

Noise Reduction to Promote Sleep Hygiene in the Pediatric Intensive Care Unit

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INTRODUCTION

Topic

Sleep disturbance is defined as “the perceived or actual alterations in nighttime sleep (both quantity and quality) with subsequent daytime impairment.” The disturbance to sleep can be an acute problem, but it is often recurrent, especially in an environment with high stimulation. Regardless of the cause, sleep disturbances have been associated with “adverse physiological outcomes, including alterations in immune function, metabolism, nitrogen balance, and protein catabolism.” Specifically in the intensive care unit (ICU) setting, sleep is often characterized by fragmented sleep, prolonged sleep onset, and poor sleep efficiency. ICU patients often describe periods of sleep as brief with frequent arousals both day and night. Stimulation is often noise related.

The US Environmental Protection Agency’s (EPA’s) Office on Noise Abatement and Control has highlighted health concerns related to noise, including that noise can produce serious physical and psychological stress to individuals. Noise is very prevalent in the Pediatric Intensive Care Unit (PICU), which houses critically ill children with a diverse spectrum of medical needs. Intensive Care Units are busy and chaotic environments alarms, equipment, constant momentum, and family and staff communication contribute to constant sources of noise. According to the literature, noise leads to physiological responses including higher heart rates, respiratory rates, and sleep deprivation. The American Academy of Pediatrics has recommended keeping sound levels below 45 decibels in hospitals. Providing an environment where sleep disturbances are minimized is important to provide restorative, protective and energy-conserving functions.

Aim

The purpose of this quality improvement project was to assess the effects of implementing a scheduled quiet time compared with not implementing a scheduled quiet time on pediatric critical care patients and caregivers (if in room overnight) quantity and quality of sleep in the Pediatric Intensive Care Unit (PICU).

METHODS

Quality Improvement Project

The project was a quality improvement project that was designed to decrease sleep disruptions by turning off patient televisions, dimming hallway lights, grouping care activities, completing baths before quiet time, and keeping conversations at a low level. In addition, previously studied non-pharmacological sleep aids were offered to patients and families, including earplugs, eye masks, and soothing music. A three-phase project was conducted.

Phases

1. Obtained parent/patient satisfaction ratings, patient sleep data, recorded baseline dosimeter measurements and educated staff on the noise reduction program.
2. Implemented noise reduction strategies, obtained parent/patient satisfaction ratings, patient sleep data and recorded dosimeter measurements.
3. Data analysis and manuscript development and dissemination.

Setting

The project took place within the Pediatric Intensive Care Unit (PICU) at Monroe Carell Children's Hospital (MCCH) at Vanderbilt.

RESULTS

The quiet at night protocol improved the quantity of sleep in patients in the PICU.

- Patients in the pre-intervention group had a mean of 4.48 hours (standard deviation of 1.61).
- Patients in the post-intervention group had a mean of 4.96 hours (standard deviation of 1.16).

There was a decrease in quality of sleep of patients after the quiet at night protocol was implemented.

- Pre-intervention, 8 patients (18.18%) were rated having poor sleep, 6 patients (13.64%) were rated having fair sleep, 23 patients (52.27%) were rated having good sleep, and 7 patients (15.91%) were rated having great sleep.
- In comparison, post-intervention data showed 46 patients (86.79%) were rated having poor sleep, 7 patients (13.21%) were rated having fair sleep, 0 patients (0%) were rated having good sleep, and 0 patients (0%) were rated having great sleep.

Caregivers had a decrease in the quantity of sleep after the quiet at night protocol was implemented.

- Pre-intervention group had a mean of 4.61 hours (standard deviation of 1.8).
- Post-intervention group had a mean of 4.36 hours (standard deviation of 1.27).

There was a decrease in quality of sleep of caregivers after the quiet at night protocol was implemented.

- Pre-intervention, 4 patients (17.39%) were rated having poor sleep, 3 patients (13.04%) were rated having fair sleep, 12 patients (52.17%) were rated having good sleep, and 4 patients (17.39%) were rated having great sleep.
- In comparison, post-intervention data showed 2 patients (6.06%) were rated having poor sleep, 14 patients (42.42%) were rated having fair sleep, 12 patients (36.36%) were rated having good sleep, and 5 patients (15.15%) were rated having great sleep.

IMPLICATIONS FOR PRACTICE

Substantial need for sleep improvement still exists in the PICU and the utilization of a quiet at night bundle has the ability to increase the quantity of sleep in the patients in the PICU. With numerous factors leading to sleep disturbance in the PICU noted throughout the study and results that showed there was a decrease in quality of sleep in the PICU for both patients and caregivers and the quantity of sleep for the caregivers after the intervention, there is still a need for sleep improvement in the PICU. Utilizing the PDSA cycle, the study will continue to be revised in the future.

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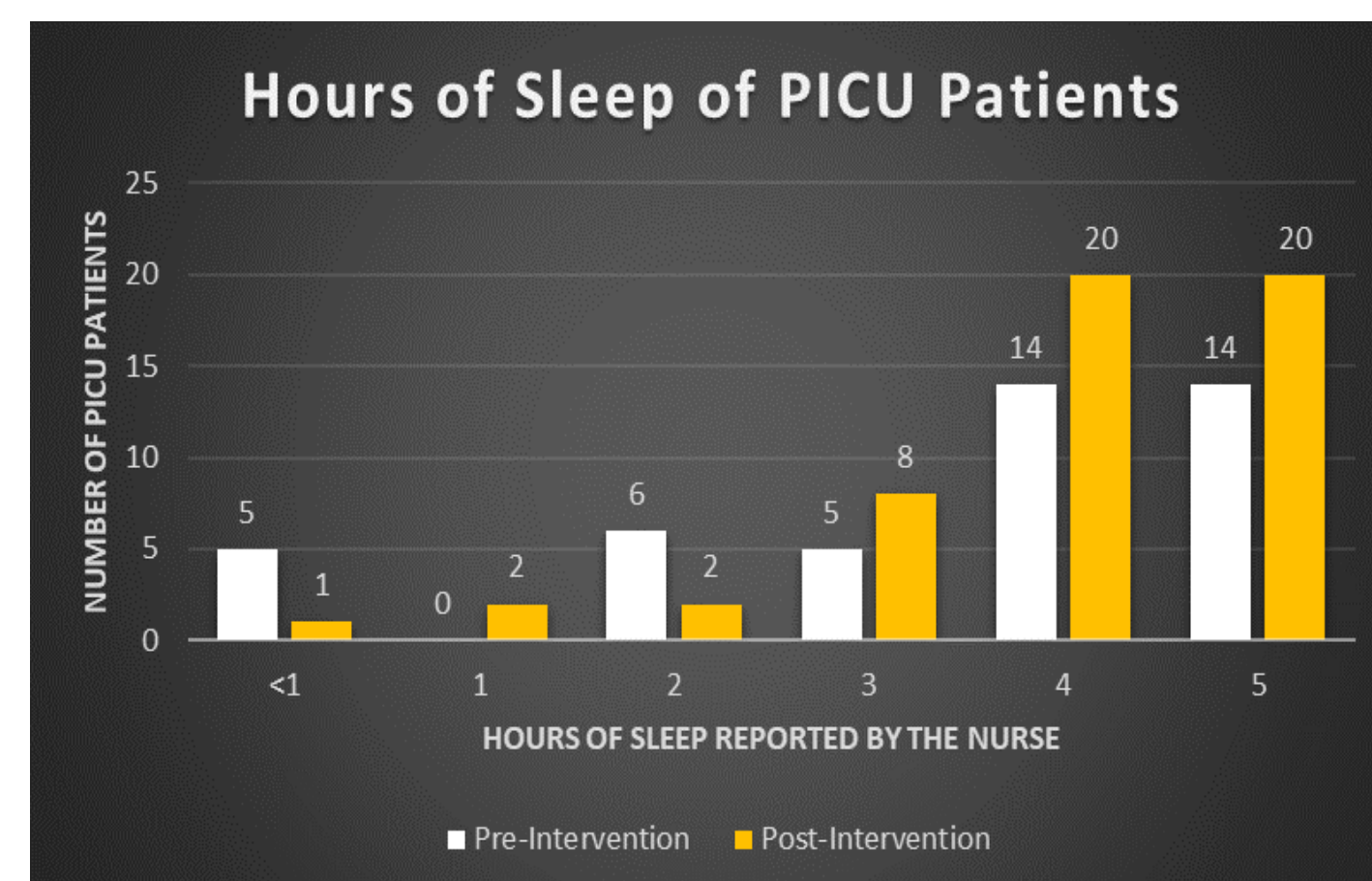


Figure 1
Hours of Sleep of PICU Patients Pre- and Post-Intervention

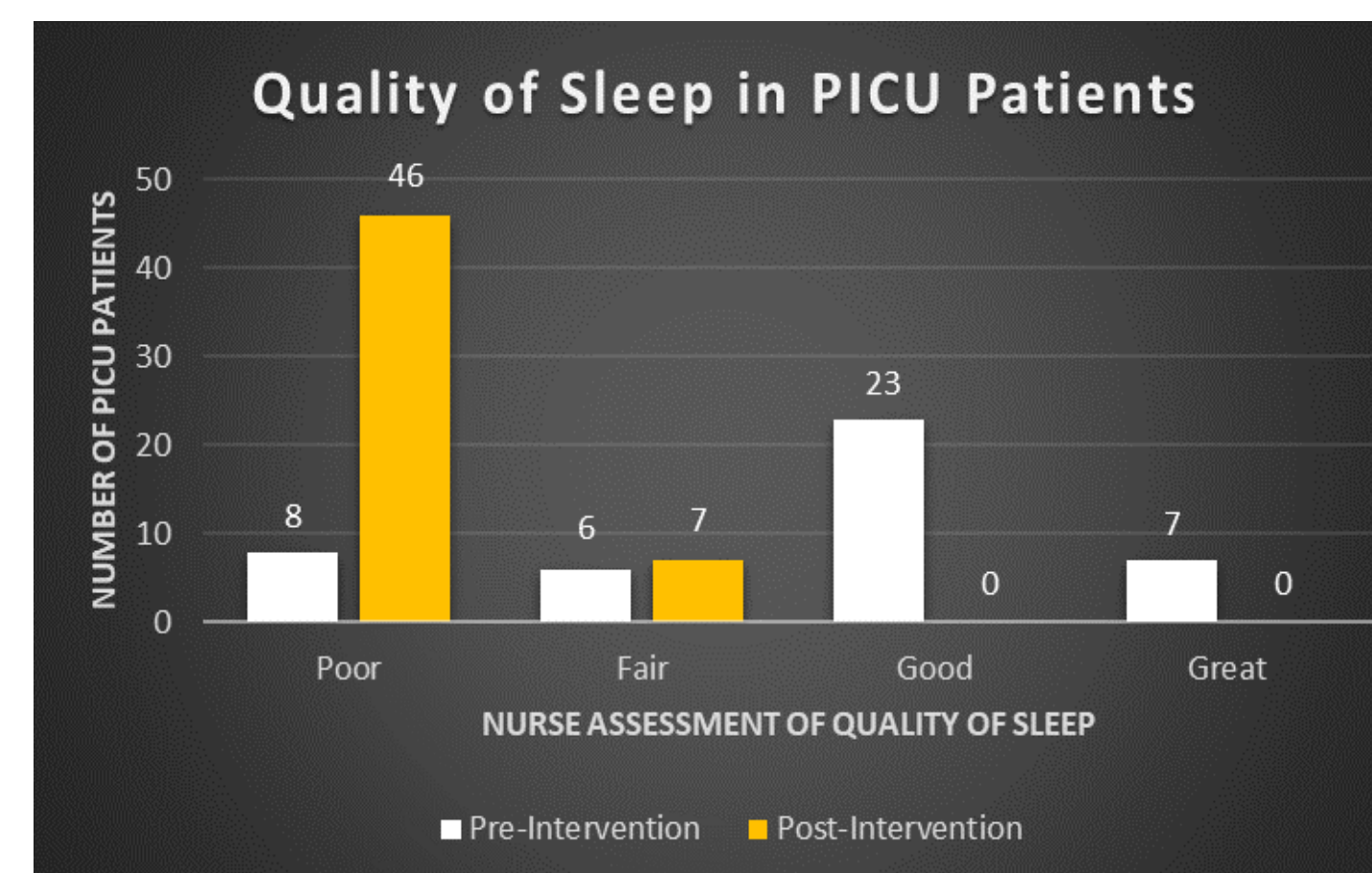


Figure 2
Quality of Sleep of PICU Patients Pre- and Post-Intervention

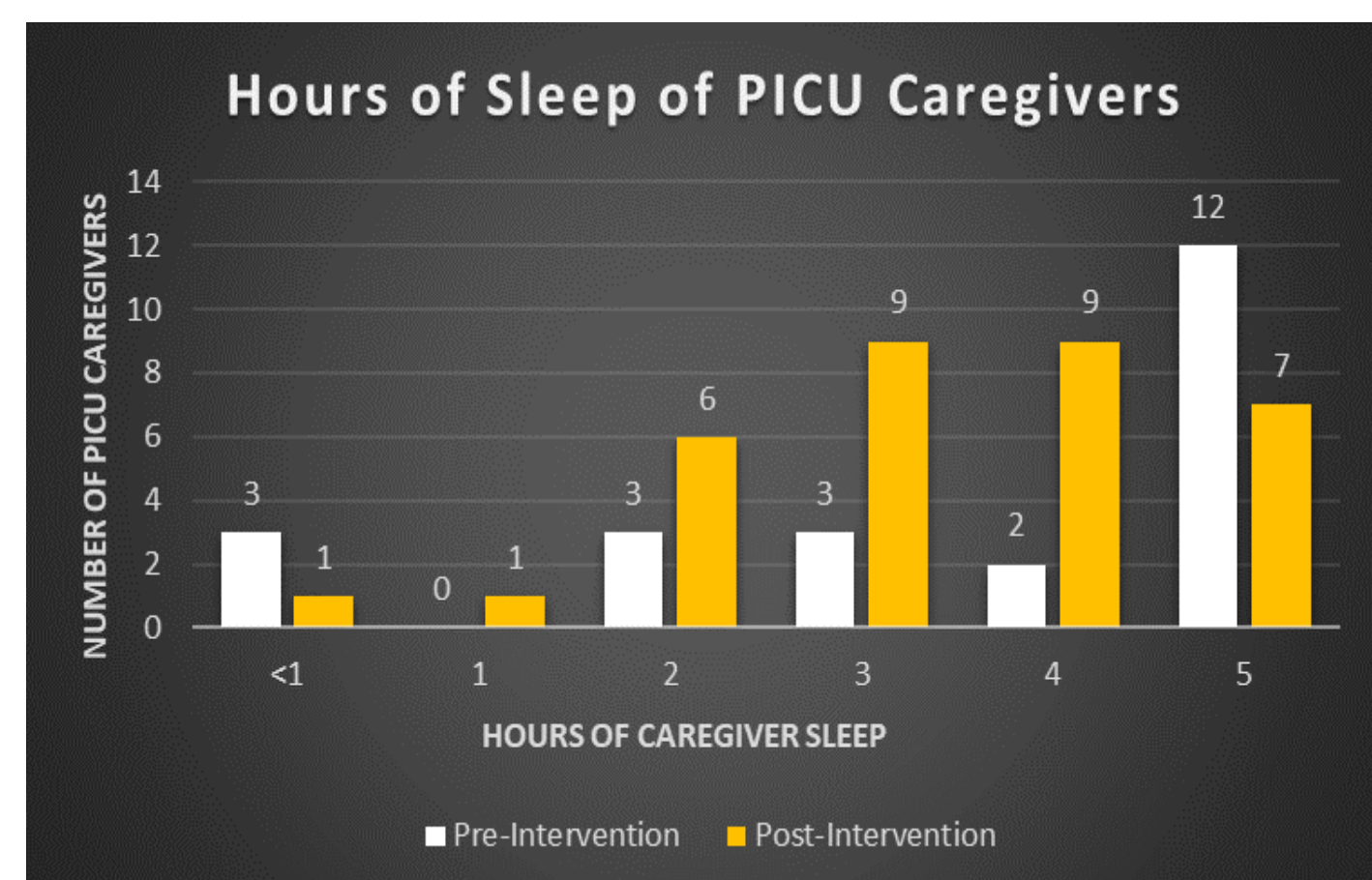


Figure 3
Hours of Sleep of PICU Caregivers Pre- and Post-Intervention

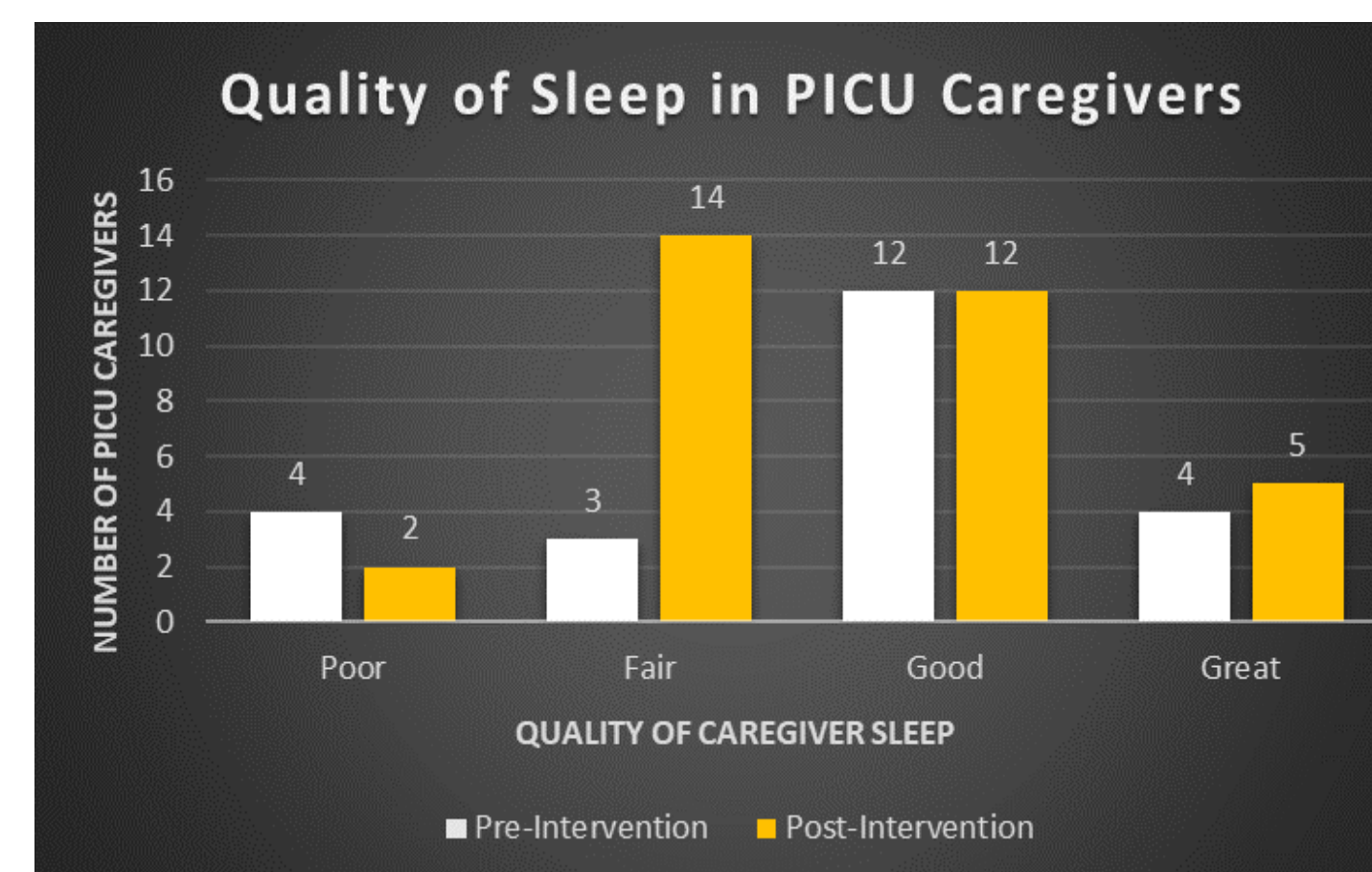


Figure 4
Quality of Sleep of PICU Caregivers Pre- and Post-Intervention

QUIET AT NIGHT

IN THE PICU

Team Members:

Courtney Hall, Victoria Jackson, and Pati Runyan

NOISE

- Noise is a disruptive sound that can be stressful
- The American Academy of Pediatrics has recommended keeping sound levels **below 45 decibels** in hospitals
- Sound levels above 50 decibels are sufficient to cause sleep disturbance, and sustained levels above 85 decibels can damage hearing
- Noise leads to physiological responses experienced by patients including **higher heart rates, respiratory rates** and also **sleep deprivation**
- One environment where noise is very prevalent = the Pediatric Intensive Care Unit (PICU)

THE PEDIATRIC INTENSIVE CARE UNIT (PICU)

- Each year, approximately **250,000 children** are admitted to the PICU in the United States (Kudchadkar et al., 2013).
- Worldwide, PICU's admit critically ill patients 0-18 years of age with the exception of critically ill neonates, who reside in the neonatal intensive care unit.
- Both medical and surgical diagnoses:
 - severe trauma
 - acute and chronic respiratory failure
 - solid organ transplants
 - multisystem organ failure requiring extracorporeal support (Kudchadkar et al., 2013)
- A critical illness exposes children to acute and significant stressors (Rennick et al., 2014).

SOURCES OF NOISE IN PICU

- 24/7 stimulation:
 - Voices
 - Buzzers
 - Telephones
 - Alarms
 - Televisions
 - Pagers
- The influence of Florence Nightingale has helped bring to light the environment's effect on health and healing (Gardner et al., 2009, p. 783).

SLEEP DISTURBANCE

- Defined as **the perceived or actual alterations in nighttime sleep (both quantity and quality) with subsequent daytime impairment**
- The disturbance to sleep can be an acute problem, but it is often recurrent, especially in **an environment with high stimulation**
- Regardless of the cause, sleep disturbances have been associated with adverse physiological outcomes, including alterations in immune function, metabolism, nitrogen balance, and protein catabolism

(Matthews, 2011, p. 2).

AIM

The **aim** of this quality improvement project:

- Assess the effects of implementing a scheduled quiet time compared with not implementing a scheduled quiet time on pediatric critical care patients and caregivers (if in room overnight) **quantity** and **quality** of sleep in the **Pediatric Intensive Care Unit (PICU)**.

Sleep

A healing environment is one that possesses nurturing and therapeutic effects.

Adequate sleep is an **essential aspect to human survival** (Richardson et al., 2009).

Sleep → therapeutic for health, and recovery (Gardner et al., 2009).

- Lack of adequate sleep may negatively impact all body systems (Richardson et al., 2009).

SLEEP

A well-designed healing environment →

- Reduce patient anxiety and stress
- Promote rest and sleep
- Accelerate recovery time

(Southwell & Wistow, 1994; Bowman, 1997; Edell-Gustafsson et al., 2003).

CONCEPTS

The primary concept chosen for this project was **sleep hygiene**.

Factors that disrupt sleep hygiene:

- Noise, light, pain, sedation, nursing intervention, and diagnostic testing.

In the Pediatric ICU:

- Heart monitor alarms, ventilator alarms, talking, doctors' and nurses' pagers and phones, television, bedside phone, and intravenous pump alarm.

CONCEPT DEFINITIONS

- **Noise** (noun): “a sound, especially one that is loud or unpleasant or that causes disturbance”
 - Heart monitor alarms, ventilator alarms, talking, doctors’ and nurses’ pagers and phones, television, bedside phone, and intravenous pump alarm.
- **Light** (noun): “the natural agent that stimulates sight and makes things visible”
- **Pain** (noun): “physical suffering or discomfort caused by illness or injury”

Interventions (noun): “the action or process of intervening”

Diagnostic testing (noun): “A type of test used to help diagnose a disease or condition”

Merriam-Webster, n.d.).

and (Diagnostic test, 2021).

FRAMEWORK

- Quality Improvement Project
- Methodology: Model for Improvement
- Plan-Do-Study-Act (PDSA) structure

Plan-Do-Study-Act (PDSA)

Before starting the PDSA cycle, three questions were asked:

1. What are we trying to accomplish?
2. How will we know that a change is an improvement?
3. What change can we make that will result in improvement?

Once those questions are structured, the PDSA cycle begins.

Plan-Do-Study-Act (PDSA)

1. Plan

- a. The objective of the test is stated, predictions are made with rationales, and plans are developed to test change (Science of Improvement, 2021, para. 3).

2. Doing the Test

- a. Researchers carry out the test, document problems and unexpected observations, and begin data analysis (Science of Improvement, 2021, para. 4).

3. Studying the Results

- a. The team sets size time to analyze the data and study the results (Science of Improvement, 2021, para. 5). Data is compared to the original predictions and a summary and reflection of learned data is provided (Science of Improvement, 2021, para. 5).

4. Action Steps

- a. Researchers refine the change based on data from the study and prepare for further tests (Science of Improvement, 2021, para. 3).

Synthesis of Evidence

Extensive literature on:

- Therapeutic effects of sleep on healing and health recovery
- How well-designed environments can promote rest and accelerate recovery time
- Sleep requirements increase for hospital patients undergoing surgery, experiencing trauma, and suffering from illness

Hospital environment produces unique challenges for patients in obtaining the quantity and quality of sleep.

Important to address environmental factors

Synthesis of Evidence

PubMed Terms:

“quiet time” AND “quality” OR “quantity” AND “sleep”

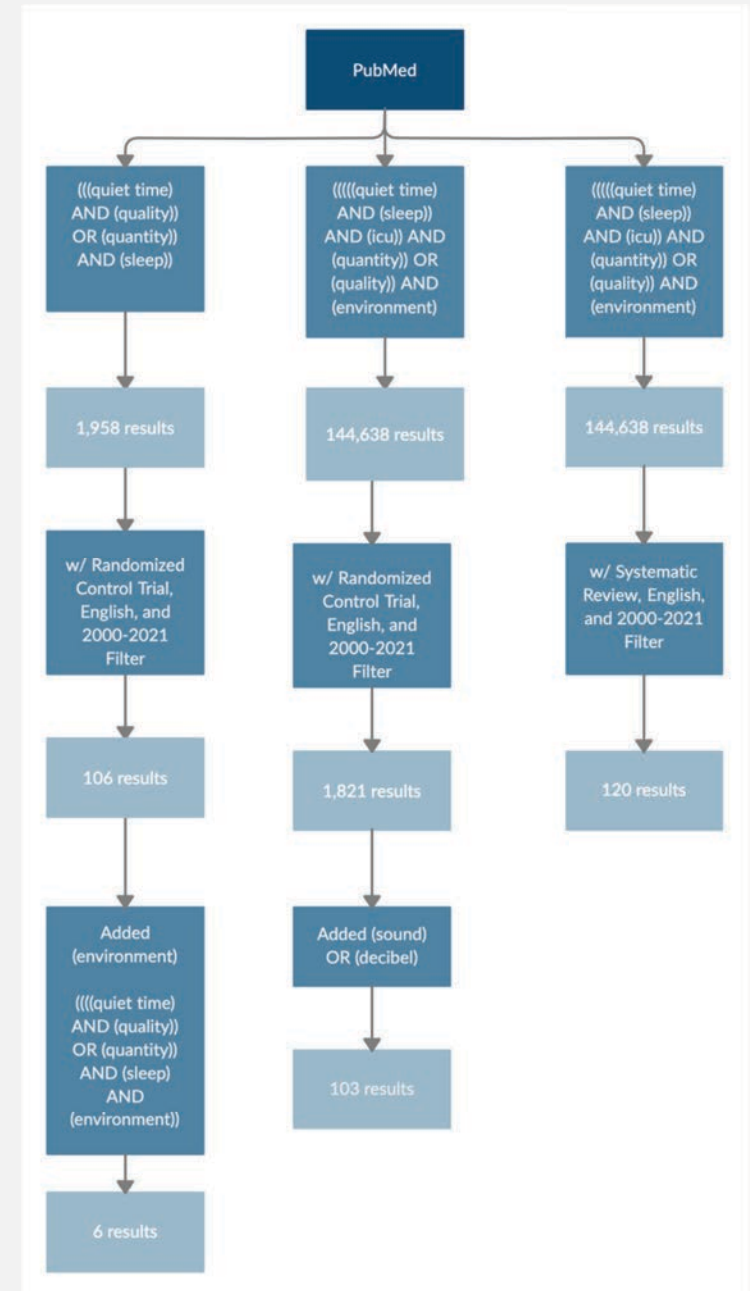
+ **“environment” AND “sound” OR “decibel”**

Reviewed Randomized Control Trials and Systematic Reviews

Inclusion criteria included:

- English
- Published between 2000 and 2021
- Peer reviewed

Five articles found → randomized control trials / high level of evidence



METHODS

The goals of each study was to **promote sleep in an ICU setting**.

The approach of each study was different in how they implemented strategies and measured the results.

- Kanuert et al. (2019) - Sleep promotion protocol (restricted non-urgent bedside care from 00:00 to 03:59)
- Huang et al. (2015) - Utilized earplugs, eye mask, and melatonin to promote sleep at night
- Hu et al. (2015) - Utilized earplugs and eye masks to reduce sound and light
- Obanor et al. (2021) - Utilized earplugs and eye masks to improve sleep perception
- Van Rompaey et al. (2012) - Utilized earplugs to improve sleep at night

SIMILARITIES

Findings:

- Adequate sleep → required for recovery after a serious illness
- Acute sleep deprivation → impairments in immune function, metabolic function, cardiovascular function and skeletal muscle function
- Sleep in ICU → higher proportion of non-rapid eye movement (NREM) sleep stage 1 and 2 (or light sleep) and reduced restorative slow wave (SW) and rapid eye movement (REM) sleep
- Lack of sleep → impaired immune function, difficult weaning from mechanical ventilation, delirium and severe morbidity
- **All studies aimed to study improved sleep in the ICU setting either through decreased distraction or decreased sound**

RESULTS AND IMPLICATIONS

All five studies showed that their intervention **produced significantly better sleep.**

Noise reduction interventions:

- Inexpensive
- Noninvasive
- Well tolerated
- Could continue throughout hospitalization

(Obanor et al., 2021, p. 825).

QUIET AT NIGHT

IN THE PICU

PROJECT DESIGN

Quality Improvement project

Goals:

- To utilize a QI Model to
 - decrease sleep disruptions by turning off patient televisions
 - dim hallway lights
 - group care activities
 - complete baths before quiet time
 - keep conversations at a low level

Project Phases

Phase one

- Dosimeters will be placed out on the unit to measure baseline noise levels

Phase two

- Education of interventions
 - Educating staff, patients, visitors, and family of the effects of quiet time on health & positive outcomes
 - Posting signs to reinforce quiet time
 - Routine staff communication to discuss challenges and recommendations

Phase three

- Implementation of interventions

Setting

The Pediatric Intensive Care Unit (PICU) at Monroe Carell Children's Hospital at Vanderbilt (MCJCHV)

Interdisciplinary team

- Doctors (attendings, fellows, and residents)
- Nurse practitioners
- Registered nurses
- Clinical support staff

All work together to team with children and families to provide the best care to critically ill children.

PARTICIPANTS

All non-intubated patients in the Pediatric ICU who have arrived at least by 2300
the night prior

- If families are in the room, they will be included

Nurse-driven intervention

INTERVENTIONS

Prior to 2300 each night:

1. Close the patient room doors as appropriate
2. Dim / turn off lights in the hallways
3. Dim / turn off lights in the patient rooms
4. Turn off or mute patient TV and other electronic devices
5. Post signage in rooms and alcoves to increase awareness of Quiet Time
6. Provide patients and overnight family members with earplugs and/or eye masks
7. Maintain conversations at a low decibel level
8. Phones and beepers silenced or placed on vibrate, as appropriate
9. Limit procedures or treatments during scheduled time frames if possible
10. Provide comfort with positioning and pain relief prior to Quiet Time

MEASUREMENT

Dosimetry will be used to measure decibel levels from 2000 - 0600 7 days a week during pre and post implementation.

An end of shift report (EOS) will be completed by each night shift Staff Leader that will capture events that occurred during the shift that may have escalated the noise (decibel levels), (ex. Codes, admits, procedures, transports) and will assist in explaining decibel spikes.

RedCap Survey at 0500

REDCAP SURVEY

PICU Quiet at Night 5AM Survey

AAA
+ -

Please complete the survey below.

Thank you!

Each morning at 0500 all non-intubated PICU patients who were admitted prior to 2300 the night before will be assessed by the nurse for quantity and quality of sleep.

Patient Room Number

5301 ▼

* must provide value

Date of the assessment

12-02-2021  Today M-D-Y

* must provide value

Day of the week of the assessment

Thursday ▼

* must provide value

!""#\$%&&'()*+##,-./0&123456.("+7.8!"96':(;

REDCAP SURVEY

Patient age

* must provide value

- 0-4 years of age
- 5-8 years of age
- >9 years of age

[reset](#)

Patient gender at birth

* must provide value

- Male
- Female
- Other

[reset](#)

How many hours of sleep do you believe your patient had overnight between the hours of 2300 and 0400 (11pm to 4am)?

* must provide value

- < 1 hour
- 1 hour
- 2 hours
- 3 hours
- 4 hours
- 5 hours

[reset](#)

REDCAP SURVEY

Did your patient receive any sleep inducing medications prior to hour of sleep?

* must provide value

- No
- Melatonin
- Precedex
- An antipsychotic
- Other

Of those hours of sleep, how would you rate the quality of your patient's sleep?

* must provide value

- Poor (consistently tossing and turning)
- Fair (occasionally tossing and turning)
- Good (little tossing and turning)
- Great (no tossing and turning)

[reset](#)

If your patient slept poor or fair, what factors contributed to that?

* must provide value

- Noise level
- Lighting
- Interventions
- Pain
- Other

REDCAP SURVEY

Was there a caregiver in the room overnight?

* must provide value

- Yes
 No

reset

How many hours of sleep do you believe your patient's caregiver had overnight between the hours of 2300 and 0400 (11pm to 4am)?

* must provide value

- < 1 hour
 1 hour
 2 hours
 3 hours
 4 hours
 5 hours

reset

Of those hours of sleep, how would you rate the quality of the caregiver's sleep?

* must provide value

- Poor (consistently tossing and turning)
 Fair (occasionally tossing and turning)
 Good (little tossing and turning)
 Great (no tossing and turning)

reset

If the caregiver slept good or great, what factors contributed to that?

* must provide value

- Reduced noise level
 Low lighting
 Few interventions
 Patient's pain controlled
 Other

ANALYSIS

Analysis will take place after the four-week implementation process.

TIMELINE OF PROJECT

September 7th: The IRB proposal was submitted

September 17th: The IRB received approval

October 18th to October 24th: Nurses were trained on the noise reduction program

November 1st to November 29th: Baseline dosimetry collection

November 15th: Baseline Redcap surveys will be utilized by our nurses to collect baseline data on our patients and their family's quantity and quality of sleep

November 29th: the Quiet Time bundle will begin

November 29th to December 27th: Quiet Time bundle will continue

January 10th to February 7th: Then data analysis will take place for four weeks

February 7th to March 14th, 2022: The manuscript will be developed and disseminated

BUDGET

All resources used for this project are provided for free by Vanderbilt Children's Hospital.

ANY QUESTIONS?

Thank you for your willingness and participation in quality
focused patient-centered care in the PICU!