Individual QI projects from single institutions

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Quasi-experimental, Nonrandomized Initiative to Minimize Sleep Disruptions among Hospitalized Children

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Abstract

Introduction: Hospitalized children experience frequent sleep disruptions. We aimed to reduce caregiver-reported sleep disruptions of children hospitalized on the pediatric hospital medicine service by 10% over 12 months. **Methods:** In family surveys, caregivers cited overnight vital signs (VS) as a primary contributor to sleep disruption. We created a new VS frequency order of "every 4 hours (unless asleep between 2300 and 0500)" as well as a patient list column in the electronic health record indicating patients with this active VS order. The outcome measure was caregiver-reported sleep disruptions. The process measure was adherence to the new VS frequency. The balancing measure was rapid responses called on patients with the new VS frequency. **Results:** Physician teams ordered the new VS frequency for 11% (1,633/14,772) of patient nights on the pediatric hospital medicine service. Recorded VS between 2300 and 0500 was 89% (1,447/1,633) of patient nights with the new frequency ordered compared to 91% (11,895/13,139) of patient nights without the new frequency ordered ($P = 0.01$). By contrast, recorded blood pressure between 2300 and 0500 was only 36% (588/1,633) of patient nights with the new frequency but 87% (11,478/13,139) of patient nights without the new frequency ($P < 0.001$). Overall, caregivers reported sleep disruptions on 24% (99/419) of reported nights preintervention, which decreased to 8% (195/2,313) postintervention ($P < 0.001$). Importantly, there were no adverse safety issues related to this initiative. **Conclusion:** This study safely implemented a new VS frequency with reduced overnight blood pressure readings and caregiver-reported sleep disruptions. *(Pediatr Qual Saf 2023;8:e666; doi: 10.1097/pq9.0000000000000666; Published online July 10, 2023.)*

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INTRODUCTION

Sleep disruption adversely affects health—impairing the immune system and leading to long-term chronic medical conditions.[1–3] Hospitalized children experience frequent sleep disruption. Children go to sleep later, wake up later, have more nighttime awakenings, and get less sleep in the hospital than at home.[4] One study reported up to 7.3 room entries per night directly correlating with caregiver-reported nighttime awakenings.[5] Efforts to reduce sleep interruptions have gained momentum as an issue nationwide, and initiatives have been executed safely in both pediatric and adult patients. For example, Cook et al[6] used the electronic health record (EHR) and clinician education sessions to safely reduce overnight blood pressure checks and nighttime interruptions by clinicians, increasing pediatric inpatient sleep duration. However, whether vital signs (VSs) are the most common cause of sleep interruptions outside this single-site study remains unknown, and if similar EHR interventions would scale to new settings.

In this quality improvement project, we aimed to reduce caregiver-reported sleep disruptions of children hospitalized on the pediatric hospital medicine service from a baseline of 24% of patient nights to 14% or lower over 12 months through (1) a greater understanding of local

drivers of sleep disruption and (2) targeted EHR interventions developed through user-centered design.[7]

We used the Institute for Healthcare Improvement model for improvement as a framework for developing this quality improvement project.[8] To discern local drivers of sleep disruptions, we surveyed caregivers about the frequency and type of sleep disruptions. Results demonstrated that sleep disruptions were frequent and VS were the primary cause of sleep disruption. Interestingly, home pulse oximetry monitoring negatively affects sleep as well.[9] Once we identified overnight VS as a frequent cause of sleep disruption, we used task analysis and user-centered design to design our intervention.[7]

METHODS

Context

The study site was a 295-bed freestanding, academic tertiary pediatric hospital in a large urban pediatric health system in the Southeastern United States. The target population was children hospitalized on the pediatric hospital medicine service, which cared for an average of 60–80 patients daily across 2 main hospital floors.

Stakeholder Team and Initial Investigation

A key driver diagram was created by a multidisciplinary team, including pediatric hospitalists, clinical informaticists, family experience liaisons, and nursing leadership in both clinical care and patient safety. Concepts included a commitment from hospital leadership, commitment from the full patient care team, and utilizing the EHR to facilitate sleep-preserving decision-making (Fig. 1).

To determine the causes of sleep disruption at our institution, we leveraged our family experience liaisons, who visited every patient room within 1–2 days of admission and administered voluntary surveys to caregivers. We added the following to their questionnaire: "Was your child's sleep interrupted last night?" with further categorizing of what specifically interrupted sleep if the answer was affirmative. Available categories included VS, environment, nurse or physician entry into the room, pain or anxiety, noisy monitors, IV issues, etc. In addition, caregivers could select multiple causes. The collection of baseline data was from October 15, 2020 to February 28, 2021. A total of 419 caregivers completed the family experience liaison survey, with 99 (24%) caregivers reporting greater than or equal to 1 sleep disruption. Figure 2 displays the resultant Pareto chart demonstrating that VS measurements were the most frequently reported cause of sleep disruption.

To determine the best approach to reduce sleep interruptions from overnight VS, we surveyed 175 nurses of which 61 (35%) responded. Unfortunately, this voluntary survey without incentive led to a lower response rate. Sixty (98%) felt reducing overnight VS could improve patient satisfaction. In comparison, 55 of 61 (90%) felt comfortable skipping all VS overnight for patients if ordered by the physician care team in the EHR.

Intervention

In the first PDSA (Plan, Do, Study, Act) cycle starting March 1, 2021, nursing and house staff received education about the upcoming initiative of VS reduction

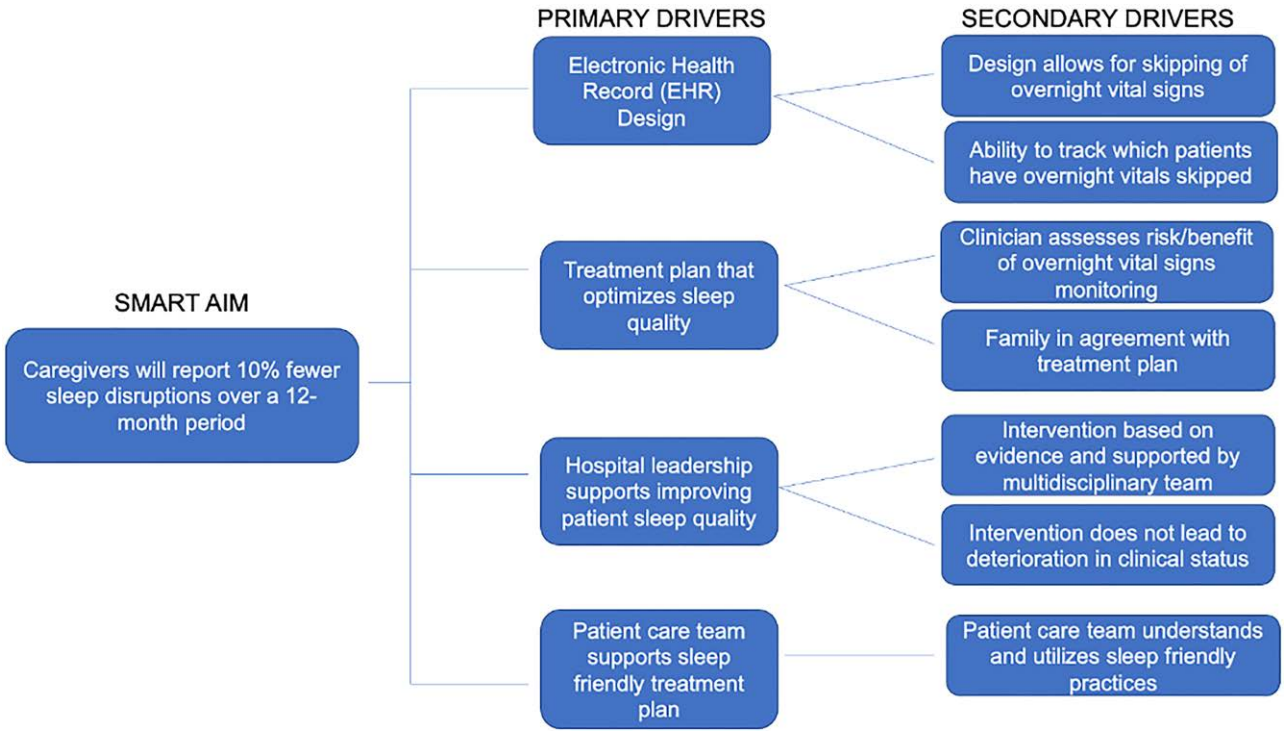

Fig. 1. Key driver diagram.

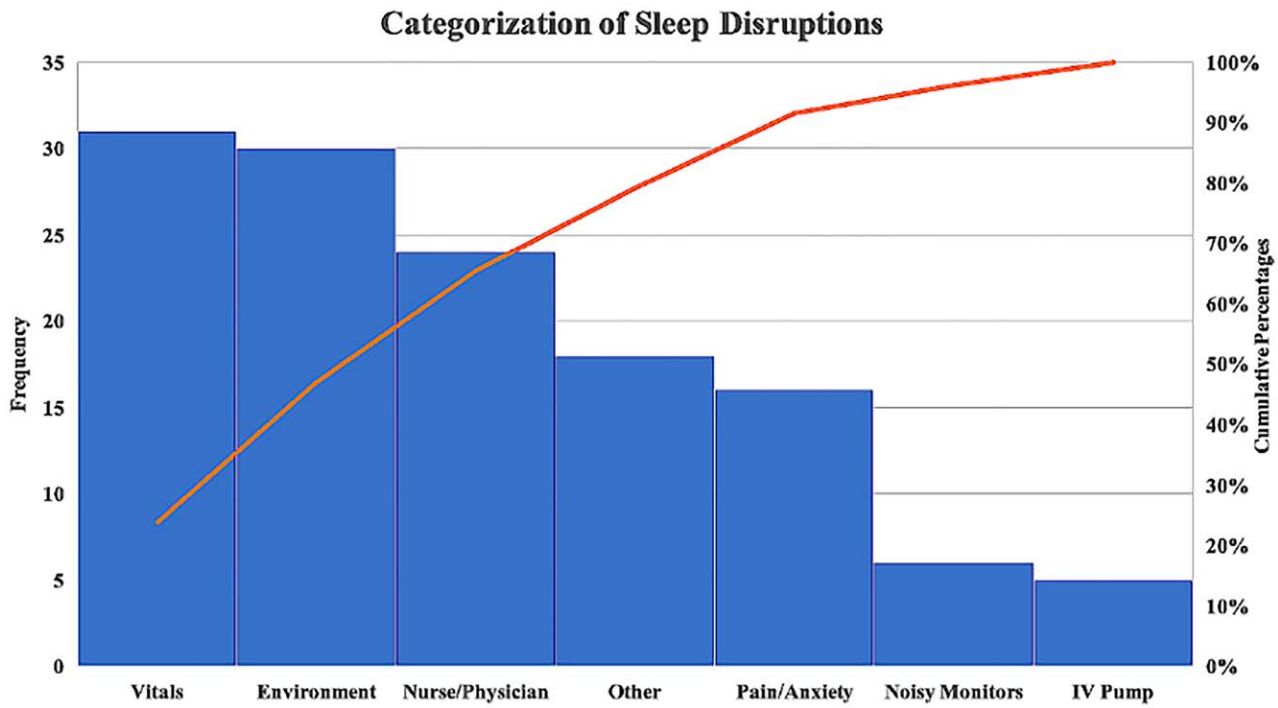

Fig. 2. Pareto Chart—categorization of sleep disruptions.

overnight. In addition, residents and attendings were educated on patient eligibility with exclusion criteria as follows: (1) age under two months, (2) sepsis, (3) respiratory distress, (4) cardiac disease, or (5) any condition deemed by the treating team as unsafe to forego overnight VS. We chose two months as the age cutoff as some of these infants start sleeping for longer periods in between feeds.

Beginning April 12, 2021, a new VS frequency of "every 4 hours (unless asleep between 2300 and 0500)" became available to order in the EHR—Epic Systems© (Verona, Wis.), as shown in Figure 3. We also removed the default VS frequency selection of "every 4 hours" in the General Pediatrics Admission order set (our most commonly used admission order set), thus requiring users to make an active choice of VS frequency at the time of admission. To promote awareness among nighttime house staff and nurses, we created a patient list column in the EHR identifying which patients had this new frequency active (Fig. 4).

The second PDSA cycle beginning November 3, 2021, provided further education to nursing, nursing leadership, and house staff to promote ongoing utilization of the new VS order.

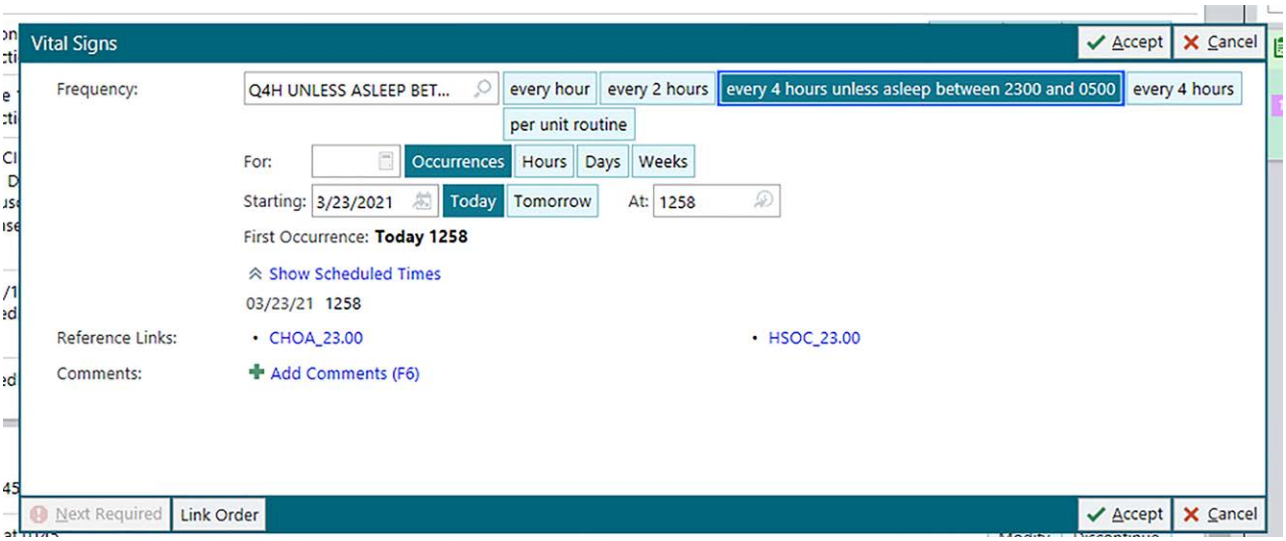

Fig. 3. New VS frequency—Epic Systems© (Verona, Wis.).

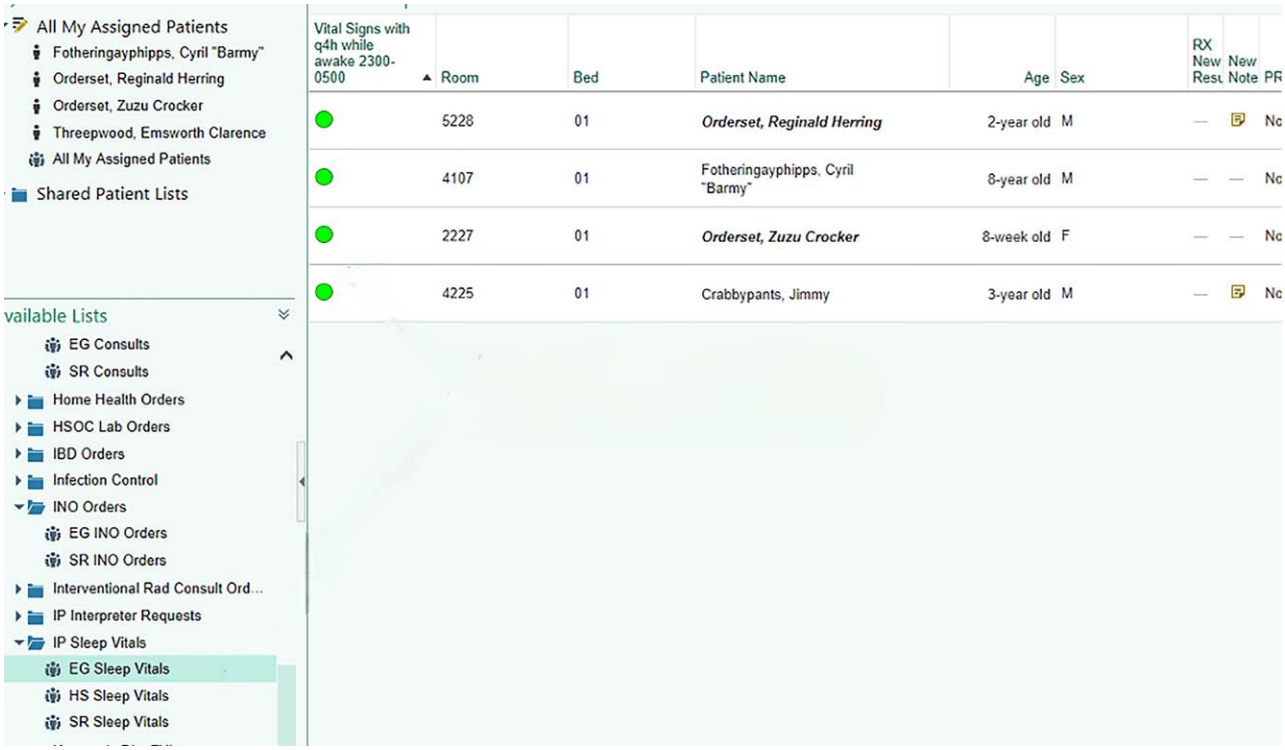

Fig. 4. Patient list column for new VS frequency—Epic Systems© (Verona, Wis.).

Study of the Intervention

We used a quasi-experimental, nonrandomized intervention design to monitor sleep interruption rates pre- and postintervention. Also, we compared the difference in overnight VS rates between those with and without the new frequency order.

Measures

The outcome measure was caregiver-reported sleep disruptions, measured via ongoing assessments from the family experience liaison team. The process measures included the proportion of patient nights with (1) an active order for the new VS frequency, (2) no VS documented between 2300 and 0500, and (3) no blood pressure documented between 2300 and 0500. As a balancing measure, we tracked rapid responses called on patients with the new VS frequency to ensure reduction in VS overnight did not decrease recognition of a clinical status change.

Analysis

A statistical process control chart tracked the outcome measure of the proportion of inpatient nights with greater than or equal to 1 caregiver-reported sleep disruption. Outcome and process measures treated as proportions were compared with chi-square tests. We did not perform statistical analysis for the balancing measure, given the small number of rapid responses (n = 4).

Reporting Standards and Ethics

The Children's Healthcare of Atlanta institutional review board determined that this initiative was quality improvement and nonhuman subject research, so it was exempt from formal review.

This article was written concordantly with SQUIRE 2.0 guidelines for quality improvement initiatives.[10]

RESULTS

Baseline data collection was from October 15, 2020 to February 28, 2021, and the intervention period was from March 1, 2021 to April 30, 2022. Two-week time intervals reflect the aggregated data. For the outcome measure, caregiver-reported sleep disruptions occurred in 24% (99/419) of patient nights preintervention, which decreased to 8% (195/2,313) postintervention (Fig. 5); $P \leq 0.001$. During the first PDSA cycle, March 1, 2021 to November 2, 2021, there was a sharp decline in caregiver-reported sleep disruptions to as low of an average as 0% during the May 15, 2021 to May 31, 2021 time interval. However, during a regular review of outcome measures, there was a concern about a lack of sustainability in maintaining these low averages, as some data points were above the new baseline. Thus, the second PDSA cycle, November 2, 2021 to April 30, 2022, emphasized reeducation on utilizing the order. We did not perform a discrete third PDSA cycle as caregiver-reported sleep disruptions remained around the desired new baseline.

Physician teams ordered the new VS frequency for 11% (1,633/14,772) of patient nights on the pediatric hospital medicine service. Recorded VS between 2300 and 0500 was 89% (1,447/1,633) of patient nights with the new frequency ordered compared to 91% (11,895/13,139)

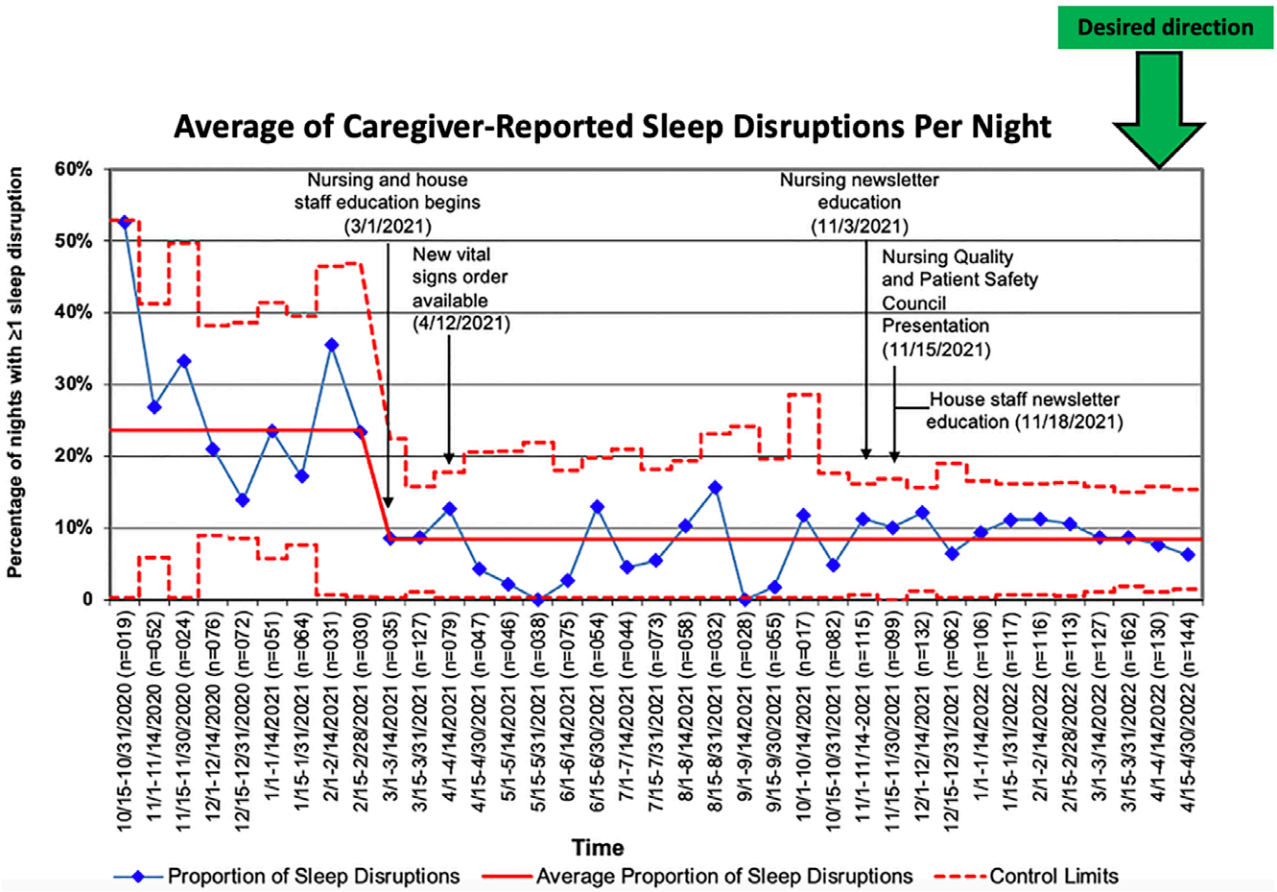

Fig. 5. P-control chart—Average of Caregiver-Reported Sleep Disruptions Per Night.

without the new frequency ordered ($P = 0.01$). Recorded blood pressure between 2300 and 0500 was only 36% (588/1,633) of patient nights with the new frequency and 87% (11,478/13,139) without the new frequency (Fig. 6); $P < 0.001$.

Four rapid responses were called on patients with the new VS frequency, but only one between 2300 and 0800 where absent overnight VS could have played a direct role. The patient was a 14-year-old boy with a medical history of meningioma who presented with myalgias and weight loss. The treating team ordered the new VS frequency on day 5 of the patient's admission. The rapid response happened the next day at approximately 0700 after he developed emesis and altered mental status. As a result, he required a PICU transfer. Of note, his VS during the rapid response were normal. The other 3 rapid responses did not occur overnight and were reviewed by a multidisciplinary team and deemed unrelated to the new VS frequency and unpreventable.

DISCUSSION

Summary

A reduction in sleep disruptions for hospitalized children and their families was temporally associated with implementing a new VS frequency stating to refrain from taking VS from 2300 to 0500 if the patient was asleep. A small percentage of patients postintervention had the new VS frequency. The rate of overnight VS documentation on patient nights with this new frequency active was not substantially different from patient nights without the new frequency. However, the rate of blood pressure documentation was substantially reduced among patients with the new VS frequency, suggesting that nurses may have specifically foregone the acquisition of blood pressure to avoid waking patients. In a postimplementation survey of 81 nurses, 74% ranked blood pressure as the most disruptive VS.

Interpretation

While we achieved our improvement aim, other unmeasured factors tangentially related to our intervention (such as a more sleep-conscious culture) likely contributed to the 16% absolute reduction in sleep disruption. Without such factors, we would not expect the magnitude of the reduction to be greater than the actual reduction in VS and blood pressure acquisition.

Other studies have allowed for similar blood pressure reduction in pediatric patients with passive VS, such as heart rate, respiratory rate, and pulse oximetry measurements, and additional measures to promote uninterrupted sleep, such as changing the time of routine laboratory

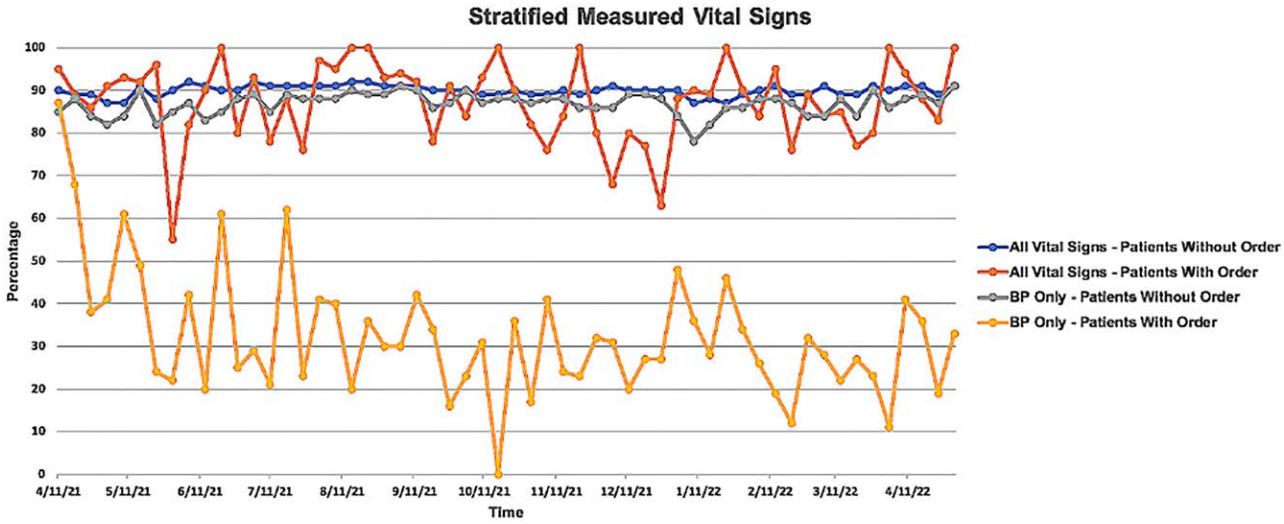

Fig. 6. Run chart—stratified measured VSs.

draws.[11] Abstaining from all VS was done safely in 2 low-risk hospitalized pediatric populations of hyperbilirubinemia and failure to thrive, except for continued temperature measurements in the hyperbilirubinemia population.[12] A randomized clinical trial to discontinue the measurement of nighttime VS was performed in hospitalized adult patients. This change led to a significant decrease in the mean number of nighttime VS checks with no increase in intensive care unit transfers or code blue alarms.[13]

As in these previous studies, we demonstrated the feasibility of safely reducing overnight VS, specifically blood pressure measurements. Foregoing blood pressure did not correlate with safety events in a population selected by the care team. Nighttime VS may not perfectly screen for looming clinical instability,[14] and while the optimal VS frequency for clinical acuity remains unknown, certain patient populations can safely tolerate a reduction in frequency to promote sleep.[15]

Similar to recent work, our study identified VS as an important contributor to overnight sleep disruption in hospitalized children and demonstrated that interventions to reduce VS in a selected group of hospitalized patients were not associated with an increase in subsequent clinical deterioration or escalation of care. Our study population included patients over two months of age, and the goal was to forego all overnight VS. This goal differed from previous studies that mainly abstained from overnight blood pressure and/or temperature monitoring.[6,11] Notably, a larger patient sample received orders to forego overnight blood pressures and/or temperatures compared to the 11% of patient nights in our study receiving the order to forego all VS. We also observed that while our intervention was intended to reduce all overnight VS, we only observed a significant reduction in the blood pressure measurements in the population with the selected order. This result may indicate that heart rate, respiratory rate, pulse oximetry, and temperature are collected without waking the patient. Alternatively, it may result from providers' or nurses' comfort with reducing but not eliminating overnight VS checks. Our study also included all ages over two months, whereas one of the previous studies only included patients over 5 years old.[12] Finally, it included patients with varied diagnoses instead of a limited low-risk tailored population.[11,12]

Limitations

First, our study involved a single institution, and our demonstrated effectiveness may depend on structural, cultural, or other factors that do not apply to other institutions. Second, there was a decline in caregiver-reported sleep disruptions; however, despite the temporal association with our intervention, we could not demonstrate whether EHR changes, education, or foregoing VS was the primary cause, and overall use of the new VS frequency was low (11%). Finally, this study only tackled the most frequent cause of sleep disruption in our population. The environment was the next frequent cause of sleep disruption, which may reflect the overall noise level in the hospital setting. In other settings, other factors (eg, alarms, laboratories, and nurse/physician disruptions) may play a more important role not addressed by our intervention. Nonetheless, the positive results seen in this and similar studies at other sites suggest this approach may be applicable across pediatric health systems.[6,11–13]

CONCLUSIONS

Minimizing sleep disruptions in the pediatric hospital setting can be accomplished safely and sustainably through the care team selection of patients that may forego overnight VS. In combination with previous studies, this work suggests that there should be a more uniform structure across medical systems to reduce VS overnight when

applicable. Further studies could determine what interval of VS measurement is most suitable in varying situations to promote patient safety while limiting excessive interruptions.

DISCLOSURES

Dr. Evan Orenstein is a co-founder and holds equity in Phrase Health©, a clinical decision support analytics company. He receives no direct revenue and is the principal investigator on an R42 grant with Phrase Health funded by the National Library of Medicine (NLM) and the National Center for Advancing Translational Sciences (NCATS). He receives salary support from NLM and NCATS. The other authors have no financial interest to declare.

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