

8-1-2016

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Accepted version. *Intensive and Critical Care Nursing*, Vol. 35 (August 2016): 22-27. [Publisher Link](#).

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Summary

Objective: Sleep disruption occurs frequently in critically ill patients. The primary aim of this study was to examine the effect of quiet time (QT) on patient sedation frequency, sedation and delirium scores; and to determine if consecutive QTs influenced physiologic measures (heart rate, mean arterial blood pressure and respiratory rate).

Method: A prospective study of a quiet time protocol was conducted with 72 adult patients on mechanical ventilation.

Setting: A Medical Intensive Care Unit (MICU) in the Midwest region of the United States.

Results: Sedation was given less frequently after QT ($p = 0.045$). Those who were agitated prior to QT were more likely to be at goal sedation after QT ($p < 0.001$). Although not statistically significant, the majority of patients who were negative on the Confusion Assessment Method (CAM-ICU) prior to QT remained delirium free after QT. Repeated measures analysis of variance (ANOVA) for three consecutive QTs showed a significant difference for respiratory rate ($p = 0.035$).

Conclusion: QT may influence sedation administration and promote patient rest. Future studies are required to further understand the influence of QT on mechanically ventilated patients in the intensive care unit.

Keywords: Critical care; Delirium; Hospital noise; Quiet time; Sleep

Implications for Clinical Practice

- The use of a quiet time or uninterrupted period of rest may decrease the need for sedation in critical care.
- Findings from this study support quiet time as a safe (no increase in delirium) and beneficial nursing intervention in critical care.
- Nursing staff expressed satisfaction with quiet time. Decreased sound and light within the critical care environment may not only be beneficial to patients, but nurses as well.

Introduction

Critically ill patients frequently experience sleep disruption and poor sleep quality ([Kamdar et al., 2012a](#) and [Trompeo et al., 2011](#)). The intensive care unit (ICU) environment contributes to sleep interruptions due to frequent patient waking for tests, procedures and treatments ([Figueroa-Ramos et al., 2009](#) and [Konkani and Oakley, 2012](#)). Additionally, critical illness and the associated immunological, hormonal and metabolic derangement increase the frequency of awakenings from sleep ([Tamburri et al., 2004](#)). ICU patients have reduced rapid eye movement (REM) sleep, frequent care interactions that interrupt sleep and patients have expressed the desire for

improved sleep ([Garbor et al., 2003](#), [Tamburri et al., 2004](#) and [Tembo et al., 2013](#)). A consequence of sleep disruption is delirium, which extends time in critical care, increases mortality and may lead to long-term cognitive dysfunction ([Desai et al., 2013](#), [Girard et al., 2010](#), [Lin et al., 2004](#) and [Thomason et al., 2005](#)). Developing and testing protocols that promote uninterrupted sleep for critical care patients is an important area of nursing research.

Background

Fatigue associated with sleep disturbance can cause respiratory muscle dysfunction and prolonged mechanical ventilation ([Fontana and Pittiglio, 2010](#) and [Tembo and Parker, 2009](#)). Modes of mechanical ventilation may also contribute to sleep disruption ([Delisle et al., 2011](#) and [Parthasarathy and Tobin, 2002](#)). Sleep is frequently interrupted during ventilatory support due to desynchronised breathing, endotracheal tube pain and communication challenges with staff ([Nakos, 2011](#), [Patel et al., 2008](#) and [Tembo and Parker, 2009](#)).

Delirium may be related to sleep disruption. Prevalence rates for delirium in mechanically ventilated patients are 60–80% ([Desai et al., 2013](#)). Sleep disturbance and the administration of benzodiazepines are delirium risk factors ([Figueroa-Ramos et al., 2009](#) and [Weinhouse et al., 2009](#)). In a study of surgical intensive care patients delirium and lorazepam dosage were independently associated with significantly reduced REM sleep ([Trompeo et al., 2011](#)).

Providing a quiet time (QT) for patients is a strategy to address sleep disruptions in hospitalised patients ([Bartick et al., 2010](#), [Dennis et al., 2010](#), [Gardner et al., 2009](#), [Maidl et al., 2013](#) and [Olson et al., 2001](#)). A QT is defined as a period of time in which there is a reduction of light and sound and interruptions are minimised within the patient's room ([Dennis et al., 2010](#), [Gardner et al., 2009](#), [Maidl et al., 2013](#) and [Olson et al., 2001](#)). Improved patient sleep, reduced noise and increased satisfaction for patients, family and staff are positive outcomes associated with QT in settings outside the ICU ([Bartick et al., 2010](#) and [Gardner et al., 2009](#)).

When a QT intervention was implemented twice daily for neuro-critical care patients ([Dennis et al., 2010](#) and [Olson et al., 2001](#)), noise

and light were significantly lower and patients were more likely to be sleeping during QT. A daily QT in cardiovascular and neurosciences ICUs resulted in higher patient ratings of sleep and lower anxiety levels (Maidl et al., 2013). Additionally, 93% of the patients in the study reported that QT was important.

No studies to date have examined the impact of QT on delirium and sedation use in mechanically ventilated patients. This study aimed to explore the influence of a QT on the mechanically ventilated patient population in a medical ICU (MICU).

Topf's Environmental Stress Model (ESM) guided the study. Noise in the environment creates ambient stressors with physiological and psychological consequences on the person (Topf, 2000). QT, by decreasing noise and patient interruptions, may improve the quality and quantity of patient sleep, decrease the analgesic and sedatives medication administration and decrease delirium (see Fig. 1).

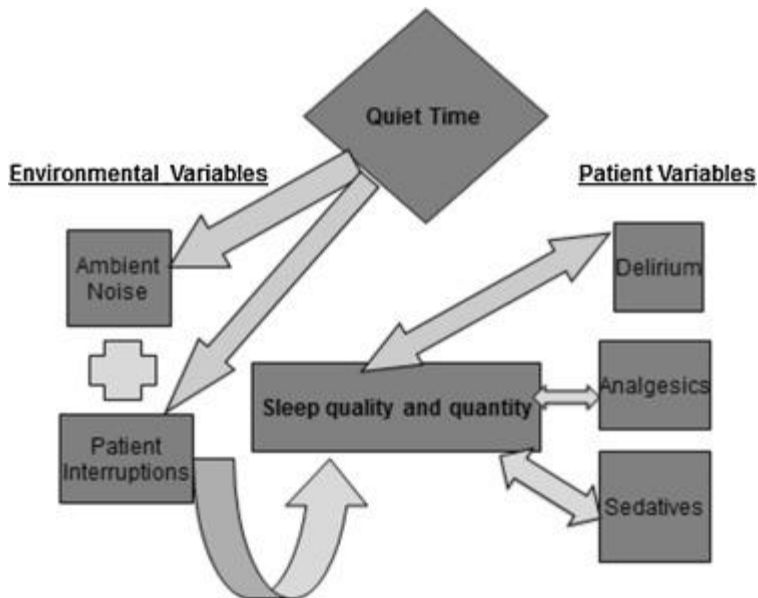


Figure 1. Effect of quiet time to reduce the noise and interruptions for nursing care/tests and procedures (environmental variables) in relationship to the potential effects of individual variables on the quality and quantity of sleep. Conceptual framework modified from the theoretical underpinnings of Topf's Environmental Stress Model (Topf, 2000).

Purpose

The purpose of this study was to examine the impact of QT on mechanically ventilated patients. The research questions to be addressed were:

- Q 1:** Does QT decrease the frequency of sedation dosing in the 24 hours after a patient has received a QT?
- Q 2:** Does QT have an effect on sedation levels in the 24 hours after the QT?
- Q 3:** Does QT have an effect on delirium in the 24 hours after the QT?
- Q 4:** What is the nurse's perception of patient sleep quantity and quality?
- Q 5:** How many interruptions occur during a QT?
- Q 6:** What is the level of nursing satisfaction with QT?
- Q 7:** Does sleep during periods of consecutive QT sessions have an effect on patient measures such as heart rate, respiratory rate or mean arterial blood pressure?

Methods

Design

This was a prospective study of a QT protocol for mechanically ventilated patients. Patients were recruited over a year from one MICU. The QT protocol involved a reduction of light and sound within the patient's room and minimised interruptions. The QT occurred daily from 2 p.m. to 4 p.m. for those enrolled in the study, which is consistent with the timing of QT in previous studies ([Dennis et al., 2010](#), [Maidl et al., 2013](#) and [Olson et al., 2001](#)).

Sample

A convenience sample of mechanically ventilated adult (age 18 or older), critical care patients were enrolled. Patients were excluded if they received neuromuscular blocking medications, underwent therapeutic hypothermia, had a Richmond Agitation-Sedation Scale (RASS) ([Sessler et al., 2002](#)) score of -4 to -5, were in the process of brain death testing or organ donation, received procedural sedation

within the last four hours, were hemodynamically unstable or were undergoing cessation of life-sustaining therapies.

Setting

The study was conducted in a 26-bed MICU of a 460 bed, level 1 adult trauma and Midwestern academic medical centre in the United States, Magnet® designated. The patient to nurse ratio was 2:1.

Data collection tools

Patient demographic data included age, gender and admitting medical diagnosis. Physiologic measures included blood pressure, respiratory rate and heart rate (recorded before and after the QT). RASS scores (before and after QT), the Confusion Assessment Method for the ICU (CAM-ICU) ([Ely et al., 2001](#)) scores (over a 24 hour period), time of last sedative and analgesic medications, overall frequency of sedative and analgesic administered within the last 24 hours, length of ICU stay and number of ventilator days. All were obtained from the electronic medical record (EMR).

Sedation Levels. In our MICU sedation is assessed every four hours with the RASS, a tool with strong interrater reliability and face validity ([Sessler et al., 2002](#)). RASS scores range from +4 (combative) to -5 (unresponsive) based on assessment of eye opening, eye contact and physical movement. Planned analysis grouped the RASS into categories: +1 to +4 indicated the participant was under sedated, 0 to -1 goal sedation, and -2 to -5 over sedated. These categories are consistent with the sedation goals in the MICU study setting. Patients on sedative drips received a daily interruption of sedation consistent with practice standards.

Delirium. The CAM-ICU detects delirium in the ICU population, specifically those who are mechanically ventilated ([Ely et al., 2001](#)). Sensitivity, specificity and interrater reliability are high ([Ely et al., 2001](#) and [Luetz et al., 2010](#)). A patient is CAM-ICU positive if he or she has a change in mental status within the last 24 hours, inattention, and an alteration in level of consciousness or

demonstrates disorganised thinking. Nurses completed the CAM-ICU every eight hours and as needed per unit guidelines.

Nurse perception of patient sleep. An investigator created tool was used to measure nurse perception of the patient's quality and quantity of sleep during QT. At the top of the tool sleep was defined as "patients who appear to have their eyes closed with decreased body movement and responsiveness". Nurses answered the following questions to capture patients' sleep: "How long did your patient actually sleep uninterrupted during the QT period" and "How would you rate the overall quality of your patient's sleep?" (0–10 scale, 0 equal to no sleep and 10 equivalent to slept very well). Nurses were asked to record the number of interruptions the patient experienced during each QT session and rated their satisfaction with QT (0–10 scale, 10 equal to very satisfied).

Ethical considerations

This study was approved by the organisation's institutional review board. Formal written consent was obtained from the participant's legally authorised representative (LAR). The IRB number for this study is PRO00018217. A cover letter informed the nurses of their rights as participants in this project and return of the tool by nurses signified consent.

Procedure

Patients were selected for the study based upon documentation of admission to the ICU in the unit record book. If a patient was on mechanical ventilation, the research team approached the patient's LAR for consent to participate in the QT study. All disciplines working in the MICU, patients, and their families were educated on the QT protocol prior to the study by the research team. A research member turned down the lights in the MICU indicating the start of QT. If the nurse caring for the patient verified it was clinically appropriate to start QT, a research member turned down the lights in the room, pulled the shades over the windows, turned off the television and closed the door to the room. Prior to starting QT, the research team recorded patient vital signs. Nurses clustered routine care before or after the QT;

however, required tests, procedures and immediate patient care needs continued during the QT as needed. Family members were encouraged to stay for the QT and usually napped or worked quietly on other activities during the patient's QT session. The bedside nurse observed the patient during the QT as part of routine care. Patients enrolled in the study had a QT daily until they became ineligible for participation due to extubation. After each QT, nurses rated the quality and quantity of patient sleep and overall satisfaction with the QT. The research team recorded the patient's vitals and collected data from the electronic medical record (EMR) after the completion of the QT.

Data analysis

A related samples sign test was used to determine differences in the frequency of sedation given before and after QT. A chi-square test was used to determine changes in levels of sedation before and after QT. A McNemar test determined differences in CAM-ICU scores in the 24 hours before and after QT. Descriptive statistics were used to determine quality and quantity of patient sleep, the number of interruptions and nursing satisfaction with QT. Blood pressure recordings were computed to mean arterial pressure for analysis. Repeated measures analysis of variance (ANOVA) was used to examine physiologic measures of heart rate, mean arterial pressure and respiratory rate.

Results

There were 72 patients in the study with at least one QT. The range of consecutive QTs was 1 to 11 (*Mdn* = 2). There were 210 QTs during the course of the study. More than half of the sample were female ($n = 41$, 57%). Patient age ranged from 19 to 85 years, with an average age of 58 ($SD = 15.10$). ICU days ranged from 2 to 35 (*Mdn* = 3). Ventilator days ranged from 0 to 33 (*Mdn* = 1). Patients' diagnoses are shown in [Fig. 2](#).

Q 1: Does QT decrease the frequency of sedation doses in the 24 hours after a patient has received a QT?

Using the 210 QTs as the unit of analysis, patients received fewer doses of sedation in the 24 hours after QT ($p = 045$).

Q 2: Does a QT have an effect on sedation scores?

For the 210 QTs, the level of sedation (RASS scores) was significantly different after QT ($\chi^2 = 180.3, p < 0.001$), such that those who were under sedated at the start of QT ($n = 29$), 9 (31%) were more likely to reach goal sedation after the QT. Additionally, the majority of patients who were at goal ($n = 81$) stayed at goal sedation ($n = 71, 87\%$).

Q 3: Does QT have an effect on delirium scores?

For the 116 QTs with documented CAM-ICU scores, QT did not have a significant effect on delirium scores ($p = 0.648$); however, the majority of patients who were CAM-ICU negative at the start of the QT, remained negative after QT ($n = 50, 86.2\%$). Additionally, some of the patients who were CAM-ICU positive converted to CAM-ICU negative after QT ($n = 11, 19\%$).

Q 4: What is the nurse's perception of patient sleep quantity and quality?

For the 204 QTs with documented sleep time, sleep quantity ranged from 0 to 120 minutes ($M = 73.49, SD = 37.41$). Sleep quality scores ranged from 0 to 10 ($M = 7, SD = 2.60$).

Q 5: How many interruptions occur during QT?

For the 205 QTs in which interruptions were reported no interruptions occurred during 33 QTs (16.1%), while the majority of QTs had one to two interruptions ($n = 105, 51.2\%$). There were three to four interruptions in 45 of the QTs (22%) and five or more interruptions for 22 QTs (10.7%). The most frequent interruption was nursing care (55.2%), followed by respiratory therapy (21.3%), other procedures (7.6%) noise (5.2%) and change in patient condition (4.5%).

Q 6: What is the level of nursing satisfaction with QT?

Nursing satisfaction with QT was moderate to high ($M = 7.39, SD = 2.38$).

Q 7: Does sleep during periods of consecutive QTs have an effect on patient measures such as heart rate, respiratory rate or mean arterial blood pressure?

Repeated analysis of variance (ANOVA) was performed for the 32 patients who experienced three consecutive QTs. There was a significant difference pre to post QT for respiratory rate, $F(1, 31) = 4.88, p = 0.035$ (see [Table 1](#)). No significant differences for heart rate, $F(1, 31) = 0.13, p = 0.72$ or MAP, $F(1, 31) = 2.6, p = 0.117$ were found.

Table 1. Repeated measures ANOVA ($n = 32$) for HR, MAP, and RR.

	QT1 M (SD)	QT2 M (SD)	QT3 M (SD)	F	p	Observed power
HR Pre QT	93.62 (22.62)	94.5 (19.14)	90.72 (20.12)	0.127	0.724	0.064
HR Post QT	91.63 (18.27)	92.72 (20.87)	93.44 (21.87)			
MAP pre QT	85.79 (14.73)	81.28 (20.43)	85.98 (13.39)	2.6	0.117	0.346
MAP post QT	81.32 (14.69)	79.68 (12.34)	84.80 (15.23)			
RR Pre QT	24.50 (8.67)	24.81 (8.01)	23.47 (8.69)	4.88	0.035	0.572
RR Post QT	23.41 (8.26)	22.53 (6.21)	21.72 (6.77)			

HR, heart rate; RR, respiratory rate; MAP, mean arterial blood pressure.

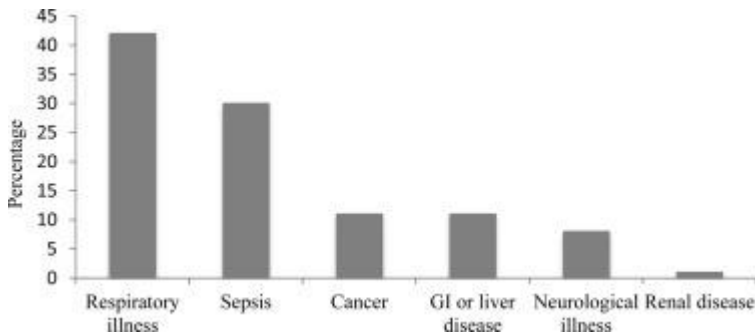


Figure 2. Patients' diagnoses.

Discussion

Patients received sedative medications less frequently after participating in the QT protocol. [Bartick et al. \(2010\)](#) also found a reduction in sedation when QT was performed on a medical/surgical ward; however, this is the first study to show that QT may impact sedation use in mechanically ventilated patients. Another important finding is patients who were under-sedated at the start of QT were more likely to reach targeted sedation levels and those who were already in the desired sedation range stayed at that level. Both sleep disruption and sedative administration may contribute to the development of delirium and long-term negative outcomes for ICU survivors ([Girard et al., 2007](#), [Kamdar et al., 2012a](#) and [Kamdar et al., 2012b](#)). Based on our findings, QT may be a potential strategy to decrease the need for sedative medications in the ICU. Sedative reduction strategies may increase the likelihood of successfully weaning from mechanical ventilation and potentially decrease the

length of time required in the ICU environment ([Sessler and Pedram, 2009](#)).

CAM-ICU scores were not significantly different before and after QT; however, the majority of patients who started as CAM-ICU negative remained negative after QT. The QT protocol did not increase delirium in our study.

Nursing staff reported moderately high patient sleep quality during QT; however, limitations imposed by measurement may relate to this finding. Nurses were asked to provide information about patient sleep, rather than patients. In a study comparing patient reported sleep quality to nurse assessment of patient sleep agreement was low to moderate, with nurses rating sleep quality higher than patients ([Kamdar et al., 2012b](#)).

Protection from interruptions during the two hour QT was difficult. Frequent interruptions in the ICU environment are documented in prior studies ([Garbor et al., 2003](#) and [Tamburri et al., 2004](#)). This study offers information about the types of interruptions that occurred, as well as the barriers to successful QT protocol implementation. The interruptions that occurred most frequently were nursing care and respiratory care. Barriers to QT included tests and procedures scheduled during QT, changes in patient condition that interrupted the QT and unnecessary interruptions from nurses or other health care providers for routine care. Ongoing education about QT was necessary to support successful protocol implementation.

Similar to previous studies ([Dennis et al., 2010](#), [Gardner et al., 2009](#), [Maidl et al., 2013](#) and [Olson et al., 2001](#)), nursing staff reported satisfaction with the QT protocol used in this study. The nurses' rating of the quality of patient rest was similar to nurses' satisfaction with QT. When QT was not successful for the patient, nurse satisfaction was not as high. Nurses' satisfaction with QT may not solely be related to patient benefits. QT may decrease nursing stress from environmental noise. Constant noise is associated with nurse tachycardia, high annoyance ratings and impacts nurses' work performance ([Konkani and Oakley, 2012](#) and [Morrison et al., 2003](#)).

We found a significant difference in the respiratory rate for three consecutive QTs, with post QT means lower than pre QT means. The QT may have promoted sleep or a restful state that produced the difference in patient respiratory rate. However, the QT did not have a significant effect on the patient measures of heart rate or MAP, which is similar to the findings of [Maidl et al. \(2013\)](#). Uncontrollable factors related to critical illness may account for the variable effect of QT on physiologic measures in our study.

Limitations

Strict adherence to the QT protocol was difficult due to fluctuating physiologic stability in some patients. Patients who experienced hypotension or tachycardia were not always able to continue QT due to the need for intervention and interruptions of QT were common. Reliance on nurses' assessment of sleep quality and quantity limits the strength of these findings. The nurses were not blind to the study purpose increasing the risk of response bias for these measures. Patient self-report of sleep is preferred; however, the patients in the study could not consistently provide this information due to sedatives and/or altered mental status. Objective tools to measure sleep such as actigraphy or polysomnography may have been beneficial; however, these tools are costly and require sleep specialists for accurate recordings ([Elliott et al., 2011](#)). Multiple factors contribute to critically ill patients' difficulties sleeping such as ventilator mode, pain and noise. Although attempts were made to capture these variables, the exploratory nature of this inquiry limits any conclusions that could be drawn about the interactions among these factors.

Conclusion

Our findings suggest that the QT protocol may influence sedation administration; however, future research is needed to understand the effect of QT on the use of sedative medications. While the impact of QT on delirium was inconclusive in this study it warrants further investigation. It is recommended that future studies implement experimental study designs that incorporate objective measures of sleep to further explicate the effects of QT on mechanically ventilated patients in the ICU.

Acknowledgements

Appreciation is expressed to the patients, families and nurses who participated in this study, and for the financial support provided by the Nursing Research Internship Award.

Funding: The authors have no sources of funding to declare.

Conflict of interest: The authors declare no competing interests.

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