Assessing the Implementation of Intermittent Sedation to Reduce the Duration of Intubation

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Abstract

Problem & Purpose: Adults admitted to a Cardiac Care Unit (CCU) at an urban teaching hospital are experiencing prolonged intubation times as evidenced by 5.0 ventilator days in 2021 and 4.8 ventilator days in 2022 as compared to 4.33 to 4.62 days nationally in similar settings. The purpose of this quality improvement (QI) initiative is to transition practice from utilizing high-dose continuous sedation for intubated patients to a nurse-driven intermittent sedation algorithm to reduce the duration of intubation for adults admitted to this unit. Evidence shows that utilizing intermittent sedation reduces the complications of intubation including delirium, immobility, and inappropriate sleep-wake cycle. **Methods:** This QI initiative was implemented over 15 weeks. A nurse-driven intermittent sedation algorithm was utilized for intubated patients who have a prescriber-ordered RASS goal of 0 or -1 with specific eligibility criteria. This QI initiative ensured daily spontaneous breathing trials (SBTs) were completed as a leading factor for extubation readiness. The primary outcome for this project was the duration of intubation in ventilator days. Secondary outcomes include CCU length of stay, use of nurse-driven intermittent sedation algorithm, average patient RASS for the previous 24 hours, and completion of daily SBT. **Results & Conclusions:** Total ventilator days during the implementation period was 6.46 days. Although most intubated patients were maintained on the nurse-managed intermittent sedation algorithm, ventilator days were still higher than historic data. This is likely because of the limited time that data was collected, higher rates of intubation during respiratory virus season, and the inability to extubate due to the patient's clinical status.

Keywords: adults, duration of intubation, intermittent sedation, nurse-driven, RASS, spontaneous breathing trial

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Adults admitted to a cardiac care unit in an urban teaching hospital experienced prolonged intubation times. A longer duration of intubation could lead to delirium, ventilator-associated pneumonia, a higher incidence of tracheostomy, prolonged hospital stay, and increased morbidity/mortality (Minhas et al., 2015). This quality improvement (QI) project focused on the use of intermittent sedation to reduce the duration of intubation for adults in a cardiac intensive care unit. Historical data for the unit showed 5.0 ventilator days in 2021 and 4.8 ventilator days in 2022. In an initiative developed by the Agency for Healthcare Research and Quality (2017a), the average duration of mechanical ventilation decreased from 4.62 days to 4.33 days after implementation.

The project site was a Cardiac Care Unit (CCU) at an urban teaching hospital. Within the project site, various causes prolonged the duration of intubation. Oversedation led to inappropriate sleep/wake cycles causing delirium which further prolonged intubation times due to the inability to wean from the ventilator (Takala, 2014). Continuous sedation was used for all intubated patients, which had the potential to prolong the duration of intubation through oversedation. The use of benzodiazepines in older adults along with staff disruptions and the hospital environment were associated with an increased risk of delirium (Klompas et al., 2016). From a pharmacotherapy perspective, the project site primarily used Fentanyl as a single continuous sedation agent; however, Midazolam was used as well if an additional agent was needed to maintain a decreased level of consciousness. Per protocol, intubated patients were expected to have daily spontaneous breathing trials (SBTs); however, numerous inexperienced

providers (physicians and nurses) did not follow this protocol. Continuous sedation was hypothesized to be the leading cause of prolonged intubation at this project site.

The purpose of this QI initiative was to transition practice from utilizing high-dose continuous sedation for intubated patients to a nurse-driven intermittent sedation algorithm, supportive of allowing for the consistent application of assessment and preparation for extubation readiness as an ongoing mechanism to reduce ventilator days. Evidence shows that utilizing intermittent sedation reduces the complications of intubation including delirium, immobility, and inappropriate sleep-wake cycle. Researchers agree intermittent sedation is the best practice and has been shown to reduce the duration of intubation for adults.

Available Knowledge

In support of aligning evidence to practice, an appraisal of evidence was conducted (Appendix A). Three studies focused on the effects of deep sedation versus light sedation. The researchers concluded that deep sedation was associated with delayed extubation and increased mortality rates (Shehabi et al., 2013; Stephens et al., 2018; Tanaka et al., 2014). Researchers testing the effects of evidenced-based protocols governing weaning and sedation practices found no significant impact on the duration of mechanical ventilation, however, results were statistically significant in indicating that protocolized sedation decreased mortality as well as decreased ICU and hospital lengths of stay (Kallet et al., 2018; Minhas et al., 2015). Strøm, Martinussen, & Toft (2010) conducted a randomized control trial that revealed patients who received no sedation had significantly fewer days on the ventilator compared to patients on a continuous propofol infusion. Klompas et al. (2016) concluded that Dexmedetomidine was associated with less time to extubation compared with benzodiazepines and propofol. Gitti et al. (2022) agreed that Dexmedetomidine should be used in patients receiving light sedation to avoid

over-sedation. Chen et al. (2022) concluded that daily sedation interruption could substantially reduce the duration of mechanical ventilation which is encompassed in the ABCDEF bundle. Devlin et al. (2018) created a clinical practice guideline for the prevention and management of pain, agitation/sedation, delirium, immobility, and sleep disruption in adult patients in the ICU known as the "PADIS" guidelines. The researchers concluded that utilizing light sedation is best to prevent delirium, immobility, and sleep disruption.

Rationale

For this QI project, the PARiHS framework was used to underpin the intervention. The three main components of this framework were evidence, context, and facilitation (Kitson et al., 1998). Evidence consisted of research, practitioner experience, community preference and experiences, and local information (Kitson et al., 1998). Context referred to the environment or setting in which the change was going to be implemented (Kitson et al., 1998). Facilitation described the type of support needed to help people change their attitudes, habits, skills, and ways of thinking to facilitate change and decrease resistance to achieve the desired outcome (Kitson et al., 1998).

Following this framework, literature evidence was compiled to support the intervention of intermittent sedation to reduce the duration of intubation. The literature gathered was very strong with clinically significant findings. Based on the literature, an appropriate procedure was translated for bedside nurses to follow to meet intended outcomes. The project team members served as experts and aided in facilitating the intervention. At the conclusion of the project, outcomes were evaluated to assess if the intervention had the intended impact.

Methods

Context

This unit is comprised of twelve beds with a nursing-to-patient ratio of one nurse to two patients (1:2) or one nurse to one patient (1:1) based on patient acuity. There are approximately fifty staff nurses who work on the unit with resident physicians who rotate through in two- or four-week intervals. Attending physicians and fellows rotate through the unit in one-week intervals. The culture on the CCU is very team oriented. Depending on patient acuity, the climate can be stressful, however, all members of the interdisciplinary team are committed to providing optimal patient care, receptive to change, and are always willing to lend a helping hand. There are roughly fifty staff nurses in the unit with approximately 75% of the nurses have less than 2 years of experience on the CCU. Potential barriers include resistance to change due to increased workload associated with intermittent sedation compared to continuous sedation. Facilitators to implementation include the desire to support the team, a sufficient allocation of clinical resources on the unit, and within leadership, as well as organization-based resources in support of applying evidenced-based practice care.

In previous practice, continuous sedation was immediately initiated on intubated patients to maintain a RASS of -2 to -3 and the dose of the analgesic was increased according to the nurse's discretion. Once a patient achieved a RASS of -2 to -3, the dose of the sedative was maintained until ventilator settings could be decreased to the lowest settings. Due to the nature of variability, this process could be anywhere from days to weeks. Once minimal ventilator settings were achieved, the sedation dose was decreased, and a spontaneous breathing trial (SBT) was performed to assess if the patient was ready to be extubated. Daily SBTs encouraged proper pulmonary mechanics and allowed the patient to strengthen muscles used in breathing.

According to the Agency for Healthcare Research and Quality (2017b), a protocol using coordinated daily spontaneous awakening trials (SAT) and SBTs was correlated with decreased intubation times (Girard et al., 2008). Daily SBTs were performed until the patient proved they were capable of breathing independently and were ready for extubation.

Intervention

To achieve the goal of decreasing the number of ventilator days at the project site, an implementing an intermittent sedation protocol was proposed. The protocol was nurse-driven and contained specified eligibility criteria which included patients with a prescriber-ordered RASS goal of 0 (alert and calm) or -1 (drowsy). Patients were managed with intermittent intravenous push (IVP) Fentanyl as tolerated to reduce the total amount of sedation received. If a patient could not tolerate the IVP sedation, as evidenced by two or more administrations in one hour, the patient was started on a low-dose continuous form of analgesia. In collaboration with the physician team if clinically appropriate, Dexmedetomidine (Precedex) could be used as an adjunct agent to decrease agitation. Non-pharmacologic measures were used to manage agitation. To ensure no eligible participant was excluded, all nurses were educated on the nurse-driven intermittent sedation protocol, and champions were elected to ensure all eligible patients were included. As a result of this intervention, a desired process was to maintain patient RASS between 0 and -1, reduce the incidence of delirium, and lastly, promote the consistent application of spontaneous breathing trials (SBTs) to exercise lungs and extubate as soon as clinically indicated.

The team was comprised of a multitude of interdisciplinary team members including nursing, pharmacy, and physician leaders. To achieve the project aims, the project lead collaborated with various stakeholders to ensure buy-in through the identification of relevance to

the problem. All stakeholders determined oversedation to be a significant problem on the unit with an impact on the duration of intubation for ventilated patients. Communication regarding project aims primarily occurred over email and in person in support of ensuring each team member understood their role. Prior to project implementation, the QI project lead created educational materials for staff and scheduled regular meetings with key stakeholders to ensure project success.

Measures

The primary outcome measure for this QI project was the duration of intubation for mechanically ventilated patients, measured in ventilator days. Ventilator days were calculated by dividing the number of days a patient was intubated by length of stay in the intensive care unit (ICU) and extracted from the electronic medical record (EMR). Secondary outcomes included duration of intubation (days), CCU length of stay, average patient RASS for the previous twelve hours, and completion of daily SBT. To measure patient agitation/sedation, the RASS scale was used. The RASS scale quantified a patient's level of consciousness on a scale between +4 (combative) and -5 (unarousable) (Han et al., 2015). The RASS scoring system had high reliability and validity and was chosen to measure patient agitation/sedation because it was the most widely used tool to measure patient level of consciousness (Sessler et al., 2002). Process measures that were monitored during this QI project included completion of daily SBT, screening patients for eligibility to participate in the intermittent sedation protocol, and use of the protocol to support the outcome of reducing the duration of intubation.

In addition to the secondary outcomes listed above, data was collected for each intubated patient regarding the duration of intubation in days and ICU length of stay in days. Data collection was suspended once the patient was extubated.

Ethics

Privacy protections were mitigated by one individual electronically entering all data in REDCap, a HIPPA-compliant, password-protected server, accessible only to the QI-PL and project faculty; no other hardware device(s) or program(s) were used for data storage. Confidentiality of data measures included patient-specific demographic data being coded as "Identifiers" within the REDCap system and if downloading the data was necessary, then the identifiers were removed prior to downloading. The project was conducted under a Non-human Subject's Research determination from the Human Research Protections Office (HRPO) of the UMSOM Institutional Review Board (IRB).

Results and Analytics

During the implementation period, a total of thirty-seven patients were extubated. It was important to note that some patients were intubated and extubated multiple times due to their clinical status. As depicted in the run chart in Appendix C, the median duration of intubation was 3.35 days with a range of 0.29 days to 27.89 days. The mean duration of intubation was 5.84 days. The median CCU length of stay was 7 days with a range of 1 day to 33 days as shown in the run chart in Appendix D. The mean CCU length of stay was 8.46 days. The calculated ventilator days during the project implementation period were 6.46 days.

In terms of the duration of intubation (Appendix C), most patients (60%) were intubated for less than or equal to six days which was our goal. There were no major shifts in the data, defined as six consecutive points either all above or all below the median. Consistent with a series of five consecutive points trending down (records 84 through 115), a trend was noted, indicating a non-random pattern in the data. There was an astronomical point (record 165). There were a total of twenty-three runs which were defined as a series of consecutive points above or

below the median ignoring points equal to the median. According to Perla et al. (2011), for a run chart with thirty-seven points, the lower limit is thirteen runs, and the upper limit is twenty-five runs indicating that our change had made a difference in the process. It was important to note that this run chart was based on the number of days a patient was intubated, also known as the duration of intubation, which was a patient-dependent outcome based on their clinical status.

Regarding length of stay (Appendix D), most patients (62%) had a length of stay less than or equal to nine days which was our goal. There were two shifts in the data above the median (records 71 through 91 and records 142 through 169) indicating non-random patterns had occurred. These patterns likely occurred because the unit had an influx of intubated patients during this timeframe who required intubation for a prolonged period thus leading to longer lengths of stay. There was one trend in the data in which five consecutive points all went down (records 157 through 172) indicating a nonrandom pattern had occurred. Three data points could be considered astronomical points (records 41, 142, and 157). There were 16 runs which were defined as a series of consecutive points above or below the median ignoring points equal to the median. According to Perla et al. (2011), for a run chart with thirty-seven points, the lower limit is thirteen runs, and the upper limit is twenty-five runs indicating that our change had made a difference in the process. The values for length of stay were not the patient's full length of stay in the CCU as data was only collected through extubation and not thereafter.

Secondary outcomes assessed included average patient RASS for the previous twelve hours and compliance with daily SBT. Out of a total of 182 records, 119 patients (65.4%) were managed on the nurse-driven intermittent sedation protocol. Appendix E illustrates the variation of RASS scores for patients for the previous twelve hours while managed on the nurse-driven intermittent sedation protocol. RASS scores ranged from +2 (agitated) to -5 (unarousable). Most

patients (31.9%) had an average RASS score of 0 (alert and calm) followed by 30.3% of patients with a score of -1 (drowsy). The distribution of patients with RASS scores greater than 0 and less than -1 was not evenly distributed with more patients having a RASS less than -1. Some patients' RASS scores were less than -1 despite intermittent sedation dosing because of their clinical status. Appendix F depicts a bar graph for compliance with daily SBTs while managed on the nurse-driven intermittent sedation protocol. 55.5% of patients managed on intermittent sedation did not have a daily SBT completed.

Discussion

Out of a total of 182 total records, 119 patients (65.4%) were managed on the nurse-driven intermittent sedation protocol. Most patients (31.9%) had an average RASS score of 0 (alert and calm) followed by 30.3% of patients with a score of -1 (drowsy). This means most patients (62.2%) had RASS scores of 0 or -1 which was one of the project's goals. 55.5% of patients managed on intermittent sedation did not have a daily SBT completed. This was due to a variety of reasons including hemodynamic instability, neurologic exclusions, ventilator settings that exclude such as PEEP greater than 8 or FiO2 greater than 50%, or other conditions excluding the patient from daily SBT. Ventilator days increased during the project implementation period. There are a variety of reasons this may have occurred including shortened data collection time, inability to extubate due to the patient's clinical status, and increased incidence of intubation during respiratory virus season. The data collected was for all patients who were intubated during the implementation period. Not every patient was maintained on the nurse-driven intermittent sedation protocol; the nurse-driven intermittent sedation protocol was used when able based on the patient's clinical status. This initiative had an impact on the

duration of intubation for adults in the CCU and created a daily discussion regarding appropriate sedation goals to best promote patient outcomes.

Despite an increase in ventilator days during the project implementation period, the findings from this QI project can be used for future implications to decrease the duration of intubation for adults in an intensive care setting. The use of intermittent sedation decreases the total amount of sedation a patient receives compared to continuous sedation. The amount of sedation a patient receives while on mechanical ventilation has an impact on the patient's level of consciousness (RASS) and ability to complete a spontaneous breathing trial which in turn correlates to their duration of intubation. Intermittent sedation reduces the overall amount of sedation a patient receives which leads to decreased duration of intubation which in turn correlates to decreased length of stay in the hospital and decreased hospital costs. Using decreased sedation means less upfront costs for the hospital and decreased hospital lengths of stay decreases costs for both the patient, insurance companies, and the hospital system. In terms of sustainability, unit champions, management, preceptors, and the house staff committee will continue to educate newly hired nurses and physicians who rotate through the unit about the nurse-driven intermittent sedation algorithm.

The findings from this QI initiative are similar to findings from other publications. According to the evidence review table and synthesis in Appendix A, previous publications have found that the use of light sedation decreases the duration of intubation, length of stay, incidence of tracheostomy, and mortality as well as increases compliance with daily spontaneous breathing trials compared to deep sedation. Studies were implemented for extended periods which makes the results more generalizable. This project was implemented during the fall, also known as respiratory virus season, which had a negative impact on the results. The unit had an increased

incidence of intubations because of the time of year this project was implemented which skewed results. Finally, there were a few patients who were unable to be extubated due to their clinical status. These patients had prolonged duration of intubations because of the inability to extubate leading to an increase in ventilator days.

Factors that may have limited internal validity include imprecision in project design. Finding historical data for the duration of intubation was challenging. The only historical data that could be found was ventilator days as calculated by the EMR which accounts for duration of intubation and total ICU length of stay. It would have been preferred to use another measurement for duration of intubation such as days of mechanical ventilation without accounting for ICU length of stay. Additionally, it is likely that more patients who were intubated during the project implementation period would likely have been eligible for the nurse-driven intermittent sedation protocol. The QI-PL conducted chart audits daily and followed up with bedside nurses caring for each intubated patient to have a discussion with the provider team to transition to the nurse-driven intermittent sedation protocol if the patient met eligibility criteria. There were times when a patient seemed to meet eligibility criteria, however, prescribers still ordered a RASS goal of -2 or less. Finally, many nurses continued to use low-dose continuous sedation after patient intubation rather than utilizing the nurse-driven intermittent sedation algorithm before proceeding to low-dose continuous sedation despite the QI-PL creating a sedation algorithm flow-chart for dosages and time intervals for administration of sedation. This is likely because utilizing continuous sedation is less work to control patient agitation compared to intermittent sedation. Despite this, the amount of sedation used during the project implementation period is still less compared to the historic use of sedation.

Conclusion

This QI initiative is a useful and valuable contribution to the profession, as it demonstrates that the use of a nurse-driven intermittent sedation protocol in reducing the total amount of sedation used during mechanical ventilation. Intermittent sedation has a better return on investment compared to continuous sedation through a reduction in cost of sedation, a reduction in duration of intubation, and thereby, a decrease in ICU and hospital length of stay. This initiative will likely sustain on the unit and possibly spread to the entire hospital system as a best practice. To support this, it will be imperative to educate all parties that this nurse-driven intermittent sedation protocol is a standard of practice, despite increased workload. Additionally, it would be beneficial to have an established algorithm for nurses and doctors to follow that encompasses all components of the nurse-driven intermittent sedation protocol including eligibility criteria and dosages of sedation with time intervals. In terms of implications for practice, there is improved staff awareness of how excess sedation can impact a patient's duration of intubation and lead to adverse outcomes. Future QI projects should be implemented over a longer period to ensure more accurate results.

References

Agency for Healthcare Research and Quality [AHRQ]. (January, 2017a). *AHRQ safety program for mechanically ventilated patients*. Retrieved from https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/quality-patient-safety/hais/tools/mvp/mvp-report.pdf

Agency for Healthcare Research and Quality [AHRQ]. (January, 2017b). *Coordinated spontaneous awakening and breathing trials protocol.* Retrieved from https://www.ahrq.gov/hai/tools/mvp/modules/technical/sat-sbt-protocol.html

Aitken, L. M., Bucknall, T., Kent, B., Mitchell, M., Burmeister, E., & Keogh, S. (2016). Sedation protocols to reduce duration of mechanical ventilation in the ICU: a Cochrane Systematic Review. *Journal of Advanced Nursing (John Wiley & Sons, Inc.)*, *72*(2), 261–272. doi: 10.1111/jan.12843

Chen, T. J., Chung, Y. W., Chen, P. Y., Hu, S. H., Chang, C. C., Hsieh, S. H., Wang, B. C., & Chiu, H. Y. (2022). Effects of daily sedation interruption in intensive care unit patients undergoing mechanical ventilation: A meta-analysis of randomized controlled trials. *International journal of nursing practice*, *28*(2), e12948. https://doi.org/10.1111/ijn.12948

Devlin, J. W., Skrobik, Y., Gélinas, C., Needham, D. M., Slooter, A. J. C., Pandharipande, P. P., Watson, P. L., Weinhouse, G. L., Nunnally, M. E., Rochwerg, B., Balas, M. C., van den Boogaard, M., Bosma, K. J., Brummel, N. E., Chanques, G., Denehy, L., Drouot, X., Fraser, G. L., Harris, J. E., Joffe, A. M., … Alhazzani, W. (2018). Clinical Practice Guidelines for the Prevention and Management of Pain, Agitation/Sedation, Delirium,

Immobility, and Sleep Disruption in Adult Patients in the ICU. *Critical care medicine*, *46*(9), e825–e873. https://doi.org/10.1097/CCM.0000000000003299

Gitti, N., Renzi, S., Marchesi, M., Bertoni, M., Lobo, F.A., Rasulo, F.A., Goffi, A., Pozzi, M., & Piva, S. (2022). Seeking the Light in Intensive Care Unit Sedation: The Optimal Sedation Strategy for Critically Ill Patients. *Frontiers in Medicine*, *9*. https://doi.org/10.3389/fmed.2022.901343

Girard, T. D., Kress, J. P., Fuchs, B. D., Thomason, J. W., Schweickert, W. D., Pun, B. T., Taichman, D. B., Dunn, J. G., Pohlman, A. S., Kinniry, P. A., Jackson, J. C., Canonico, A. E., Light, R. W., Shintani, A. K., Thompson, J. L., Gordon, S. M., Hall, J. B., Dittus, R. S., Bernard, G. R., & Ely, E. W. (2008). Efficacy and safety of a paired sedation and ventilator weaning protocol for mechanically ventilated patients in intensive care (Awakening and Breathing Controlled trial): a randomised controlled trial. *Lancet (London, England)*, *371*(9607), 126–134. https://doi.org/10.1016/S0140-6736(08)60105-1

Green, S., & Staffileno, B. A. (2021). Favorable Outcomes After Implementing a Nurse-Driven Sedation Protocol. *Critical Care Nurse*, *41*(6), 29–35. https://doi.org/10.4037/ccn2021625

Guenther, U., Popp, J., Koecher, L., Muders, T., Wrigge, H., Ely, E. W., & Putensen, C. (2010). Validity and reliability of the CAM-ICU Flowsheet to diagnose delirium in surgical ICU patients. *Journal of critical care*, *25*(1), 144–151. https://doi.org/10.1016/j.jcrc.2009.08.005

Han, J. H., Vasilevskis, E. E., Schnelle, J. F., Shintani, A., Dittus, R. S., Wilson, A., & Ely, E. W. (2015). The Diagnostic Performance of the Richmond Agitation Sedation Scale for

Detecting Delirium in Older Emergency Department Patients. *Academic emergency medicine : Official journal of the Society for Academic Emergency Medicine*, *22*(7), 878. https://doi.org/10.1111/acem.12706

Johns Hopkins Medicine. (2020, September). 102.2a Organization Policy on Quality Improvement/Quality Assurance Activity. Retrieved from https://www.hopkinsmedicine.org/institutional_review_board/guidelines_policies/organization_policies/102_2a.html

Johns Hopkins Medicine. (2021a, February). JH School of Nursing Project Ethical Review Committee (PERC). Retrieved from https://www.hopkinsmedicine.org/institutional_review_board/guidelines_policies/guidelines/jhson_project_ethical_review_committee.html

Johns Hopkins Medicine. (2021b, February). Johns Hopkins Medicine and University of Maryland Baltimore Guidelines for Collaborative Research and IRB Review. Retrieved from https://www.hopkinsmedicine.org/institutional_review_board/guidelines_policies/guidelines/jhm_umb_collaborative_research_irb_review.html

Kallet, R. H., Hanjing Zhuo, Yip, V., Gomez, A., & Lipnick, M. S. (2018). Spontaneous Breathing Trials and Conservative Sedation Practices Reduce Mechanical Ventilation Duration in Subjects With ARDS. *Respiratory Care*, *63*(1), 1–10. doi: 10.4187/respcare.05270

Kitson, A., Harvey, G., & McCormack, B. (1998). Enabling the implementation of evidence based practice: a conceptual framework. *Quality in health care : QHC*, *7*(3), 149–158. https://doi.org/10.1136/qshc.7.3.149

Klompas, M., Li, L., Szumita, P., Kleinman, K., Murphy, M.V., & CDC Prevention Epicenters Program (2016). Associations Between Different Sedatives and Ventilator-Associated Events, Length of Stay, and Mortality in Patients Who Were Mechanically Ventilated. *Chest*, *149*(6), 1373–1379. https://doi.org/10.1378/chest.15-1389

Krewulak, K. D., Rosgen, B. K., Ely, E. W., Stelfox, H. T., & Fiest, K. M. (2019). The CAM-ICU-7 and ICDSC as measures of delirium severity in critically ill adult patients. *PLoS ONE*, *15*(11). https://doi.org/10.1371/journal.pone.0242378

Minhas, M. A., Velasquez, A. G., Kaul, A., Salinas, P. D., & Celi, L. A. (2015). Effect of Protocolized Sedation on Clinical Outcomes in Mechanically Ventilated Intensive Care Unit Patients: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Mayo Clinic proceedings*, *90*(5), 613–623. https://doi.org/10.1016/j.mayocp.2015.02.016

Perla, R. J., Provost, L. P., & Murray, S. K. (2011). The run chart: a simple analytical tool for learning from variation in healthcare processes. *BMJ quality & safety*, *20*(1), 46–51. https://doi.org/10.1136/bmjqs.2009.037895

Sessler, C. N., Gosnell, M. S., Grap, M. J., Brophy, G. M., O'Neal, P. V., Keane, K. A., Tesoro, E. P., & Elswick, R. K. (2002). The Richmond Agitation-Sedation Scale: validity and reliability in adult intensive care unit patients. *American journal of respiratory and critical care medicine*, *166*(10), 1338–1344. https://doi.org/10.1164/rccm.2107138

Shehabi, Y., Chan, L., Kadiman, S., Alias, A., Ismail, W. N., Tan, M. A., Khoo, T. M., Ali, S. B., Saman, M. A., Shaltut, A., Tan, C. C., Yong, C. Y., Bailey, M., & Sedation Practice in Intensive Care Evaluation (SPICE) Study Group investigators. (2013). Sedation depth and long-term mortality in mechanically ventilated critically ill adults: a prospective

longitudinal multicentre cohort study. *Intensive care medicine*, *39*(5), 910–918. https://doi.org/10.1007/s00134-013-2830-2

Stephens, R., Dettmer, M., Roberts, B., Ablordeppey, E., Fowler, S., Kollef, M. & Fuller, B. (2018). Practice Patterns and Outcomes Associated With Early Sedation Depth in Mechanically Ventilated Patients: A Systematic Review and Meta-Analysis*. *Critical Care Medicine, 46* (3), 471-479. doi: 10.1097/CCM.0000000000002885

Strøm, T., Martinussen, T., & Toft, P. (2010). A protocol of no sedation for critically ill patients receiving mechanical ventilation: a randomised trial. *Lancet (London, England)*, *375*(9713), 475–480. https://doi.org/10.1016/S0140-6736(09)62072-9

Takala J. (2014). Of delirium and sedation. *American journal of respiratory and critical care medicine*, *189*(6), 622–624. https://doi.org/10.1164/rccm.201401-0195ED

Tanaka, L.M., Azevedo, L.C., Park, M., Schettino, G., Nassar, A.P., Réa-Neto, A., Tannous, L., de Souza-Dantas, V.C., Torelly, A., Lisboa, T., Piras, C., Carvalho, F.B., Maia, M., Giannini, F.P., Machado, F.R., Dal-Pizzol, F., de Carvalho, A.G., dos Santos, R.B., Tierno, P.F., … ERICC study investigators. (2014). Early sedation and clinical outcomes of mechanically ventilated patients: a prospective multicenter cohort study. *Critical care (London, England)*, *18*(4), R156. https://doi.org/10.1186/cc13995

Appendix A

Evidence Review of Research Studies Related to Intermittent Sedation

Citation #1: Shehabi, Y., Chan, L., Kadiman, S., Alias, A., Ismail, W. N., Tan, M. A., Khoo, T. M., Ali, S. B., Saman, M. A., Shaltut, A., Tan, C. C., Yong, C. Y., Bailey, M., & Sedation Practice in Intensive Care Evaluation (SPICE) Study Group investigators. (2013). Sedation depth and long-term mortality in mechanically ventilated critically ill adults: a prospective longitudinal multicentre cohort study. *Intensive care medicine*, *39*(5), 910–918. https://doi.org/10.1007/s00134-013-2830-2					**Level:** 3
Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**
The purpose of this study is to "To ascertain the relationship among early (first 48 h) deep sedation, time to extubation, delirium and long-term mortality."	Multicenter, prospective, longitudinal, observational, non-interventional cohort study in 11 Malaysian hospitals	**Sampling Technique:** Convenience **Eligible:** Patients were included if they had been ventilated within the previous 24 h, were receiving continuous or intermittent sedative and/or analgesic medication and were expected to be ventilated for longer than 24 h. **Excluded:** Patients were excluded if they were <18 years, had proven or suspected neurological impairment, psychiatric illness, burns, dementia, palliative care or were unable to communicate with caretakers/investigators because of language difficulty. **# Accepted:** 259 adults who were intubated within the previous 24 hours. Patients were placed on	No intervention (observational study) **Lightly Sedated:** n=45 **Deeply Sedated:** n=209 Patients in a RASS range of -2 to +1 were considered lightly sedated, RASS range of -3 to -5 deeply sedated.	**DV:** Time to extubation, RASS, Risk of Death, & Incidence of delirium. **Measurement tool (reliability), time, procedure:** ~ Richmond Agitation Sedation Score (RASS) ~ Confusion assessment method for intensive care (CAM-ICU)	Irrespective of sedative choice, early deep sedation was independently associated with delayed extubation and higher mortality, and thus was a potentially modifiable risk in interventional trials.

		intermittent or continuous sedation and placed into the appropriate category. **Lightly Sedated:** n=45 **Deeply Sedated:** n=209 **Power analysis:** 260 patients would have 90 % power with a two-sided *p* value of 0.05 to detect a difference of 2 in the number of times deep sedation was reported in the first 48 h between patients who died or survived. Power analysis not met which increases the risk for Type II error. **Group Homogeneity:** Intervention/Control homogeneous based on NS p values on Table 1 for demographics and clinical characteristics			
Citation #2: Klompas, M., Li, L., Szumita, P., Kleinman, K., Murphy, M.V., & CDC Prevention Epicenters Program (2016). Associations Between Different Sedatives and Ventilator-Associated Events, Length of Stay, and Mortality in Patients Who Were Mechanically Ventilated. *Chest*, *149*(6), 1373–1379. https://doi.org/10.1378/chest.15-1389					**Level:** 3
Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**

"The goal of the present article was to evaluate associations between different sedatives and patient outcomes within a large, diverse cohort of unselected patients."	Retrospective, longitudinal, single center, observational study	**Sampling Technique:** Convenience **Eligible:** using the EHR, all patients who required invasive mechanical ventilation for more than 3 days at Brigham and Women's Hospital located Boston, Massachusetts between July 1, 2006 and December 31, 2013. **Excluded:** Exclusion criteria not stated. **# Accepted:** n=9603 **Power analysis:** Power analysis not stated by researchers **Group Homogeneity:** Intervention/Control homogeneous based on NS proportions and standard deviations in Table 1 for demographics and clinical characteristics	**Intervention fidelity (describe the protocol):** Large observational study that used the electronic medical record (EMR) to assess patient outcomes based on the type of sedation used during mechanical ventilation.	**DV: Measurement tool (reliability), time, procedure:** ~Ventilator associated events (pneumonia, infection, other complications) ~Days of mechanical ventilation ~Hospital death	**Statistical Procedures(s) and Results:** Benzodiazepines and propofol were associated with increased VAE risk, whereas dexmedetomidine was not. Propofol was associated with less time to extubation compared with benzodiazepines (HR, 1.4; 95% CI, 1.3-1.5). Dexmedetomidine was associated with less time to extubation compared with benzodiazepines (HR, 2.3; 95% CI, 2.0-2.7) and propofol (HR, 1.7; 95% CI, 1.4-2.0), but relatively few dexmedetomidine exposures were available for analysis.
Citation #3: Minhas, M. A., Velasquez, A. G., Kaul, A., Salinas, P. D., & Celi, L. A. (2015). Effect of Protocolized Sedation on Clinical Outcomes in Mechanically Ventilated Intensive Care Unit Patients: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Mayo Clinic proceedings*, *90*(5), 613–623. https://doi.org/10.1016/j.mayocp.2015.02.016					**Level:** 1
Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**
"To assess the effects of protocolized sedation (algorithm or daily interruption) compared with usual care without protocolized sedation on clinical outcomes in mechanically ventilated adult intensive care unit (ICU) patients via a systematic review	Systematic review with meta-analysis of randomized control trials	**Search Strategy:** The following databases from inception through February 28, 2013 were searched: Ovid MEDLINE, EMBASE,	**Control:** Patients on a non-standardized, discretionary approach to sedation management	**DV:** Overall mortality, Duration of mechanical ventilation, ICU and Hospital length of stay (LOS), incidence of tracheostomy	~Overall Mortality: After pooling the longest followed mortality from each included study, protocolized sedation was associated with a significant reduction in overall mortality compared with usual care

and meta-analysis of randomized controlled trials (RCTs)."		Cochrane CENTRAL, Web of Science, and ClinicalTrials.gov. We used Cochrane's Highly Sensitive Search Strategy for RCTs in MEDLINE. No search had language or other limitations. **Eligible Studies:** Randomized Control Trials that focused on the effects of protocolized sedation on clinical outcomes in mechanically ventilated patients. **Excluded:** One reviewer excluded duplicate articles and clearly ineligible studies based on title and abstract. Two reviewers independently screened the remaining articles in full text to determine review eligibility based on the inclusion criteria. In all cases, a third reviewer, or group consensus, resolved disagreements. **Included:** Of 4782 records screened, 6 RCTs including 1243 patients met the inclusion criteria. All studies identified were conducted in high-income, developed countries. **PRISMA:** This systematic review and meta-analysis was guided by the Preferred Reporting Items for Systematic	**Intervention:** Patients on a protocolized sedation regimen **Intervention fidelity (describe the protocol):** Not applicable for systemic review.	**Measurement tool (reliability), time, procedure:** ~Overall mortality: # of patients who died within a year of hospitalization ~Duration of mechanical ventilation: # of days a patient was on ventilator ~ICU and Hospital length of stay (LOS): # of days patient was in the ICU and # of days patient was on this hospital ~incidence of tracheostomy: # of patients requiring tracheostomy due to inability to wean from the ventilator	without protocolized sedation (RR, 0.85; 95% CI, 0.74 to 0.97; P=.02; I 2=0%; NNT, 20; P=.11). ~Duration of Mechanical Ventilation: Among the included studies, protocolized sedation produced no significant difference in mean days of mechanical ventilation compared with usual care without protocolized sedation (WMD, –1.04 days; 95% CI, –2.54 to 0.47 days; P=.18; I 2=74%). ~ICU and Hospital LOSs: the included studies, protocolized sedation was associated with a significant reduction in mean ICU LOS (WMD, –1.73 days; 95% CI, –3.32 to –0.14 days; P=.03; I 2=60%) and mean hospital LOS (WMD, –3.55 days; 95% CI, –5.98 to –1.12 days; P=.004; I 2=12%) compared with usual care without protocolized sedation ~Tracheostomy: Among the 5 reporting studies protocolized sedation was associated with a significant reduction in tracheostomy compared with usual care without protocolized sedation (RR, 0.69; 95% Cl, 0.50 to 0.96; P=.03; I 2=30%; NNT, 16.6; P=.04; 5 RCTs).

		Reviews and Meta-analyses statement. **Power analysis:** Not indicated for systematic review			
Citation #4: Strøm, T., Martinussen, T., & Toft, P. (2010). A protocol of no sedation for critically ill patients receiving mechanical ventilation: a randomised trial. *Lancet (London, England)*, *375*(9713), 475–480. https://doi.org/10.1016/S0140-6736(09)62072-9					**Level:** 1
Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**
"We aimed to establish whether duration of mechanical ventilation could be reduced with a protocol of no sedation versus daily interruption of sedation"	Experimental, Prospective, Unblinded Randomized Control Trial	**Sampling Technique:** Convenience **# Eligible:** 428 **# Accepted:** 140 **# Control:** 70 **# Intervention:** 70 **Power analysis: "**To provide 80% power with p values of less than 0.05 judged to be significant, a sample of size of 100 patients would be needed to detect a mean difference of 1.5 days of mechanical ventilation, a SD of 5,14 and a median ventilation time of 5–7.5 days.**"** **Group Homogeneity:** "Overall, a higher pro portion of men (n=76 patients, 67%) than women (n=37, 33%) were included in the study, and the ratio of men to women was higher in the intervention group than in the control group. Otherwise, the control and	**Control: "**The control group received intravenous morphine in bolus doses (2.5 or 5 mg) as needed and were sedated with an infusion of propofol (20 mg/mL) titrated to reach a Ramsay score of 3–4" **Intervention:** "The intervention group received intravenous morphine in bolus doses (2.5 or 5 mg) as needed." **Intervention fidelity (describe the protocol): "**For the intervention group, for cases in which delirium was suspected, intravenous haloperidol was given as bolus doses (1, 2.5, or 5 mg), but if the patient still seemed uncomfortable after this treatment, the patient was sedated with propofol for 6 h. Afterwards, a new trial to manage the patient	**DV:** Number of days without mechanical ventilation (after successful extubation, or removal of ventilator support for patients with tracheostomies) in a 28-day period **Measurement tool (reliability), time, procedure:** The dependent variable was measured in days. the 28-day period began at intubation, or, for patients transferred to our intensive care unit while intubated, at admission to our unit. Patients who were intubated again within 24 h, or were dependent on noninvasive ventilation after extubation, were judged to have been receiving mechanical ventilation.	**Statistical Procedures(s) and Results:** "The no sedation strategy was associated with a significantly higher number of days without ventilation than was the sedation strategy. The mean difference after correction for baseline variables was 4.2 days (95% CI 0.3–8.1; table 2); without correction for baseline variables the difference remained significant (p=0.0350)."

		intervention groups were homogenous."	without sedation was started; if sedation had to be started three times, the patient was kept sedated, with daily interruption of sedation, according to the protocol for the control group. However, crossover between the groups was not allowed, and patients who needed sedation as per the control group protocol remained in the intervention group for analysis by intention to treat. For the control group, Daily interruption of sedation and testing was done by a nurse and checked by the attending doctor; if the nurse and attending doctor were in doubt of whether the patient could be judged as awake, the investigators assessed the patient." Patients in both groups were mobilized daily.	Patients dying or dependent on mechanical ventilation for more than 28 days had zero days without ventilation. We also recorded the total length of stay in the intensive care unit and in hospital, where data were available, and mortality in the intensive care unit and hospital.	
Citation #5: Tanaka, L.M., Azevedo, L.C., Park, M., Schettino, G., Nassar, A.P., Réa-Neto, A., Tannous, L., de Souza-Dantas, V.C., Torelly, A., Lisboa, T., Piras, C., Carvalho, F.B., Maia, M., Giannini, F.P., Machado, F.R., Dal-Pizzol, F., de Carvalho, A.G., dos Santos, R.B., Tierno, P.F., … ERICC study investigators. (2014). Early sedation and clinical outcomes of mechanically ventilated patients: a prospective multicenter cohort study. *Critical care (London, England)*, *18*(4), R156. https://doi.org/10.1186/cc13995					**Level:** 3
Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**

“The aim of this study was to assess the association of early sedation strategies with outcomes of critically ill adult patients under mechanical ventilation (MV).” “Our primary hypothesis was that early sedation strategies, namely sedation depth, could be associated with clinical outcomes including hospital mortality, so we chose to evaluate the sedation level on the second day of MV.”	Prospective, observational, multicenter cohort study This study was a secondary analysis of a multicenter prospective cohort conducted in 45 Brazilian ICUs (from the Brazilian Research in Intensive Care Network) from 12 states between 1 June 2011 and 31 July 2011	**Sampling Technique:** Convenience **Eligible:** Adult patients (≥18 years old) requiring invasive ventilatory support in the first 48 hours of ICU admission using sedatives on the second day of MV were included. **Excluded:** Exclusively to noninvasive MV and those presenting with primary neurological disorders. We also excluded those with missing data regarding sedation depth on the second day of MV **# Eligible:** n=322 **# Deep Sedation:** n=113 **# Light Sedation:** n=209 **Power analysis:** Power analysis not stated by researchers. **Group Homogeneity:** Intervention/Control homogeneous based on NS p values on Table 2 for demographics and clinical characteristics	**Intervention fidelity (describe the protocol):** This is an observational study which looked at patient outcomes based on the types and amounts of sedatives used during mechanical ventilation. Therefore, there is no explicit study protocol, intervention, or control groups.	**DV:** **Measurement tool (reliability), time, procedure:** ~ICU length of stay (days) ~Hospital Length of Stay (days) ~ICU mortality ~Hospital mortality	**Statistical Procedures(s) and Results:** “Overall, ICU and hospital mortality rates were 30.4% and 38.8%, respectively. Deep sedation was observed in 113 patients (35.1%). Longer duration of ventilatory support was observed (7 (4 to 10) versus 5 (3 to 9) days, P = 0.041) and more tracheostomies were performed in the deep sedation group (38.9% versus 22%, P = 0.001) despite similar PaO2/FiO2 ratios and acute respiratory distress syndrome (ARDS) severity. In a multivariate analysis, age (Odds Ratio (OR) 1.02; 95% confidence interval (CI) 1.00 to 1.03), Charlson Comorbidity Index >2 (OR 2.06; 95% CI, 1.44 to 2.94), Simplified Acute Physiology Score 3 (SAPS 3) score (OR 1.02; CI 95%, 1.00 to 1.04), severe ARDS (OR 1.44; CI 95%, 1.09 to 1.91) and deep sedation (OR 2.36; CI 95%, 1.31 to 4.25) were independently associated with increased hospital mortality.”
Citation #6: Aitken, L. M., Bucknall, T., Kent, B., Mitchell, M., Burmeister, E., & Keogh, S. (2016). Sedation protocols to reduce duration of mechanical ventilation in the ICU: a Cochrane Systematic Review. *Journal of Advanced Nursing (John Wiley & Sons, Inc.)*, *72*(2), 261–272. doi: 10.1111/jan.12843					**Level:** 1
Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**

The aim of this study was to assess the effects of protocol directed sedation management on the duration of mechanical ventilation and other relevant patient outcomes (Table 1) in mechanically ventilated ICU patients.	Cochrane systematic review of randomized controlled trials. RCTs and quasi-randomized controlled trials published in any language were included. An RCT was defined as a study, where patients were allocated to treatment groups based on a random or quasi-random method (e.g. using random number tables, hospital number, date of birth)	We included two studies (Brook et al. 1999, Bucknall et al. 2008). The studies were similar in design and examined the impact of protocol-directed sedation on a range of outcomes including duration of mechanical ventilation, mortality, ICU and hospital length of stay and some adverse events (Table 2). Brook et al. (1999) enrolled 332 participants from a single 19-bed medical ICU in a university-affiliated urban teaching hospital in the USA, with data collected in 1997–1998. In contrast, Bucknall et al. (2008) enrolled 316 participants from a 24-bed mixed ICU in a major Australian metropolitan university-associated teaching hospital. Participants were adults who were mechanically ventilated. Both studies were single-centre RCTs. The interventions were similar, with Bucknall et al. (2008) indicating they modelled their intervention on that reported by Brook et al. (1999).	In both studies, nurses used a structured approach for assessment to determine whether analgesics or sedatives (or both) were required by the patient, then administered pre-specified medications according to their ongoing assessment. Differences in the medications used existed, with Brook et al. (1999) using diazepam, midazolam, fentanyl and morphine, while Bucknall et al. (2008) used midazolam, propofol and morphine. The most important difference between the two studies was the usual method of providing sedation-related aspects of care to patients in each of the two study sites. In the US study, all aspects of sedation were ordered by the treating physicians and nurses could not make changes without a physician's written or verbal order (Brook et al. 1999). In the Australian study, ICU medical staff prescribed the type of sedation medication and dose limits for infusion and boluses, with each patient's ICU nurse free to assess, titrate and manage	~Duration of mechanical ventilation ~Intensive Care unit and hospital mortality ~Length of intensive care unit stay ~Hospital length of stay ~Adverse events ~Incidence of tracheostomy	There is insufficient evidence to evaluate the effectiveness of protocol-directed sedation as results from the two randomized controlled trials were conflicting.

			sedation, including the ceasing of sedation, in those limits (Bucknall et al. 2008).		
Citation #7: Green, S., & Staffileno, B. A. (2021). Favorable Outcomes After Implementing a Nurse-Driven Sedation Protocol. *Critical Care Nurse*, *41*(6), 29–35. https://doi.org/10.4037/ccn2021625					**Level:** 3
Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**
To reduce exposure to sedative and analgesic medications among patients receiving mechanical ventilation by implementing a nurse-driven sedation protocol.	Quality improvement project	~medical ICU at a midwestern urban teaching hospital consisting of 22 beds. ~Patients who received mechanical ventilation from January 2019 to February 2019 (before protocol implementation) and from January 2020 to February 2020 (after protocol implementation) were considered for medical record review	This quality improvement project followed a plan-do-study-act cycle. Nurses were educated on the protocol, and 30 patient medical records were reviewed both before and after protocol implementation. Data were extracted on intensive care unit length of stay, duration of mechanical ventilation, duration of continuous sedation, presence of delirium, pain, level of sedation, and performance and documentation of spontaneous awakening trials. Data were analyzed using descriptive statistics, the r2 test, and calculated percent change	~Days receiving mechanical ventilation ~Days in the ICU ~Delirium present per CAM-ICU ~Minutes receiving continuous sedation ~Fentanyl use ~Propofol use ~Dexmedetomidine use ~Midazolam use ~SAT documented ~SAT performed ~RASS Score (-5 to 4) ~Pain per CPOT Score (0 to 8)	These preliminary data suggest that implementation of a nurse-driven sedation protocol resulted in favorable outcomes by decreasing duration of mechanical ventilation, intensive care unit length of stay, and duration of continuous sedation and increasing the number of spontaneous awakening trials performed.
Citation #8: Chen, T. J., Chung, Y. W., Chen, P. Y., Hu, S. H., Chang, C. C., Hsieh, S. H., Wang, B. C., & Chiu, H. Y. (2022). Effects of daily sedation interruption in intensive care unit patients undergoing mechanical ventilation: A meta-analysis of randomized controlled trials. *International journal of nursing practice*, *28*(2), e12948. https://doi.org/10.1111/ijn.12948					**Level:** 1
Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**

This study aimed to assess the effects of daily sedation interruption on the mechanical ventilation duration and relevant outcomes in mechanically ventilated patients in the intensive care unit (ICU).	systematic review and meta-analysis of randomized controlled studies	45 studies involving 5493 participants were included.	Daily sedation interruption versus control	~Mechanical ventilation duration ~ICU stay length ~sedation duration ~incidence of tracheostomy ~incidence of ventilator-associated pneumonia (VAP)	Daily sedation interruption could substantially reduce the duration of mechanical ventilation, particularly when it was applied to patients with high disease severity
Citation #9: Stephens, R. , Dettmer, M. , Roberts, B. , Ablordeppey, E. , Fowler, S. , Kollef, M. & Fuller, B. (2018). Practice Patterns and Outcomes Associated With Early Sedation Depth in Mechanically Ventilated Patients: A Systematic Review and Meta-Analysis*. *Critical Care Medicine, 46* (3), 471-479. doi: 10.1097/CCM.0000000000002885					**Level:** 2
Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**
The objectives of this study were to 1) describe the global literature focused on sedation practices within 48 hours of initiating mechanical ventilation and 2) quantify the impact of early sedation depth on clinical outcomes. We hypothesized that deep sedation in the 48-hour period following initiation of mechanical ventilation would be associated with increased mortality, longer mechanical ventilation duration, and increased hospital and ICU lengths of stay	~Systematic Review and Meta-Analysis ~Randomized controlled trials and nonrandomized studies were included	Nine studies (n = 4,521 patients) published between 2012 and 2017 were included.	~Light versus Deep sedation	The primary outcome was hospital mortality. Secondary outcomes included delirium, duration of ventilation, hospital and ICU stay, and tracheostomy frequency.	Deep sedation in mechanically ventilated patients, as evaluated in a small number of qualifying heterogeneous randomized controlled trials and observational studies, was associated with increased mortality and lengths of stay.
Citation #10: Kallet, R. H., Hanjing Zhuo, Yip, V., Gomez, A., & Lipnick, M. S. (2018). Spontaneous Breathing Trials and Conservative Sedation Practices Reduce Mechanical Ventilation Duration in Subjects With ARDS. *Respiratory Care*, *63*(1), 1–10. doi: 10.4187/respcare.05270					**Level:** 3

Purpose or Hypothesis	Type of Evidence and Research Design	Sample (population, size, setting)	Intervention Procedures	Primary Outcome/Measures	Results Conclusions
Spontaneous breathing trials (SBTs) and daily sedation interruptions (DSIs) reduce both the duration of mechanical ventilation and ICU length of stay (LOS). The impact of these practices in patients with ARDS has not previously been reported. We examined whether implementation of SBT/DSI protocols reduce duration of mechanical ventilation and ICU LOS in a retrospective group of subjects with ARDS at a large, urban, level-1 trauma center.	Retrospective, observational study	~large, urban, level-1 trauma center ~intubated ARDs patients ~ ARDS survivors from 2002 to 2016 (N 1,053) were partitioned into 2 groups: 397 in the pre-SBT/DSI group (June 2002–December 2007) and 656 in the post-SBT/DSI group (January 2009 –April 2016). Patients from 2008, during the protocol implementation period, were excluded. An additional SBT protocol database (2008 –2010) was used to assess the efficacy of SBT in transitioning subjects with ARDS to unassisted breathing	**~Implementation of SBT/DSI protocols**	**~ICU LOS** **~Duration of mechanical ventilation**	Evidenced-based protocols governing weaning and sedation practices were associated with both reduced mechanical ventilation duration and ICU LOS in subjects with ARDS. However, higher respiratory system compliance in the SBT/DSI cohort also contributed to these improved outcomes.
Citation #11: Gitti, N., Renzi, S., Marchesi, M., Bertoni, M., Lobo, F.A., Rasulo, F.A., Goffi, A., Pozzi, M., & Piva, S. (2022). Seeking the Light in Intensive Care Unit Sedation: The Optimal Sedation Strategy for Critically Ill Patients. *Frontiers in Medicine*, *9*. https://doi.org/10.3389/fmed.2022.901343					**Level:** 1
Purpose or Hypothesis	**Type of Evidence and Research Design**	**Sample (population, size, setting)**	**Intervention Procedures**	**Primary Outcome/Measures**	**Results Conclusions**

The key concept is that a “calm, comfortable, and collaborative” patient (i.e., lightly sedated) allows active cognitive stimulation, earlier liberation from the endotracheal tube, active mobilization, and also improved interaction with the healthcare team and the family, all of them being important patient-centered outcomes.	~Systematic Review and Meta-Analysis ~Randomized controlled trials and nonrandomized studies were included	~21 published articles (RCTs, systematic reviews and meta-analysis) ~Intubated adult patients in ICUs	~light sedation versus deep sedation	Each of the 21 studies assessed focused on various outcomes, however the following were the most prominent outcomes assessed: ~Duration of MV ~ICU mortality ~Hospital mortality ~ICU LOS ~Hospital LOS ~Incidence of self extubation ~Incidence of reintubation ~Incidence of tracheostomy	The approach to the management of critically ill patients is multidimensional, and targeted sedation should be considered in the context of the ABCDEF bundle. No doubt exists about the need to limit deep sedation to restricted clinical circumstances, while the light sedation (or non-sedation) approach could not explicit its beneficial effects when taken alone and not in the context of an ABCDEF bundle approach. When light sedation is applied, propofol or dexmedetomidine should be used, carefully evaluating their possible contraindications. Moreover, whenever clinical evaluation of the level of sedation is not feasible, a processed and raw EEG signal could be useful to avoid the detrimental effects of over-sedation

Evidence Synthesis of Research Studies Related to Intermittent Sedation

Project Title: **Using Intermittent Sedation to Reduce the Duration of Intubation for Adults in a Cardiac Intensive Care Unit**

JHNEBP Model Level	Total Number of Sources	Author and Quality Rating of each study	Synthesis of Findings
Level 1 Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs with or without meta-analysis	5	1. Minhas, M. A., Velasquez, A. G., Kaul, A., Salinas, P. D., & Celi, L. A. (2015) ○ **Good and consistent evidence** 2. Strøm, T., Martinussen, T., & Toft, P. (2010). ○ **Strong, compelling evidence, consistent results** 3. Aitken, L. M., Bucknall, T., Kent, B., Mitchell, M., Burmeister, E., & Keogh, S. (2016). ○ **Little or no evidence** 4. Chen, T. J., Chung, Y. W., Chen, P. Y., Hu, S. H., Chang, C. C., Hsieh, S. H., Wang, B. C., & Chiu, H. Y. (2022). ○ **Strong, compelling evidence, consistent results** 5. Gitti, N., Renzi, S., Marchesi, M., Bertoni, M., Lobo, F.A., Rasulo, F.A., Goffi, A., Pozzi, M., & Piva, S. (2022). ○ **Strong, compelling evidence, consistent results**	• Protocolized sedation did not show a significant difference in mean duration of intubation compared to usual care, however protocolized sedation did significantly reduce ICU LOS as well as reduced incidence of tracheostomy (Minhas et al., 2015). • Patients who were not given sedation had significantly higher number of days without ventilation compared to patients given sedation (Strøm et al., 2010). • Insufficient evidence to evaluate the effectiveness of protocolized sedation as results from the two RCTs was conflicting (Aitken et al., 2016). • Daily sedation interruption could substantially reduce the duration of mechanical ventilation, particularly when it was applied to patients with high disease severity (Chen et al., 2022). • Light, or no, sedation should be used whenever possible to limit the detrimental effects of deep sedation (Gitti et al., 2022).
Level II Quasi-experimental studies · Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis	1	1. Stephens, R., Dettmer, M., Roberts, B., Ablordeppey, E., Fowler, S., Kollef, M. & Fuller, B. (2018). • **Strong, compelling evidence, consistent results**	• Deep sedation in mechanically ventilated patients, as evaluated in a small number of qualifying heterogeneous randomized controlled trials and observational studies, was associated with increased mortality and lengths of stay (Stephens et al., 2018).
Level III Non-experimental study · Systematic review of a combination of RCTs, quasi-experimental, and non-experimental studies, or non-experimental studies only, with or without meta-analysis · Qualitative study or systematic review of qualitative studies with or without meta-synthesis	5	1. Shehabi, Y., Chan, L., Kadiman, S., Alias, A., Ismail, W. N., Tan, M. A., Khoo, T. M., Ali, S. B., Saman, M. A., Shaltut, A., Tan, C. C., Yong, C. Y., Bailey, M., & Sedation Practice in Intensive Care Evaluation (SPICE) Study Group investigators. (2013). • **Strong, compelling evidence, consistent results** 2. Klompas, M., Li, L., Szumita, P., Kleinman, K., Murphy, M.V., & CDC Prevention Epicenters Program	• Irrespective of sedative choice, early deep sedation was independently associated with delayed extubation and higher mortality, and thus was a potentially modifiable risk in interventional trials (Shehabi et al., 2013). • Benzodiazepines and propofol were associated with increased ventilator associated events (VAEs) compared to dexmedetomidine. Propofol and dexmedetomidine were associated with less time to extubation compared to

		(2016). • **Strong, compelling evidence, consistent results** 3. Tanaka, L.M., Azevedo, L.C., Park, M., Schettino, G., Nassar, A.P., Réa-Neto, A., Tannous, L., de Souza-Dantas, V.C., Torelly, A., Lisboa, T., Piras, C., Carvalho, F.B., Maia, M., Giannini, F.P., Machado, F.R., Dal-Pizzol, F., de Carvalho, A.G., dos Santos, R.B., Tierno, P.F., … ERICC study investigators. (2014). • **Strong, compelling evidence, consistent results** 4. Green, S., & Staffileno, B. A. (2021). • **Strong, compelling evidence, consistent results** 5. Kallet, R. H., Hanjing Zhuo, Yip, V., Gomez, A., & Lipnick, M. S. (2018). • **Good and consistent evidence**	benzodiazepines (Klompas et al., 2016). • For patients in deep sedation, a longer duration of ventilatory support was observed and more tracheostomies were performed as well as increased hospital mortality (Tanaka et al., 2014). • Implementation of a nurse-driven sedation protocol resulted in favorable outcomes by decreasing duration of mechanical ventilation, intensive care unit length of stay, and duration of continuous sedation and increasing the number of spontaneous awakening trials performed (Green & Staffileno, 2021). • Evidence based protocols governing weaning and sedation practices were associated with reduced mechanical ventilation duration and ICU LOS in subjects with ARDs (Kallet et al., 2018).
Level IV Opinion of respected authorities and/or reports of nationally recognized expert committees/consensus panels based on scientific evidence	0	n/a	n/a
Level V Evidence obtained from literature reviews, quality improvement, program evaluation, financial evaluation, or case reports · Opinion of nationally recognized expert(s) based on experiential evidence	0	n/a	n/a
Overall Quality Rating w/rational and Recommendation: The evidence synthesis reveals that there are multiple research studies of various levels of evidence per the JHNEBP model and the majority with good and consistent evidence or strong, compelling evidence with consistent results which suggests an indication for practice change.			
Recommendations Based on Evidence Synthesis • Strong, compelling evidence, consistent results: solid indication for a practice change. • Good and consistent evidence – practice change • Good but conflicting evidence: questionable indication for practice change; consider risk/benefit analysis • Little or no evidence: no indication for practice change			

Appendix B

Data Collection/Audit Tools

Data Dictionary Codebook 04/01/2024 1:09pm

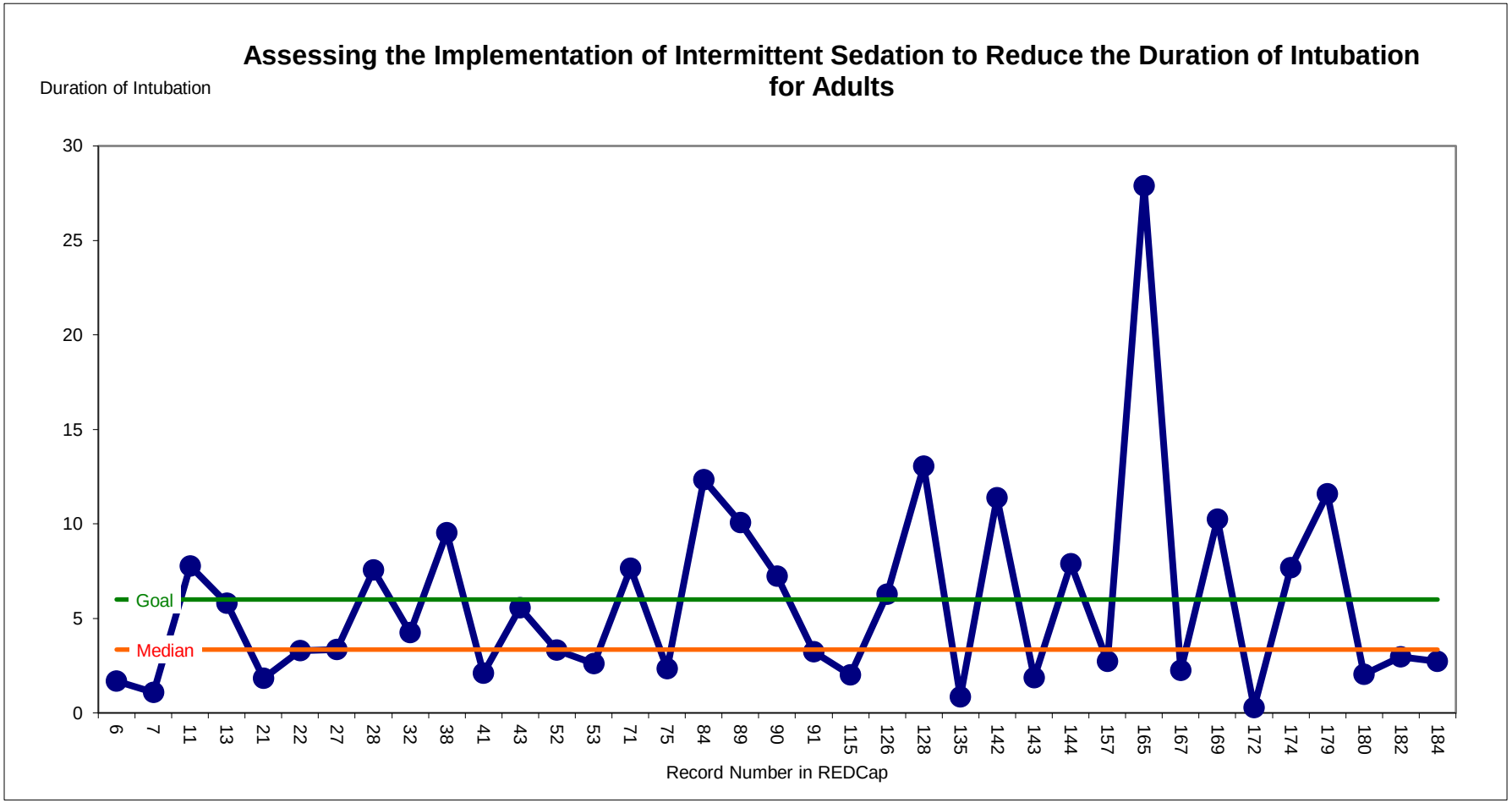
PLEASE NOTE : DO NOT collect live data if project is in development mode .

#	Variable / Field Name	Field Label *Field Note*	Field Attributes (Field Type, Validation, Choices, Calculations, etc.)
Instrument: Intubated Patient Data (intubated_patient_data)			
1	[record_id]	Record ID	text
2	[mrn]	MRN *Patient MRN for longitudinal data collection*	text (mrn_10d), Required, Identifier
3	[today_s_date]	Today's Date	text (date_mdy), Required
4	[icu_admission_date]	CCU Admission Date	text (date_mdy), Required, Identifier
5	[calculated_icu_length_of_s]	Calculated CCU Length of Stay	calc Calculation: datediff([today_s_date], [icu_admission_date], "d")
6	[patient_date_of_intubation]	Patient Date of Intubation *Placement date and time for ETT*	text (datetime_mdy), Required
7	[intermittent_sedation]	Intermittent Sedation *Does the patient meet the eligibility criteria for intermittent sedation protocol?*	yesno, Required 1, Yes 0, No
8	[patient_rass]	Patient RASS *What is the Patient's average RASS score for the day?*	dropdown, Required +4, +4 +3, +3 +2, +2 +1, +1 0, 0 -1, -1 -2, -2 -3, -3 -4, -4 -5, -5
9	[spontaneous_breathing_tria]	Spontaneous Breathing Trial (SBT) *Has a daily SBT been completed?*	yesno, Required 1, Yes 0, No
10	[date_time_of_extu	Date & Time of Extubation	text (datetime_mdy)

	bation]		
11	[datediff_patient_date_of_i]	Calculated Duration of Intubation	calc Calculation: datediff ([patient_date_of_intubation], [date_time_of_extubation], "d")
12	[notes]	Notes	text
13	[intubated_patient_data_complete]	Section Header: *Form Status* Complete?	dropdown 0, Incomplete 1, Unverified 2, Complete

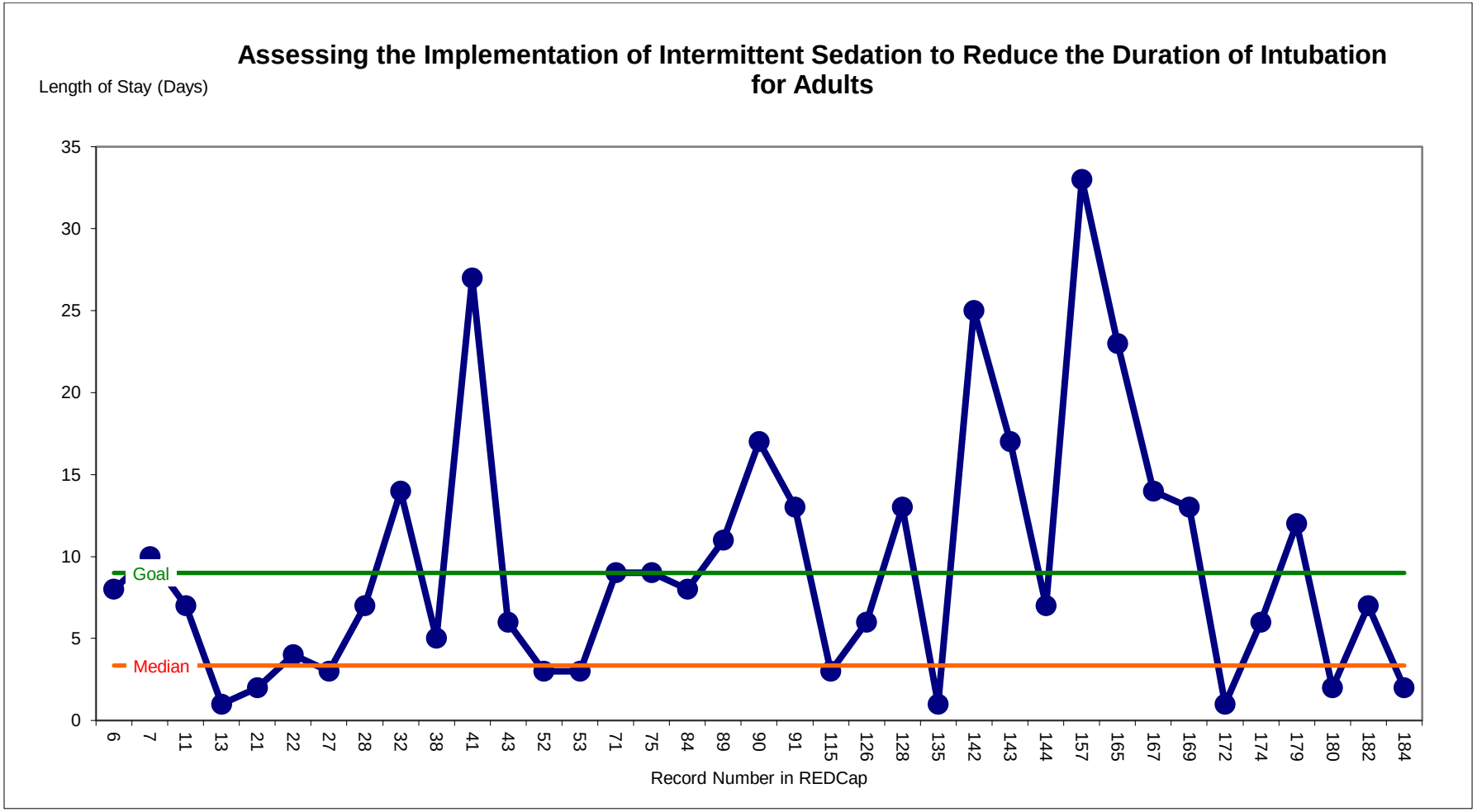
Appendix C

Run Chart for Duration of Intubation (Days)



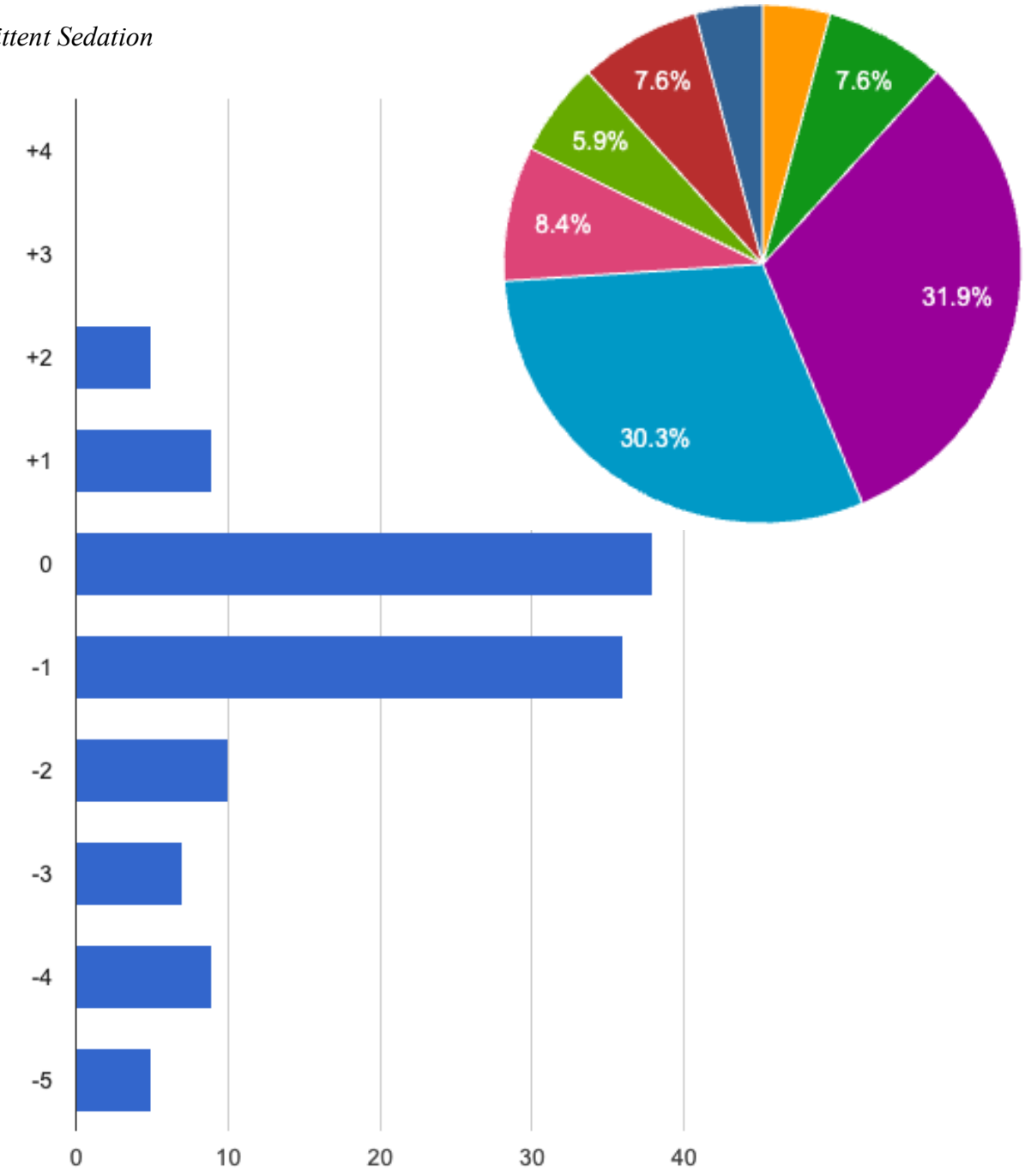
Appendix D

Run Chart for CCU Length of Stay (Days)



Appendix E

Bar Graph and Pie Chart for Average Patient RASS for Previous 12-hours for Patients Managed on Intermittent Sedation

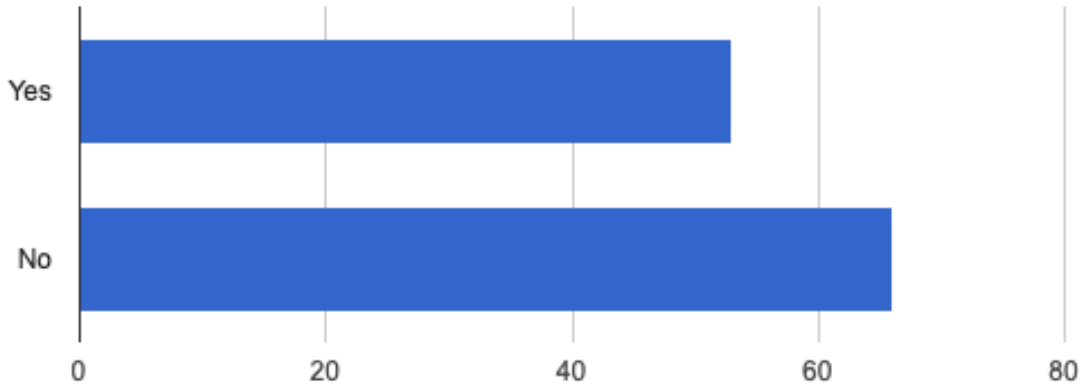


Total Count (N) = 119

Counts/frequency: +4 (0, 0.0%), +3 (0, 0.0%), +2 (5, 4.2%), +1 (9, 7.6%), 0 (38, 31.9%), -1 (36, 30.3%), -2 (10, 8.4%), -3 (7, 5.9), -4 (9, 7.6%), -5 (5, 4.2%)

Appendix F

Bar Graph for Daily Spontaneous Breathing Trial Compliance for Patients Managed on Intermittent Sedation



Total Count (N) = 119
Counts/frequency: Yes (53, 44.5%), No (66, 55.5%)