Delirium in the Pediatric Cardiovascular Intensive Care Unit

Ricardo Hernandez

Edison College of Nursing and Health Innovation, Arizona State University

Author Note

Ricardo Hernandez is a registered nurse at Phoenix Children's Hospital in the nursing department.

He has no conflict of interest to disclose.

Correspondence should be addressed to Ricardo Hernandez, Edison College of Nursing and Health Innovation, Arizona State University, Downtown Campus, 550 N. 3rd Street, Phoenix, AZ 85004. Email: Raherna2@asu.edu

Abstract

Objective: Delirium frequently occurs in Pediatric Cardiac intensive Care Units (PCICU) of hospitals with critically ill patients. An inflammatory process of the brain causes neurotransmitters imbalances and neuronal alterations, leading to increased days on mechanical ventilation, length of stay in the ICU, and possible self -harm. Delirium can be reduced and controlled if detected early through frequent patient monitoring and screening. The purpose of this project is to evaluate the implementation of a delirium screening tool along with education on delirium

Study Selection: An education module on delirium and the Cornell Assessment of Pediatric Delirium (CAP-D) screening tool along with a non-pharmacological bundle was implemented on a pediatric cardiac intensive care unit for patients 2 to 18 years of age, admitted to an Arizona metropolitan children's hospital. All nurses were required to attend the education session. Data was collected by using pre- and post-survey questions on delirium for those nurses who chose to participate in the study.

Data Synthesis: The results from the pre- and post-tests suggest there was an increase in education. The average score for the 15 nurses on the pre-test was 87.1% while the same nurses scored 100% on the post-test. Chart reviews of the CAP-D screening tool from November 2000 – February 2021 had 71 patients on the unit and had 8 patients scored on the CAP-D screening tool. Chart reviews after implementation of the education module from November 2021 – February 2022, were conducted and 118 patients were on the unit while only 23 patients were scored on the CAP-D screening tool.

Conclusion: So far, the use of an education module and implementation of a non-pharmacological bundle has proven some promising results in helping with delirium and its reduction in the PCICU.

Keywords: Delirium, delirium prevention, pediatrics delirium, cardiac intensive care unit, education, nonpharmacological bundle.

Delirium in the Pediatric Cardiovascular Intensive Care Unit

Delirium frequently occurs in intensive care units (ICU) of hospitals with critically ill patients. It is associated with increased length of stay and long-term cognitive impairment. An inflammatory process of the brain causes neurotransmitter imbalances and neuronal alterations. Delirium can be controlled and reduced if it is detected early through frequent patient monitoring and screening.

Background and Significance

Pediatric Patients in the PCICU

Delirium has been well researched in adults since the 1940s and is heavily prevalent in adult ICU settings (Bryant, 2018). The patients that are affected by delirium the most are those who are mechanically ventilated, are receiving continuous sedation, and have greater severity of illness (Alvarez et al., 2018; Bryant, 2018; Patel et al., 2017; Simeone et al., 2018; Staveski et al., 2018; Staveski et al., 2020). Delirium causes disturbances in attention, awareness, behavior, cognition, and perception increasing the patient's potential to hurt themselves (Staveski et al., 2018). In adult studies, after postoperative cardiac surgeries, it has been determined that prolonged bypass time, longer aortic clamp time, atrial fibrillation, lower systemic perfusion pressures, and lower cerebral oxygenation saturation levels lead to a higher incidence of delirium (Bryant, 2018).

This data has been studied in pediatric populations with recent and proper additions to pediatric delirium screening tools. There is a 25% point prevalence rate of delirium in the PICU (Alvarez et al., 2018). More recently, authors have reported an increased delirium prevalence of 49% in the PCICU because children have cyanotic heart diseases and complex surgical intervention (Staveski et al., 2018). Surgical interventions play a role in delirium because the children can spend an extended amount of time on cardiac bypass (Patel et al., 2017). To date, studies of children after cardiopulmonary bypass document 49%-57% of postoperative cardiac surgery patients screening positive for delirium (Staveski et al., 2020). Many patients in the PCICU are mechanically ventilated, on sedating medication, and are severely ill for an extended time (Alvarez et al., 2018; Bryant, 2018; Patel et al., 2017; Simeone et al., 2018; Staveski et al., 2018; Staveski et al., 2020)

Delirium Screening Tool

In recent years the importance of a screening tool has been identified because the absence of such tools has resulted in delirium going unnoticed in 70% of patients (Bannon et al., 2016). Two main screening tools have been proven effective for screening delirium in children. The first is the preschool and pediatric version of the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU). The second is the Cornell Assessment of Pediatric Delirium (CAP-D). However, before using either one of these tools, one must complete an arousal assessment using the Richmond Agitation-Sedation Scale (RASS). The RASS scale assesses three different arousal states: plus one through plus four for agitation, minus one through minus three for decreased arousal with retained responsiveness to verbal stimulation, and minus four through minus five for unresponsiveness to verbal stimulation or comatose (Bryant, 2018). Thus, if the patient has a

minus-four or minus five score, they cannot continue with the delirium screening tool because verbal stimulation is required to diagnose delirium.

The CAM-ICU was developed from the adult version and is the most commonly used delirium tool in adults. The pediatric version (pCAM-ICU) is highly valid in critically ill children from the age of six months to children older than five years of age (Alvarez et al., 2018; Bryant, 2018; Patel et al., 2017; Simeone et al., 2018; Staveski et al., 2020; Valdivia & Carlin, 2019). It tests four features of delirium, the first being acute change in mental status, the second is inattention, the third is altered level of consciousness, and the fourth is disorganized thinking. The presence of delirium requires the first and second features plus feature three or feature four. When one scores a feature three, it means the patient's RASS score is anything other than zero. The RASS score can also determine the type of delirium. The CAM-ICU uses the patient's RASS score as a prescreening and for scoring the patient's delirium (Alvarez et al., 2018; Bryant, 2018; Patel et al., 2017; Simeone et al., 2018; Staveski et al., 2020; Valdivia & Carlin, 2019).

The CAP-D was adapted and revised from the Pediatric Anesthesia Emergence Delirium tool and used the Diagnostic and Statistical Manual of Mental Disorders, 5th ed. (DSM-V) criteria for diagnosing delirium (Patel et al., 2017). This revised edition better identified delirium in pediatric patients by identifying fluctuations and alterations in cognitive functioning. In addition, anchor points were made for the CAP-D screening tool that described age-appropriate developmental expectations. The tools ask a total of eight questions regarding patients' consciousness, cognition, psychomotor activity, and affect, with scoring a zero through four for each question. Scoring a nine or above is considered a diagnosis of delirium. Unlike the CAM-ICU, the CAP-D is designed to be performed halfway through each 12-hour nursing shift, after the nurses have observed the patient's behavior for several hours and should only take two

minutes to complete (Alvarez et al., 2018; Bryant, 2018; Patel et al., 2017; Simeone et al., 2018; Staveski et al., 2020; Valdivia & Carlin, 2019).

PCICU Current Utilization and Desired outcome

A PICU in an urban freestanding children's hospital in the southwestern United States (U. S.) is currently using the CAP-D screening tool. The nurse's chart on the tool once shifts at noon and midnight in the electronic medical record. However, the PCICU currently does not use a delirium screening tool.

To decrease PCICU length of stay and minimize mechanical ventilation time, this project will focus on screening for delirium in PCICU patients. Specifically, this project aims to improve the nurse's knowledge of screening for delirium and the need for interventions. In addition, the educational interventions will focus on their use of the CAP-D screening tool.

Search Strategy

A review of the most current evidence was used to answer the PICOT question stated above. Three databases were searched – CINAHL, PubMed, and Cochrane Database. These were used for their unique and relevant information on delirium and screening in the ICU. These databases are well known and used continuously for their up-to-date data in medical journals.

Search Yield

The initial search in PubMed used the key terms *delirium, PCICU, Screening,* and *tools* yielded only one article. When rephrasing and using other key terms such as *delirium, children, screening,* and *intensive care,* the results yielded 100 articles. When searching the CINAHL database, the same key terms were used *delirium* and *intensive care*. The first search yielded 900 results, while the last searched use key terms *delirium, pediatric,* and *screening* produced 50 articles within the inclusion and exclusion criteria. With the COCHRANE database, the first

search used key terms *delirium and intensive care unit* and *yielded* 575 articles when subsequent searches resulted in 71 articles using the key terms *delirium, screening,* and *intensive care*. Among all these searches, careful consideration led to ten articles being chosen for this review. These ten studies address the PICOT question appropriately and accurately.

Key Terms

The databases were searched using combinations of key terms that address all aspects of the PICOT questions. The terms included: *delirium, intensive care unit, pediatric,* and *screening*. The key terms, however, did not include *cardiac* because it narrowed the search too greatly. Each database was used with a different combination of the key terms to yield articles appropriate for the research.

Inclusion Criteria, Exclusion Criteria, and Limitations

The inclusion criteria focused on articles in English and the date range of 2016 to present. Articles that were published greater than five years ago were excluded except the article dated 2014 that studies the reliability and validity of the CAP-D screening tool in the PICU. Inclusion criteria also focused on pediatrics, delirium in the ICU setting, and the screening tools used to acknowledge delirium. All studies were completed in the U. S., with the exception of two articles. Studies that were excluded were those that were opinion-based and studies that lacked evidence. The inclusion and exclusion criteria were used on all three databases.

Critical Appraisal and Synthesis of Evidence

Melnyk and Finout-Overholt (2019) developed the rapid critical appraisal process to determine the quality and strength of the selected articles for this study. The studies were of the highest quality because they were conducted without bias. All the studies used (see Appendix A, Table A1), were quantitative and compared to each other (see Appendix A, table A2). The

majority of the studies were conducted within the last five years and in the U. S. The average sample size of the studies was between 100-200 people from 2-18 years of age, and all genders were included in each study, one exception, which only included males. Upon further comparison, the most common screening tools were the CAP-D in conjunction with the RASS tool.

The delirium screening times varied with five studies screening twice a day, and the remaining five screening only once a day. Six studies used or implied the social cognitive theory (SCT). Most of the studies concluded delirium was prevalent in most of the population, and screening led to a decreased length of stay in the ICU.

Theory Application

The underpinning theory that best fits this project is the Social Cognitive Theory (SCT). The core of the SCT consists of three factors associated with behavior change, personal/cognitive and environmental factors (see appendix B, Figure 1). Each of these three factors influences one another and determines if a change will occur. *Personal/ cognitive factors* are comprised of self-efficacy, outcome expectations, and knowledge. Self-efficacy is defined as the confidence one feels to carry out a specific behavior (Bandura, 1986). These factors are represented in the evidence as becoming knowledgeable about delirium and how it is an issue in the PCICU and its causes. *Environmental factors* can be physical or social and are represented in the evidence as non-pharmacological bundles that the studies implemented to treat delirium before using medications. *Finally, behavior factors* are skills used by the nurses to help reinforce to the families the importance of environmental factors and reducing environmental stimuli. The studies all used one of the constructs of the SCT design with hopes of creating a change. For instance, many of the studies implemented a non-pharmacological bundle to help combat

delirium in the PCICU, which focuses on the patient's environment and helps influence self-efficacy when scoring the patients on one of the delirium screening tools to find out how delirious the patient is.

Implementation Framework

This project will be guided by the plan-do-study-act (PDSA) cycle and the model for improvement. Using PDSA cycles enables one to test out changes on a small scale, building on the learning from these test cycles structured before wholesale implementation. This allows stakeholders to determine if the proposed change will succeed. This way, the change process is safer and less disruptive for patients and staff (Coury et al., 2017). In addition, the PDSA model for improvement provides a framework for developing, testing, and implementing changes leading to improvement.

This framework has three simple steps that build on one another. To begin the first step, one must ask the questions "what is one trying to accomplish," "How will one know that change is an improvement," and "what changes can be made that will result in improvement?" Once these questions are answered, and structured step two takes place by starting the PDSA cycle. The plan defines the objectives in questions and the predictions and plans data collection to answer the questions. Next is Do, which is done by carrying out the plan and beginning the analysis of data. The study comes next in the cycle, which consists of completing the data analysis, comparing the predictions, and summarizing what is learned. Lastly, Act plans the next cycle if another is needed or decides whether the change can be implemented (see appendix B, Figure 2) (Coury et al., 2017).

Planning the Intervention

Evidence has shown that when combining a non-pharmacological bundle and a delirium screening tool such as the CAP-D tool, the incidence of delirium has decreased in several ICUs. Among patients seen in the PCICU, how will education improve nurses' ability to screen for delirium after implementing a delirium screening tool that can help identify and treat delirium? The development of a non-pharmacological bundle explicitly tailored to the PCICU and teaching the nurses how to score delirium correctly according to the CAP-D screening tool will decrease the incidence of delirium in the PCICU.

This will begin with a pre-project survey that assesses nursing knowledge regarding delirium, delirium screening, and non-pharmacological ways to treat delirium. After this, a learning module will be generated based on the results of the nursing survey. This can be introduced to the nurses during the annual review course for critical care nursing or through the companies online learning system used for continuing education. The learning module will define delirium, review the tools needed to screen for delirium, and describe the implementation of the new non-pharmacological bundle in the PCICU. Once the project has been conducted, a post-survey will be given to the nurses to assess barriers that hinder effective delirium screening.

Step by Step:

1. Participants (Nurses in the PCICU) will have two weeks to complete the pre-survey
    a. QR codes will be placed around the unit for easy access to the survey
2. The learning module will be presented via the online learning module system at the organization.
    a. Participants will be given three weeks to finish the learning module
3. CAP-D screening tool will be implemented into the electronic medical record, and scoring will commence.

   a. QR codes with easy access to the developmental anchor points placed at computers along with reminders on when to score delirium

4. After four months of scoring delirium, a post-survey will be conducted, and nurses will have two weeks to complete
   a. QR codes for the survey were also placed around the unit for easy access to complete.

Participants and Recruitment

The study participants will be all the nurses for the day and night shifts in the PCICU. Patients between the ages of 3 months and 18 years of age will be recruited for the study. They each will be screened the same using the CAP-D screening tool at noon and midnight or the hours of 0600 and 1800, depending on then the PCICU decides to score the patients. This allows each patient to be scored the same way and makes the scoring fair and appropriate. If the score is greater than 9, action will need to be taken to help the patient's delirium, either by the non-pharmacological bundle or by prescribing a medication to help with sleep and wake cycles. Many can argue that a patient experiencing delirium can cause pain. It will be up to the providers to use the delirium score to ease the patient's pain. Faculty mentors and the IRB will review the project's methodology through ASU and Phoenix Children's Hospital (PCH) IRB. The patients, however, will not need to consent to the study because the scoring will take place regularly with the nurse's assessment. By sticking to the ethical principles, the rights and risks of every patient will be protected and taken into consideration. Human rights will be protected by following the policies of PCH and ensuring no violations of HIPAA will occur.

Data collection and outcomes measurement

The outcome that plans to be measured is an increase in knowledge about delirium and how to score delirium appropriately amongst the nurses in the PCICU. The initial pre-survey will indicate the nurse's current knowledge about delirium as well as some demographic questions. These demographic questions consist of how long they have been a nurse, their age range, gender, and the ages of patients they take care of. The post-survey will be given and show if nursing knowledge increased from the pre-survey and after education and a period of screening patients. This outcome of increased knowledge links to both the SCT and PDSA cycle. Increasing nursing knowledge and implementing a non-pharmacological bundle to help combat delirium in the PCICU focuses on the patient's environment. It helps influence self-efficacy when scoring the patients on the CAP-D screening tool, emphasizing the SCT model's point. The PDSA model for improvement provides a framework for developing, testing, and implementing changes leading to improvement; the core of this project is implementing change and leading to scoring improvement amongst nurses in the PCICU.

Results

Descriptive Statistics

Frequencies and percentages were calculated for Age and Experience_in_years. The most frequently observed category of Age was 20-25 (n = 6, 40.00%). The most frequently observed category of Experience_in_years was 0-5 (n = 12, 80.00%). Frequencies and percentages are presented in Table 1.

Table 1

Frequency Table for Nominal Variables

Variable	*n*	*%*
Age		

20-25	6	40.00
26-30	4	26.67
31-35	3	20.00
36+	2	13.33
Missing	0	0.00
Experience_in_years		
0-5	12	80.00
6-10	1	6.67
11-20	1	6.67
21+	1	6.67
Missing	0	0.00

Note. Due to rounding errors, percentages may not equal 100%.

Two-Tailed Paired Samples *t*-Test

A two-tailed paired samples *t*-test was conducted to examine whether the mean difference of Delirium Pretest and Delirium Posttest was significantly different from zero.

A Shapiro-Wilk test was conducted to determine whether the differences in Delirium Pretest and Delirium Posttest could have been produced by a normal distribution (Razali & Wah, 2011). The results of the Shapiro-Wilk test were significant based on an alpha value of .05, $W = 0.80$, $p = .004$. This result suggests the differences in Delirium Pretest and Delirium Posttest are unlikely to have been produced by a normal distribution, indicating the normality assumption is violated.

Levene's test was conducted to assess whether the variances of Delirium Pretest and Delirium Posttest were significantly different. The result of Levene's test was significant based on an alpha value of .05, $F(1, 28) = 28.00$, $p < .001$. This result suggests it is unlikely that Delirium Pretest and Delirium Posttest were produced by distributions with equal variances, indicating the assumption of homogeneity of variance was violated.

The result of the two-tailed paired samples *t*-test was significant based on an alpha value of .05, $t(14) = -4.03$, $p = .001$, indicating the null hypothesis can be rejected. This finding

suggests the difference in the mean of Delirium Pretest and the mean of Delirium Posttest was significantly different from zero. The mean of Delirium Pretest was significantly lower than the mean of Delirium Posttest. The results are presented in Table 2. A bar plot of the means is presented in Figure 1.

Table 2

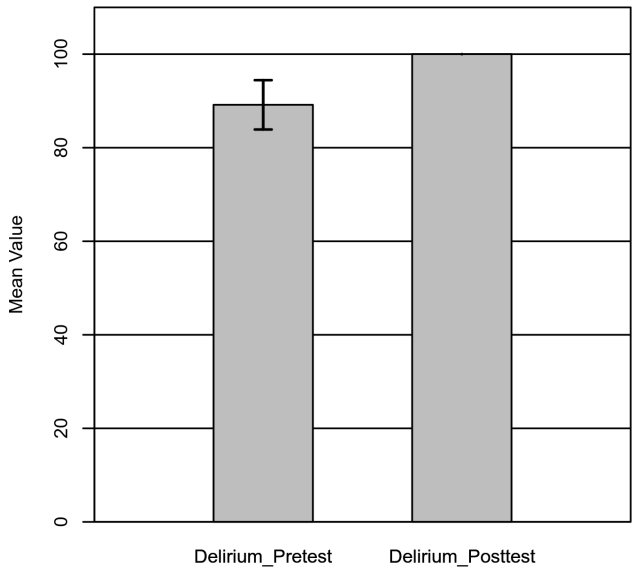
Two-Tailed Paired Samples t-Test for the Difference Between Delirium Pretest and Delirium Posttest

Delirium_Pretest		Delirium_Posttest				
M	*SD*	*M*	*SD*	*t*	*p*	*d*
89.17	10.42	100.00	0.00	-4.03	.001	1.04

Note. N = 15. Degrees of Freedom for the *t*-statistic = 14. *d* represents Cohen's *d.*

Figure 1

The means of Delirium_Pretest and Delirium_Posttest with 95.00% CI Error Bars



Two Proportions *z*-Test

A two proportions *z*-test was conducted to examine whether there was a significant difference between the proportions of Patients Scored on CAP-D Pre-Intervention and Patients Scored on CAP-D Post Intervention.

The assumption of normality was assessed using the Central Limit Theorem (CLT). The mean of any random variable will be approximately normally distributed as sample size increases according to the CLT. Therefore, with a sufficiently large sample size ($n > 50$), deviations from normality will have little effect on the results (Pituch & Stevens, 2015). The sample size ($n_{s1} = 71$, $n_{s2} = 118$) indicates that the CLT applies, and normality can be assumed for the purposes of the *z*-test.

The result of the two proportions *z*-test was not significant based on an alpha value of .05, $z = -1.55$, $p = .122$, 95.00% CI = [-.18, .02], indicating the null hypothesis cannot be rejected. This suggests there was no significant difference between the proportions of Patients scored on CAP-D Pre-Intervention and Patients scored on CAP-D Post Intervention. The 95.00% confidence interval for the difference between the proportions of Patients scored on CAP-D Pre-Intervention and Patients scored on CAP-D Post Intervention is -.18 to .02. Table 3 presents the results of the two sample proportions *z*-test.

Table 3

Two Proportions z-Test for the Difference between Patients_Scored_on_CAPD_Pre_Intervention and Patients_Scored_on_CAPD_Post_Intervention

Samples	Responses	*n*	Proportion	*SD*	*SE*
Patients_Scored_on_CAPD_Pre_Intervention	8	71	.11	0.32	0.04
Patients_Scored_on_CAPD_Post_Intervention	23	118	.19	0.40	0.04

Note. $z = -1.55$, $p = .122$, 95.00% CI: [-.18, .02]

The impact of the project had some mixed reviews. Initially, 30 nurses opted for the project by taking the pre-survey; however, only 15 nurses completed the post-survey resulting in a 50% attrition rate. The feedback from providers and nurses was positive, and the providers began asking each nurse during rounds what their patient's delirium score was, which helped the nurses remember to score each patient. The project can be sustained by implementing a unit or hospital-wide delirium screening policy in intensive care units.

Discussion

The results suggest that implementing a non-pharmacological bundle and education on delirium increases knowledge of delirium, but the results did not suggest an increase in scoring patients. This could be a limitation because most of the patients admitted into the PCICU are less than two years of age and the study only focused on patients 2-18 years of age. The CAP-D screening tool does have anchor points that help the nurse score patients less than 2; however, the initial response on the unit made it difficult to add this into a focused part of the education. With this being difficult to teach and bring up, the unit's clinical nurse attending, and educator will give follow-up teaching on the anchor points so more patients can be scored. This is what has been shown in other research that it is difficult for nurses to get into the habit of scoring for delirium. The project's strengths were that the education was informative and received well by most nurses on the unit. The providers and nursing education can further sustain the intervention in this setting by having an auto-populating chart reminder at noon and midnight to remind the nurse to score for delirium. Overall, with the importance of cutting delirium and being aware patients experience delirium, we can decrease days on mechanical ventilation, length of stay in the PCICU, and possible self-harm.

References

Alvarez, R. V., Palmer, C., Czaja, A. S., Peyton, C., Silver, G., Traube, C., Mourani, P. M., & 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 Publishing. (2013). *Diagnostic and statistical manual of mental disorders: Dsm-5* (5th ed.).

Bandura, A. (1986) Social foundation of thought and action: A social cognitive theory. Prentice-Hall.

Bannon, L., McGaughey, J., Clarke, M., McAuley, D., & Blackwood, B. (2016). Impact of non-pharmacological interventions on prevention and treatment of delirium in critically ill patients: Protocol for a systematic review of quantitative and qualitative research. *Systematic Reviews*, *5*(1). https://doi.org/10.1186/s13643-016-0254-0

Bryant, K. J. (2018). Pediatric delirium in the cardiac intensive care unit: Identification and intervention. *Critical Care Nurse*, *38*(4), e1–e7. https://doi.org/10.4037/ccn2018947

Coury, J., Schneider, J. L., Rivelli, J. S., Petrik, A. F., Seibel, E., D'Agostini, B., … Coronado, G. D. (2017). Applying the PLAN-DO-STUDY-ACT (PDSA) approach to a large pragmatic study involving safety net clinics. *BMC Health Services Research*, *17*(1). https://doi.org/10.1186/s12913-017-2364-3

Feroz, S., & Donnelly, K. M. (2020). Not just to survive but to thrive. *Current Opinion in Cardiology*, *35*(1), 70–75. https://doi.org/10.1097/hco.0000000000000690

Intellectus Statistics [Online computer software]. (2021). Intellectus Statistics. https://analyze.intellectusstatistics.com/

Khan, B., Perkins, A., Campbell, N., Gao, S., Farber, M., Wang, S., Khan, S., Zarzaus, B., and Boustani, M. (2019). Pharmacological management of delirium in the ICU: A randomized pragmatic clinical trial. *Journal of the American Geriatric Society, 67(5)*, 1057- 1065. https://doi.org/10.1111/jgs.15781.

Malas, N., Brahmbhatt, K., McDermott, C., Smith, A., Ortiz-Aguayo, R., & Turkel, S. (2017). Pediatric delirium: Evaluation, management, and special considerations. *Current Psychiatry Reports*, *19*(9). https://doi.org/10.1007/s11920-017-0817-3

Melynk, B.M., & Fineout-Overholt, E. (2019). Evidence-based practice in nursing and healthcare: A guide to best practice (4th ed.). Lippincott, Williams & Wilkins.

Mission & Values. Phoenix Children's Hospital. (2020). https://phoenixchildrens.org/about-us/mission-values

Patel, A. K., Bell, M. J., & Traube, C. (2017). Delirium in pediatric critical care. *Pediatric Clinics of North America*, *64*(5), 1117–1132. https://doi.org/10.1016/j.pcl.2017.06.009

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), 165–171. https://doi.org/10.1097/pcc.0000000000001032

Pituch, K. A., & Stevens, J. P. (2015). *Applied multivariate statistics for the social sciences* (6th ed.). Routledge Academic. https://doi.org/10.4324/9781315814919

Razali, N. M., & Wah, Y. B. (2011). Power comparisons of Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors and Anderson-Darling tests. *Journal of Statistical Modeling and Analytics, 2*(1), 21-33.

Si, M. S. (2018). Delirium postcardiac surgery: Intellectual insufficiency and insufficiently understood. *The Journal of Thoracic and Cardiovascular Surgery*, *155*(1), 276–277. https://doi.org/10.1016/j.jtcvs.2017.09.037

Silver, G. H., Kearney, J. A., Bora, S., De Souza, C., Giles, L., Hrycko, S., Jenkins, W., Malas, N., Namerow, L., Ortiz-Aguayo, R., Russell, R., Pao, M., Plioplys, S., & Brahmbhatt, K. (2019). A clinical pathway to standardize care of children with delirium in pediatric inpatient settings. *Hospital Pediatrics*, *9*(11), 909–916. https://doi.org/10.1542/hpeds.2019-0115

Simeone, S., Pucciarelli, G., Perrone, M., Teresa, R., Gargiulo, G., Guillari, A., Castellano, G., Tommaso, L., Niola, M., & Iannelli, G. (2018). Delirium in ICU patients following cardiac surgery: An observational study. *Journal of Clinical Nursing*, *27*(9-10), 1994–2002. https://doi.org/10.1111/jocn.14324

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., Large, B. J., Fineman, L. D., Gibson, K. H., Mohler, L. A., Callow, L., Barnes, S. S., & Curley, M. Q. (2020). Prevalence of ICU delirium in postoperative pediatric cardiac surgery patients. *Pediatric Critical Care Medicine*, *22*(1), 68–78. https://doi.org/10.1097/pcc.0000000000002591

Staveski, S. L., Pickler, R. H., Lin, L., Shaw, R. J., Meinzen-Derr, J., Redington, A., & Curley, M. Q. (2018). Management of pediatric delirium in pediatric cardiac intensive care patients. *Pediatric Critical Care Medicine*, *19*(6), 538–543. https://doi.org/10.1097/pcc.0000000000001558

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. doi:10.1097/CCM.0b013e3182a66b76

Traube, C., Silver, G., Reeder, R.W., Doyle, H., Hegel, E., Wolfe, H.A., Schneller, C., Chung, M.G., Dervan, L.A., DiGennaro, J.L., Butram, S.D.W., Kudchadkar, S.R., Madden, K., Hartman, M.E., DeAlmeida, M.L., Walson, K., Ista, E., Baarslag, M.A., Salonia, R.,…Bell, M. (2017). Delirium in critically ill children: An international point prevalence study. *Critical Care Medicine.* doi:10.1097/CCM.00000000000002250

Valdivia, H. R., & Carlin, K. E. (2019). Determining interrater reliability of the Cornell assessment of pediatric delirium screening tool among PICU nurses. *Pediatric Critical Care Medicine*, *20*(4), e216–e220. https://doi.org/10.1097/pcc.0000000000001896

Appendix A

Evaluations and Synthesis Tables

Table A1

Quantitative Evaluation Table

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
Simeone et al., 2018. Delirium in ICU patients following cardiac surgery: An observational study. **Country:** Italy **Funding:** None	TVTF	**Type:** OD **Method:** RASS CAM-ICU	N= 89 **Demographics:** Male, Married, over 18 years old, in ICU for >24 hours EC: Drug use, **RASS** score less than 4, **HD.**	**IV:** Age, Duration of ICU stay, BP, LRS. **DV:** Delirium	RASS CAM-ICU	Independent sample *t* test	Reported as: P values % change SD of 6.9 in the study showed that the patients age, duration on MV, exposure to artificial light, and sleep disturbance	**LOE:** Level I **Strengths:** RASS, CAM-ICU Results of testing **Weakness:** Adult only No test-retest **Feasibility:** yes Good indications

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **DSM-V** Diagnostic Statistical manual of Mental Disorders 5th edition; **EC** Exclusion Criteria; **HD** Hearing Disorder; **IC** Inclusion Criteria; **ICU** Intensive Care Unit**; IV** Independent Variable; **LRS** Location in regard to sunlight; **LOS** Length of Stay; **MV** Mechanical Ventilation; **OD** Observational Design; **PICU** Pediatric Intensive Care Unit; **RN** Registered Nurse; **RASS** Richmond Agitation Sedation Scale; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
Bias: Delirium was conducted once daily							leads to delirium.	
Valdivia et al., 2019. Determining Interrater Reliability of the Cornell Assessment of Pediatric Delirium Screening Tool Among PICU Nurses. **Country:** USA	SCT	**Type:** Cross sectional study conducted over the course of a year. **Purpose:** To determine the interrater reliability of the CAP-D screening tool among PICU nurses.	N = 108 **Demographics:** Sex: male and female Age 2-18years of age **IC:** All patients eligible for a CAP-D assessment **EC:** All patients who had a RASS	**Variables:** Primary Diagnosis Hospital Unit: PICU or CICU Developmental delay Patient Intubated Patient Sedated	**KC:** 0.60 indicating moderate agreement >2 years KC was 0.85 **Instrumentation:** Score patients at Noon with the CAP-D tool. First the RN then the Research Nurse scores keeping blindly the	Scores agree 72.4% of the time for patients < 2 years old Scores agree 94% of the time for patients >2 years old.	**Findings:** Age: Higher association with agreement	**LOE:** Level II **Strengths:** Teaching staff how to correctly score using CAP-D screening tool before beginning the study **Weakness:** Dosage of opioid medications

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
Funding: Yes but was not stated from where. **Bias:** Delirium screening was conducted once daily			score of -4 or -5 based on CAP-D procedure; Five were excluded for missing information		results of the score.			for sedations patients were on. No patients >8 years old **Conclusion:** Need to accurately identify patients who are at higher risk for delirium prior to the study and encourage consistency among RN's scoring with the CAP-D

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
Alvarez et al., 2017. Delirium is a Common and Early Finding in Patients in the Pediatric Cardiac Intensive Care Unit. **Country:** USA **Funding:** Not Stated **Bias:** Delirium screened twice a day	Theoretical Framework	**Design:** Single-Centered prospective observational study of CICU patients. **Purpose:** To determine incidence, associated risk factors, and characteristics of delirium in pediatric CICU.	N = 99 Sex: male and female Age: 2-18 Primary diagnosis Comorbidities Admission type Respiratory Support Mechanical Ventilation	**Variables:** Types of Delirium: Hyperactive Hypoactive Mixed Patterns: Continuous N =17 Intermittent N = 12 Recovery N=25 CPB time MV	Age 4- 46 months P < 0.001 MV mean 39.9 vs 8.8 hours P = .002 CPB mean 126 vs 81 minutes P = 0.001 LOS 3 vs 1-day P = 0.0001	Sample t test	**Findings:** Incidence of delirium was 57% and median time to be diagnosed with delirium was 1 day. Diagnosed using CAP-D screening tool and a RASS score lower than -4.	**LOE:** Level III **Strengths:** Using the CAP-D screening tool for consistency **Limitations:** compliance with screening was 85% resulting in missing data **Conclusion:** Delirium is common in patients in the CICU and is

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
								associated with greater LOS. Benefits in prevention by targeting modifiable risk factors.
Traube et al., 2017. Pediatric Delirium in critically ill children: An international point prevalence study. **Country:** USA New Zealand, Australia, Saudi	Environmental theory	**Design:** Multi-institutional point prevalence study **Purpose:** To determine prevalence of delirium in critically ill children and explore risk factors	N = 994 **Demographic:** Sex: Male/female Age: >2 Primary diagnosis Days in PICU Admission type	**Variables:** Age >2 years Restraints. MV Drugs used	Male n = 537 (54%) LOS: > 6 days n = 537 RD: n = 415 MV n = 335	REDCap	**Findings:** Delirium prevalence was 38% across 25 institutions. Diagnosed using the CAP-D screening tool and RASS score lower than -4.	**LOE:** Level IV **Strengths:** The multi institutional nature proved that delirium is widely prevalent in children with a critical illness. **Limitations:** CAP-D is originally

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
Arabia, the Netherlands **Funding:** Gerber foundation and from salary/ employment form Seattle Children's Hospital **Bias:** Delirium was Scored once daily mid-day.			Respiratory Support Medications used					used to be scored at end of shift, but this study did score mid-day. Child may not have shown fluctuating symptoms of delirium at this time. **Conclusion:** 84% of the 994 subjects that were in the study proved to have delirium as a common complication

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
								of critical illness.
Patel et al., 2017. Delirium in children after cardiac bypass surgery. **Country:** USA **Funding:** undisclosed **Bias:** No biasness	SCT	**Design:** prospective observational single-center study **Purpose:** To describe the incidence of delirium in pediatric patients after CPB surgery	N= 194 **Demographic:** Sex Age Primary diagnosis Days in PICU Admission type Respiratory Support Medications used	**Variables:** Age >2 years Restraints. MV Drugs used CPB	LOS p<0.001 Delirium p values < 0.03	Chi square/ Fischer's exact tests Independent sample t-tests Multivariable linear regression	**Findings:** 49% incidence of delirium lasting 1-2 days and after 1-3 days of being on CPB. 60% increase in LOS Diagnosed using the CAP-D screening tool and RASS score	**LOE:** Level III **Strengths:** First study to be conducted in PCICU **Limitation:** Delirium was screened only once/ day. Delirium subtype was not determined **Conclusion:** Children undergoing

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
							lower than -4.	CPB are at high risk for delirium post-operatively causing an increase in LOS.
Staveski et al., 2018. Management of pediatric delirium in pediatric cardiac intensive care patients: An international survey of current practice. **Country:**	SCT	**Design:** Descriptive Self report Survey **Purpose:** Describe how PCICU clinicians assess for delirium and manage delirium in following cardiac surgery	N = 173 **Demographic:** PCICU Clinicians Age Gender ICU Type # of pediatric cardiac surgeries the institution	**Variables:** Physicians and Nurses	Physicians n = 81 Nurses n = 92	REDCap with descriptive statistics chi- square or exact tests were used.	**Findings:** 570 members were contacted through e-mail 58% responded to all survey questions. 75% of respondent reported their ICU does not	**LOE:** Level II **Conclusion:** The study results show a need for the importance of delirium education in PCICU as well as appropriate systematic evaluation of current

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
North America, European Union, United Kingdom, South America, Australia and Asia. **Funding:** Internal grants from the Cincinnati Children's Hospital **Bias:** Non noted			performs per year				screen for delirium. 61% never attended a lecture on delirium 86% were not satisfied with current delirium screening, diagnosis, and management practices.	delirium assessment and management practices.

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
Staveski et al., 2021. Prevalence of ICU delirium in postoperative pediatric cardiac surgery patients. **Country:** USA **Funding:** none noted **Bias:** 1-day study; scored CAPD in am.	SCT	**Design:** 1-Day multicenter point-prevalence study **Purpose:** To determine the prevalence of ICU delirium in children < 18 years old that underwent cardiac surgery.	N = 181 **Demographics:** Delirium positive Delirium Negative	**Variable:** Age Gender Race Past medical history Cardiac history MV Vasoactive infusion Invasive Catheters Respiratory Support	Focus group	REDCap with descriptive statistics exact tests, and Wilcoxon sum tests were used.	**Findings:** 40% screened positive for delirium 55% required longer MV Diagnosed using the CAP-D screening tool and RASS score lower than -4.	**LOE:** Level III **Strengths:** **Limitations:** Inability to estimate occurrence and challenges of disease process. Data was collected during day shift **Conclusion:** Delirium is a common problem after cardiac

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
								surgery with several modifiable risk factors.
Bannon et al., 2016. Impact of non-pharmalogical interventions on prevention and treatment of delirium in critically ill patients: protocol for a systematic review **Country:** USA	Environmental theory	**Design:** meta-analysis **Purpose:** the interest of non-pharmalogical interventions and this systematic review addresses delirium in critically ill patients and will help guide	**Demographics:** Critically ill patients in the ICU requiring Oxygen Pressor medication MV Pediatric and Adult populations	**Variables:** Exclude studies of interventions delivered after ICU discharge	DSM-V CAM-ICU	Data extraction form	**Findings:** Non-pharmalogical interventions have been studied outside of the ICU	**LOE:** Level II **Strengths:** Searched many different data bases for studies on non-pharmalogical studies. **Limitations:** Only used the DSM-V and CAM-ICU assessments

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
Funding: not disclosed **Bias:** Cochran risk of bias form was used		delirium management.						**Conclusion:** Further studies need to be done in the ICU for non-pharmalogical interventions.
Traube et al., 2014. Cornell Assessment of pediatric delirium : A valid, rapid, observational tool for screening delirium in the PICU. **Country:**	SCT	**Design:** Double blinded assessment **Purpose:** To determine the validity and reliability of the CAP-D screening tool.	N = 111 **Demographics:** Age Gender Respiratory support Diagnosis	**Variables:** Age Developmental delay Mental status examination	DSM-V CAP-D	Sample t-test	**Findings:** CAP-D has overall 94% sensitivity rate. Diagnosed using CAP-D screening tool and a RASS score lower than -4.	**LOE:** Level III **Strengths:** The CAP-D scoring tool can be done in > 2 min **Limitations:** Was only tested in a single institution, low screening

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
USA **Funding:** None notes **Bias:** not identified								in adolescents, significant developmental delay can create false positives. **Conclusion:** Delirium is a common problem in the PICU and the CAP-D scoring assessment is a rapid and valid tool in assessing Delirium.
Kahn, B et al., 2019. Pharmalogic	SCT	**Design:** Randomized	N = 351	**Variables:**	RASS CAM-ICU	Fisher exact test	**Findings:**	**LOE:** Level I

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
al management of delirium in the ICU: A randomized pragmatic clinical trial **Country:** USA **Funding:** National institute on aging **Bias:** not identified		pragmatic clinical trial **Purpose:** To test the Efficacy of a PMD bundle in the ICU.	**Demographic:** Age Race ICU Diagnosis	Medications used to address delirium	LOS	Mann-Whitney U	No significant difference within median delirium days versus usual care days. There was a in delirium severity days when the CAM-ICU was used.	**Strengths:** Haloperidol was determined to be efficacious in treating delirium **Limitations:** Single city study Some may have received intervention 48 hours post randomization decreasing the efficacy. **Conclusion:** Implementation of a PMD

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Citation	Theory/ Conceptual Framework	Design/ Method/ Sampling	Sample/Setting	Major Themes Studied/ Definitions	Measurement/ Instrumentation	Data Analysis	Findings/ Themes	Level/Quality of Evidence; Decision for practice/ application to practice/ Generalization
								bundle does not necessarily reduce delirium among critically ill patients.

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Table A2

Synthesis Table

Study (Author and year)	Simeone et al., 2018	Valdivia et al., 2019	Alvarez et al., 2017	Traube et al., 2017	Patel et al., 2017	Staveski et al., 2018	Staveski et al., 2021	Bannon et al., 2016	Traube et al., 2014	Kahn, B et al., 2019
Design/LOE	Level I	Level II	Level III	Level IV	Level III	Level II	Level III	Level II	Level III	Level I
Sample										
N of subjects	89	108	99	994	194	173	181	85	111	351
Country	Italy	USA	USA	USE, New Zealand, Australia, Saudi, Netherlands	USA	USA, Europe, United Kingdom, South America, Australia, Asia	USA	USA	USA	USA
Delirium Assessed Daily	Once	Once	Twice	Once	Twice	Twice	Once	Once	Twice	Twice
MV	•	•	•	•	•	•	•	•	•	
Diagnosis		•	•	•	•	•	•		•	•
Demographic										
Age in years	>18	2-18	2-18	2-18	2-18	2-18	2-18	2-18	2-18	2-18
Sex	Male	Male/female	Male/female	Male/female	Male/female	Male/female	Male/female	Male/female	Male/female	Male/female

Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Applicable measurement tools										
CAP-D		•	•	•	•	•	•		•	
CAM-ICU	•							•		•
RASS	•	•	•	•	•	•	•		•	•
DSM-V								•	•	
Framework	TVTF	SCT	TVTF	Environmental	SCT	SCT	SCT	Environmental	SCT	SCT
Outcomes										
Length of Stay	•	•	•		•	•	•	•		•
Decrease in hospital cost			•	•		•				
Decrease mortality	•		•	•		•	•			

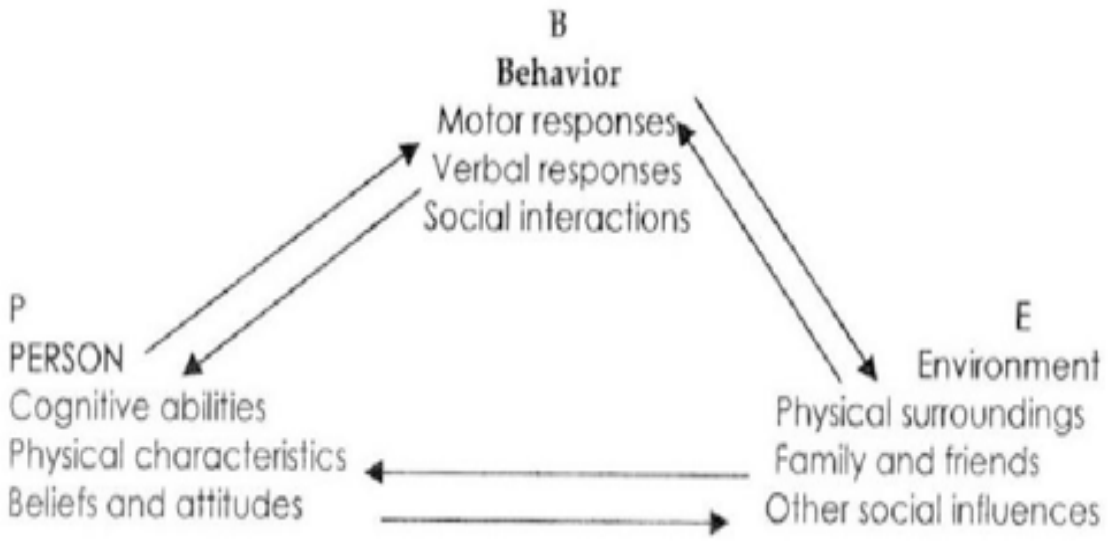
Key: **BP** Blood Pressure**; CAM-ICU** Confusion Assessment Method for the ICU; **CAP-D** Cornell Assessment of Pediatric Delirium; **CICU** Cardiac Intensive Care Unit; **CPB** Cardiopulmonary Bypass; **DV** Dependent Variable; **HD** Hearing Disorder; **ICU** Intensive Care Unit**; IV** Independent Variable; **KC** Kappa Coefficient; **LRS** Location in regard to sunlight; **LOE** Level of Evidence; **LOS** Length of Stay; **MV** Mechanical Ventilation; **N** Total number of Sample Size; **n** Amount in sample group; **OD** Observational Design; **PCICU** Pediatric Cardiac Intensive Care Unit**; PICU** Pediatric Intensive Care Unit; **PMD** Pharmalogical management of delirium; **RASS** Richmond Agitation Sedation Scale; **RD** Respiratory Disease; **REDCap** Research Electronic Data Capture; **SCT** Social Cognitive Theory; **SD** Standard Deviation; **TVTF** Theoretical Validity Testing Framework

Appendix B

Models and Frameworks

Figure B1

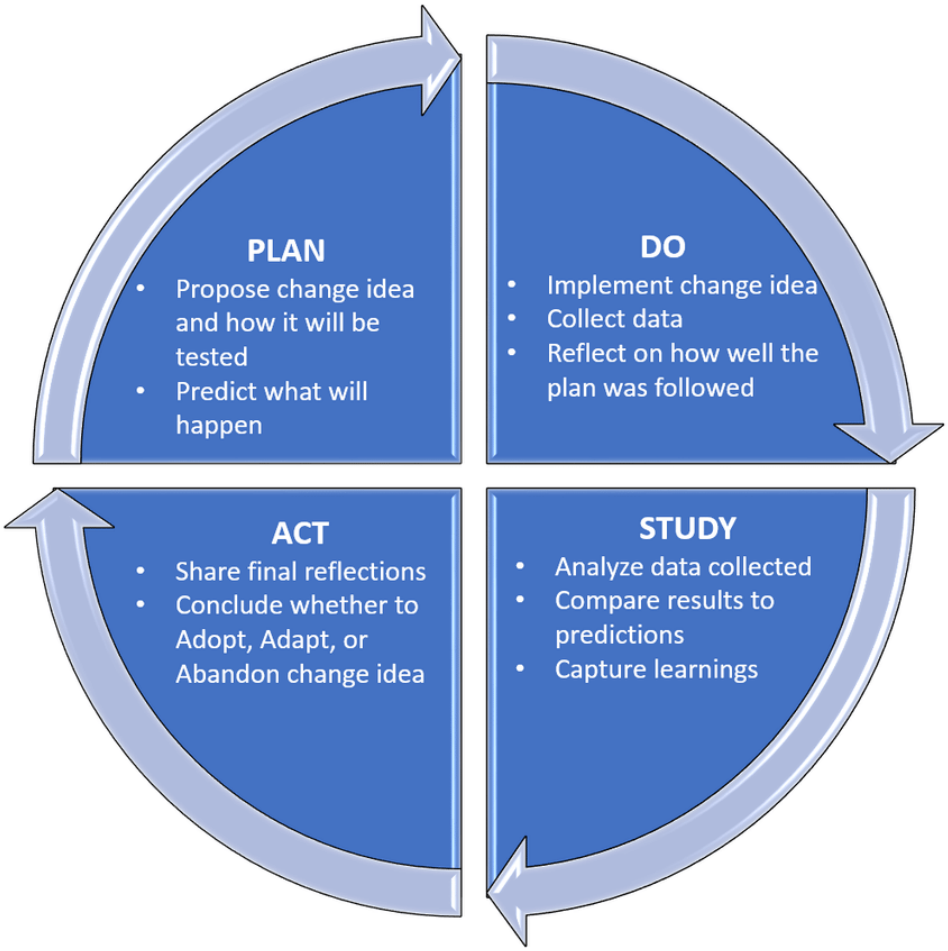
Social Cognitive Theory



Bandura (1986)

Figure B2

Plan-Do-Study-Act (PDSA) Cycle



(Coury et al., 2017)