted for GSB application was significantly associated with LOS, with a 0.12-point increase of mean PSQI score for each additional day in LOS ($p = 0.0204$). The comparison adjusted for admission to ICU (yes or no) showed a mean difference of PSQI score change between admission and discharge of –1.76 (SD 4.05) for the control group, which was statistically not significant ($p = 0.0876$). On the contrary, for the GSB group, the comparison showed a mean difference of PSQI score change between admission and discharge of –3.30 (SD 3.94), which was statistically significant ($p = 0.0010$).

Comparison adjusted for gender, showed that female patients had a mean difference of PSQI score change between admission and discharge of 4.35 (SD 4.23), which was significant ($p = 0.0013$).

All the presented comparative results were confirmed through a stepwise multiple linear regression analysis. In particular, for the GSB group, female gender had a mean difference of PSQI score of 3.08 points less than male gender ($p = 0.0395$). Furthermore, ICU admission increased the mean PSQI score by 2.61 points ($p = 0.0003$) (Table 4).

However, in the subgroups of patients admitted to the ICU, the control group had a mean PSQI score change of 5.29 (SD 3.86), whereas those receiving the GSB showed a PSQI score change of 3.57 (SD 4.59). For both groups, none of the patients had a diagnosis of delirium during hospitalization.

Blood drawings performed during the study were retrospectively analyzed as indicator of adherence to GSB. The percentage of blood drawings performed before 7 AM significantly decreased from 53.4% in the control group to 2.5% in the GSB group ($p < 0.001$).

**Table 4.** Results from the stepwise multiple linear regression analysis

| Variables | Mean difference PSQI score | SE | *p*-value |
|---|---|---|---|
| Male, control group | 2.55 | 0.705 | 0.0004 |
| Female vs male, control group | 1.84 | 1.100 | 0.0968 |
| Male GSB group | −1.35 | 0.880 | 0.1281 |
| Female vs male GSB group | −3.08 | 1.481 | 0.0395 |
| ICU admission yes vs no | 2.61 | 0.702 | 0.0003 |

GSB: Good Sleep Bundle; ICU: intensive care unit; PSQI: Pittsburgh Sleep Quality Index.

## DISCUSSION

Although the importance of sleep among hospitalized patients and the need to reduce unnecessary sleep fragmentation is gaining increasing attention globally,[44,45] sleep disturbance reduction programs are not widely spread and incorporated in hospital routines.[36,46] Most previous studies on nonpharmacological interventions have been focused on evaluating the efficacy of the implementation of interventions in the ICU setting, although non-ICU settings have environmental disturbance factors needing as much attention as the ICU setting.[47,48] Most of studies on non-ICU settings, on the contrary, have focused on a limited set of interventions being implemented in isolation, addressing the reduction of noise levels only,[49] or in combination with use of eye mask and earplugs[50,51] or reducing unnecessary clinical intervention during the night.[52] On the contrary, in this study, we adopted a multidisciplinary and multimodal approach involving several nonpharmacological interventions: modification of clinical interventions; provider education; limiting environmental factors, such as noise, light, and temperature; providing patients with eye mask and earplugs; and also educating them on sleep.

To our knowledge, there are very few studies addressing almost all the multicomponent approaches to reduce disturbance factors into an intervention outside the ICU setting.[53] However, results from the studies were not significant regarding improvements in patients' perceived quality of sleep[30] or did not assess quality of sleep.[53] Furthermore, a crucial, and not always adopted, component included in our approach was the active involvement of patients in two ways: (1) administering internal preliminary survey in the first phase of the project to identify the specific environmental disturbances factors experienced in our unit, and design an intervention tailored to these disturbance factors; and (2) providing education to patients regarding the importance of sleep in hospitalized patients and their role in improving the quality of sleep, which may have contributed to maintaining a better quality of perceived sleep even after hospital discharge.

Our findings on the efficacy of involving patients are in line with previous research,[54] which shows that educating patients and providing them with a tool to sleep better and reduce disturbance factors, such as earplugs and eye mask, is effective in improving perceived quality of sleep. Based on two reviews, no conclusions can be drawn on the effectiveness of nonpharmacological interventions conducted so far, mainly because of study design and use of subjective measures to evaluate sleep duration and quality.[55,56] Nevertheless, there is a strong consensus on use of nonpharmacological approaches as the first-line option,[57] and, given the heterogeneous causes of sleep disturbances in hospital settings, multimodal approaches seem reasonably to be the strategy that could produce better results. Several challenges during our intervention were faced because of changes to be made to several processes, such as delaying laboratory test drawings and consequently processing hours, requiring the involvement of different health providers and different settings. In this regard, although changing the vital signs monitoring frequency during the night was supported by evidence,[58,59] and thus was easily accepted, the modification of timing of blood tests and, thus, the postponement of availability of results, was the hardest barrier to be overcome because it required changing medical staff routines. In our experience, the endorsement and support of the hospital leadership was a key factor for the successful implementation of the GSB.

Study secondary endpoints included explorative comparisons adjusted for different factors. Comparison adjusted for gender showed that female patients had a significant mean difference of PSQI score change between admission and discharge. These data confirm the results of previous studies.[39,40] As already described in the literature, admission to the ICU produced a worsening in the PSQI score, showing a negative influence on the quality of sleep.[12,25]

As shown by the multiple linear regression analysis, the ICU effect was independent of the ICU LOS, showing that the mere fact of being admitted to the ICU is an important cause of sleep impairment. In our study, the negative effect produced by admission to the ICU was observed in both groups. However, in the subgroups of patients admitted to the ICU, the control group had a mean PSQI score change significantly higher compared with those receiving the GSB, which might indicate a mitigation effect of the GSB on the negative influence caused by the ICU admission.

### Study Limitations

The study was conducted in a surgical cardiothoracic and transplant unit, with a very high level of patient clinical complexity and severity. Generalizability of these results is not certain. The distribution of disturbance factors was not compared between the control and GSB groups, and this might represent a major limitation.

The choice to use the PSQI was motivated by the intention of carrying out an evaluation on the effectiveness of the intervention from the point of view of the patient's experience. Yet, the choice to evaluate patients' subjective experience is associated with less accuracy in the measurement of sleep quality and duration than objective measurement instruments such as polysomnography or sensor technology.

As a multicomponent intervention, we could not determine if specific sleep-promoting interventions only, or the bundle itself was associated with the observed results.

## CONCLUSIONS

This study evaluated the efficacy of GSB, a multicomponent program introduced to reduce sleep quality

worsening during hospitalization, and the effects of such worsening 30 days after discharge. Results show a highly significant GSB effect in reducing the negative influence of the hospitalization on the quality of sleep, encouraging implementation of organizational interventions for improving patients' quality of sleep during hospitalization.

With feasible changes in environment and healthcare workers' routines, at a low cost, we can conceivably remove, when possible, or minimize the negative effects of hospitalization on perceived quality of sleep. Future research is needed to determine whether tailored interventions, based on patient-specific sleep dysfunction risk factors, can maximize effects. Future research is also needed to assess whether all routine clinical practices performed at night are supported by scientific evidence to support their minimization in order to limit sleep disruptions for patients in the hospital setting.

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