Delirium in the Critically Ill Child

Sharon Norman, RN, MSN, CCRN

Oregon Health & Science University

Abstract

Background: A diagnosis of delirium places the critically ill child at risk of increased mortality morbidity in addition of increased hospital costs. Although delirium is common only 2% of pediatric intensive care units screen for delirium at least once a shift every day. The impediments to screening include knowledge deficits of delirium and screening tools for the critically ill child.

Purpose/Aims: The purpose of this quality improvement project was three-fold. The first was to implement delirium screening in the pediatric intensive care unit (PICU). The second wasa to measure sustainability of PICU nurses' delirium knowledge after delirium education over a three month time period, and the third was to measure the PICU nurses' self-confidence and attitude towards delirium over a three month time period.

Intervention: Delirium screening for critically ill children in a northwest PICU was implemented after multifaceted education. A questionnaire on delirium knowledge, self-confidence and attitude was voluntarily completed by nurses for a baseline measurement prior to education, post-education, and repeated three months post implementation of delirium screening.

Results: Delirium knowledge for the PICU cohort of nurses increased from a baseline mean of 14.28 to a post education mean of 14.98 (p=.003) and three months post implementation of delirium a mean of 14.84 (p=.023). Self-confidence increased from a baseline mean of 2.83 to a post education mean of 3.76 (p=.000) and three months post implementation of delirium a mean of 3.81 (p=.000). Attitude towards delirium increased from a baseline mean of 3.81 to a post education mean of 4.07 (p=.036) and three months post implementation of delirium a mean of 4.08 (p=.027)

Conclusions & implication for practice: Findings from this science improvement project demonstrated an increase in nursing knowledge, self-confidence and positive attitude toward delirium after education. Increasing nurses knowledge, self-confidence and attitude toward delirium may lead to preventing, mitigating adverse effects of delirium in the critically ill child. From an organizational perspective there is the potential to decrease cost of hospitalization.

Keywords: delirium, nurse, nurses, children, pediatric, critical care, knowledge, hospitalized, critically ill

Delirium in the Critically Ill Child

Delirium is a common manifestation of acute brain dysfunction in critically ill children, occurring in up to 30% of patients in the pediatric intensive care init (PICU) (Silver et al., 2012; Smith et al., 2011). A diagnosis of delirium adds to the cost of caring for critically ill children and places them at risk for adverse outcomes including mortality and morbidity (Smeets et al., 2010; Smith, Berutti, et al., 2013, Traube et al., 2016; Traube, Silver, Gerber et al., 2017). Critically ill children with delirium experience longer hospital stays and prolonged mechanical ventilation, (Schieveld et al., 2008; Smeets et al., 2010; Traube, Silver, Gerber et al., 2017, Traube, Silver, Reeder et al., 2017; Turkel, & Tavaré, 2003). Other adverse effects of delirium can include post-traumatic stress disorder after hospitalization (Colville, Kerry, & Pierce, 2008) and increased hospital and intensive care unit costs (Smeets et al.; Traube et al., 2016).

Delirium as defined by *The Diagnostic and Statistical Manual of Mental Disorders*, is a disturbance of attention or awareness from baseline that develops acutely and fluctuates in severity along with an additional disturbance in cognition that cannot be explained by a pre-existing neurocognitive disorder and the disturbance is a direct physiological consequence of another medical condition (American Psychiatric Association, 2013). Risk factors for developing delirium are infections, metabolic disorders, severity of illness, mechanical ventilation, medications, age, developmental delay, sleep disruption, restraints, urinary catheters, and intravenous lines (Schieveld, Ista, Knoester, & Molag, 2015; Silver, Traube et al., 2015; Traube, Silver, Gerber et al., 2017; Traube, Silver, Reeder et al. 2017)

Early recognition of signs and symptoms of delirium and routine screening for

delirium in critically ill children may mitigate adverse outcomes associated with delirium (Silver, Kearney, Traube, & Hertzig, 2015; Traube, Silver, Gerber et al., 2017). Three validated screening tools for delirium in critically ill children have been published in the past five years. These tools are the Pediatric Confusion Assessment Method for the ICU (pCAM-ICU) (Smith et al., 2011), the Preschool Confusion Assessment Method for the ICU (psCAM-ICU) (Smith et al., 2016), and the Cornell Assessment of Pediatric Delirium (CAPD) (Traube et al., 2014).

The regular use of delirium screening tools for all critically ill children is recommended in the position statement of the European Society of Paediatric and Neonatal Intensive Care (ESPNIC) (Harris et al., 2016) as well as by national and international pediatric delirium experts. In a survey sent to members of the World Federation of Pediatric Intensive and Critical Care Societies (WFPICCS), 71% of pediatric intensivists stated they do not routinely screen patients for delirium (Kudchadkar, Yaster, & Punjabi, 2014). In the same survey only 2% of pediatric intensivists responded their patients were screened for delirium every day at least once a shift (Kudchadker et al., 2014). The impediments to screening for delirium included knowledge deficits regarding delirium and screening tools for the critically ill child. Delirium in critically ill children goes unrecognized and untreated due to knowledge deficit (Flaigle, Ascenzi, & Kudchadkar, 2016).

The first step in recognizing delirium as a problem is to increase awareness of it among pediatric critical care nurses. Delirium education for nurses resulted in improved knowledge regarding delirium and risk factors on post-education questionnaires (Marino, Bucher, Beach, Yegneswaran, & Cooper, 2015; Speed, 2015). Studies showing the best

success in increasing knowledge and recognition of delirium used a multi-faceted approach (Yanamadala, Wieland, & Heflin, 2013). Results of educational initiatives have demonstrated improved knowledge of delirium immediately post education (Gesin et al., 2012; Marino et al., 2015; Speed, 2015). One study evaluated the sustainability of delirium knowledge over 12 months (Babine, Honess, Wierman, & Hallen, 2016). An organizational emphasis on minimizing delirium prevalence in critically ill children is necessary to decrease the impact of delirium on critically ill children and the healthcare systems who care for them.

The purpose of this Doctor of Nursing Practuce project was three fold, one was to implement delirium screening in a PICU in the northwest, the second was to measure sustainability of PICU nurses' delirium knowledge, after delirium education over a three month time period, and finally to measure the PICU nurses' self-confidence and attitude towards delirium over a three month time period.

Literature Review

Search Strategy

To determine current evidence regarding delirium in critically ill children a literature search was conducted. The databases searched included Cumulative Index to Nursing and Allied Health Literature (CINAHL), Ovid MEDLINE, PsychINFO, and Web of Science. The timeframe for the literature was expanded to the past 10 years as there was minimal literature on delirium in critically ill children. Studies written prior to 2011 were almost always cited in the more recent studies. Inclusion criteria included manuscripts written in English; systematic reviews, prospective studies, retrospective studies, and case reports. Adult critical care literature was included due to the limited

literature in critically ill children. Inclusion criteria for adult critical care studies were systematic reviews and evidence-based guidelines published in the past five years. Exclusion criteria included manuscripts on emergence delirium, in non-hospital settings, non-critically ill adults, palliative care, and commentaries, editorials, and dissertations.

Medical Subject Headings (MeSH) used in the search were “delirium”, “child”, “critical care”, “critically ill”, “critical care nursing”, “knowledge”, “education”, “nurses”, “pediatric”, “hospitalized child” and the keyword “pediatric critical care nursing”. Other MeSH terms used were “delirium”, “knowledge”, “education”, and “nurse”. The MeSH terms were searched using various combinations (Appendix A).

Search Results

The initial search yielded 880 manuscripts, after removing duplicates and applying inclusion and exclusion criteria there were 24 manuscripts relevant to delirium in the critically ill child. For the search specific to delirium and knowledge or education after applying the inclusion and exclusion criteria 13 relevant manuscripts were selected for review. In addition, three clinical guidelines or systematic reviews in the adult critical care literature were included in the literature review. References in the relevant manuscripts were searched for additional manuscripts to be included in the literature review. The relevant manuscripts were then searched in Google scholar for additional cited manuscripts to ensure a comprehensive search was achieved.

Definition and Diagnosis

Delirium is an acute brain dysfunction that cannot be explained by another neurocognitive disorder. Diagnosis is based on the Neurocognitive Disorders chapter in

Diagnostic and Statistical Manual of Mental Disorders (5th ed.; *DSM-5;* American Psychiatric Association, 2013) and includes five criteria:

A. A disturbance in attention (i.e., reduced ability to direct, focus, sustain, and shift attention) and awareness (reduced orientation to the environment).
B. The disturbance develops over a short period of time (usually hours to a few days), represents a change from baseline attention and awareness, and tends to fluctuate in severity during the course of a day.
C. An additional disturbance in cognition (e.g., memory deficit, disorientation, language, visuospatial ability, or perception).
D. The disturbances in Criteria A and C are not better explained by another preexisting, established, or evolving neurocognitive disorder and do not occur in the context of a severely reduced level of arousal, such as coma.
E. There is evidence from the history, physical examination, or laboratory findings that the disturbance is a direct physiological consequence of another medical condition, substance intoxication or withdrawal (i.e., due to a drug of abuse or to a medication), exposure to a toxin, or multiple etiologies. (American Psychiatric Association, 2013, Neurocognitive chapter, paragraph 1)

The gold standard to diagnose delirium in critically ill children is an evaluation by a pediatric psychiatrist using the *DSM-5* criteria (Silver, Kearney, Traube, Atkinson, et al., 2015; Smith et al., 2016; Traube et al., 2014).

Delirium is further differentiated as one of three subtypes depending on psychomotor activity (Smith et al., 2009). The subtypes of delirium are hyperactive,

hypoactive, and mixed. Children with hyperactive delirium exhibit agitation, irritability and are combative while children with hypoactive delirium are apathetic and uninterested in the environment and have psychomotor retardation (Grover et al., 2014; Schieveld, et al, 2015; Smith et al., 2016). Fluctuation between hyperactive and hypoactive is considered a mixed type of delirium (Smith, Brink, Fuchs, Ely & Pandharipande, 2013).

Delirium Prevalence and Incidence

Prevalence of delirium in critically ill children has been reported in prospective studies from The Netherlands and the United States (US) with rates up to 53% (Schieveld et al., 2007; Smith et al., 2016; Traube et al., 2014; Traube, Silver, Gerber et al., 2017, Traube, Silver, Reeder et al., 2017). Delirium prevalence varied depending on the child's age and how the diagnosis was made.

Results of the Dutch and US studies demonstrated different prevalence of delirium for critically ill children. The study from The Netherlands included only critically ill children referred to child psychiatry. This study found a delirium prevalence of 5%, with 19% occurring in adolescents aged 15-18 years (Schieveld et al., 2007). Schieveld et al., (2008) found that of the critically ill children with delirium, 85% were mechanically ventilated and 62.5% were males.

Delirium prevalence in critically ill children in the US ranged from 13% to 53% (Silver et al., 2012; Smith et al., 2011; Smith et al., 2016; Traube et al., 2014). Smith et al. (2011) reported a prevalence of 13% for delirium when the authors evaluated all patients admitted to a PICU who were developmentally and chronologically greater than 5 years old. Of the participants in the Smith et al. (2011) study 6% were mechanically ventilated. Smith et al. (2016), found the delirium prevalence to be 44% for those 6

months to 5 years old and 53% for participants 6 months to 2 years old admitted to a PICU. Forty-three percent of the study participants were mechanically ventilated, a significantly higher number when compared to the study conducted by the same research group looking at patients greater than 5 years (Smith et al., 2016). Silver et al. (2012) and Traube et al. (2014) evaluated all patients admitted to a PICU ages 0-21 years for delirium and found the prevalence to be 21-29%. Seventeen percent of the study subjects were mechanically ventilated (Traube et al., 2014).

The key difference between the prospective studies conducted in The Netherlands and the US was the Dutch study required a referral to child psychiatry whereas the US studies included all patients admitted to the PICU. In the Dutch study the pediatric psychiatrist used DSM-IV criteria to determine a diagnosis of delirium. In the U.S. studies all subjects admitted to the PICU were evaluated for delirium by a pediatric psychiatrist using the DSM-IV criteria and an intensivist or nurse using a screening tool. Prevalence of delirium was higher when all patients were evaluated for delirium as opposed to only those who were referred to child psychiatry. For children referred to child psychiatry the incidence of hypoactive delirium was 22.5% (Schieveld et al., 2008). When all critically ill children are evaluated for delirium using a screening tool the prevalence of hypoactive delirium was 43% to 81% (Silver et al., 2012; Smith et al., 2016). Other differences included a higher prevalence for delirium in those less than 5 years old in the US versus adolescents in The Netherlands. There were differences in mechanical ventilation rates for those diagnosed with delirium, 85% in The Netherlands (Schieveld et al., 2008) as compared to 54.5% in the US. (Silver, Traube, et al., 2015).

A point prevalence study was conducted in 25 pediatric intensive care units across the US, the Netherlands, New Zealand, Australia, and Saudi Arabia. There were 994 subjects enrolled in the study (Traube, Silver, Reeder et al., 2017). The children were screened for delirium using the Cornell Assessment of Pediatric Delirium (CAPD) tool. The CAPD was completed by the principal investigator or research coordinator based on the bedside nurse's clinical observation throughout their shift with a minimum observation of four hours prior to screening. The median delirium prevalence rate was 23.3% ((IQR, 20.0-35.4%, p=0.038) (Traube, Silver, Reeder et al., 2017).

Adverse Outcomes

The literature demonstrating adverse outcomes for patients with delirium was predominately focused on critically ill adults. There were seven studies that evaluated outcomes for the critically ill child diagnosed with delirium, of which one was a qualitative study (Colville et al., 2008), one was retrospective (Turkel & Tavaré, 2003), and five were prospective in design (Schieveld et al., 2008; Silver, Traube, et al., 2015; Smeets et al., 2010; Traube, Silver, Gerber et al., 2017; Traube, Silver, Reeder et al., 2017). Adverse outcomes associated with delirium included increased mortality, increased length of stay, cognitive impairment, and PTSD. In addition there was an increased financial cost for the PICU admission (Smeets et al., 2010; Traube et al., 2016).

In critically ill adults, delirium was associated with increased mortality (Barr et al., 2013; Baron et al., 2015; Salluh et al., 2015). The evidence for mortality associated with delirium in critically ill children was limited. Three studies found a range of 2.4% to 20% incidence of mortality (Schieveld et al., 2008; Smeets et al., 2010; Turkel & Tavaré, 2003). Two of these studies were prospective and conducted in the same PICU, the third

study was a retrospective study. Traube, Silver, Gerber, et al. (2017) in a prospective study found greater in-hospital mortality in critically ill children with delirium with an adjusted odds ratio of 4.39 ($p< 0.001$). Other adverse outcomes for critically ill adults and children were related to morbidity.

Delirium has been shown to prolong the intensive care unit (ICU) and hospital length of stays for adult ICU patients based on high quality randomized controlled trials (RCT) [level of evidence A, based on Grading of Recommendations Assessment, Development and Evaluation Method (GRADE)] (Barr et al., 2013; Baron et al., 2015; Salluh et al., 2015). Silver, Traube et al., (2015) in a prospective study found hospital length of stay was significantly longer (18 days versus 3 days; $p < .0001$) for critically ill children with delirium versus those without. The critically ill child with delirium also experienced a prolonged PICU length of stay as compared to the critically ill child without (2.4 – 3 days; $p < .0001$ and 7-11 days vs. 3 days; $p< .001$) (Schieveld et al., 2008; Smeets et al. 2010; Traube, Silver, Gerber et al., 2017; Traube, Silver, Reeder et al., 2017; Turkel & Tavaré, 2003).

Critically ill adults and children diagnosed with delirium experienced adverse outcomes while hospitalized and for up to 12 months after hospitalization (Colville et al., 2008; Girard et al., 2010; Pandharipande al., 2013). Cognitive impairment and PTSD are the only adverse outcomes associated with delirium in critically ill adults or children after hospital discharge for which there was any published evidence (Barr et al., 2013; Baron et al., 2013; Colville et al., 2008; Salluh et al, 2015). RCTs with significant limitations or high-quality observational studies (level of evidence B, based on GRADE) have shown delirium in the adult ICU patient is associated with the development of cognitive

impairment as measured at three months and 12 months post hospital discharge (Girard et al., 2010; Pandharipande et al., 2013). Only one study evaluated the impact of delirium on the critically ill child after hospital discharge. Colville, Perry and Pierce, (2008) found that three months following hospital discharge, one in three children suffered from delusional memories of their critical illness experience. This was associated with higher PTSD scores post discharge.

Two prospective observational studies reported an increased cost for critically ill children with delirium. Smeets et al. (2010) found an increase of 1.5% in direct medical costs related to increased PICU length of stay for critically ill children with delirium. Traube et al. (2016) found that a diagnosis of delirium was independently associated with an 85% increase in PICU cost ($p < 0.0001$) after controlling for severity of illness, length of stay and mechanical ventilation.

Critically ill patients with delirium had higher rates of mortality, prolonged hospital stays, prolonged stays in the intensive care unit, and prolonged brain dysfunction after hospitalization when compared to patients who did not experience delirium while hospitalized.

Delirium Screening Tools

Recognition of delirium requires knowledge of delirium including clinical signs and symptoms and proper use of screening tools. The validity of the screening tools was established by comparing results of the delirium screening tool to diagnosis of delirium using the DSM IV definition. The DSM IV delirium definition was utilized in the validation studies, as the DSM-5 had not yet been published. The differences between the DSM IV and DSM-5 are not major and include the removal of consciousness and

"that inattention or changes in cognition must not occur in the context of a severely reduced level of arousal such as coma" (European Delirium Association, 2014, p. 2). Tools included the Pediatric Confusion Assessment Method for the Intensive Care Unit (ICU) (pCAM-ICU), Preschool Confusion Assessment Method for the ICU (psCAM-ICU), and Cornell Assessment of Pediatric Delirium (CAPD).

The pCAM-ICU screening tool is for critically ill children chronologically and developmentally greater than 5 years old (Smith et al., 2011), and the psCAM-ICU for those 6 months to 5 years (Smith et al., 2016). The pCAM-ICU and psCAM-ICU compared diagnosis of delirium by a pediatric psychiatrist using the DSM IV to the results of the screening tool by a research provider. The research providers were an intensivist, APRN, and pediatric critical care nurse. The screening tool had four features: 1) acute onset of altered mental status or fluctuating course of mental status; 2) inattention; 3) altered level of consciousness; and 4) disorganized thinking. The screening is performed in a stepwise progression beginning with feature one, if yes, assess feature two, if yes; then assess three and four to determine delirium (p/ps CAM-ICU positivity). To demonstrate interrater reliability two research providers observed the child at the same time, while one blindly evaluated the behavioral response to each feature as the other performed the features of the tool and both scored the screening tool. The pCAM-ICU screening tool demonstrated a sensitivity of 83% and a specificity of 99% when compared to delirium diagnosis by a pediatric psychiatrist in critically ill children (Smith et al., 2011). The interrater reliability of the pCAM-ICU was high (kappa = 0.96). The psCAM-ICU demonstrated a sensitivity of 75%, a specificity of 91% and interrater reliability of 0.79 when compared to delirium diagnosis by a pediatric

psychiatrist (Smith et al., 2016). The pCAM-ICU and psCAM-ICU delirium screening tools allow nurses to screen critically ill children greater than 6 months up to 21 years old, measured behavior at a single point in time, and could be completed by the bedside nurse in less than 2 minutes (Smith et al., 2011; Smith et al., 2016).

The CAPD delirium screening tool can be used for critically ill children from birth to 21 years regardless of developmental age (Traube et al., 2014). The CAPD tool was validated and demonstrated interrater reliability in critically ill patients 0-21 years of age, which included developmentally delayed children (20%) and those receiving mechanical ventilation (17%) (Traube et al., 2014). The validation compared the results of the CAPD screening tool used by the bedside pediatric critical care nurse with an assessment by a pediatric psychiatrist using the DSM IV delirium criteria. The CAPD screening tool demonstrated a sensitivity of 94%, specificity of 79% and kappa of 0.94 (Traube et al., 2014). The CAPD tool did not perform as well for adolescents (13 - 21 years), with a sensitivity of 50% and specificity of 98% (Traube et al., 2014). This was attributed to the small sample size, as only two out of fifty-six critically ill adolescents had a confirmed delirium diagnosis. The CAPD evaluated the child's behavior over time, taking into account the delirium requirement of fluctuation of behavior and takes less than two minutes for the nurse to complete.

Use of the CAPD screening tool in newborns and toddlers can be challenging due to significant variability in developmental behaviors across this age group. To provide guidance in using the CAPD for the newborn to two year old, developmental anchor points were created as a resource for the nurse performing delirium assessment in this age group. The anchor points were developmental behaviors at key points of age; newborn, 4

weeks, 6 weeks, 8 weeks, 28 weeks, 1 year and 2 years of age (Silver, Kearney, Traube, & Hertzig, 2015). Content validity was established for the anchor points by an expert panel of pediatric psychiatrists, pediatric intensivists, pediatric nurses, developmental psychologists and a psychometrician (Silver, Kearney, Traube, & Hertzig, 2015).

Delirium Knowledge

A systematic review of the literature identified that nurses have a knowledge deficit regarding delirium (Yaghmour & Gholizadeh, 2016). The systematic review included seven studies addressing nurses' knowledge of delirium. Although the studies specific to delirium knowledge used various methodologies to evaluate knowledge, they each demonstrated a lack of delirium knowledge by nurses. The methodologies used included validated and non-validated questionnaires and validated case vignettes. The seven studies reviewed included nurses caring for adult patients across a variety of settings including acute, intensive and palliative care units. Three studies that specifically measured intensive care nurses' knowledge of delirium found a low level of delirium knowledge with results ranging from 63% to 67% on a delirium questionnaire (Christensen, 2014; Elliott, 2014, Hamdan-Mansour, Farhan, Othman, & Yacoub, 2010).

An additional six studies evaluated nurses' knowledge of delirium using questionnaires prior to delirium education. The results of the knowledge questionnaire scores were 58% to 81% (Detroyer et al., 2016; Gesin et al., 2012; Gordon, Melillo, Nannini, & Lakatos, 2013; Marino et al., 2015; McCrow, Sullivan & Beatie 2014; Speed, 2015). Three of the studies were specific to nurses who worked in an ICU and found a knowledge deficit regarding delirium. The scores on the delirium questionnaire for the

ICU nurses ranged from 61% - 75% (Gesin et al., 2012; Marino et al., 2015; Speed, 2015). Only one study was found describing PICU nurses' knowledge of delirium.

Flaigle, Acenszi, and Kudchakar (2016) developed a delirium knowledge questionnaire to be completed by PICU nurses. Results of the questionnaire demonstrated a knowledge deficit related to delirium risk factors and treatment of delirium. The Glasgow coma scale was believed to be an appropriate method to screen for delirium by 11% of PICU staff while 38% responded that benzodiazepines are beneficial in treating delirium (Flaigle et al., 2016). Other results of the questionnaire included 13% of staff responding, the presence of a urinary catheter was not a risk factor and 43% responded delirium lasts several hours (Flaigle et al., 2016).

Delirium Education

A systematic review evaluated delirium education and the impact of education on learning. The review cited several studies and found delirium education increased self-confidence and knowledge of delirium (Yanamadala et al., 2013). According to Yanamadala, Wieland, and Heflin (2013), using a multifaceted educational approach produced the most effective outcome for increased delirium knowledge, screening and recognition of delirium for nurses. Multifaceted education was defined as including dissemination of information, communication, and didactic, providing resources (protocols, guidelines), reinforcing factors (reminders and feedback) (Yanamadala et al., 2013).

Seven studies have measured the effect of delirium education on delirium knowledge in nurses (Detroyer et al., 2016; Gesin et al. 2012; Gordon et al., 2013; Marino et al., 201 5; McCrow et al., 2014; Speed, 2015; van de Steeg et al., 2015).

Educational methods used for education on delirium included e-learning and web-based modules (Detroyer et al., 2016; McCrow et al., 2014; van de Steeg et al., 2015). Four studies used in-person didactic presentations and bedside coaching to deliver delirium education (Gesin et al. 2012; Gordon, et al., 2013; Marino et al., 2015; Speed, 2015). Content of the delirium education included definition and signs and symptoms of delirium (Speed, 2015). Delirium education also addressed adverse outcomes, types of delirium, and delirium prevalence (Gesin et al., 2012; McCrow et al., 2014). Other educational interventions added content on risk factors, prevention and treatment (Detroyer et al., 2016; Gordon et al., 2013; van de Steeg et al., 2015). Marino, Bucher, Beach, Yegneswaran, and Cooper (2015) included evidence based practice recommendations in their education to intensive care nurses.

Three of the studies evaluated the impact of delirium education on delirium knowledge for intensive care nurses (Gesin et al., 2012; Marino et al, 2015; Speed, 2015). The educational intervention was similar in content and format in all three studies although there were a few differences in how the content was communicated. The same critical care pharmacist or experienced critical care nurse consistently led formal didactic presentations and provided handouts after presentations in each study. Gesin et al. (2012) developed a webcast of the live presentation for nurses to view and provided bedside education on the delirium screening tool, while Marino et al. (2015), exclusively used case studies during the didactic presentations. Each study evaluated delirium knowledge using a multiple-choice test. Marino et al. (2015) and Speed (2015) used the same test pre and post education, while Gesin et al. (2012) used a different multiple choice test pre and post education. All three studies demonstrated a significant increase ($p < .001$) in

delirium knowledge measured shortly after an educational intervention (Gesin et al., 2012; Marino et al., 2015; Speed, 2015).

In an effort sustain delirium knowledge and screening Babine et al. (2016) led a quality improvement project in adult inpatient units. They measured delirium screening, knowledge, and communication pre-education, three, six and twelve months after education. They found multifaceted education increased the sustainability of delirium knowledge ($p < .001$) at each interim measurement through twelve months post initial education (Babine et al., 2016). The multifaceted education included a live didactic presentation, followed by e-learning two weeks later. Delirium information using brochures and posters was provided at three months, six months and the live presentation was repeated at 12 months post implementation of delirium screening. There was a gap in the literature on the impact of delirium education for pediatric intensive care nurses.

Policy and Organizational Systems

The Institute of Medicine of the National Academies (IOM) defines clinical practice guidelines as statements that include recommendations intended to optimize patient care that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options (Institute of Medicine of the National Academies [IOM], 2011). Evidence-based clinical guidelines for management of delirium in the critically ill adult have been published by the Society of Critical Care Medicine (SCCM) (Barr et al., 2013); and German Society of Anaesthesiology and Intensive Care Medicine (DGAI) and German Interdisciplinary Association for Intensive Care and Emergency Medicine (DIVI) (Baron et al., 2015). These guidelines grade the evidence and provide recommendations for delirium assessment and management

including recommendations regarding screening tools and frequency of delirium screening.

From a pediatric critical care perspective there have been three guidelines published in the past two years. One by an international group of pediatric delirium experts, one by an international nursing society, and one by a national nursing organization.

Schieveld, Ista, Knoester, and Molag, (2015), international known pediatric delirium experts published a chapter on treatment and practices of pediatric delirium based on scientific evidence, although the authors failed to cite the level of evidence used to write the chapter. The chapter is comprehensive and includes delirium definition epidemiology, clinical characteristics, etiology, diagnosis including the use of screening tools, treatment, and sequelae of delirium.

In April 2016, the European Society of Paediatric and Neonatal Intensive Care (ESPNIC) published a position statement regarding clinical recommendations for pain, sedation, withdrawal, and delirium assessment in critically ill infants and children (Harris et al., 2016). The ESPNIC clinical recommendations were to use validated delirium screening tools and perform a delirium assessment every 8-12 hours. All three screening tools have a level of evidence A, but the assessment for delirium is level of evidence D (Harris et al., 2016). The levels of evidence for critically ill children are not robust due to limited prospective studies.

In 2016, the American Association of Critical-Care Nurses published a practice alert for delirium across the life span. The practice alert provides expected nursing practice expectations with supporting evidence. The expectations incorporate

identification and modification of risk factors, routine use of delirium assessment tools, medical management, medications and delirium, and interprofessional collaboration, including family (American Association of Critical-Care Nurses, 2016).

Although there are published clinical practice guidelines (CPG) for delirium, adherence to CPGs is problematic. Adherence in general to clinical practice guidelines (CPG) by nurses ranged from 53% - 83.4% (Jun, Kovner, & Stimpfel, 2016). Jun, Kovner and Stimpfel (2016) in an integrative literature review analyzed 16 manuscripts evaluating nurses' use of CPGs. Internal and external barriers and facilitators to the use of CPGs were identified. Internal factors related to the nurse were attitudes, perception, and knowledge. Each factor was identified as either a barrier or facilitator. Lack of knowledge of the CPG was seen as a barrier while education prior to implementation and continued throughout the implementation phase of the CPG was identified as a facilitator (Jun et al., 2016). External factors were the CPG (usability, access, content) itself, resources (time, staffing, supplies, equipment, logistics), leadership, and organizational culture. Organizational culture barriers identified by nurse included an organizational culture of resistance, a lack of peer endorsement, and lack of clear communication. Facilitators specific to organizational culture involved support and use of an interprofessional approach, motivation and consensus building, and clear communication (Jun et al., 2016).

Purpose

The purpose of this DNP project is to implement delirium screening along with increasing knowledge, improving self-confidence and attitude toward delirium assessment in critically ill children. The proposed solution is multifaceted education and

on unit resources including the pediatric critical care CNS and staff delirium champions. The project involves measuring PICU nurses' baseline delirium knowledge, self-confidence and attitude, followed by education and then repeating delirium knowledge, self-confidence and attitude measurements after education and three months after implementing delirium screening (Figure 1).

Methods

Setting

The setting for this quality improvement project was a PICU in a pacific northwest metropolitan hospital, community based teaching hospital providing tertiary care for children ages 0-21. Nursing units of care in this hospital include pediatric intensive care, neonatal intensive care, medical/surgical and rehabilitation. The hospital has a dedicated children's emergency room, procedure suite, day surgery and day treatment unit as well as a multitude of general and specialty care outpatient clinics. The setting for this project will be the pediatric intensive care unit (PICU). The PICU has 24 beds and serves patients who are 0-21 years of age with acute and potentially life threatening conditions, and chronic or disabling conditions including patients who are mechanically ventilated, post cardiac surgery, and extracorporeal life support. Patients frequently receive opioids and benzodiazepines for analgesia and sedation, putting them at risk for delirium.

The PICU is staffed by pediatric intensivists, pediatric cardiologists, 60 RNs, dedicated respiratory care practitioners, pediatric pharmacists, pediatric dieticians, child life specialists, and pediatric social workers. Ratios are one to two patients to one RN (1-2:1) working 12 hour shifts. The average daily census is 10.3 (T. Hughes, personal communication, 29 August, 2016). On average nearly 38% percent of patients are 2 years old or less and an additional 18% are between 2 and 5 years old (C. Shelak,

personal communication, May 7, 2015).

Population

Participants included a convenience sample of 60 registered nurses (RN) with less than one year to 40 years of work experience as an RN and variable years of experience working in a PICU. The RNs had either a nursing diploma, associate degree, bachelor's degree, or master's degree. Inclusion criteria included staff RNs who were employed in the pacific northwest metropolitan hospital and worked in the PICU, full-time, part time or on-call. Exclusion criteria include those who were on a leave of absence or declined to complete the questionnaire.

Recruitment consisted of electronic communication and hand delivery of the questionnaire to individual nurses. The anonymous questionnaires were distributed prior to education to obtain a baseline, immediately after education and approximately three months after implementation of delirium screening. Completion of the questionnaire was voluntary.

Instrument

Although the instruments used to evaluate delirium knowledge, self-confidence and attitude have not been validated they have been used with critical care nurses. The knowledge questionnaire was used with pediatric intensive care nurses and is the only published delirium knowledge questionnaire specific to critically ill children. The delirium knowledge questionnaire was developed at Johns Hopkins Hospital by experts in pediatric delirium. The questionnaire was piloted with PICU nursing leadership. The 17 true false questions were based on available evidence and addressed risk factors, screening methods, treatments, and diagnostic criteria for adult and pediatric delirium

(Flaigle et al., 2016).

The self-confidence and nursing attitude instrument was developed by an acute care nurse practitioner at UPMC Hamot hospital and used with adult critical care nurses (Marino et al., 2015). Self-confidence and attitude towards delirium are measured with a 5-point Likert scale. The five perceived self-confidence and nursing attitude statements of which three measure self-confidence and two measure attitude towards delirium.

Organizational Change Readiness

Organizational readiness to change is considered essential for successful implementation of change. According to Weiner (2009), organizational change readiness refers to the shared level of commitment to implement a change (change valence) and the shared belief in their ability to make the change (change efficacy). Change valence and change efficacy are the determinants of an organizations readiness to change (Weiner, 2009).

"Change commitment is a function of change valence" (Weiner, 2009, p. 3). Commitment to change is influenced by several factors; valuing the change, being required to change, or feeling obligated to change. Valuing change leads to the highest level of commitment to implementing change. Organizational commitment requires the collective members of the organization to value the change. Change efficacy is the perceived ability to complete the change (Weiner, 2009). Organizational members appraise task demands, availability of resources, and situational factors to determine the capability to implement a change. The appraisal may include determining what course of action is necessary, how much time is needed, how to sequence the activities, sufficiency of time to implement the change, and internal political environments that support the

change (Weiner, 2009). A shared sense of confidence the change can be implemented demonstrates a high change efficacy in the organization.

Organizational readiness to implement delirium screening, measure knowledge, self-confidence and attitude towards delirium in the PICU is high. Commitment to implementing this change is a shared value as demonstrated by including delirium screening as a strategic goal and by requests from physicians and nurses to screen for delirium and institute measures to reduce delirium in critically ill children. To evaluate change efficacy, PICU leadership considered stakeholder involvement, required timeline, tasks, and time needed for staff education.

Implementation of delirium screening was one of the strategic goals set by PICU leadership that included the nurse manager, assistant nurse manager, clinical educator, medical director, physician champion, and clinical nurse specialist. Strategic goals and tactics to achieve the goals were addressed, as was change efficacy. Specifically the discussion included current commitments of stakeholders, current system and unit initiatives, time commitment to implement delirium screening, and the budget for educational hours. A high level of confidence was shared among PICU leadership that change efficacy for implementing delirium screening was achievable and the first step of addressing delirium in critically ill children.

Barriers and Facilitators

Barriers and facilitators should be identified in order to mitigate or enhance, and ensure success and sustainability of the process. Prior to implementing delirium screening in the PICU, organizational and individual barriers and facilitators need to be determined. The BARRIERS scale (Funk, Tornquist, & Champagne, 1995) will be

utilized to identify specific barriers and facilitators that could influence implementation of a delirium assessment scale.

The BARRIERS scale has 4 components; organizational factors, individual factors, communicational factors, and innovation (quality of research) factors that affect translation of evidence into practice (Funk, Tornquist, & Champagne, 1995). Each factor has barriers and facilitators that are relevant to implementing a new delirium assessment scale in the PICU in a metropolitan hospital in the pacific northwest.

Organizational. Elements of organizational factors are associated with limitations or barriers associated with the setting. Included in the PICU strategic plan are tactics to standardize sedation and approaches to delirium and sleep. The availability of the CAPD delirium screening tool and developmental anchor points in the electronic heath record is an organizational barrier. Organizational facilitators include dedicated time for front-line staff to meet, review the research, develop the education and evaluate the outcomes. Front-line staff has the authority from nursing leadership to determine nursing practice at the unit level with input from clinical experts.

Individual. Barriers specific to the individual include the nurse's research values, skills, and awareness. The PICU nurses in this pacific northwest metropolitan hospital did not feel capable of evaluating the quality of the research and relied on the physicians or nursing leadership to determine quality of research. The PICU nurses in this hospital were not aware of current research or see the need to change practice. The PICU nurses in this metropolitan hospital were constantly being asked to implement new practices that were part of the system quality initiatives: Oregon's Hospital Transformation Performance Program (HTPP), level one pediatric trauma designation,

and Solutions for Patient Safety (SPS) initiatives. Thus they were less enthusiastic toward additional quality improvement initiatives.

Individual facilitators for PICU nurses in this pacific northwest metropolitan hospital included interest in improving patient outcomes and willingness to change practice to achieve improved patient care. There were PICU nurses in the metropolitan hospital who were interested and engaged in addressing delirium and willing to champion delirium screening in PICU patients. There were also PICU nurses who were engaged in translating evidence to the bedside and actively participated in the Evidence Based Practice Council (EBP) which provided recommendations based on current evidence to shared governance councils in the pacific northwest metropolitan hospital.

Communication. This factor refers to presentation and accessibility of the research. Barriers specific to the communication of the research and the statistical finding of the research findings are also pertinent. The literature and research studies on scales used to assess delirium for patients in the PICU are few, in various journals and not complied in one place. The statistical analysis is difficult to understand for a front-line nurse without a recent statistics course.

Facilitators relevant to communication of the research for PICU staff in a pacific northwest metropolitan hospital include the availability for staff to request a literature search from the library, the ability to access literature from work or home or request the library to obtain the article and send to the individual. The staff can also ask the EBP council to review the research studies and provide an analysis and or recommendation for practice specific to a topic or individual research article.

Innovation. Innovation factors are associated with the quality of the research. A

barrier specific to research on pediatric delirium assessment methods is that there are limited research studies. The studies are site specific and have not yet been replicated in other institutions or multisite studies. Facilitators related to innovation include the methodological quality of each study and potential applicability to all PICU patients within the age range of the specific scale.

Implementation and Evaluation

Research Based Practice

Utilization of the Iowa Model of Evidence-Based Practice to promote quality of care (Iowa Model) to implement delirium screening in the PICU facilitates consideration of the organizational barriers and facilitators. A knowledge focused trigger initiates the process of translating the evidence to the bedside (Titler et al., 2001). The trigger in this case was recent research citing a high prevalence of delirium in critically ill children seen by the Pediatric Critical Care Clinical Nurse Specialist (CNS), the chair of the PICU quality committee, and a pediatric intensivist. The next decision point using the Iowa Model was to determine if delirium screening was a priority for the organization (Titler, 2001). As the PICU strategic plan included developing tactics to standardize approaches to delirium, the PICU Quality committee recommended including delirium screening in the quality plan for the coming year. This recommendation was approved by PICU Central Council, which is the governance body for the PICU. Following the Iowa Model algorithm, an interprofessional team was formed. The team included nurses from day shift and night shift, a pharmacist, an intensivist, the PICU quality committee chair, and the Pediatric Critical Care CNS. In the Iowa Model the next step would be to assemble research on delirium screening tools for the critically ill child for critique and synthesis.

Studies for delirium screening tools were reviewed by the delirium task force and based on critique of the research the CAPD tool was selected. According to the Iowa Model if the evidence supported implementing delirium screening a pilot would be performed. The delirium task force determined the literature warranted implementation of delirium screening in the PICU. Included in this step was selecting outcomes, collecting baseline data, designing an evidence-based practice guideline, implementing the guideline, and evaluating the process and outcomes. Outcomes selected included measuring baseline knowledge of PICU nurses, prevalence of delirium once screening was implemented and knowledge of PICU nurses after education. The final decision point in the Iowa Model would be to determine if the change is appropriate for adoption into practice, if yes the change is implemented in practice. Once instituted, process and outcome data would need to be monitored and analyzed (Titler et al., 2001).

Change in a process or outcome is considered sustained when at a minimum of a year later the process or outcome has not returned to the previous status (Parsons & Cornett, 2011). According to Willis et al. (2014), six guiding principles have been found to be associated with sustaining organizational culture change. They are: align vision and action; make incremental changes within a comprehensive transformation strategy; foster distributed leadership; promote staff engagement; create collaborative interpersonal relationships; assess cultural changes. These six principles align with the organizational, staff, and process factors identified by Parsons and Cornett (2011) that can be used when planning and during implementation of a change while keeping sustainability in mind.

Implementation

Measurement of PICU nurses' delirium knowledge, self-confidence and attitude towards delirium will be done prior to education, after education and three months after implementation of delirium screening. The measurement will be conducted using a questionnaire with permission from the original developer. The delirium questionnaire was developed by pediatric experts in delirium and published by Flaigle, Acenzi and Kudchadkar (2016) although it has not been validated. The questionnaire has demographic information, 17 questions on delirium knowledge and risk factors (Appendix A). Five questions on delirium self-confidence and attitude towards delirium with likert scale responses are included in the questionnaire. The likert scale is from one to five, with 1 being strongly disagree, 2 disagree, 3 neutral, 4 agree and 5 strongly agree.

Electronic communication was sent to all PICU RNs with a summary of the quality improvement project. The anonymous questionnaire was hand delivered to the PICU RNs for voluntary completion. The questionnaire was completed prior to education, immediately after education, and three months after implementation of delirium screening.

Education was multifaceted and included live didactic, e-learning module, and one on one at the bedside. Topics included in the delirium education were definition, prevalence, risk factors, adverse outcomes, and delirium screening using the CAPD tool. After PICU RNs completed initial education, additional bedside education by the clinical nurse specialist and delirium champions was done as needed. The bedside education focused on scoring of the Cornell Assessment of Pediatric Delirium (CAPD) tool, use of the developmental anchor points, and answering questions on delirium.

The quality improvement project evolved over time as delirium screening and

practice guidelines were implemented in the PICU. After delirium education and the post-education questionnaires were completed, delirium screening using the CAPD tool was implemented. Once delirium screening was being performed PICU nurses provided feedback on the screening tool. PICU nurses felt the screening tool was subjective. This perspective lead to lack of value in screening for delirium and potentially impacted nurses' attitude towards screening for delirium. To address concerns brought forward by bedside nurses, each day the CNS rounded at the bedside of every patient with each nurse to review CAPD screening and use of the developmental anchor points. The intensivists also supported delirium screening by discussing the results for each patient during interprofessional rounds. To facilitate the discussion on rounds a request was made to add the CAPD score to the PICU charge nurse interprofessional rounds progress note.

Unintended consequences included a request for education by other disciplines and the need to provide education to RNs from acute care units who cared for patients in the PICU during high census times to meet staffing needs. To address the lack of knowledge on the CAPD and developmental anchor points for acute care staff, just in time education was provided to acute care staff by the CNS or PICU delirium champions. There were also several nurses who were hired after initiation of the project, necessitating education on delirium and use of the CAPD tool during their orientation. Delirium practice guidelines were rolled out at the same time as the three month post implementation of delirium screening questionnaire. This may have influenced the results of the questionnaire.

Over the course of the project, as data were collected over a six month time period, there was attrition of the sample population, as two PICU nurses resigned, three

transferred to other positions within the system, and one retired. This lead to missing data, as some of those who completed the baseline questionnaire were not working in the PICU during either the post-education data collection period or the three months post implementation of screening data collection time period. Other missing data was attributed to two nurses on a leave of absence during one of the data collection time periods.

Ethical Considerations

Ethical approval was received from the institutional research board (IRB) at Legacy Health. The OHSU IRB determined that the science improvement project was not research involving human subjects and IRB review and approval was not required (Appendix C). All participants were informed that their participation in this project was anonymous and voluntary. There was no funding for this quality improvement project.

Statistical Analysis

Data analysis was done using descriptive and inferential statistics. Continuous variables (age, years of RN experience, years of experience in PICU), were analyzed using mean and standard deviation. Proportions were used for categorical variables, (educational preparation and gender). Inferential statistics using repeated measures (ANOVA) were conducted to compare the effect of education on PICU nurses self-confidence, attitude towards delirium, and delirium knowledge at two different time points, post-education and three months post implementation of delirium screening. Statistical significance was defined at $p < 0.05$. All statistical analyses were done using SPSS version 23.

Results

Forty-three nurses (73%) out of a convenience sample of 60 nurses voluntarily completed the delirium questionnaire at all three time intervals, pre-education, post-education, and three months post implementation of delirium screening. The mean age was 40 years, with a mean of nearly 15 years of RN experience, and nearly 12.5 years experience as an RN working in the PICU (Table 1). Ninety-five percent of the respondents were female. The educational background varied, 79% had a bachelor of science, 14% an associates degree, 5% had a diploma, and 2% a master of science (Table 1).

Inferential statistics were performed for delirium knowledge, self-confidence and attitude towards delirium using repeated measures ANOVA. Delirium knowledge increased from a mean number correct at baseline of 14.28 to 14.98 post education and 14.83 post implementation of screening (Table 2). Delirium knowledge increased significantly from baseline to post education (p=.003) and from baseline to post implementation screening (p=.023). Delirium knowledge prior to education was strong, although a knowledge gap was demonstrated related to risk factors, specifically benzodiazepine use, gender, and family history of dementia.

Repeated measures ANOVA reported a delirium self-confidence increase from a baseline mean of 2.83 to 3.76 post education and 3.81 post implementation of screening. Delirium self-confidence increased significantly from baseline to post education (p<.001) and baseline to post implementation of screening (p<0.001) (Table 3).

Inferential statistics were performed for attitude towards delirium using repeated measures ANOVA. Attitude towards delirium increased from a baseline mean of 3.81 to 4.07 post education and 4.08 three months post implementation of delirium screening.

Attitude towards delirium increased significantly from baseline to post education (p=.036) and baseline to three months post implementation of delirium screening (p=0.027) (Table 4).

Discussion

The main objective of this quality improvement project was to evaluate the effect of multifaceted delirium education on knowledge, self-confidence and attitude toward delirium over time for PICU nurses in a pacific northwest metropolitan hospital. A significant increase in delirium knowledge was demonstrated post education and at three months post implementation of delirium screening as compared to baseline delirium knowledge. There was a significant increase in self-confidence and positive attitude toward delirium post-education and at three months post implementation of delirium screening.

The PICU nurses baseline knowledge of delirium was a mean of 14.28 (84%) questions answered correctly pre-education. The strong knowledge base may be a reflection of delirium discussion by the intensivists and nursing staff prior to the pre-education assessment of delirium knowledge. The increase in delirium knowledge post education as compared to pre-education knowledge was significant (p= .003). The increase in delirium knowledge was also significant (p =.023) three months post implementation of delirium screening when compared to baseline knowledge. The increased knowledge post education may be attributed to the formal education. Informal education at the bedside, monitoring of performing the delirium score, and discussion of the delirium score (CAPD)on interprofessional rounds may have contributed to the nurses' increased knowledge post implementation of delirium screening may.

Flaigle et al. (2016), evaluated PICU nurses' knowledge of delirium prior to education. The results of their questionnaire demonstrated a knowledge deficit of delirium in critically ill children. The responses ranged from 35%-100% on a delirium knowledge questionnaire. Knowledge gaps were found for risk factors and treatment of delirium in the critically ill child. Thirty-eight percent of the PICU nurses responded, benzodiazepines are beneficial in the treatment of delirium (Flaigle et al., 2016). This same questionnaire was used in in this quality improvement project and 28% of the PICU nurses responded, benzodiazepines are beneficial in the treatment of delirium. Flaigle et al. (2016) found that 62% of the PICU nurses believed children generally do not remember being delirious, and 51% of the PICU nurses in this quality improvement project believed children generally do not remember being delirious. Although the findings are not the same, they highlight similar knowledge deficits for PICU nurses at two different hospitals.

Results were comparable between PICU and adult ICU nurses in regard to knowledge of delirium and the effect of education on delirium knowledge. Three studies (Gesin et al., 2012; Marino et al., 2015; Speed, 2015) evaluated the impact of delirium education on knowledge for adult critical care nurses. The delirium knowledge ranged from 61%- 75% pre-education to 82%-95% post-education in the studies of adult ICU nurses. All three studies demonstrated a significant increase ($p < .001$) in delirium knowledge after providing education. This significant increase in delirium knowledge after education for adult ICU nurses was also found in the current quality improvement project. Although the pre-education delirium knowledge for PICU nurses was higher at 84%, the post-education mean score of 88% was within the range found in the studies

conducted with adult ICU nurses. The higher pre-education delirium knowledge found in PICU nurses may be the secondary to discussion of this initiative at the quality council and strategic planning meetings as well as one intensivist who had been involved in the implementation of delirium screening at a different children's hospital.

One study evaluated self-confidence and attitude with adult critical care nurses (Marino, et al., 2015). They conducted a quality improvement project and demonstrated a significant increase (p <.0001) in self-confidence and positive attitude toward delirium occurred after delirium education. These findings are consistent with the results found in this quality improvement project in which both self-confidence and positive attitude increased (p <.001), when comparing pre-education values to post-education and three months post implementation of delirium screening.

A systematic review of studies evaluating the effect of education on delirium knowledge found multifaceted education was the most effective strategy to increase delirium knowledge among nurses (Yanamadala et al., 2013). Multifaceted education consisting of a live didactic presentation, e-learning, and bedside education was utilized during this quality improvement project. Although the multifaceted increased may have lead to the significant increase in delirium knowledge, the lack of continued increase after implementation of delirium screening may have indicated multifaceted education should have continued throughout the project. Although multifaceted education was provided, it is possible the education could have been further adapted to address different learning styles. Another approach would have been to provide education specific to the commonly missed knowledge questions on the pre-education questionnaire thus potentially further increasing delirium knowledge post-education.

Project Costs

This quality improvement project was part of a strategic goal to improve patient experience and address delirium for critically ill children in the PICU at Randall Children's Hospital. There were no additional costs associated with the quality improvement project. Cost of the project is related to nurses time to attend the mandatory skills day education and completion of the questionnaire at three time intervals. There is the potential to decrease patient PICU and hospital costs if duration of delirium was decreased.

Implications for Practice

The results of this quality improvement project demonstrated increased knowledge, self-confidence and attitude in PICU nurses immediately after education. This was achieved with multifaceted education and high organizational change readiness. Formal education should be ongoing throughout the implementation phase of delirium screening or any other initiative to translate evidence to the bedside. Ongoing formal education can increase nursing knowledge throughout the process. Multifaceted education should be considered to address different learning styles. Education is only one component needed to reliably screen for delirium in critically ill children. Ongoing monitoring, reinforcement of delirium screening and discussion on interprofessional rounds also facilitate adherence to delirium screening. Leadership support and organizational change readiness are essential to the success of introducing delirium screening for critically ill children.

The literature states use of an evidence-based model (EBP) increases the likelihood of translating the evidence and successfully implementing delirium screening

at the bedside. Early in the EBP model of change is determining organizational change readiness. A commitment by leaders and staff to implement delirium screening along with a shared sense of confidence in the ability to make the change is essential for successful implementation of delirium screening.

Another consideration in implementing a change in practice is the identification of facilitators and barriers to the practice change. Internal and external facilitators and barriers need to be identified from both an individual and organizational perspective.

Internal factors are related to the nurse and include evaluating attitudes, perceptions, and knowledge regarding delirium and delirium screening. A lack of knowledge is a barrier and providing education throughout the implementation phase would be considered a facilitator for the nurse. Delirium education should be multifaceted as this educational strategy has been shown to be the most effective in increasing nurses knowledge of delirium. Multifaceted education incorporates, e-learning, formal didactic presentations, bedside mentoring, use of delirium champions, delirium guidelines and protocols.

External factors are related to the practice change, implementation of delirium screening, resources, leadership and organizational culture. The delirium screening tool and resources need to be readily available and easy to use. This means the screening tool should be incorporated into the medical record and the developmental anchor points accessible at the bedside. From a leadership and organizational perspective, the DNP should ensure there is an interprofessional approach to implementation of delirium education, implementation of screening and evaluation throughout the process.

Limitations

Limitations to this project include use of a non-validated delirium knowledge questionnaire. The survey has been previously utilized and published although it has not been validated or shown to have interrater reliability. The questionnaire is quantitative and questions could be misinterpreted where as a qualitative design may have yielded different results. The years of experience as an RN and working in a PICU had a wide range, 0-40 years, and it is possible there was a selection bias if those who declined to complete the questionnaire had a different change in delirium knowledge, self-confidence, or attitude over the project timeline.

The sample was small and without a comparison group. It is possible for staff who did not have didactic or e-learning education could have experienced increased knowledge, or changes in self-confidence and attitude towards delirium through performing delirium screening and participating in interprofessional rounds. The study was conducted in one PICU which limits the generalizability to other PICU nurses. Although the results are in line with other studies, comparability is limited due to different methods, instruments and sample population.

Conclusion

Delirium is common in critically ill children and associated with adverse effects such as increased mortality, increased PICU and hospital stays as well as PTSD. Increased PICU costs are also seen for critically ill children with delirium. Delirium education and screening are key to mitigating adverse outcomes associated with delirium in critically ill children as they lead to early recognition of delirium.

Multifaceted education increased delirium knowledge, self-confidence, and a positive attitude towards delirium for PICU nurses. Delirium education should be

ongoing and incorporate enabling and reinforcing educational methods when implementing delirium screening for critically ill children.

Education is only one strategy to increase early recognition of delirium. Use of a validated delirium screening tool on a routine basis for all critically ill children will facilitate early recognition of delirium. Early recognition of delirium provides an opportunity to mitigate adverse outcomes associated with delirium for the critically ill child the organization.

For the child this would mean a decreased duration and/or prevalence of delirium. This could lead to a reduced PICU and hospital length of stay, risk of mortality, and PTSD. For the organization this may lead to a decrease in hospital cost and improved patient experience.

Sustainability of delirium screening and incorporating practice changes to mitigate adverse effects associated with delirium in critically ill children requires ongoing measurement and communication of delirium outcomes to the interprofessional team. Sustainability of initiatives to translate evidence to the bedside also requires an organizational culture of safety. Approaches to reducing the prevalence and duration of delirium should include organizational culture of safety as well as development of organizational and national delirium policies for critically ill children.

The DNP APRN has the skill set to translate and disseminate evidence to improve outcomes for critically ill children. Utilization of an evidence-based practice model facilitates and delineates each step in the process. Findings of science improvement projects based on evidence are an important piece of disseminating knowledge and experience to other PICU nurses. Another approach to consider is policy development at

the local, regional and national level. Ultimately implementation of best practices for delirium can improve health outcomes for children and reduce costs for the organization.

Summary and Next Steps

Increasing PICU nurses' knowledge of delirium, improving self-confidence and attitude towards delirium is the first step to mitigating adverse outcomes from delirium for critically ill children. Research to validate the knowledge questionnaire is needed in addition to research on strategies to prevent and treat delirium in the critically ill child.

Implementing the ABCDEF bundle for critically ill children is warranted until delirium research is available. The bundle would incorporate sedation guidelines; delirium screening, prevention and management practices; progressive mobility; and family engagement. Ultimately, implementing the ABCDEF bundle provides an opportunity to mitigate adverse effects of delirium and improve patient outcomes for all critically ill children

References

American Association of Critical-Care Nurses (2016). AACN practice alert: Assessment and management of delirium across the life span. *Critical Care Nurse, 36*(5), e14-19. doi: 10.4037/ccn201642

American Psychiatric Association. (2013). Neurocognitive Disorders. In *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington. doi: 10.1176/appi.books.9780890425596.dsm17

Babine, R. L., Honess, C., Wierman, H. R., & Hallen, S. (2016). The role of clinical nurse specialists in the implementation and sustainability of a practice change. *Journal of Nursing Management*. *24*(1), 39-49. doi: 10.1111/jonm.12269

Baron, R., Binder, A., Biniek, R., Braune, S., Buerkle, H., Dall, P., ... & Fietze, I. (2015). Evidence and consensus based guideline for the management of delirium, analgesia, and sedation in intensive care medicine. Revision 2015 (DAS-Guideline 2015)–short version. *GMS German Medical Science*, *13*, 1-16. doi: 10.3205/000223

Barr, J., Fraser, G. L., Puntillo, K., Ely, E. W., Gélinas, C., Dasta, J. F., ... & Coursin, D. B. (2013). Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit. *Critical Care Medicine*, *41*(1), 263-306. doi: 10.1097/CCM.0b013e3182783b72

Christensen, M. (2014). An exploratory study of staff nurses' knowledge of delirium in the medical ICU: An Asian perspective. *Intensive and Critical Care Nursing*, *30*(1), 54-60. doi: 10.1016/j.iccn.2013.08.004

Colville, G., Kerry, S., & Pierce, C. (2008). Children's factual and delusional memories

of intensive care. *American Journal of Respiratory and Critical Care Medicine*, *177*(9), 976-982. doi: 10.1164/rccm.200706-857OC

Detroyer, E., Dobbels, F., Debonnaire, D., Irving, K., Teodorczuk, A., Fick, D. M., ... & Milisen, K. (2016). The effect of an interactive delirium e-learning tool on healthcare workers' delirium recognition, knowledge and strain in caring for delirious patients: A pilot pre-test/post-test study. *BMC Medical Education*, *16*(1), 1. doi: 10.1186/s12909-016-0537-0

Elliott, S. R. (2014). ICU delirium: A survey into nursing and medical staff knowledge of current practices and perceived barriers towards ICU delirium in the intensive care unit. *Intensive and Critical Care Nursing*, *30*(6), 333-338. doi: 10.1016/j.iccn.2014.06.004

European Delirium Association. (2014). The DSM-5 criteria, level of arousal and delirium diagnosis: inclusiveness is safer. *BMC medicine*, *12*(1), 141. doi: 10.1186/s12916-014-0141-2

Flaigle, M. C., Ascenzi, J., & Kudchadkar, S. R. (2016). Identifying barriers to delirium screening and prevention in the pediatric ICU: Evaluation of PICU staff knowledge. *Journal of Pediatric Nursing*, *31*(1), 81-84. doi:10.1016/j.pedn.2015.07.009

Funk, S. G., Tornquist, E. M., & Champagne, M. T. (1995). Barriers and facilitators of research utilization. *Nursing Clinics of North America*, *30*(3), 395-407. Retrieved from https://www.researchgate.net/profile/Mary_Champagne/publication/15630684_Ba

rriers_and_facilitators_of_research_utilization._An_integrative_review/links/00b4953a97853516fd000000.pdf

Gesin, G., Russell, B. B., Lin, A. P., Norton, H. J., Evans, S. L., & Devlin, J. W. (2012). Impact of a delirium screening tool and multifaceted education on nurses' knowledge of delirium and ability to evaluate it correctly. *American Journal of Critical Care*, *21*(1), e1-e11. doi: 10.4037/ajcc2012605

Girard, T. D., Jackson, J. C., Pandharipande, P. P., Pun, B. T., Thompson, J. L., Shintani, A. K., ... & Ely, E. W. (2010). Delirium as a predictor of long-term cognitive impairment in survivors of critical illness. *Critical Care Medicine*, *38*(7), 1513. doi: 10.1097/CCM.0b013e3181e47be1

Gordon, S. J., Melillo, K. D., Nannini, A., & Lakatos, B. E. (2013). Bedside coaching to improve nurses' recognition of delirium. *Journal of Neuroscience Nursing*, *45*(5), 288-293. doi: 10.1097/JNN.0b013e31829d8c8b

Grover, S., Ghosh, A., Kate, N., Malhotra, S., Mattoo, S. K., Chakrabarti, S., & Avasthi, A. (2014). Do motor subtypes of delirium in child and adolescent have a different clinical and phenomenological profile? *General Hospital Psychiatry*, *36*(2), 187-191. doi:10.1016/j.genhosppsych.2013.10.005

Hamdan-Mansour, A. M., Farhan, N. A., Othman, E. H., & Yacoub, M. I. (2010). Knowledge and nursing practice of critical care nurses caring for patients with delirium in intensive care units in Jordan. *The Journal of Continuing Education in Nursing*, *41*(12), 571-576. doi: 10.3928/00220124-20100802-01

Harris, J., Ramelet, A. S., van Dijk, M., Pokorna, P., Wielenga, J., Tume, L., ... & 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*, 1-15. doi:10.1007/s00134-016-4344-1

Institute of Medicine of the National Academies [IOM]. (2011). *Clinical practice guidelines we can trust.* Retrieved from http://www.nationalacademies.org/hmd/Reports/2011/Clinical-Practice-Guidelines-We-Can-Trust.aspx

Jun, J., Kovner, C. T., & Stimpfel, A. W. (2016). Barriers and facilitators of nurses' use of clinical practice guidelines: An integrative review. *International Journal of Nursing Studies*, *60*, 54-68. doi: 10.1016/j.ijnurstu.2016.03.006

Kelly, P., & Frosch, E. (2012). Recognition of delirium on pediatric hospital services. *Psychosomatics*, *53*(5), 446-451. doi: 10.1016/j.psym.2012.04.012

Kudchadkar, S. R., Yaster, M., & Punjabi, N. M. (2014). Sedation, sleep promotion, and delirium screening practices in the care of mechanically ventilated children: A wake-up call for the pediatric critical care community. *Critical Care Medicine*, *42*(7), 1592-1600. doi: 10.1097/CCM.0000000000000326

Marino, J., Bucher, D., Beach, M., Yegneswaran, B., & Cooper, B. (2015). Implementation of an intensive care unit delirium protocol. *Dimensions of Critical Care Nursing*, *34*(5). doi: 10.1097/01.DCC.0000470808.28935.9f

McCrow, J., Sullivan, K. A., & Beattie, E. R. (2014). Delirium knowledge and recognition: A randomized controlled trial of a web-based educational intervention for acute care nurses. *Nurse education today*, *34*(6), 912-917. doi: 10.1016/j.nedt.2013.12.006

Pandharipande, P. P., Girard, T. D., Jackson, J. C., Morandi, A., Thompson, J. L., Pun, B. T., ... & Moons, K. G. (2013). Long-term cognitive impairment after critical illness. *New England Journal of Medicine*, *369*(14), 1306-1316. doi: 10.1056/NEJMoa1301372

Parsons, M. L., & Cornett, P. A. (2011). Leading change for sustainability. *Nurse Leader*, *9*(4), 36-40. doi: 10.1016/j.mnl.2011.05.005

Salluh, J. I., Wang, H., Schneider, E. B., Nagaraja, N., Yenokyan, G., Damluji, A., ... & Stevens, R. D. (2015). Outcome of delirium in critically ill patients: systematic review and meta-analysis. *The BMJ*, *350*, h2538. doi: 10.1136/bmj.h2538

Schieveld, J. N., Leroy, P. L., van Os, J., Nicolai, J., Vos, G. D., & Leentjens, A. F. (2007). Pediatric delirium in critical illness: Phenomenology, clinical correlates and treatment response in 40 cases in the pediatric intensive care unit. *Intensive Care Medicine*, *33*(6), 1033-1040. doi: 10.1007/s00134-007-0637-8

Schieveld, J. N., Lousberg, R., Berghmans, E., Smeets, I., Leroy, P. L., Vos, G. D., ... & van Os, J. (2008). Pediatric illness severity measures predict delirium in a pediatric intensive care unit. *Critical Care Medicine*, *36*(6), 1933-1936. doi: 10.1097/CCM.0b013e31817cee5d

Schieveld JNM, Ista E, Knoester H, & Molag ML. (2015). Pediatric delirium: A practical approach. In J.M. Rey (Ed.), *IACAPAP e-Textbook of Child and Adolescent Mental Health* (pp. 1-17). Geneva: International Association for Child and Adolescent Psychiatry and Allied Professions. Retrieved from: http://iacapap.org/wp-content/uploads/I.5-DELIRIUM-2015.pdf

Silver, G., Traube, C., Kearney, J., Kelly, D., Yoon, M. J., Moyal, W. N., ... & Ward, M.

J. (2012). Detecting pediatric delirium: Development of a rapid observational assessment tool. *Intensive Care Medicine*, *38*(6), 1025-1031. doi: 10.1007/s00134-012-2518-z

Silver, G., Kearney, J., Traube, C., Atkinson, T. M., Wyka, K. E., & Walkup, J. (2015). Pediatric delirium: Evaluating the gold standard. *Palliative and Supportive Care*, *13*(03), 513-516. doi: 10.1017/S1478951514000212

Silver, G., Kearney, J., Traube, C., & Hertzig, M. (2015). Delirium screening anchored in child development: The Cornell Assessment for Pediatric Delirium. *Palliative and Supportive Care*, *13*(04), 1005-1011. doi: 10.1017/S1478951514000947

Silver, G., Traube, C., Gerber, L. M., Sun, X., Kearney, J., Patel, A., & Greenwald, B. (2015). Pediatric delirium and associated risk factors: A single-center prospective observational study. *Pediatric Critical Care Medicine*, *16*(4), 303-309. doi: 10.1097/PCC.0000000000000356

Smeets, I. A., Tan, E. Y., Vossen, H. G., Leroy, P. L., Lousberg, R. H., Van Os, J., & Schieveld, J. N. (2010). Prolonged stay at the paediatric intensive care unit associated with paediatric delirium. *European Child & Adolescent Psychiatry*, *19*(4), 389-393. doi: 10.1007/s00787-009-0063-2

Smith, H. A., Fuchs, D. C., Pandharipande, P. P., Barr, F. E., & Ely, E. W. (2009). Delirium: An emerging frontier in the management of critically ill children. *Critical Care Clinics*, *25*(3), 593-614. doi: 10.1016/j.ccc.2009.05.002

Smith, H. A., Boyd, J., Fuchs, D. C., Melvin, K., Berry, P., Shintani, A., ... &

Sopfe, J. (2011). Diagnosing delirium in critically ill children: Validity and reliability of the pediatric Confusion Assessment Method for the intensive care unit. *Critical Care Medicine*, *39*(1), 150. doi: 10.1097/CCM.0b013e3181feb489

Smith, H. A., Brink, E., Fuchs, D. C., Ely, E. W., & Pandharipande, P. P. (2013). Pediatric delirium: Monitoring and management in the pediatric intensive care unit. *Pediatric Clinics of North America*, *60*(3), 741-760. doi:10.1016/j.pcl.2013.02.010

Smith, H. A., Berutti, T., Brink, E., Strohler, B., Fuchs, D. C., Ely, E. W., & Pandharipande, P. P. (2013). Pediatric critical care perceptions on analgesia, sedation, and delirium. *Seminars in Respiratory and Critical Care Medicine, 34*(02), 244-261. doi: 10.1055/s-0033-1342987

Smith, H. A., Gangopadhyay, M., Goben, C. M., Jacobowski, N. L., Chestnut, M. H., Savage, S., ... & Acton, M. (2016). The Preschool Confusion Assessment Method for the ICU: Valid and reliable delirium monitoring for critically ill infants and children. *Critical Care Medicine, 44*(03), 592-600. doi: 10.1097/CCM.0000000000001428

Speed, G. (2015). The impact of a delirium educational intervention with intensive care unit nurses. *Clinical Nurse Specialist*, *29*(2), 89-94. doi: 10.1097/NUR.0000000000000106

Titler, M. G., Kleiber, C., Steelman, V. J., Rakel, B. A., Budreau, G., Everett, L. Q., ... & Goode, C. J. (2001). The Iowa Model of Evidence-Based Practice to Promote Quality Care. *Critical Care Nursing Clinics of North America*, *13*(4), 497-509.

Traube, C., Silver, G., Kearney, J., Patel, A., Atkinson, T. M., Yoon, M. J., ... &

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., Mauer, E. A., Gerber, L. M., Kaur, S., Joyce, C., Kerson, A., ... & Greenwald, B. M. (2016). Cost associated with pediatric delirium in the ICU. *Critical Care Medicine*, *44*(12), e1175-e1179. doi: 10.1097/CCM.0000000000002004

Traube, C., Silver, G., Gerber, L. M., Kaur, S., Mauer, E. A., Kerson, A., ... & Greenwald, B. M. (2017). Delirium and Mortality in Critically Ill Children: Epidemiology and Outcomes of Pediatric Delirium. *Critical Care Medicine*. doi: 10.1097/CCM.0000000000002324

Traube, C., Silver, G., Reeder, R. W., Doyle, H., Hegel, E., Wolfe, H. A., ... & Buttram, S. D. (2017). Delirium in critically ill children: An international point prevalence study. *Critical care medicine*, *45*(4), 584-590. doi: 10.1097/CCM.0000000000002250

Turkel, S. B., & Tavaré, C. J. (2003). Delirium in children and adolescents. *The Journal of Neuropsychiatry and Clinical Neurosciences*. Retrieved from: http://neuro.psychiatryonline.org/doi/pdf/10.1176/jnp.15.4.431

van de Steeg, L., IJkema, R., Wagner, C., & Langelaan, M. (2015). The effect of an e-learning course on nursing staff's knowledge of delirium: A before-and-after study. *BMC Medical Education*, *15*(1), 1-8. doi: 10.1186/s12909-015-0289-2

Weiner, B. J. (2009). A theory of organizational readiness for change. *Implementation Science*, *4*(1), 1-9. doi: 0.1186/1748-5908-4-67

Willis, C. D., Saul, J., Bevan, H., Scheirer, M. A., Best, A., Greenhalgh, T., ... & Bitz, J. (2016). Sustaining organizational culture change in health systems. *Journal of Health Organization and Management*, *30*(1), 2-30. doi: 10.1108/JHOM-07-2014-0117

Yaghmour, S. M., & Gholizadeh, L. (2016). Review of Nurses' Knowledge of Delirium, Dementia and Depressions (3Ds): Systematic Literature Review. *Open Journal of Nursing*, *6*(3), 193. doi: 10.4236/ojn.2016.63020

Yanamadala, M., Wieland, D., & Heflin, M. T. (2013). Educational interventions to improve recognition of delirium: a systematic review. *Journal of the American Geriatrics Society*, *61*(11), 1983-1993. doi: 10.1111/jgs.12522

Table 1

Descriptive Characteristics of PICU Nurses

Characteristics *N*=43	*M* (range)	*SD*
Age (yrs)	39.92 (22-63)	18.16
RN Experience (yrs)	14.87 (0-40)	10.99
PICU RN Experience (yrs)	12.45 (0-40)	11.43
	n	%
Gender		
Female	41	95%
Educational Background		
Diploma	2	5
ADN	6	14
BSN	34	79
MSN	1	2

Note. ADN = Associates Degree in Nursing; BSN = Bachelor of Science in Nursing; MSN = Master of Science in Nursing

Table 2

Repeated measures ANOVA of Delirium Knowledge Over Time in PICU Nurses

Time of delirium knowledge test	*N*	*M* correct	*SD*	*p*-value
Pre-education	43	14.28	1.24	
Post-education	43	14.98	1.14	.003
Three months[a]	43	14.84	1.53	.023

Note. [a] Three months = three months post implementation of delirium screening

Table 3

Repeated Measures ANOVA for Delirium Self-Confidence Over Time in PICU Nurses

Time of self-confidence score	*N*	*M*	*SD*	*p*-value
Pre-education	43	2.83	.69	
Post-education	43	3.76	.62	.000
Three months[a]	43	3.80	.62	.000

Note. [a]Three months = three months post implementation of delirium screening.

Table 4

Repeated measures ANOVA for Delirium Attitude Over Time in PICU Nurses

Time of attitude score	*N*	*M*	*SD*	*p*-value
Pre-education	42	3.81	.68	
Post-education	42	4.07	.59	.036
Three months[a]	42	4.08	.75	.027

Note. [a]Three months = three months post implementation of delirium screening.

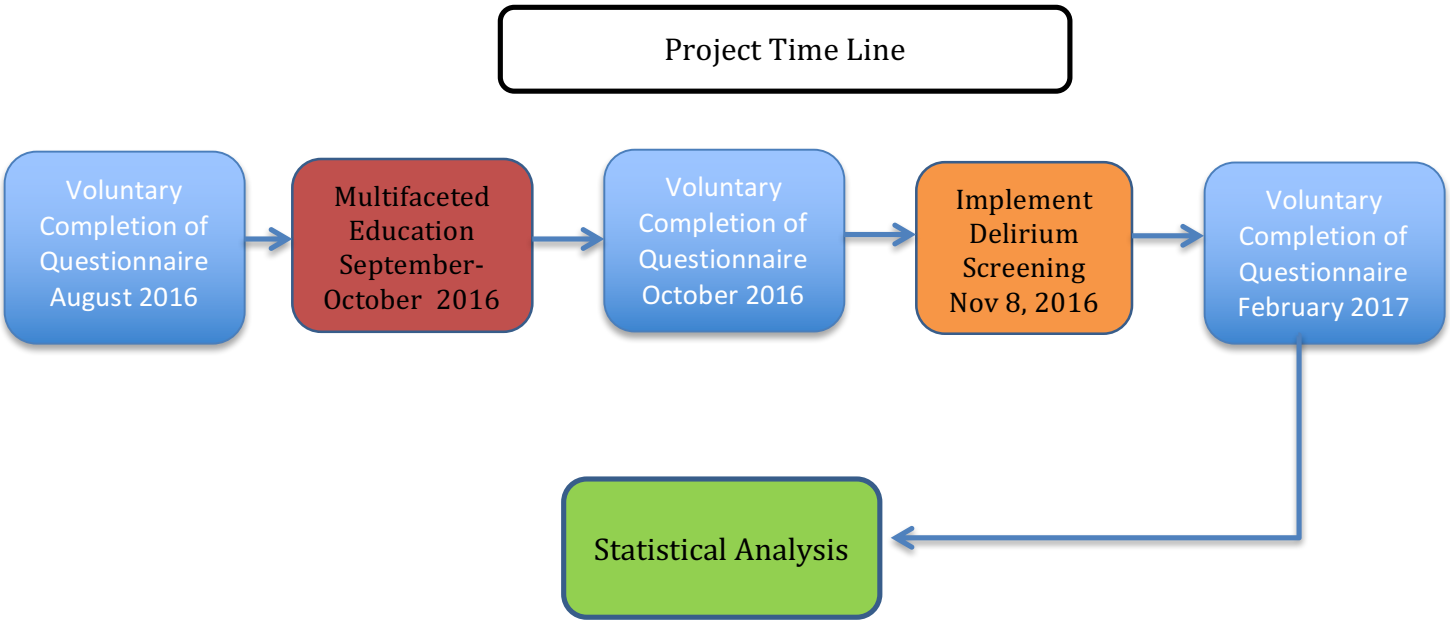


Figure 1. Display of time line for completion of questionnaire, education, and delirium screening.

Appendix A
Delirium Questionnaire

Is each statement true or false?

1. Fluctuation between orientation and disorientation is not typical of delirium	True False
2. Poor nutrition increases the risk of delirium	True False
3. The GCS score is the best way to diagnose delirium in critically ill children	True False
4. Hearing or vision impairment increases the risk of delirium	True False
5. Delirium in children always manifests as a hyperactive, confused state	True False
6. Benzodiazepines can be helpful in the treatment of delirium	True False
7. Behavioral changes in the course of the day are typical of delirium	True False
8. Patients with delirium will often experience perceptual disturbances	True False
9. Altered sleep/wake cycle may be a symptom of delirium	True False
10. Symptoms of depression may mimic delirium	True False
11. The greater the number of medications a patient is taking, the greater their risk of delirium	True False
12. Delirium usually lasts several hours	True False
13. A urinary catheter in situ reduces the risk of delirium	True False
14. Gender has no effect on the development of delirium	True False
15. Dehydration can be a risk factor for delirium	True False
16. Children generally do not remember being delirious	True False
17. A family history of dementia predisposes a patient to delirium	True False

For the following statements, please respond using the below scale

Strongly disagree 1 Disagree 2 Neutral 3 Agree 4 Strongly agree 5

I am comfortable assessing my PICU patients for delirium _____

If asked, I am confident that I can provide an accurate definition of delirium _____

I am confident in communicating my concerns about presence of or risk for delirium to my patient's critical care provider _____

I can identify at least two interventions that can be used to prevent or decrease duration of delirium in ICU patients. _____

I feel that assessing PICU patients for delirium twice a day is a worthwhile intervention. _____

Demographic information

Have you previously had education on delirium ____ yes ____ no

Have you ever used a delirium screening tool ____ yes ____ no

Years experience as RN _____ (years)

Years experience working in PICU _____ (years)

Age _____ (years)

Nursing degree ____ Diploma ____ ADN ____ BSN ____ MSN/MN

Gender ____ Female _____ Male

Appendix B
Legacy IRB Response

Legacy Research Institute
1225 N.E. Second Ave.
Portland, OR 97232
503.413.2491 *phone*
503.413.4942 *fax*

August 10, 2016

Legacy IRB: FWA00001280

Sharon Norman, RN, MSN CCRN
Randall Children's Hospital at Legacy Emanuel
Pediatric Critical Care Clinical Nurse Specialist
2801 N. Gantenbein Avenue, Suite 6804
Portland, OR 97227
snorman@lhs.org

Dear Ms. Norman:

SUBJECT: IRB EXEMPTION—REGULATORY OPINION
Protocol Title: ***Pediatric Intensive Care Nurses' delirium knowledge, self-confidence, and attitudes over a six month time period***
Investigator: Sharon Norman, RN, MSN CCRN

This letter is in response to your request for an opinion as to whether the above mentioned project would constitute human subject research requiring IRB review.

This opinion is based on federal regulation 45 CFR 46 and associated guidance.

Under 45 CFR 46.102(d), research means "a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge. Activities which meet this definition constitute research for purposes of this policy, whether or not they are conducted or supported under a program which is considered research for other purposes…."

Quality improvement projects do not meet the definition of research under 45 CFR 46.102(d).

This project does not involve research as you have indicated that intent of the QI project is to determine PICU nurses' baseline knowledge, attitude and self-confidence regarding delirium and whether this changes over time. The intervention will involve education on delirium and including delirium scores in multidisciplinary rounds. QI procedures involve the use of a voluntary survey of PICU nurses before and after education regarding pediatric delirium:

> "The questionnaire will be completed prior to education, within two weeks after education, three months after education and 6 months after education. Education will be multifaceted and include live didactic, e-learning module, and video demonstration of delirium tool use. After PICU RNs complete initial education, additional bedside education by the clinical nurse specialist and delirium champions will commence. The bedside education will focus on scoring of the Cornell Assessment of Pediatric Delirium (CAPD) tool, use of the developmental anchor points, and answering questions on delirium."

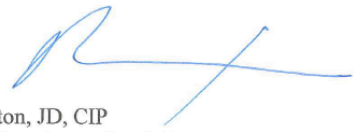
Your project does not collect data on Legacy patients. The subjects of the survey are the RN's receiving the education regarding delirium.

You have also indicated that you have received permission from Cindy Hill, and Tessie Hughes of Legacy to conduct this project improvement.

The Legacy IRB is governed by an assurance granted by the Office of Human Research Protections (Federal Wide Assurance #00001280). In addition to that assurance, the Legacy IRB is governed by FDA regulations (21CFR50) and Legacy institutional policy (LHS 100.18).

If you have any questions, or if we can be of further assistance, please contact Research Regulatory Specialist Sr, Paul Newton, JD, CIP, at 503-413-5355, or e-mail at pwnewton@lhs.org.

Sincerely,



Paul Newton, JD, CIP
Research Regulatory Specialist Sr.
Legacy Research Institute
1225 NE 2nd Ave
Portland, OR 97232
Phone (503) 413-5355
pwnewton@lhs.org

Appendix C
OHSU IRB Response

NOT HUMAN RESEARCH

IRB MEMO

Research Integrity Office
3181 SW Sam Jackson Park Road - L106RI
Portland, OR 97239-3098
(503)494-7887 irb@ohsu.edu

September 1, 2016
Dear Investigator:

On 9/1/2016, the IRB reviewed the following submission:

Title of Study:	Pediatric Intensive Care Nurses' delirium knowledge, self-confidence, and attitudes over a six month time period
Investigator:	Sharon Norman
IRB ID:	STUDY00016392
Funding:	None

The IRB determined that the proposed activity is not research involving human subjects. IRB review and approval is not required.

Certain changes to the research plan may affect this determination. Contact the IRB Office if your project changes and you have questions regarding the need for IRB oversight.

If this project involves the collection, use, or disclosure of Protected Health Information (PHI), you must comply with all applicable requirements under HIPAA. See the HIPAA and Research website and the Information Privacy and Security website for more information.

Sincerely,

The OHSU IRB Office