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Evaluating the RASS

and CAP-D in a Pediatric Cardiac Intensive Care Unit

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A Dissertation Submitted to The Graduate School at the University of Missouri-St. Louis in partial fulfillment of the requirements for the degree of Doctor of Nursing Practice with an emphasis in Pediatric Acute Care Nurse Practitioner

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Abstract

Problem: Pediatric delirium is highly prevalent in the intensive care setting, as much as seventy to eighty-seven percent. Kalvas & Harrison (2020) found that sixty-six percent of critically ill children in a pediatric intensive care unit suffered from a diagnosis of delirium. Delirium has been widely linked with increased costs, mortality, and length of stay.

Methods: The quality improvement (QI) project used a descriptive design to collect retrospective and prospective data before and after an individualized bedside education session was completed. The QI project used a purposive convenience sampling to assess the ability to accurately identify the presence of delirium and its sub-type among patients undergoing cardiac surgery in a pediatric cardiac intensive care unit (CICU).

Results: Descriptive statistics and Chi-square tests were ran and although there was not statistical significance between the identification of delirium and its sub-types, however there was a notable shift. A larger sample size may be necessary to show statistical significance.

Implications for practice: There should be continued education on the use of the Richmond Agitation Sedation Score (RASS) and Cornell Assessment of Pediatric Delirium (CAP-D), whether that be quarterly or annually. There should also be initial education on the RASS and CAP-D for newly hired staff. The RASS and CAP-D should continue to be used identify delirium and its sub-types accurately. Multiple Plan-Do-Study-Act (PDSA) cycles may be necessary to reach even greater compliance. One such PDSA cycle might include adding delirium specific rounding to practice.

Evaluating the RASS

CAP-D in a Pediatric Cardiac Intensive Care Unit

Delirium is a dysfunction of neurons, causing an acute state of confusion in which reversibility is possible (McCance & Huether, 2014). Delirium causes an acute disruption in awareness and attention that may vary in severity throughout the day. Additionally, delirium can cause a disruption in cognition. Delirium can be a direct result of a specific medication, condition, or multiple etiologies. Diagnostic criteria include the presence of the symptoms previously mentioned accompanied by an absence of other established disorders. Additional diagnostic criteria include a thorough history, physical examination, and laboratory values (American Psychiatric Association, 2013). Three sub-types known as hyperactive delirium, hypoactive delirium, and mixed-level delirium can further express the diagnosis of delirium. Hyperactive delirium is an increase in psychomotor activity and is depicted by irritability, agitation, and inability to be subdued (American Psychiatric Association, 2013; McCance & Huether, 2014). Hyperactive delirium is increasingly important to detect and treat quickly as it can lead to sudden death (McCance & Huether, 2014). Hypoactive delirium is a decrease in psychomotor activity represented by lethargy and withdrawal (American Psychiatric Association, 2013; McCance & Huether, 2014). Mixed-level delirium is quite simply a mixture of hyperactive and hypoactive delirium represented by a normal psychomotor activity with quickly shifting activity levels (American Psychiatric Association, 2013).

Cardiac surgery can include a multitude of procedures; however, for this project, cardiac surgery includes exposure to cardiopulmonary bypass.

Reports of the specific prevalence of delirium vary among sources. Some state that it is as high as seventy to eighty-seven percent. The overall sentiment is consistent, concluding, that delirium is greatly predominant in the intensive care unit setting

(American Psychiatric Association, 2013). Kalvas & Harrison (2020) found that 66% of critically ill children in a pediatric intensive care unit suffered from a diagnosis of delirium. Pediatric delirium is less widely studied than adult delirium. There has recently been an emergence of interest in the topic, as it has been widely linked with increased costs, mortality, and length of stay. Pediatric delirium is under identified in the critically ill population and can be linked to difficulty assessing symptoms (Harris et al., 2016). It is increasingly difficult to assess in patients experiencing developmental delay. Although numerous studies have looked at pediatric delirium, more research is needed when identifying delirium subtypes and looking at effective screening tools that can accurately identify pediatric delirium (Kalvas & Harrison, 2020). Furthermore, a deeper dive must be done when considering risk factors of pediatric delirium. While multiple risk factors are present for developing pediatric delirium, one that is of extreme importance and need of investigating is developmental delay, specifically those undergoing cardiac surgery. Cardiac surgery, specifically exposure to cardiopulmonary bypass, considerably increases predisposition to pediatric delirium (Patel et al., 2017). Developmentally delayed children account for thirty-eight percent of the pediatric intensive care unit population and are at an increased risk of pediatric delirium (Kauer et al., 2020).

Accurate identification of pediatric delirium has long been scrutinized. Numerous tools are available to aid in the identification of pediatric delirium; however, focusing on ones that are valid and reliable is key to accurate identification. The Richmond Agitation and Sedation Score (RASS) is a scale that measures a patient's agitation, sedation, and alertness. The scale of the RASS goes from -5 to 4 describing factors for each level. Negative scores represent a more sedating level, whereas positive scores represent more agitation (Boettger et al., 2019). Kerson et al. (2016) found the

RASS to be valid in critically ill pediatrics, both ventilated and non-ventilated, while also helping to accurately identify pediatric delirium. The RASS should be completed every four hours, as sedation, agitation, and presence of delirium is ever changing. The Cornell Assessment of Pediatric Delirium (CAP-D) is a valid and reliable tool used to help identify pediatric delirium, including sub-types. It consists of eight questions that capture the shifting progression of delirium. The CAP-D is an easy tool to use and takes only a few minutes to complete and should be completed every twelve hours (Traube et al., 2014).

In a pediatric cardiac intensive care unit, there is an opportunity to evaluate delirium in patients that have undergone cardiac surgery. The evidence-based practice model used in this project is the Iowa Model. The purpose of this project is to appropriately identify delirium and its sub-types in pediatric cardiac surgical patients in the CICU. The overall aim of this project is to increase the accuracy of identifying delirium in patients undergoing cardiac surgery, including sub-types by ten percent over a twelve-week period using the RASS and CAP-D. The primary outcome measure is the accuracy at identifying delirium in patients undergoing cardiac surgery using the RASS and CAP-D. The project question for this was: In a pediatric CICU, what is the impact of individualized bedside education for staff nurses on the use of the RASS and CAP-D at accurately identifying delirium and its sub-types?

Review of Literature

The literature review process included a search of PubMed, MEDLINE (EBSCO), and Cumulative Index of Nursing and Allied Health Literature (CINAHL). Key search terms and phrases included *RASS, Richmond Agitation Score, CAP-D, Cornell Assessment for Pediatric Delirium, delirium, developmental delay, cardiac surgery, and cardiopulmonary bypass*. Boolean operators including AND and OR were

used. Initially 418 results were generated based on the key search terms and phrases. Inclusion criteria were studies from 2014 to 2021 and published in the English language. Exclusion criteria were those publications outside of the date range and those not published in the English language. After inclusion and exclusion criteria were applied, 80 publications were generated. Ultimately, 16 publications were chosen for this review.

Delirium

The prevalence of delirium varies among studies; however, most were found to last one to two days and develop within the first three days postoperatively (Patel et al., 2017; Traube et al., 2017). Delirium is comprised of three subtypes that include hypoactive, hyperactive, and mixed. Some limitations exist within the literature as not many studies have focused on information surrounding delirium sub-types. Hypoactive delirium is the most common sub-type, with as much as forty-six percent presenting (Traube et al., 2017). Mixed delirium has a similar occurrence at forty-five percent (Traube et al., 2017). Hyperactive delirium is the least common sub-type, presenting with only eight percent (Traube et al., 2017). It is necessary for future studies to focus on these sub-types as it could help deliver thorough interventions for patients suffering from delirium.

Delirium is a known complication of being critically ill and more specifically after undergoing cardiac surgery. Delirium has been largely studied in adults with less focus on the pediatric population, especially within the pediatric cardiac population. Postoperative delirium after cardiac surgery has not been largely studied in pediatrics; however it has been found to be associated with poorer outcomes in adults post cardiac surgery (Patel et al., 2017). Additionally, assessing those with developmental delay is increasingly difficult. Cardiac surgery has been found to significantly impact the development of delirium postoperatively (Patel et al., 2017). Furthermore, these patients

will spend a significant amount of time in the intensive care unit (ICU), which has also been identified as increasing the incidence of developing delirium. The development of delirium in the postoperative and ICU patient has been shown to significantly lengthen the amount of time in the ICU and hospital (Patel et al., 2017; Straveski et al., 2021). The length of mechanical ventilation has also been shown to increase with the development of delirium (Patel et al., 2017; Straveski et al., 2021). Given this information, these patients must be adequately screened for delirium. With the recent increase in pediatric delirium research, the RASS and CAP-D have been looked at and found to be valid and reliable at identifying delirium in this specialized population (Kaur et al., 2020; Kerson et al., 2016).

Risk Factors

Several risk factors must be considered when discussing delirium, including those that are modifiable and non-modifiable. Modifiable risk factors include mechanical ventilation, sedating medications, other medications, physical restraints, nutrition, exposure to blood products, and length of cardiopulmonary bypass. Being mechanically ventilated requires exposure to sedating medications, therefore increasing the risk of developing delirium. Additionally, developing delirium can lead to an increase in the amount of time a patient is mechanically ventilated, ultimately lengthening the amount of time spent in the ICU and hospital, while increasing the risk of mortality (Alvarez et al., 2018). The use of sedating medications, most notably benzodiazepines, leads to an increase incidence of delirium (Alvarez et al., 2018; Holly et al., 2018; Meyburg et al., 2017; Traube et al., 2017). According to Straveski et al. (2021), there is as much as a 43% increase in risk for delirium when using benzodiazepines. Pediatric cardiac intensive care units (CICU) rely heavily on using benzodiazepines for sedation purposes; therefore this population is at an increased risk

of developing delirium. Introducing the use of the RASS in early and accurate identification of delirium in these patients has been shown to reduce the over-sedation of mechanically ventilated patients, ultimately reducing mechanical ventilation days and length of stay (Carraway et al., 2021). Anticholinergic and vasoactive drugs are also commonly used in pediatric CICUs and have displayed the ability to increase the development of delirium (Straveski et al., 2021). Due to multiple factors, many pediatric CICU patients must be physically restrained, and mobility must be reduced. Physical restraints and lack of mobility have been independently identified as a precursor for delirium (Straveski et al., 2021; Traube et al., 2017). Early mobilization and referral to physical or occupational therapy is exceedingly important to help decrease delirium in this population. Patel et al. (2017) found that the development of delirium was significantly associated with low albumin levels. Therefore, adequate nutrition must be initiated in these patients as soon as possible. Patel et al. (2017) also found that the presence of blood transfusion and length of cardiopulmonary bypass time were independently associated with the development of delirium. This is largely unavoidable in this population; therefore, care must be taken to identify delirium accurately and in a timely manner. Non-modifiable risk factors include age, developmental delay, and severity of illness. Children aged two or less were regularly recognized as being an independent factor of developing delirium (Alvarez et al., 2018; Holly et al., 2018; Meyburg et al., 2017; Patel et al., 2017; Traube et al., 2017). Association can be made between the presence of developmental delay and patients aged less than two years. Both present difficulty in accurate identification when using delirium-screening tools. Those with developmental delay are at an increased risk of developing delirium. Developmental delay can be described as neurological disability resulting in dependence on others and has been indicated as an independent risk factor of delirium (Patel et al.,

2017; Traube et al., 2017). Severity of illness, or most notably, presence of cyanotic heart disease, in this particular population has been acknowledged as an independent risk factor of delirium (Patel et al., 2017). All of these modifiable and non-modifiable risk factors are typically present in any single pediatric CICU patient and add up to the increased significance of delirium within this specialized population.

RASS and CAP-D

Identifying delirium has been a long-time challenge, especially in specific populations; however recent studies have made progress in validating screening tools. Additionally, it has been difficult to find a screening tool to identify delirium in a wide range of patients from sedated/drowsy to awake/alert. The RASS and CAP-D are the two screening tools that have been identified as valid and reliable in the population of focus. Boettger et al. (2020) found several characteristics that correctly recognized delirium regardless of alertness level, when using the RASS. Implementation of the RASS can reduce mechanical ventilation time and length of stay in both the ICU and hospital (Carraway et al., 2021; Kaur et al., 2020; Kerson et al., 2016). When considering identifying delirium in the developmentally delayed, the RASS in conjunction with the CAP-D was found to have sensitivity and specificity (Kaur et al., 2020). The bedside nurse completes the RASS every four hours and the CAP-D every twelve hours. These screening tools are highly reliable among multiple types of health care professionals (Ely et al., 2003; Kihlstrom et al., 2018). Both the RASS and CAP-D take approximately twenty seconds to complete, are easily conducted, and provide an accurate identification. The use of these two screening systems is an acceptable solution to this critical issue.

Conclusion

In summary, there remains a need at accurately identifying delirium for the pediatric CICU population, specifically those identified with undergoing cardiac surgery. Additionally, delirium sub-types are under-diagnosed and under-recognized within the literature. The RASS and CAP-D have been found to be quick, easy, valid, and reliable screening tools at identifying delirium in the pediatric population. More research is needed in regards to patients undergoing cardiac surgery. The Iowa Model was used in a single center pediatric CICU to collect and evaluate data regarding postoperative delirium among those undergoing cardiac surgery. This data and research will add to the literature by focusing on a specific and under-researched, yet growing population.

Methods

Design

The overall approach of this project is quality improvement using a pre and post observational design. Initial implementation of the RASS was completed in May 2021 in the center educating bedside nursing staff on the correct use and interpretation. There was no education done on the importance of completing the RASS and CAP-D together and what that may help identify. There was no follow-up done to evaluate the effectiveness of this tool to accurately identify delirium in the pediatric patient undergoing cardiac surgery. The methodology of this study was to implement a cycle of educating nursing staff on the appropriate use and interpretation of the RASS and CAP-D. This project included a prospective and retrospective chart review process from the patient's CICU records. The retrospective chart review included patients undergoing cardiac surgery from October 1, 2021 to December 31, 2021. The prospective chart review included patients undergoing cardiac surgery from February 7, 2022 to May 2,

2022. The intervention of RASS and CAP-D education was completed from January 19, 2022 to February 6, 2022.

Setting

The setting for this project was a large urban, Midwestern pediatric academic center serving both urban and rural communities. The center serves patients from infancy to adolescence. The center has 402 beds and of those, 44 are designated to the area under study. The center sees approximately 275,000 patients a year including those from across the world. The center employees 3,423 individuals as well as 881 physicians. The center is nationally ranked in 10 specialties. The center is one of 78 members of a non-competitive national collaborative of children's hospitals, the Children's Hospitals' Solutions for Patient Safety Network.

Sample

The sample of this project was a purposive convenience sample. The sample included a population of patients from the age of newborn to 18 years. Inclusion criteria within this stated population included those patients admitted to the pediatric CICU, undergoing cardiac surgery.

Data Collection and Analysis

All data was collected prospectively and retrospectively from October 1, 2021 to May 2, 2022 looking at patient medical charts. Demographic data including age, gender, and race was collected. Data including length of CICU stay, length of mechanical ventilation, length of cardiopulmonary bypass, presence of developmental delay, diagnosis of delirium, and interventions was collected. Additionally RASS and CAP-D scores on the targeted population were collected and analyzed. An example of the RASS and CAP-D scores can be found in Appendix A, B, and C respectively. All data was collected from the patient charts using EPIC. Data was transcribed into a Microsoft

Excel spreadsheet. Data was stored on a password-protected computer owned by the primary investigator. All data was de-identified. Statistical analyses including descriptive statistics and Chi-square analysis were used.

Approval Process

Approval for this project was obtained from the center of study and from the University of Missouri-St. Louis. Approval from the Institutional Review Board (IRB) was not needed as this is a quality improvement project. Approval from both institutions can be found in Appendix D and E respectively.

Procedures

The RASS was initially implemented in May 2021, however data was not collected at this time. Therefore, translational evidence could not be ascertained, thus the reason for this project. Key stakeholders including leadership, physician, advanced practice provider, and nursing representatives were consulted and engaged. Key stakeholders convened and decided on the implementation of this project with subsequent data collection. The project intervention included the re-education of medical and nursing staff regarding the RASS and CAP-D, including the interrelationship of the scores and ability to identify delirium sub-types. Focus was placed on those patients undergoing cardiac surgery. The education included a Power Point presentation and individual education done by the primary investigator, in which at least ninety percent participation was achieved. The data was then collected prospectively and retrospectively. The data was analyzed and reported on.

Results

Patient Demographics

Data was collected from the electronic health records of 75 White (75.6%), African American (17.1%), Asian (4.9%), and Other/Pacific Islander (2.4%) Female (58.5%) and Male (41.5%) patients. All of the patients identified as Non-Hispanic/Latino (n = 75). The average age of patients was 1895.03 days (SD = 2667.954). The average weight in kilograms was 20.4 (SD = 23.6). The average CICU length of stay was 8.69 (SD = 14.3). Pre-existing developmental delay was seen in 29 (39%) of patients. All of the patients (n = 75) received anesthesia and Intra-operative blood product transfusions. Less than half of the patients (n = 29) received some length of cardiopulmonary bypass. The majority of hospitalized days were spent receiving invasive mechanical ventilation (32.7%) and only a small percentage (8.3%) of hospitalized days required the use of restraints.

Statistical Analysis

The purpose of this analysis was to examine the impact of an individualized bedside educational intervention and whether the training improved participants' level of recording delirium. Both pre-intervention and post-intervention data were collected from patient charts following the individualized bedside education of nursing staff. Since the data for delirium was categorical in nature, inferential statistics (e.g. t tests, regressions, or ANOVAs) were not able to be performed because all of them require at least one continuous or interval variable. Based on this, nonparametric analysis was used (e.g. Chi-square). Since the purpose of the training was to increase health care workers documenting patient delirium; if delirium was recorded it was coded as 1, if delirium was not recorded it was coded as 0.

First descriptive statistics were performed. Examination of Table 3 (Appendix G) revealed that for pre analysis (n = 46) patients had delirium recorded in their charts. Following the educational intervention, a total of (n = 57) patients had delirium recorded in their charts (see Table 4, Appendix H). Based on this, nonparametric analysis was warranted to determine whether there was a significant difference between (n = 46) patients on the pre-intervention and (n = 57) patients on the post-intervention. Next, Chi- square analysis was employed to determine whether the difference in recorded/not recorded for the pre-intervention was the same or statistically different on the post-intervention. Table 5 (Appendix I) provides an overview of expected and observed count. Table 6 (Appendix J) provides the results of the Chi-square analysis. Examination of the Chi-square results table below revealed that the difference between pre-intervention to post-intervention was not statistically different (p = .277). The same process was used to examine sub-types of delirium being recorded pre and post-intervention. First descriptive statistics were performed. Examination of Table 7 (Appendix K) revealed that for pre-intervention (n = 46) patients had sub-types of delirium recorded in their charts. Following the education, a total of (n = 73) patients had delirium recorded in their charts (see Table 8, Appendix L). Based on this, nonparametric analysis was warranted to determine whether there was a significant difference between (n = 46) patients on the pre-intervention and (n = 73) patients on the post-intervention. Table 9 (Appendix M) provides the crosstab analysis. Table 10 (Appendix N) provides the results of the Chi-square analysis. Examination of the Chi-square results table below revealed that the difference between pre to post-intervention was not statistically different (p = .071).

Discussion

The purpose of this quality improvement project was to identify the impact of an individualized educational session of bedside nurses to see if it made a difference on the number of recorded occurrences of delirium and its sub-type. Through retrospective, prospective data collection, an intervention, descriptive statistical analysis, and Chi-square testing, it was shown that there is no statistical significance between the two categorical variables of delirium, including sub-type identification and whether or not it was recorded by the bedside nurse. This relates to the study question by showing that the individualized education did not statistically and significantly affect the ability of the bedside nurse to record the RASS and CAP-D of a given patient undergoing cardiac surgery. There are many factors involved that contributed to the outcome of this study. One positive factor was that the stakeholder buy-in was significant and provided for unit-wide participation. However there were also several barriers. One major barrier to this project was the overwhelming turn-over of bedside staff. While the primary investigator was able to reach at least ninety percent of staff for education, many of that staff is now different. There was also a high number of contracted bedside staff that participated in the intervention. This may have led to inadequacies in the project as that staff is not as familiar with unit specific practices. Another barrier included the burden of completing the RASS and CAP-D on the bedside staff, which may be an interesting topic for future study. Another area of future study that would be interesting to look at is the confidence level of the bedside staff to appropriately administer the RASS and CAP-D. This project did not look at that and because of that, may have some missed opportunities. Additionally, the sample size may have been too small to get an adequate idea of the relationship between identification of delirium, including sub-type, and whether or not it was recorded appropriately. This project has shown that individualized

bedside education can be utilized to impact the identification of delirium, including sub-type, however further study with more participants and continued education has the potential to lead to statistical significance. There should be continued education on the use of the RASS and CAP-D, whether that be quarterly or annually. The question remains as to how and what that continued education should look like. There should also be initial education on the RASS and CAP-D for newly hired staff. Ultimately, the RASS and CAP-D should continue to be used to accurately identify delirium and the sub-types. Recommendations of further study involving the RASS and CAP-D includes continued data collection and analysis of current practices. Multiple Plan-Do-Study-Act (PDSA) cycles may be necessary to reach even greater compliance. One such PDSA cycle might include adding delirium specific rounding to practice. This would allow for continued education and attention to the topic.

Conclusion

This quality improvement project failed to show statistical significance between the identification of delirium, including sub-type, and whether the RASS and CAP-D were recorded correctly, although it did show a notable positive shift. Appendix O shows a run chart of the positive shift in RASS and CAP-D compliance, while Appendix P shows the decrease in prevalence of delirium. While there were many barriers present, the initial stakeholder involvement done by the primary investigator continues to be a great positive impact on this project. This project has given rise to numerous ideas for continued study and shown the importance of initial and continued education.

References

Alvarez, R. V., Palmer, C., Czaja, A. S., Peyton, C., Silver, G., Traube, C., … Kaufman, J. (2018). Delirium is a common and early finding in patients in the pediatric cardiac intensive care unit. *The Journal of Pediatrics, 195, 206-212.* https://doi.org/10.1016/j.jpeds.2017.11.064

American Psychiatric Association, & American Psychiatric Association. DSM-5 Task Force. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (5th ed., pp. 596-602). American Psychiatric Association.

Boettger, S., Meyer, R., Richter, A., Rudiger, A., Schubert, M., Jenewein, J., & Nuñez, D. G. (2020). Delirium in the intensive care setting dependent on the richmond agitation and sedation scale (RASS): Inattention and visuo-spatial impairment as potential screening domains. *Palliative & Supportive Care, 18*(2), 148.

Carraway, J. S., Carraway, M. W., & Truelove, C. A. (2021). Nursing implementation of a validated agitation and sedation scale: An evaluation of its outcomes on ventilator days and ICU length of stay. *Applied Nursing Research, 57*, 151372-151372. https://doi.org/10.1016/j.apnr.2020.151372

Delany, D. R., Gaydos, S. S., Romeo, D. A., Henderson, H. T., Fogg, K. L., McKeta, A. S., Kavarana, M. N., & Costello, J. M. (2021). Down syndrome and congenital heart disease: Perioperative planning and management. *Journal of Congenital Cardiology, 5*(1), 1-14. https://doi.org/10.1186/s40949-021-00061-3

Ely, E. W., Truman, B., Shintani, A., Thomason, J. W. W., Wheeler, A. P., Gordon, S., Francis, J., Speroff, T., Gautam, S., Margolin, R., Sessler, C. N., Dittus, R. S., & Bernard, G. R. (2003). Monitoring sedation status over time in ICU patients:

Reliability and validity of the richmond agitation-sedation scale (RASS). *JAMA : The Journal of the American Medical Association, 289*(22), 2983. https://doi.org/10.1001/jama.289.22.2983

Harris, J., Ramelet, A., van Dijk, M., Pokorna, P., Wielenga, J., Tume, L., Tibboel, D., & Ista, E. (2016). Clinical recommendations for pain, sedation, withdrawal and delirium assessment in critically ill infants and children: An ESPNIC position statement for healthcare professionals. *Intensive Care Medicine, 42*(6), 972-986. https://doi.org/10.1007/s00134-016-4344-1

Holly, C., Porter, S., Echevarria, M., Dreker, M., & Ruzehaji, S. (2018). Recognizing delirium in hospitalized children: A systematic review of the evidence on risk factors and characteristics. *The American Journal of Nursing, 118 (4),* 24-36. http://dx.doi.org/10.1097/01.NAJ.0000532069.55339.f9

Kalvas, L. B., & Harrison, T. M. (2020). State of the science in pediatric ICU delirium: An integrative review. *Research in Nursing & Health, 43*(4), 341-355. https://doi.org/10.1002/nur.22054

Kaur S, Silver G, Samuels S, Rosen AH, Weiss M, Mauer EA, Gerber LM, Greenwald BM, Traube C. (2020). Delirium and Developmental Disability: Improving Specificity of a Pediatric Delirium Screen. *Pediatric Critical Care Medicine*, *21(5)*, 409-414. doi: 10.1097/PCC.0000000000002248. PMID: 32106184.

Kerson, A. G., DeMaria, R., Mauer, E., Joyce, C., Gerber, L. M., Greenwald, B. M., Silver, G., & Traube, C. (2016). Validity of the richmond agitation-sedation scale (RASS) in critically ill children. *Journal of Intensive Care, 4*(1), 65-65. https://doi.org/10.1186/s40560-016-0189-5

Kihlstrom, M. J., Edge, A. P., Cherry, K. M., Zarick, P. J., Beck, S. D., & Boyd, J. M. (2018). Multi-modal educational curriculum to improve richmond agitation-sedation scale inter-rater reliability in pediatric patients. *Pediatric Quality & Safety, 3*(5), e096-e096. https://doi.org/10.1097/pq9.0000000000000096

Lin, N., Liu, K., Feng, J., Chen, R., Ying, Y., Lv, D., Zhou, Y., & Xu, H. (2021). Development and validation of a postoperative delirium prediction model for pediatric patients: A prospective, observational, single-center study. *Medicine (Baltimore), 100*(20), e25894-e25894. https://doi.org/10.1097/MD.0000000000025894

McCance, K. L., & Huether, S. E. (2014). *Pathophysiology: The biologic basis for disease in adults and children* (Seventh ed.). Elsevier.

Meyburg, J., Dill, M., Traube, C., Silver, G., & von Haken, R. (2017). Patterns of postoperative delirium in children. *Pediatric Critical Care Medicine, 18*(2), 128.

Patel, A. K., Biagas, K. V., Clarke, E. C., Gerber, L. M., Mauer, E., Silver, G., Chai, P., Corda, R., & Traube, C. (2017). Delirium in children after cardiac bypass surgery.*Pediatric Critical Care Medicine, 18*(2), 165.

Staveski, S. L., Pickler, R. H., Khoury, P. R., Ollberding, N. J., Donnellan, A. L., Mauney, J. A., Lincoln, P. A., Baird, J. D., Gilliland, F. L., Merritt, A. D., Presnell, L. B., Lanese, A. R., Lisanti, A. J., Large, B. J., Fineman, L. D., Gibson, K. H., Mohler, L. A., Callow, L., Barnes, S. S., . . . Curley, M. A. Q. (2021). Prevalence of ICU delirium in postoperative pediatric cardiac surgery patients. *Pediatric Critical Care Medicine, 22*(1), 68.

Traube, C., Silver, G., Gerber, L. M., Kaur, S., Mauer, E. A., Kerson, A., Joyce, C., & Greenwald, B. M. (2017). Delirium and mortality in critically ill children: Epidemiology and outcomes of pediatric delirium. *Critical Care Medicine, 45*(5), 891-898. https://doi.org/10.1097/CCM.0000000000002324

Traube, C., Silver, G., Kearney, J., Patel, A., Atkinson, T. M., Yoon, M. J., Halpert, S., Augenstein, J., Sickles, L. E., Li, C., & Greenwald, B. (2014). Cornell assessment of pediatric delirium: A valid, rapid, observational tool for screening delirium in the PICU.*Critical Care Medicine, 42*(3), 656-663. https://doi.org/10.1097/CCM.0b013e3182a66b76

Zamoscik, K., Godbold, R., & Freeman, P. (2017). Intensive care nurses' experiences and perceptions of delirium and delirium care. *Intensive & Critical Care Nursing, 40*, 94.

Appendix A

Richmond Agitation Sedation Scale (RASS)

Score	Term	Description	
+4	Combative	Overtly combative, violent, immediate danger to staff	
+3	Very agitated	Pulls or removes tube(s) or catheter(s); aggressive	
+2	Agitated	Frequent non-purposeful movement, fights ventilator	
+1	Restless	Anxious but movements not aggressive vigorous	
0	Alert and calm		
-1	Drowsy	Not fully alert, but has sustained awakening (eye-opening/eye contact) to *voice* **(≥ 10 seconds)**	Verbal Stimulation
-2	Light sedation	Briefly awakens with eye contact to *voice* **(≥ 10 seconds)**	
-3	Moderate sedation	Movement or eye opening to *voice* **(but no eye contact)**	
-4	Deep sedation	No response to voice, but movement or eye opening to *physical* Stimulation	Physical Stimulation
-5	Unarousable	No *response to voice* or physical stimulation	

Procedure for RASS Assessment

1. Observe patient
   a. Patient is alert, restless, or agitated (score 0 to +4)
2. If not alert, state patient's name and *say* to open eyes and look at speaker.
   a. Patient awakens with sustained eye opening and eye contact. (score -1)
   b. Patient awakens with eye opening and eye contact, but not sustained. (score -2)
   c. Patient has any movement in response to voice but no eye contact. (score -3)
3. When no response to verbal stimulation, physically stimulate patient by shaking shoulder or rubbing sternum
   a. Patient has any movement to physical stimulation (score -4)
   b. Patient has no response to any stimulation (score -5)

Appendix B

Figure 1. Cornell Assessment of Pediatric Delirium (CAPD) revised

RASS Score _____ (if -4 or -5 do not proceed)

Please answer the following questions based on your interactions with the patient over the course of your shift:

	Never 4	Rarely 3	Sometimes 2	Often 1	Always 0	Score
1. Does the child make eye contact with the caregiver?						
2. Are the child's actions purposeful?						
3. Is the child aware of his/her surroundings?						
4. Does the child communicate needs and wants?						
	Never 0	Rarely 1	Sometimes 2	Often 3	Always 4	
5. Is the child restless?						
6. Is the child inconsolable?						
7. Is the child underactive—very little movement while awake?						
8. Does it take the child a long time to respond to interactions?						
					TOTAL	

Appendix C

Developmental Anchor Points For Youngest Patients

	NB	4 weeks	6 weeks	8 weeks	28 weeks	1 year	2 years
1. Does the child make eye contact with the caregiver?	Fixates on face	Holds gaze briefly Follows 90 degrees	Holds gaze	Follows moving object/caregiver past midline, regards examiner's hand holding object, focused attention	Holds gaze. Prefers primary parent. Looks at speaker	Holds gaze. Prefers primary parent. Looks at speaker	Holds gaze. Prefers primary parent. Looks at speaker
2. Are the child's actions purposeful?	Moves head to side, dominated by primitive reflexes	Reaches (with some discoordination)	Reaches	Symmetric movements, will passively grasp handed object	Reaches with coordinated smooth movement	Reaches and manipulates objects, tries to change position, if mobile may try to get up	Reaches and manipulates objects, tries to change position, if mobile may try to get up and walk
3. Is the child aware of his/her surroundings?	Calm awake time	Awake alert time Turns to primary caretaker's voice May turn to smell of primary care taker	Increasing awake alert time Turns to primary caretaker's voice May turn to smell of primary care taker	Facial brightening or smile in response to nodding head, frown to bell, coos	Strongly prefers mother, then other familiars. Differentiates between novel and familiar objects	Prefers primary parent, then other familiars, upset when separated from preferred care takers. Comforted by familiar objects especially favorite blanket or stuffed animal	Prefers primary parent, then other familiars, upset when separated from preferred care takers. Comforted by familiar objects especially favorite blanket or stuffed animal
4. Does the child communicate needs and wants?	Cries when hungry or uncomfortable	Cries when hungry or uncomfortable	Cries when hungry or uncomfortable	Cries when hungry or uncomfortable	Vocalizes /indicates about needs, eg. hunger, discomfort, curiosity in objects, or surroundings	Uses single words, or signs	3-4 word sentences, or signs. May indicate toilet needs, calls self or me
5. Is the child restless?	No sustained awake alert state	No sustained calm state	No sustained calm state	No sustained calm state	No sustained calm state	No sustained calm state	No sustained calm state
6. Is the child inconsolable?	Not soothed by parental rocking, singing, feeding, comforting actions	Not soothed by parental rocking, singing, feeding, comforting actions	Not soothed by parental rocking, singing, feeding, comforting actions	Not soothed by parental rocking, singing, comforting actions	Not soothed by usual methods eg. singing, holding, talking	Not soothed by usual methods eg. singing, holding, talking, reading	Not soothed by usual methods eg. singing, holding, talking, reading (May tantrum, but can organize)
7. Is the child underactive—very little movement while awake?	Little if any flexed and then relaxed state with primitive reflexes (Child should be sleeping comfortably most of the time)	Little if any reaching, kicking, grasping (still may be somewhat discoordinated)	Little if any reaching, kicking, grasping (may begin to be more coordinated)	Little if any purposive grasping, control of head and arm movements, such as pushing things that are noxious away	Little if any reaching, grasping, moving around in bed, pushing things away	Little if any play, efforts to sit up, pull up, and if mobile crawl or walk around	Little if any more elaborate play, efforts to sit up and move around, and if able to stand, walk, or jump
8. Does it take the child a long time to respond to interactions?	Not making sounds or reflexes active as expected (grasp, suck, moro)	Not making sounds or reflexes active as expected (grasp, suck, moro)	Not kicking or crying with noxious stimuli	Not cooing, smiling, or focusing gaze in response to interactions	Not babbling or smiling/laughing in social interactions (or even actively rejecting an interaction)	Not following simple directions. If verbal, not engaging in simple dialogue with words or jargon	Not following 1-2 step simple commands. If verbal, not engaging in more complex dialogue

Appendix D

Children's
HOSPITAL ST. LOUIS

One Children's Place
St. Louis, Missouri 631 10-1077
StLouisChildrens.org

November 18, 2021

Dear Ms. Sarah Anderson:

This letter confirms the proposed project titled " A QI project evaluating the Richmond Agitation Sedation Score and Cornell Assessment of Pediatric Delirium Score in patients undergoing cardiac surgery in a PICU" has been reviewed and is not considered human subject research. Therefore, review and approval by the Washington University in St. Louis' institutional review board is not required. Please let us know when your project is completed and please update us with your final results.

Sincerely,

Jennifer L. Broeder

Jennifer L. Broeder, PhD, RN
Manager, Research & Outcomes
St. Louis Children's Hospital

Appendix E

Table 1

Descriptives: Sample for Study (categorical data)

Variable	Frequency	Percentage
Gender		
Female	44	58.5
Male	31	41.5
Race		
Asian	4	4.9
Black or African American	13	17.1
Other/Pacific Islander	2	2.4
White	56	75.6
Ethnicity		
Hispanic	0	0
Non-Hispanic	75	100
Pre-Existing Developmental Delay		
No	46	70.7
Yes	29	29.3
Receive Anesthesia in 24 hour period		
Yes	75	100
No	0	0
Respiratory Support		
Invasive Mechanical Ventilation	71	32.7
BiPAP	2	1
CPAP	1	0.5
HFNC	33	15.2

NC	56	25.9
None/RA	46	21.1
Intra-op Blood Product Transfusion		
Yes	75	100
No	0	0
Required Restraints		
Yes	18	8.3
No	200	91.7

Appendix F

Table 2

Descriptives: Sample for Study (continuous data)

Variable	*M*	*SD*
Age in days	1895.03	2667.954
Weight in Kg	20.4406	23.62976
Hospital Days	8.69	14.254

Appendix G

Table 3

Descriptive Statistics for Recording Delirium (pre)

	Frequency	Percent	Valid Percent
Recorded	46	61.3	61.3
Not Recorded	29	38.7	38.7
Total	75	100.0	100.0

Appendix H

Table 4

Descriptive Statistics for Recording Delirium (post)

	Frequency	Percent	Valid Percent
Recorded	57	76.0	76.0
Not Recorded	18	24.0	24.0
Total	75	100.0	100.0

Appendix I

Table 5

Crosstab Count Calculation: Delirium Recoded Pre to Post

			Recorded	Not Recorded	Total
Delirium (Yes/No) PRE	Record	Count	33	13	46
		Expected Count	35.0	11.0	46.0
		% within Delirium (Yes/No) PRE	71.7%	28.3%	100.0%
		% of Total	24	5	29
	Not Record	Count	22.0	7.0	29.0
		Expected Count	82.8%	17.2%	100.0%
		% within Delirium (Yes/No) Post	57	18	75
		% of Total	57.0	18.0	75.0
Total		Count	59	76.0%	24.0%
		Expected Count	59.0	16.0	75.0
		% within Delirium (Yes/No) PRE	78.7%	21.3%	100.0%
		% of Total	78.7%	21.3%	100.0%

Appendix J

Table 6

Results of Chi Square: Recording Delirium Pre to Post

	Value	*df*	Sig.
Pearson Chi-Square	1.184[a]	1	.277
N of Valid Cases	75		

Appendix K

Table 7

Descriptive Statistics for Recording Sub Type Delirium (pre)

	Frequency	Percent	Valid Percent
Recorded	46	61.3	61.3
Not Recorded	29	38.7	38.7
Total	75	100.0	100.0

Appendix L

Table 8

Descriptive Statistics for Recording Sub Type Delirium (post)

	Frequency	Percent	Valid Percent
Recorded	73	97.3	97.3
Not Recorded	2	2.7	2.7
Total	75	100.0	100.0

Appendix M

Table 9

Crosstab Count Calculation: Sub Type Delirium Recoded Pre to Post

				Recorded	Not Recorded	Total
Delirium	PRE	Record	Count	46	0	46
			Expected Count	44.8	1.2	46.0
			% within Delirium (Yes/No) PRE	100.0%	0.0%	100.0%
			% of Total	27	2	29
		Not Record	Count	28.2	.8	29.0
			Expected Count	93.1%	6.9%	100.0%
			% within Delirium (Yes/No)	73	2	75
	POST					
			% of Total	73.0	2.0	75.0
Total			Count	59	97.3%	2.7%
			Expected Count	59.0	16.0	75.0
			% within Delirium (Yes/No) POST	78.7%	21.3%	100.0%
			% of Total	78.7%	21.3%	100.0%

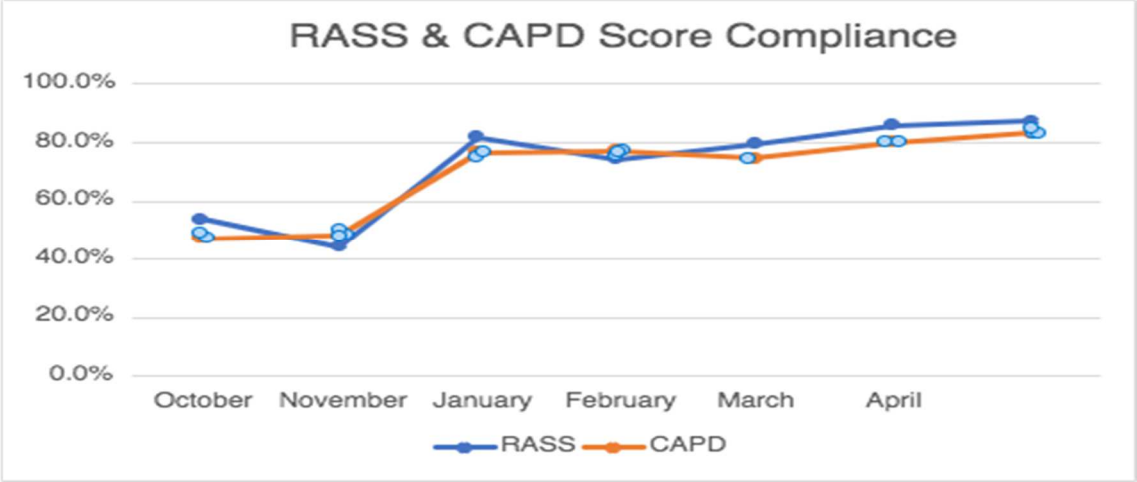
Appendix N

Table 10

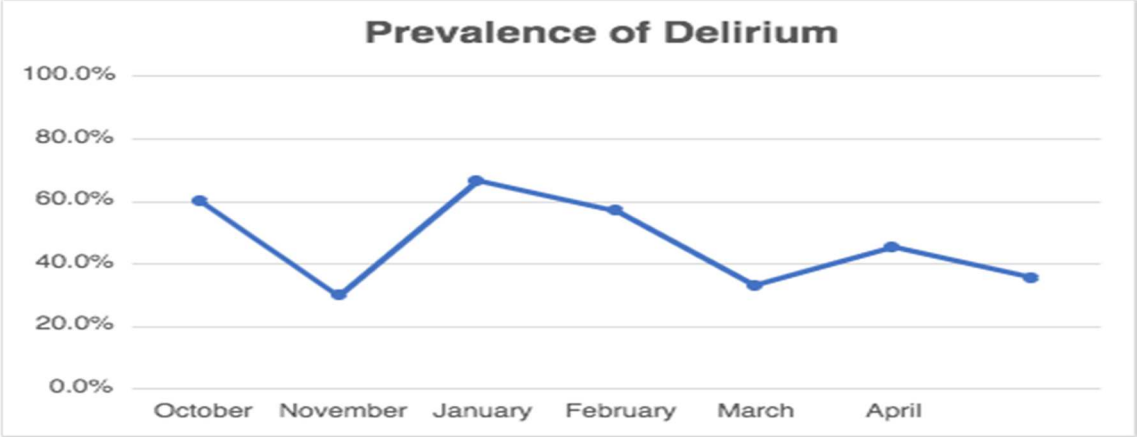
Results of Chi Square: Recording Sub Type Delirium Pre to Post

	Value	*df*	Sig.
Pearson Chi-Square	3.259[a]	1	.071
N of Valid Cases	75		

Appendix O


RASS & CAPD Score Compliance
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
October
November
January
February
March
April
RASS
CAPD

Appendix P


Prevalence of Delirium
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
October
November
January
February
March
April