Implementation and Evaluation of Critical Care Pain Observation Tool (CPOT)

Kalsang D. Dorji
Touro University California

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IMPLEMENTATION AND EVALUATION OF CRITICAL CARE PAIN

OBSERVATION TOOL (CPOT)

by

Kalsang D. Dorji

Touro University, California.

Author Note

DNP Capstone Chair: Anne Stolzman

DNP Capstone Committee Member: Alonya Elgrably, DNP, AC-NP; Patricia Lead, FNP;

Dr. Krishnamurthy Umapathy, MD.

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ABSTRACT

Background: Pain assessment in critically ill patients using an evidence-based and reliable tool is crucial in providing pain management and promoting recovery of the patients in the Intensive Care Units (ICU). Inadequate pain management can have short-term and long-term complications. Critical Care Pain Observation Tool (CPOT) has been rigorously tested and has been recommended as a valid and reliable pain assessment tool by the Society of Critical Care Medicine and the American Association of Critical Care Medicine.

Objective: To implement CPOT and evaluate the impacts of CPOT implementation in the ICUs at NorthBay Medical Center and Vacavalley Hospital.

Methods: This evidence-based project utilized the IOWA Model of evidence-based practice change to implement CPOT. Nurses were provided education on CPOT for twenty minutes during mandatory quarterly ICU skills fairs in November 2017. The CPOT was implemented in both ICUs in April 2018. A descriptive study design was used to compare the before and after implementation groups. Forty patient charts were reviewed from the pre-implementation group and another forty patient charts were reviewed from the post-implementation group. Data was collected on number of pain assessments, pain reports, pain reassessments, amount of analgesia administered, ventilator days, and ICU days. Nursing feasibility and applicability survey were collected during pre-implementation and two months’ post-implementation.

Results: An inter-rater reliability of 93.3% from thirty pain observations was obtained during the pilot trial. There were no significant differences found between pre-and post-implementation groups in regards to pain assessment frequency, pain reports, analgesia usage, ventilator days, and ICU days. However, there was a statistically significant increase in the pain reassessment frequency ($t=2.22, p=0.02$). The mean of frequency of pain reassessment was 0.55 for the pre-implementation group and 1.425 for the post-implementation group. Nursing survey results
showed positive evaluations for CPOT with 100% of the nurses agreeing that CPOT is easy to use and 100% of the nurses agreed that they received adequate CPOT education. 95.9% of the nurses believed that CPOT helped to assess pain accurately in critically ill adult patients on ventilator and 93.8% believed that CPOT positively influenced their practice.
INTRODUCTION

The subjective nature of pain makes it very challenging for the clinicians to accurately assess and manage pain in critically ill patients on the ventilator who cannot verbally communicate. Various factors including: presence of an endotracheal tube, sedative medications, and level of consciousness can hinder accurate assessment of pain in this patient population. Accurate pain assessment with a validated behavioral pain assessment tool and effective pain management can improve patient comfort, decrease use of sedatives, decrease duration of intubation (DOI), decrease length of stay (LOS) in the Intensive Care Unit (ICU), and reduce complications (Arbour, Gélinas, & Michaud, 2011). It has been reported that 33% of critically ill patients experience pain at rest and 56% have significant pain during routine care including repositioning, endotracheal suctioning, and wound care (Payen et al., 2007). There was no difference noted in the incidence and intensity of pain between medical ICU and surgical ICU patients, but medical patients were less frequently treated with preventive analgesia prior to undergoing painful procedures or mobilization. (Chanques et al., 2007).

Acute pain stimulates the stress response in the body and can generate multiple physiological effects such as: increased production of catecholamine resulting in vasoconstriction; impaired tissue perfusion which can delay wound healing; catabolic hypermetabolism which can cause hyperglycemia and muscle breakdown; and suppression of natural killer T cells activity which can weaken the immune response (Barr et al., 2013). Inadequate assessment and management of acute pain can also trigger acute psychological conditions such as anxiety, insomnia, depression, and delirium. Untreated acute pain can have long-term negative physical and psychological impact on patients including: the development of chronic pain, post-traumatic stress disorder, and decrease the quality of life (Barr et al., 2013).
Several pain assessment tools are currently available for the assessment of pain in non-verbal patients. These include Behavioral pain scale (BPS), Critical care pain assessment tool (CPOT), Faces, legs, activity, cry, and consolability (FLACC), Nonverbal pain scale (NPVS), and Pain assessment in advanced dementia (PAINAD). In 2013, the Society of Critical Care Medicine (SCCM) and American Association of Critical Care Medicine (ACCM) published the clinical practice guidelines for the management of pain, agitation, and delirium (PAD) in critically ill adults in the intensive care unit (Barr et al., 2013). Since the publication of the PAD guidelines, there have been many changes in the care delivery and treatment of patients on the ventilator in the ICU. The PAD guidelines for pain assessment recommend using a validated and reliable behavioral pain scale such as CPOT or BPS (Barr et al., 2013).

Both the CPOT and BPS are valid and reliable behavioral pain scales for assessment of pain in adult ICU patients with intact motor function and observable behaviors (Barr et al., 2013). However, in comparison between the two scales, the CPOT has been more rigorously tested for validity, reliability, feasibility, sensitivity, and specificity (Varndell, Fry, & Elliott, 2016). Additional studies have been conducted to include a broader range of critical care patient populations such as medical, cardiovascular surgical, neurosurgical, trauma, and ICU patients with delirium (Chanques et al., 2007; Gélinas, Fillion, Puntillo, Viens, & Fortier, 2006; Echegaray-Benites, Kapoustina, & Gélinas, 2014; Gélinas, Harel, Fillion, Puntillo, & Johnston, 2009; Kanji et al., 2016). The discriminant validity of CPOT was also found to be better than BPS (Rijkenberg, Stilma, Endeman, Bosman, & Oudemans-van Straaten, 2015). The CPOT can also be used for non-ventilator critical care patients who are not able to communicate (Varndell et al., 2016). Due to the higher strength of evidence currently available for CPOT and broader applicability for the various ICU patient populations, the CPOT would be the most appropriate instrument for pain assessment in critically ill patients.
The CPOT can be used to assess pain in both mechanically ventilated and non-ventilated critical care patients (Gélinas et al., 2006). It assesses four behavioral domains: facial expression, body movements, muscle tension, and compliance with the ventilator (for ventilated patients) or vocalization (for non-ventilated patients). Each category is scored from 0-2 with total scores ranging from 0 to the maximum of 8. Pain ratings of 3-4 is mild pain, 5-6 is moderate pain, and 7-8 severe pain (Gélinas et al., 2006) (Appendix A).

**Problem Statement**

The impetus for practice change in regards to pain assessment in the ICUs at North Bay Medical Center (NBMC) in Fairfield, California and Vacavally Hospital (VVH) in Vacaville, California, was that the current pain assessment tool used for critical care patients was not a validated evidence-based tool for adult patients in the ICU. The pain assessment tool currently used to assess critically ill ventilated adult patients in the ICU is FLACC scale. The FLACC scale assesses pain based on the observation of facial expression, activity of legs, general body activity, cry, and consolability. The FLACC scale was initially designed to assess pain in children between the ages of two months and seven years or children with cognitive impairment. The FLACC scale has been proven to be effective in pain assessment with children, however there is a lack of evidence for applicability and reliability of the FLACC in non-verbal adults. A study by Voepel-Lewis, Zanotti, Dammeyer, & Merkel (2010) showed a high internal consistency of the FLACC scale with Cronbach $\alpha$ of 0.882 but the “cry assessment” component accounted for 68.9% variance of the FLACC score. Crying as a response to pain in adults is not a reliable indicator for pain and can vary based on many different factors such as pain tolerance level or cultural influence.

Heeding to the recommended guidelines from the SCCM, the ICUs at VVH and NBMC have successfully implemented evidence-based practice changes for spontaneous awakening and
breathing trials, delirium assessment and management, early progressive mobility, and family engagement. However, accurate pain assessment and adequate pain management are crucial components of care for intubated patients. The nursing practice of utilizing the FLACC scale for pain assessment in the intubated patient was not congruent with the current evidence-based practice (EBP) PAD guidelines. Adequate pain management is essential in evaluating a patient’s readiness for extubation during spontaneous breathing trials and advancing their progressive mobility plan. Uncontrolled pain can disrupt sleep and rest which can cause delirium and increase complications. The successful management of all the components of care for intubated patients is based on the fundamental step of assessing pain with a validated tool and providing adequate pain management. Thus, this clinical practice gap served as the impetus for my doctoral of nursing practice (DNP) capstone project.

**Aims and Purpose**

The objective of this project was to successfully implement the CPOT pain scale assessment tool in the ICUs at NBMC and VVH and evaluate the following outcomes:

a) Number of pain assessment, reports of pain, and reassessments

b) Inter-rater reliability of Nurses using CPOT pain scale

c) Comparison of Nurses’ feasibility and applicability survey between FLACC and CPOT

d) Amount usage of analgesics

e) Number of ventilator days

f) Number of ICU days

**Study Question**

The PICO question that guided this doctoral project was: In critically ill adult patients on the ventilator, does the implementation of the CPOT, compared to the FLACC scale, affect pain assessment, management, and clinical outcomes of the patients?
Evidence-Based Practice Theoretical Framework

The IOWA model for evidence-based practice change was used as the framework for this project. The steps of the IOWA model include; a) problem identification, b) forming a team, c) critique of the relevant literature, d) implementing practice change, and e) dissemination of findings (Titler et al., 2001) (APPENDIX B). New guidelines in healthcare practices are continually evolving and the clinical practices of the nurses are also changing continuously. Hence, the EBP nursing council of North Bay Healthcare has adopted the IOWA model for identifying and implementing any evidence-based nursing practice change in the organization. The nursing staff at both the ICUs in NBMC and VVH have been introduced to this theoretical framework at Shared Governance Council meetings and during the implementation of previous EBP projects in the organization. This DNP project also provided the opportunity to introduce IOWA model for the rest of the staff who are not familiar with the model. The IOWA model was initially developed in 1994 and revised in 2001. The latest revision, published in 2017, was based on new changes in health care such as the development of implementation science and emphasis of patient engagement (Buckwalter et al., 2017). The IOWA model provides a systematic guideline to identify a priority problem, which can be either a clinical problem-focused or new knowledge-focused trigger.

The first step of the IOWA model is problem identification, and that can be based on “problem-focused triggers” or “knowledge-focused triggers” (Titler et al., 2001). For this study, the problem identification was based on the knowledge-focused triggers. There is a clinical practice recommendation from the SCCM to utilize an evidence-based behavioral pain assessment scale such as the CPOT or the BPS. Since the ICUs at NBMC and VVH were not using a validated behavioral pain scale for pain assessment in critically ill patients, the implementation of a behavioral pain scale was a crucial step needed to appropriately assess and
manage pain. The second step of the IOWA model is to determine if the identified topic is a priority for the organization (Titler et al., 2001). Implementation of CPOT took priority in the ICUs because both the NBMC and VVH ICUs had successfully implemented the PAD guidelines and ABCDEF bundle with exception of the “P” of the PAD, which is “pain assessment and management”, and the “A” of the ABCDEF bundle, which is “assess, prevent, and manage pain”. The clinical outcome of the patient on the ventilator depends on all the components of the bundle. With “A” as the only remaining part of the bundle that hasn’t been implemented, implementation of the CPOT was a priority in both the ICUs and was fully supported by the ICU leadership team.

The third step of the IOWA model is to form a team (Titler et al., 2001). A team including leadership personnel, clinical educator, clinical nurse leader, ICU pharmacists, Intensivists, and staff nurses was formed to plan for evidence based practice change. The fourth and fifth steps are to assemble, critique, and synthesize relevant research and literature to identify the level of evidence and sufficiency of the evidence to guide the practice change (Titler et al., 2001). A literature review and synthesis of evidence was performed and is included in the next section of this paper. The sixth and seventh steps of the IOWA model is to determine if there is sufficient evidence available to make a practice change and if there is sufficient evidence base then the change is piloted in practice. If there are substantial evidence available, then other types of evidence such as case reports, expert opinions, and scientific principles can be reviewed or new research can be conducted to develop more research evidence (Titler et al., 2001).

If there is sufficient research available to evaluate the process as well as outcomes, then a pilot trial is the next essential step in the EBP process. Piloting will help in identifying the issues with implementation of the practice change in a real-world clinical setting. A pilot implementation is highly interactive and can change the process based on feedback and
feasibility of the practice change. It is a fluid state where the implementation plan can change its course.

After evaluating the outcomes of the pilot test, any needed changes can be incorporated into the implementation plan to prepare for adoption in practice. The eighth and the ninth step for the Iowa model is to deem whether the change is appropriate for adoption and if so, to institute the practice change. Some of the key strategies identified for integration and sustainability of the practice change are: a) identify and engage key personnel, b) hardwire the change into system, c) monitor key indicators through quality improvement, and d) re-infuse as needed (Buckwalter et al., 2017). The revised version of the Iowa Model in 2017 delves deeper into implementation and dissemination science and guides healthcare providers more clearly through the implementation, integration, and sustenance of the practice change. Four phases of implementation include: a) creating awareness and interest, b) building knowledge and commitment, c) promoting action and adoption, and d) pursuing integration and sustainability (Cullen et al., 2017). Once the change is instituted into practice, the structure, process, and outcome data are monitored and analyzed. The last step of the Iowa model is to disseminate the results within the organization and larger healthcare community to expand the nursing knowledge and support the growth of EBP culture (Titler et al., 2001).

**REVIEW OF THE LITERATURE**

A comprehensive literature search was conducted to identify the most current and relevant research available on pain assessment in critically ill ventilator patients. The following keywords and phrases were used with different combination for the literature search: critically ill, ventilator patients, pain assessment, behavioral pain scales, and PAD guideline. The databases utilized for the search are PubMed, CINAHL, Ebsco, Proquest, Google Scholar, and Joanna Briggs. An inclusion criteria of English language, published in the last 15 years and full text
articles were applied. The PAD guidelines were accessed at the Society of Critical Care Medicine website (SCCM.org). The search yielded 11 articles with varying level of clinical evidence, and the articles were critically appraised.

**Psychometric Properties of CPOT**

Varndell et al. (2016) performed a systematic review of the psychometric properties of the five pain assessment scales available for use in nonverbal adult critically ill patients on the ventilator. The five pain assessment scales reviewed were: BPS, CPOT, FLACC, Non-verbal pain scale (NPVS), and Pain Assessment in Advanced Dementia (PAINAD). They reviewed 21 studies from 2001 to 2016 in relevance to validity, reliability, feasibility, and clinical utility among the five different pain assessment scales. Their objective was to review all the available pain assessment tools and identify the most appropriate tool for use in the critically ill adult patients on the ventilator in the emergency department. 14 studies for the CPOT were reviewed as compared to only two available studies for FLACC. The CPOT was identified to be the most extensively tested pain scale for validity, reliability, sensitivity, and specificity. The CPOT also has the most reliable evidence for effective pain assessment in critically ill adult ventilator patients (Varndell et al., 2016). Even though a common limitation among most of the studies were small sample size, convenience sampling, and low item-to-subject ratio, CPOT was found to be tested with adequate sample sizes and item-to-subject ratio. The CPOT was also evaluated vigorously in comparison with the gold-standard pain assessment method of self-report as well as BPS, NVPS, and PAINAD. The systematic review recommended the use of the CPOT for assessment of pain in critical ill adult patients on ventilator in the emergency department (Varndell et al., 2016).
Validity

Validity refers to how well the CPOT pain assessment scale truly measures pain in critically ill ventilator patients. Different aspects of validity such as content validity, criterion validity, and discriminant validity has been extensively studied and yielded statistically significant results to validate the CPOT pain scale (Gélinas et al., 2006; Buttes, Keal, Cronin, Stocks, & Stout, 2014; Echegaray-Benites et al., 2014; Kanji et al., 2016; Chanques et al. 2014; Rijkenberg et al. 2015).

Gélinas et al. (2006) performed a repeated measure quantitative study on 105 post cardiac surgery patients who were on the ventilator. They evaluated the patients at rest, during a painful procedure (positioning), and 20 minutes after positioning at three different testing periods when patient was intubated and unconscious, intubated and conscious, and extubated. Content validity of CPOT was established with indices of 0.88 to 1.00. Criterion Validity was evaluated to analyze the relationship between the COPT scores and the patients’ self-report of pain, which is considered the gold standard for pain assessment. The CPOT scores were higher for intubated patients who also reported pain than those who did not have pain. A moderate correlation was seen between patients’ self-report and CPOT score with Spearman correlation of 0.40-0.59 and P ≤ 0.001 (Gélinas et al., 2006).

Discriminant validity was evaluated to discriminate pain or lack of pain at rest and during a painful procedure of positioning. Results showed that CPOT pain scores increased significantly during positioning compared to at rest and post-positioning. Paired t-test of CPOT scores at rest time and positioning were compared for all three testing periods, and t was calculated to be -9.01, -12.01, -15.96 with P<0.001. This validated the ability of CPOT to discriminate pain during positioning from lack of pain at rest. Limitations of the study included inability to collect data on
all 105 patients on ventilator due to drowsiness and generalizability of these findings of post-cardiac surgery patients to general ICU patients (Gélinas et al., 2006).

Buttes et al. (2014) performed a replication study of the previously discussed study by Gélinas et al. (2006) in post-cardiac surgery patient. They performed a non-randomized prospective study on 75 patients in the general ICU patient population with exclusion of positive CAM-ICU delirium scores and chronic pain history. They completed the CPOT and FLACC scales with randomized order and then asked patients to rate their pain level using Numeric Rating Scale (NRS) either verbally or by pointing to the printed pain scale. Pain assessments were completed at rest, during positioning, and 20 minutes after the positioning procedure. Criterion validity for CPOT with NRS was established with Spearman Correlation of 0.50 to 0.69 and P < 0.001, which indicated a strong correlation between CPOT scores and NRS pain reports. Discriminant Validity was calculated by paired t-tests between assessment performed at rest and during positioning. There was significant increase in CPOT pain score during positioning with mean of 1.85 compared to at rest of 0.60. Limitations of the study included using only two pain-raters and lack of randomization. Researchers suggest that a larger sample size and more nurse raters could improve the reliability of the findings (Buttes et al., 2014).

Validity of the CPOT have also been studied in post-neurosurgical patients. Echegaray-Benites et al. (2014) evaluated the use of the CPOT using a repeated measure with prospective design study in 43 elective brain surgery patients in a Canadian University hospital. Consented facial and behavioral responses of participants were video recorded with non-painful procedure such as manual blood pressure measurement, painful-procedure such as turning, and fifteen minutes after the painful procedure. A total of six CPOT assessments per participants were completed, and self-report of pain was obtained. Results validated criterion validity with a moderate positive correlation with $r = 0.571$ and $P<0.001$ during the turning procedure.
Discriminant validity was also established with a significant increase in the median CPOT score from 0 during blood pressure measurement to 2 during turning procedure. Findings of good correlation of CPOT with self-reports of pain and higher CPOT scores with more painful stimuli adds evidence to the validity of CPOT usage in post-neurosurgical patients (Echegaray-Benites et al., 2014). Limitations of the study included convenience sampling, small sample size, interference of the head bandage with assessment of facial expression, inability to blind raters to the type of procedure, and generalizability of this finding in a sub-population to all other neurosurgical patients (Echegaray-Benites et al., 2014).

Kanji et al. (2016) studied the validity of the CPOT in the critically ill patients with delirium. They conducted a prospective cohort study with n=40 adult patients in ICUs identified with delirium based on the Confusion Assessment Method for ICU (CAM-ICU). A study investigator and a bedside nurse performed CPOT at baseline, during non-painful stimulus of noninvasive blood pressure measurement, and during a painful stimulus of repositioning, endotracheal suctioning, or wound dressing change. Discriminant validity was evaluated by using paired T-tests to compare the baseline scores between a non-painful stimulus and painful stimulus. Results showed that CPOT scores were higher during a painful stimulus than the baseline non-painful stimulus with a mean difference of $3.13 \pm 1.56$, $P<0.001$ and adequate effect size or Cohen D coefficient of 2 ($>0.8$ is significant effect size). Cohen D coefficient or effect size coefficient identifies the ability of the tool to distinguish changes in different situations (Chanques et al., 2014) or the responsiveness of the tool to different situations (Kanji et al., 2016). The researchers also analyzed other psychometric properties of CPOT such as reliability and internal consistency, and their findings will be discussed in this literature review in the appropriate section. A major limitation of this study was the impossibility to compare CPOT with the gold standard self-report of pain since the patients with delirium compromised the validity of
the self-report of pain. Other limitations were that some patients were being treated for delirium and some were not, and hence the validity of CPOT is questionable for the varying severities of delirium. The researchers also felt that standardization of the painful and the non-painful stimulus and evaluation of the recovery period would have generated stronger evidence for discriminant validity (Kanji et al. 2016).

Chanques et al. (2014) compared the psychometric properties of three different pain scales namely CPOT, BPS, and NPVS. Pain assessments were performed by four investigators and 20 nurses before, during, and 10 minutes after routine care procedures in 30 patients in the ICU. They found significant increase in the pain scores from the baseline to procedure as well as significant decrease in pain 10 minutes after the procedure (P<0.001). Discriminant validity was established for CPOT with a calculated effect size of 1.55. Other psychometric properties of the tool such as internal consistency and inter-rater reliability were evaluated in this study and will be discussed in the appropriate section of this literature review. Limitations of the study were that some of the raters could have been more familiar with the NPVS scale and BPS scale and hence created a bias in the results. The researchers felt that more education or training about the pain scales for the raters could have yielded different results (Chanques et al., 2014).

**Inter-rater Reliability**

Inter-rater reliability is the degree to which two raters agree on their measurement, provides a consistent score, and the κ coefficient measures inter-rater reliability with score of 0 – 1. Gélinas et al. (2006) obtained a moderate to high inter-rater reliability with κ coefficient from 0.52 to 0.88 for CPOT.

Marmo and Fowler (2010) compared the CPOT, FLACC, and NPVS pain scales in the critically ill post-cardiac surgery patient population. They performed a descriptive repeated-measures study with (n= 24) nonverbal critically ill patients in a cardiac post-anesthesia unit.
Data were collected before, 1 minute after, and 20 minutes after two painful events of suctioning and repositioning. Results showed that both CPOT and NPVS had high reliability with Cronbach \( \alpha \) coefficient of 0.89, but CPOT had the highest inter-rater reliability compared to FLACC and NPVS. Agreement rates among nurses suctioning and repositioning for each tool was as follows: CPOT scored 80% for suctioning and 85% for repositioning; NPVS scored 78% for suctioning and 79% repositioning; FLACC scored 78% for suctioning and 84% for repositioning (Marmo & Fowler, 2010).

The authors concluded that CPOT is a better tool for pain assessment in post-open heart surgery patients on the ventilator compared with NPVS and FLACC (Marmo & Fowler, 2010). Limitations of this study included; the use of a convenience sample, pain assessments performed only during day shift, and the generalizability of these findings from post-cardiac surgery patients to all other ICU patients (Marmo & Fowler, 2010).

Rijkenberg et al. (2015) compared the psychometric properties between the two most validated behavioral pain assessment tools, CPOT and BPS, for non-verbal mechanically ventilated patients. They conducted a prospective observational cohort study in 68 mechanically ventilated patients in a mixed-adult ICU teaching hospital in Netherlands. The BPS and CPOT were performed simultaneously and independently at four-time intervals: at rest before non-painful procedure, during non-painful procedure, at rest just before painful procedure, and during painful procedure. Oral care was used as non-painful procedure, and turning was used as painful procedure. The nurses for the paired assessments were not randomized, and all four different assessments were performed on the same day between 4am to 10am. All ICU nurses were trained to use BPS and CPOT and a trial run of 1 month was completed (Rijkenberg et al., 2015).

The researchers found evidence of inter-rater reliability for CPOT with an intra-class
correlation coefficient of 0.75, CI 95%, and P 0.001. The intra-class correlation for the BPS scores was 0.74, CI 95%, and P 0.001. There was significant increase in pain scores between rest and non-painful procedure with the use of BPS when the CPOT scores remained the same. This raised the question of discriminant validity of the BPS and further led the researchers to conclude that CPOT was superior to BPS for pain assessment in adult patients on mechanical ventilators in the ICU (Rijkenberg et al., 2015). Limitations of the study were that BPS was always completed first and oral care for non-painful procedure could have affected the assessment of facial expression component of the pain scales. The researchers also identified that training for BPS and CPOT were done for the English version of the tools and actual assessments were performed in a Dutch version, created by a group of hospital staff and a qualified English language translator. Other limitations of the study include relatively small sample size, nurses not blinded to the procedures, and presence of delirium, which could have interfered with the behaviors associated with pain seen in the patients (Rijkenberg et al., 2015).

In the study by Chanques et al. (2014), inter-rater reliability was calculated by the weighted kappa coefficients for a total of 258 paired pain assessments using the three different pain scales. The weighted kappa coefficients of 0.81± 0.03 for CPOT and BPS were significantly higher than NVPS (0.71+/-0.04). This finding showed almost near perfect inter-rater reliability for CPOT and BPS (Chanques et al., 2014). Similar findings with strong inter-rater reliability were seen by Kanji et al. (2016) with κ of 0.669 and inter-class correlation r of 0.957 in the nonverbal ICU patients with delirium. Gélinas, Arbour, Michaud, Vaillant, and Desjardins (2011) also found inter-rater reliability scoring of 87% to 100% for 29 nurses evaluated at 12 months post-implementation of CPOT assessment tool.
Internal Consistency

Internal consistency is the measure of how consistent the results are for different domains for the same construct. The internal consistency has been evaluated for the CPOT by several studies by using the Cronbach-\(\alpha\) method. A Cronbach-\(\alpha\) value of 0.7 or higher validates internal consistency of the tool and reflects high inter-relation between the different domains of the tool (Chanques et al. 2014). A high level of internal consistency with Cronbach-\(\alpha\) coefficient of 0.81 for CPOT compared to 0.80 for BPS and 0.76 for NVPS was found. (Chanques et al., 2014). Likewise, Kanji et al. (2016) obtained overall Cronbach \(\alpha\) of 0.778 for CPOT usage in ICU patients with delirium and Rijkenberg et al. (2015) found satisfactory internal consistency of Cronbach \(\alpha\) values of 0.71 during painful procedure for CPOT compared to 0.70 for BPS. All these studies substantiate ample evidence that there is high correlation between the four domains of the CPOT tool.

Sensitivity and Specificity

Interventions for pain management for non-verbal patients on the ventilator usually involve high doses of intravenous pain medications, such as, Fentanyl and Hydromorphone. Therefore, it is salient to use a pain assessment tool that is not only valid and reliable but also has high specificity and sensitivity. High specificity value indicates that pain scores truly represent pain and not some other conditions like delirium or psychosis. It reduces the rate of false positive identification of pain and will prevent overmedication for pain. High sensitivity value indicates that all pain episodes will be identified and not missed or overlooked. This minimizes the risk for false negative assessments and provides appropriate pain management for the patients.

Gélinas et al. (2009) further investigated the sensitivity and specificity of the CPOT in adult ventilator patients after cardiac surgery. They evaluated 105 patients over three months and
compared pain at rest (pre-exposure), during painful procedure of repositioning (exposure), and 20 minutes after pain procedure (post-exposure). CPOT pain assessments were completed first to minimize bias. The patient was asked to nod if having pain or not and then asked to rate pain by using the Descriptive Pain Scale or Faces Pain Thermometer to score their pain. The researchers found that CPOT had a high sensitivity value of 86% and specificity value of 78% during painful procedures. The sensitivity and specificity for post-exposure were 63% and 97.4%. However, the pre-exposure sensitivity was lower at 47.2%, and specificity was 82.9%. This could indicate that CPOT is not as effective in identifying mild or moderate baseline pain experienced by post-cardiac surgery patients at rest. The sensitivity and specificity of the CPOT needs to be further investigated with different patient populations (Gélinas et al., 2009).

**Clinical Outcomes after CPOT implementation**

Extensive studies and research have identified a useful and effective pain assessment tool for non-communicative patients requiring mechanical ventilation. However, minimal studies have investigated the effects of implementation of the CPOT or the BPS scales on pain management and clinical outcomes. In theory, an effective pain assessment tool should improve nursing pain management practices, provide better pain relief, reduce the amount of sedation needed, which in turn should reduce delirium, improve mobility compliance, decrease ventilator days due to improved compliance with ventilator weaning, and decrease ICU length of stay. But how much of this hypothesis stands true or not needs to be further investigated.

In 2011, Arbour et al. were the first to conduct a study to evaluate the effects of implementing the CPOT on pain management and clinical outcomes in mechanically ventilated trauma ICU patients. They performed a pilot pre-experimental before and after study with a sample of 30 medical files, which included 15 pre-implementation and 15 post-implementation of the CPOT. Nurses were trained in a 90-minute training session, and CPOT was included in the
ICU nursing flow sheet. Researchers found that pain was assessed three times more often in the post-implementation group and the frequency of pain episodes were four times higher in the post-implementation group than in the pre-implementation group. More analgesics and higher doses of analgesics were given in the post-implementation group compared to the pre-implementation group. Sedatives or Propofol was used as much as two times more in the pre-implementation group compared to the post-implementation group. The rates of pain reassessment documentation by nurses in the post-implementation group were 93.3% compared to 40% in the pre-implementation group. Although more analgesics were administered in the post-implementation, better efficiency of the pharmacological interventions were also noted (Arbour et al., 2011).

The number of complications were reduced from a mean of 4.53 pre-implementation to 1.87 post-implementation and ICU LOS mean of 10.53 days pre-implementation to 5.33 days post-implementation. A decrease in number of ventilator days was also noted from 6.93 days pre-implementation to 4 days post-implementation but no statistical difference was found (Arbour et al., 2011). Limitations of the study were small sample size with a homogenous group of only trauma patients, which reduced the generalizability to the general ICU population. The familiarity of the nurses with CPOT can generate bias and results can be different in the other ICUs where different tools were used. Another limitation was that the medication order practices were not consistent among all patients and this may affect the efficiency of the pharmacological interventions (Arbour et al., 2011).

Gélinas, Arbour, Michaud, Vaillant, and Desjardins (2011) also performed a before and after study to evaluate the effects of implementation of CPOT on nurses’ pain assessment and pain management practices. They reviewed 30 medical files at pre-implementation, another 30 files at 3 months post-implementation, and another 30 files at 12 months post-implementation.
Evaluation of reports of pain, behaviors indicative of pain, administration of analgesia and sedative, and the reports of effectiveness of pharmacological interventions were completed. Results showed that post-implementation reports of pain had increased to 10.5 assessments in 24-hour period compared to pre-implementation report of 3 assessments in 24-hour period. The 12-months post-implementation evaluation also showed much higher reports of pain at 12 assessments in 24 periods, which was about four times the pre-implementation rate. The pain reassessment rates after the pharmacological intervention had also increased from 9.92% pre-implementation to 43.1% at 3-months post-implementation, and 59.1% at 12-months post-implementation. Likewise, the effectiveness of pain intervention had also increased from 64.3% pre-implementation to 75% at 3-months post-implementation, and 80.8% at 12-months post-implementation. Their findings also included a decrease in analgesic boluses and sedative (Propofol) boluses given in the post-implementation phase. The increase in nursing documentation in reports of pain and reassessment of pain can be attributed to the higher sensitivity and specificity level of CPOT. Other factors like recent training and incorporating CPOT use in the standard of care could have increased the rate of documentation (Gélinas et al., 2011).

The limitation of the study was that the institution had changed from tertiary trauma center to secondary trauma center and hence the number of trauma patients in the study had decreased to 4 trauma patients at 12-months post-implementation from 9 at the pre-implementation and 3-months post-implementation period. This could have affected the prevalence and incidence of pain since generally trauma patients experience more acute pain and require more pharmacological interventions. Other limitation of the study was high turn-over rate of nurses which allowed for the trained nurses count to decrease from 60 at pre-implementation to 29 at post-implementation (Gélinas et al., 2011).
The current Pain, Agitation, Delirium (PAD) guidelines by SCCM recommends using either the CPOT or BPS for effective pain assessment (Barr et al., 2013). Many research studies have been completed to establish the validity and reliability of the CPOT and BPS pain scales in various patient populations in the critical care such as: trauma, medical, neurosurgical, cardiovascular surgery, and dementia. However, there remains a research gap linking the association between the use of the CPOT and improved clinical outcomes such as: mortality, complications, patient satisfaction, LOS, delirium, chronic pain, and post-ICU syndrome. More randomized clinical studies are needed to investigate the impacts of effective pain assessment and clinical outcomes (Georgious, Hadjibalassi, Lambrinou, Andreou, & Papathanassoglou, 2015).

**METHODOLOGY**

**Design**

This study utilized the IOWA Model of evidence-based practice change to translate evidence into clinical practice. A descriptive study design was used to compare the before and after implementation groups. Patients’ charts were reviewed to evaluate patient outcomes and surveys from nurses were used to evaluate for CPOT feasibility and applicability. This project was inspired from the works of Arbour et al. (2011), Gélinas (2010), and Gélinas et al. (2011) and certain elements of this project’s design were adapted and replicated from those studies.

**Setting and Sample**

The ICU at VVH has a 6-bed capacity with a mixture of medical and surgical ICU patients. The ICU at North Bay has a 24-bed capacity with a mixture of medical, trauma, surgical, and cardiac ICU patients.

The sample of patients was obtained from a list of ICU patients on the ventilator for 3 months in 2017 during the pre-implementation phase and 3 months in 2018 during the post-
implementation phase. The inclusion criteria were non-communicative ICU adult patients with mechanical ventilation for 24 hours or more. The exclusion criteria included patients who received neuromuscular blockade infusions and who were ventilated for less than 24 hours. ICU patients were listed based on the chronological order of the date of their intubation. From the list of patients for months of May, June, and July in 2017, patients’ charts were reviewed and the first forty patients that met the inclusion criteria was used as pre-implementation patient sample. From the list of patients for months of June, July, and August in 2018, patients’ charts were reviewed, and the first forty patients that met the inclusion criteria were used as post-implementation patient sample. A sample size of 40 was used in each group in order to achieve 80% power and a Type I Error Rate of 0.05. All analyses were conducted using R Statistical Software version 3.44.

Nursing participants included ICU nurses who completed a voluntary survey pre- and post-implementation of the CPOT to assess for their knowledge, adequacy of the training program, and feasibility of the pain tool. Nurse participants were all ICU nurses who routinely assessed pain in critically ill, intubated patients. Educational level of the nurses included Associate degree in Nursing, Bachelor of Science in Nursing, and Master of Science in Nursing. Participants included nurses from both day and night shifts.

**Ethics**

The Institutional Review Board (IRB) of Touro University approved this study in December 2017. After the university’s approval, this study was submitted to the North Bay Health Care’s IRB. A review presentation was done in December 2017 for the North Bay IRB board. However, the study was not approved for implementation due to some necessary changes required to the electronic Medication Administration Record (eMAR) of the electronic health record (EHR). After three months, the necessary changes to the eMAR and integration of the
CPOT pain scale in the EHR were completed by the end of March 2018. The study was hence re-submitted for IRB approval to the North Bay IRB in April 2018. The North Bay IRB at that time approved this EBP research and the pilot study was commenced.

**Study Procedures**

**Implementation Planning Phase**

During the planning phase of this project, a CPOT change team was formed with the clinical nurse leader, clinical educator, clinical coordinator, lead nurses, and staff change agents, who were willing to be change champions and clinical resources for staff. The DNP candidate primarily conducted educational sessions except for four sessions that were taught by two change agents, Rani Barrera and Arold Nelson. Meetings with ICU director, clinical nurse specialist, ICU pharmacy director, and health informatics director were completed successfully to discuss the plan for transition from the FLACC to the CPOT in the EHR. Multiple individual meetings were also held with ICU Medical Director, ICU physicians, ICU pharmacists, and respiratory therapists to update them about the progress of the project. The original plan was to complete the education in December 2017 during the fourth quarter mandatory ICU nursing skills fair and start implementation of CPOT by January 4th, 2018.

**Nursing Education**

ICU nurses were trained in a 20-minute training session during twelve different mandatory ICU skills fair sessions from November 2nd, 2017 to December 6th, 2017. This training was conducted prior to the research approval with permission from the ICU management team in order to coincide the training times with the last mandatory ICU skills fair in 2017. The training included power point presentation, video case presentations, CPOT handouts, and CPOT scoring exercises. Topics for the presentation included importance of accurate pain assessment and management, introduction to use of CPOT, training video presentation, and CPOT scoring
exercises for three patients’ video case-scenarios. The CPOT training material available publicly from the SCCM ICU liberation webpage and American Association of Critical Care Nurses webpage were utilized to create an educational power point and video presentation for the NBMC and VVH ICU nurses. Nurses were provided with opportunities to ask questions during the training session and encouraged to contact the CPOT change agents in the units with any questions or barriers. Prior to the training, nurses were requested to complete the Feasibility and Applicability Survey for the current pain scale used, FLACC (Appendix D). A paper documentation tool for the CPOT was developed in case the CPOT was not incorporated into the EHR by January 4th (Appendix C). The paper documentation form also included a reference on the back of the form for staff to refer for appropriate scoring of CPOT (Appendix C). However, the paper documentation form was not used in this project because CPOT documentation was already incorporated in the EHR by the time the second IRB approval process was obtained.

**EHR Modifications**

The CPOT pain scale ranged from 0-8 compared to the Numeric pain scale or FLACC that ranged from 0-10. This created a discrepancy in the interpretation of the numeric values as mild, moderate, or severe pain. For example, a pain rating of 7 would be severe pain based on CPOT scale but could be interpreted as moderate pain based on FLACC scale. The Cerner EHR system used by both NBMC and VVH had eMAR orders that were built-in for “prn” or as needed doses of analgesics with numeric ranges next to it such as “prn moderate pain (4-7) or prn severe pain (8-10)”. This created a huge hurdle for implementation of CPOT since many different order sets for admission, post-surgical, analgesics, etc. had to be changed to remove the numeric ratings on the eMARs. Hence, repeated meetings and requests were submitted to the hospital Information Technology department and Nursing Informatics representatives to expedite the required changes to the eMAR in order to safely implement this project.
Pilot Trial

There was a delay of almost four months between the delivery of nursing education and implementation of the CPOT in the units. Once NorthBay IRB approval was obtained in April of 2018, a pilot trial was launched in both ICU units for two weeks with use of the CPOT scale for pain assessment and reassessment. During the pilot trial period, poster boards and CPOT reference flyers were available in the ICUs at NBMC and VVH. The CPOT training power point presentation was also saved in the ICU K drive so that it is easily accessible by staff from any computer in the organization. A unit huddle guide was created and communicated during shift huddles to reinforce the appropriate use of CPOT in the ventilator patients (Appendix F). An organizational huddle guide was also created and communicated with the other units in the organization to provide seamless pain assessment and pain management of patients transferring from the ICU to the other units (Appendix G). Education about CPOT assessment was continually reinforced during daily shift huddle meetings. Feedback and suggestions were obtained to improve the implementation process. An email communication was also received informing the implementation team of a missing CPOT documentation link on the eMAR task list for pain response documentation. An urgent IT ticket was submitted to the nursing informatics department and the missing task link on the eMAR was created promptly. During the pilot trial, inter-rater reliability of the CPOT among ICU nurses was assessed. 30 pain assessment observations were completed between the bedside nurses, DNP candidate, and two change agents.

Resources

The resources needed for the implementation of this project were the venue and time for staff training, paper documentation supplies, ICU management personnel’s time for meetings, and nursing informatics team’s time to incorporate CPOT in the Cerner EHR. Since this
evidence-based practice change is recommended by SCCM and is a part of the PAD guidelines, NorthBay ICU management team agreed to allow the training of the staff during the ICU skills fair. Appropriate pain management has been one of the quality indicators of our organization’s patient satisfaction survey and it was identified as one of the annual performance improvement goals for both ICUs in 2018.

**Data Collection**

**Inter-Rater Reliability**

During the pilot trial, inter-rater reliability among raters was measured between bedside nurses and three educators on thirty different pain assessment observations.

**Nursing Feasibility and Applicability Survey**

During the twelve different training sessions for CPOT in November and December of 2017, nurses were asked to complete a voluntary survey of feasibility and applicability of the FLACC scale at the beginning of each training session (APPENDIX D). Again, at two months post-implementation of the CPOT, voluntary nursing surveys were used to assess the feasibility and applicability of the CPOT scale and were distributed to the ICU nurses at both hospitals and results were collected (APPENDIX E).

**Pain Assessments, Pain reports, and Reassessment Frequencies**

A list of all the patients on the ventilator was received from the Respiratory Therapy Department’s manager for three months in 2017 for pre-implementation data collection and three months in 2018 for post-implementation data collection. EHRs were reviewed and the first forty patients meeting the inclusion criteria from May to July, 2017 were used as the sample population for pre-implementation phase. The first forty patients meeting inclusion criteria from June to August 2018 were used as the sample population for post-implementation phase. Each patient chart was reviewed for the first 24 hours post-intubation to collect data on number of pain
assessment, reports of pain episodes, and number of pain reassessment. Other relevant data such as gender, age, classification of medical, surgical, or trauma patient status were also collected.

**Administration of Analgesics**

From the EHR review, the amount of analgesic medications administered to the participants for the first 24 hours post-intubation were recorded. Total amounts of the analgesics were derived from the eMAR summary and Intake and Output documentation for the continuous analgesic infusions. Non-fentanyl analgesics such as Hydromorphone and Morphine were converted to equivalent dosage of fentanyl based on the narcotic equivalency chart (Table 1).

<table>
<thead>
<tr>
<th>EQUI-ANALGESIC DOSE (mg) – IV</th>
<th>EQUI-ANALGESIC DOSE (mg) – P.O.</th>
<th>TIME TO ONSET</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fentanyl</strong></td>
<td>0.1</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Hydromorphone</strong></td>
<td>1.5</td>
<td>7.5</td>
</tr>
<tr>
<td><strong>Morphine</strong></td>
<td>10</td>
<td>30</td>
</tr>
</tbody>
</table>

**Ventilator Days**

Each patient’s EHR was reviewed to identify the number of ventilator days. Days were counted as each calendar day of mechanical ventilation starting at 0000 hour.

**ICU Days**

Each patient’s EHR was reviewed to find the date of admission or transfer order to the ICU and date of transfer or discharge from the ICU. Days in the ICU were counted as each calendar day starting at 0000 hour.
Data Analysis and Management

Data Analysis

Two sample T-test statistics were used to compare the means between the pre-implementation and post-implementation patient population groups to determine if there were statistically significant difference among the various measured outcomes. Inter-rater reliability percentage was calculated based on the thirty pain assessment observations. The nursing survey results were compared by the percentage agreement from the questions presented on the FLACC and CPOT survey.

Security of Data

The data was de-identified and entered into an Excel Spreadsheet that was saved in the ICU drive space named the “K drive” in the NorthBay Healthcare’s computer system. Only the DNP candidate had access to the participants’ names, which were saved on a list in protected Cerner EHR. Access to the Cerner EHR requires an individual’s user identification and password. The data entered into the Excel spreadsheet referred to the participants by serial numbers to maintain confidentiality.

RESULTS AND FINDINGS

Description of the Sample

Patient Sample Characteristics

From the pre-implementation phase, a total of 96 patient charts were reviewed and 56 patient charts met exclusion criteria. 48 were excluded due to less than 24 hours of mechanical ventilation, and 8 were excluded because of paralytic medication infusions such as Vecuronium or Rocuronium infusion. The final sample included 40 patient charts from pre-implementation phase. The mean age was 64.55 years with 47.5% males and 52.5% females. 5% of the sample
(n=2) was trauma ICU patients, and 95% of the sample (n=38) was medical surgical ICU patients (Table 2).

From the post-implementation phase, a total of 72 patient charts were reviewed, and 32 patient charts met exclusion criteria. 32 were excluded due to less than 24 hours of mechanical ventilation, and no patients had received paralytic medication infusions. The final sample included 40 patient charts from the post-implementation phase. The mean age was 66.70 years with 62.5% males and 37.5% females. 2.5% of the sample (n=1) was a trauma ICU patient, and 97.5% of the sample (n=39) were medical surgical ICU patients (Table 2).

**TABLE 2. Characteristics of the Patient Sample**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Pre-Implementation Group</th>
<th>Post-Implementation Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (%)</td>
<td>47.5</td>
<td>62.5</td>
</tr>
<tr>
<td>Female (%)</td>
<td>52.5</td>
<td>37.5</td>
</tr>
<tr>
<td>Trauma (%)</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>Medical Surgical (%)</td>
<td>95</td>
<td>97.5</td>
</tr>
<tr>
<td>Mean Age</td>
<td>64.5</td>
<td>66.7</td>
</tr>
<tr>
<td>Min Age</td>
<td>26</td>
<td>20</td>
</tr>
<tr>
<td>Max Age</td>
<td>92</td>
<td>93</td>
</tr>
</tbody>
</table>

**Nurse Participants**

The nurse participants were ICU nurses that were full time, part-time, or on-call. Their level of education included: an associate degree in nursing, a bachelor’s degree in nursing, or a master’s degree in nursing. Seventy-five nurses from NBMC attended the CPOT training. Three nurses were sick and nine were on leave of absence. Thirty-one nurses from VVH attended the CPOT training and one nurse was on a leave of absence.
Process Measure Findings

Inter-rater Reliability of ICU Nurses in Using the CPOT

The inter-rater reliability assessed between ICU nurses on 30 different pain observation assessments showed an agreement of 93.3%.

Pain Assessment Frequency

In the pre-implementation group, the pain assessment frequency ranged from 5 assessments to 24 assessments in a 24-hour period with a mean of 13. In the post-implementation group, the pain assessment frequency ranged from 9 to 23 assessments in a 24-hour period with a mean of 13.28. A Two-Sample Wilcoxon Rank Sum Test indicated there was no significant increase in mean pain assessment (Z= 0.88, p=0.37).

Pain Reassessment Frequency

In the pre-implementation group, the pain reassessment frequency ranged from none to 5 reassessments in a 24-hour period. In the post-implementation group, the pain assessment frequency ranged from none to 8 reassessments in a 24-hour period. A Two-Sample T Test indicated there was a significant increase in reassessment (t=2.22, p=0.02). The mean was 0.55 for the pre-implementation group and 1.425 for the post-implementation group. The graph below shows the comparison of number of reassessments.
FIGURE 1. Comparison of pain reassessment frequencies

Structure Measure Findings

Reports of Pain

In the pre-implementation group, the reports of pain ranged from none to 16 times in a 24-hour period with a mean of 2.825. In the post-implementation group, the reports of pain ranged from none to 8 times in a 24-hour period with a mean of 1.925. A Two-Sample T-Test indicated there was no significant increase in number of pain episodes (t=1.39, p=0.91).

Administration of Analgesics

In the pre-implementation group, 31 out of 40 participants received some form of pharmacological analgesic intervention. Fentanyl was administered for the majority of the patients with exception of 5 patients who received other forms of analgesia such as Morphine Sulfate or Hydromorphone. All non-fentanyl analgesic dosages were calculated based on the equi-analgesic dosage chart and resulted in milligrams (mg) of fentanyl dosage. The pre-implementation group had received a total of 26.96 mg of Fentanyl dosage.
In the post-implementation group, 27 out of 40 participants received some form of pharmacological analgesic intervention. 3 out of 27 patients were administered Hydromorphone for pain control, and the remaining patients received Fentanyl. The post-implementation group received a total of 25.22 mg of Fentanyl dosage. A Two-Sample T-Test indicated there was no significant difference in fentanyl dosage given (t=0.19, p=0.57) between pre-implementation and post-implementation groups.

**Outcome Measure Findings**

**Ventilator Days**

Ventilator days ranged from 2 days to 26 days in the pre-implementation group compared to 2 days to 21 days in the post-implementation group. The means showed a small decrease from 6.525 days to 6.075 days, but it was not statistically significant based on a Two-Sample T-Test (t=0.39, p=0.35).

**TABLE 3. Comparison of Clinical Outcomes Between Groups**

<table>
<thead>
<tr>
<th></th>
<th>Pre-implementation group (mean)</th>
<th>Post-implementation group (mean)</th>
<th>Statistical Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pain Assessment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>13</td>
<td>13.28</td>
<td>Wilcoxon Rank Sum Test</td>
</tr>
<tr>
<td><strong>Number of Pain Reports</strong></td>
<td>2.825</td>
<td>1.925</td>
<td>Welch Two Sample T test</td>
</tr>
<tr>
<td><strong>Amount of Fentanyl (mg) given</strong></td>
<td>0.674</td>
<td>0.630</td>
<td>Welch Two Sample T test</td>
</tr>
<tr>
<td><strong>Pain Reassessment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>0.55</td>
<td>1.425</td>
<td>Welch Two Sample T test</td>
</tr>
<tr>
<td><strong>Ventilator Days</strong></td>
<td>6.525</td>
<td>6.075</td>
<td>Welch Two Sample T test</td>
</tr>
<tr>
<td><strong>ICU Days</strong></td>
<td>8.525</td>
<td>7.575</td>
<td>Welch Two Sample T test</td>
</tr>
</tbody>
</table>
ICU Days

ICU days ranged from 3 days to 26 days in the pre-implementation group compared to 2 days to 26 days in the post-implementation group. The means showed a decrease from 7.5 days to 5.5 days but there was no statistical significant difference based on a Two-Sample T-Test (t=0.77, p=0.22).

Nursing Feasibility and Applicability Survey Findings

Pre-Implementation Survey on FLACC Scale

During the pre-implementation phase, 70 nurses completed the survey prior to the CPOT training. 48.5% agreed and 51.5% disagreed that FLACC is validated pain assessment tool for critically ill adults. 45.7% agreed and 54.3% disagreed that FLACC helps to assess pain accurately in critically ill adult patients. 91.4% of the nurse participants agreed that FLACC pain scale was easy to use. 61.4% of the nurse participants agreed that they received adequate training for the FLACC pain scale. 61.4% also agreed that FLACC pain scale had positively influenced their practice (FIGURE 2).

Post-Implementation Survey on CPOT Scale

During the post-implementation phase, 49 nurses completed the survey on the CPOT one month after using the tool in the unit. 97.95% agreed that CPOT is a validated pain assessment tool for critically ill adults. 100% of the nurse participants agreed that the CPOT tool was easy to use. 95.9% agreed that the CPOT helped them to assess pain accurately in critically ill adult patients on ventilator. 100% of the nurse participants agreed that they received adequate training for the CPOT pain scale. 93.8% agreed that the CPOT pain scale had positively influenced their practice (FIGURE 2).
DISCUSSION OF FINDINGS

Summary

Implementation of the CPOT in the two ICUs provided an evidence-based pain assessment scale for the ICU clinicians to appropriately assess and manage pain in critically ill non-communicative patients. Nurses were trained effectively on how to assess pain using the CPOT and re-educated on the hospital’s standard policy regarding the assessment, monitoring, and management of pain.

The expected outcomes from this study were; a) increased frequency of pain assessment, b) increase in patient reported pain, c) increase in pain reassessments, d) increase in analgesic usage, e) decrease in ventilator days, and f) decrease in ICU length of stay. The results showed a significant increase in number of pain reassessments but no significant difference in rest of the outcomes. There was no statistical difference in the means of pain assessment in the pre-implementation group (M = 13, SD 3.64)) and post-implementation group (M = 13.28, SD 2.76).
One possible reason for this could be that nurses were required to assess and document for pain every two hours in compliance with the hospital pain policy. Hence, it was required for the nurses to document at least 12 pain assessments for all ICU patients in a 24-hour period.

The pain reassessment documentation rate increased significantly from a mean of 0.55 for the pre-implementation group to 1.425 for the post-implementation group (t=2.22, p=0.02). This may be due to the fact that the nurses were provided recent education on CPOT documentation and the importance of performing reassessments promptly in order to assess for uncontrolled pain was emphasized. Due to the higher sensitivity of the CPOT in assessing for pain compared to all other pain scales (Gélinas et al., 2009), it was hypothesized that an increase in pain reports and increase in analgesic usage would be seen in post-implementation group. However, a Two-Sample T-Test indicated there was no significant increase in number of pain episodes (t=1.39, p=0.91) and amount of fentanyl dosages given (t=0.19, p=0.57).

Multiple factors can influence these findings such as patient acuity, history of chronic pain, surgical versus nonsurgical patients, and the difference in pain management practices among healthcare providers.

Findings from the nursing surveys about the FLACC showed that 48.5% of the nurses thought that FLACC was a validated pain assessment tool in the adult patient population. This finding identified a significant nursing knowledge gap since the PAD guidelines were published in 2013 and the CPOT was recommended as an evidence-based pain assessment tool for critically ill adult patients. However, after the CPOT education and implementation, 97.9% nurses agreed that the CPOT is a valid pain tool for the critically ill intubated adult patients. Both the FLACC (91.4%) and the CPOT (100%) were found to be easy to use by the nurses. Results showed that 100% of the nurses believed that they were trained effectively on the use of the CPOT and 95.9% felt that the CPOT helped them to assess pain accurately. The reason for more
accurate pain assessment could be due to the ability of the CPOT to evaluate for ventilator compliance and vocalization, which was not included in the FLACC. Ventilator compliance is crucial in improving a patient’s clinical condition and incorporating ventilation into pain assessment allowed the nurses to manage pain and improve ventilation with the use of analgesics. 93.8% of the nurses agreed that the CPOT had positively influenced their practice. The prior nursing practice would be to administer more sedative medications, which could improve ventilation but also mask the pain symptoms resulting in the undue suffering of the patients.

**Strengths of the Study**

The strength of this study was that there was abundant evidence and established critical care guidelines that supported the use of the intervention implemented in this project. Prior to this practice change, the NBMC and VVH ICUs were using a pain scale developed for non-verbal pediatric patients to assess pain in adult patients. Implementation of the CPOT was the final intervention to complete the full ABCDE bundle. Additionally, the incorporation of the PAD guidelines into clinical practice will improve pain management, reduce delirium, improve mobility, decrease ventilator days, improve patient outcomes, and reduce ICU related PTSD. The enthusiasm and unwavering support from the ICU leadership team, medical providers, and ICU nurses to incorporate this evidence-based intervention in daily patient care was a key driver for this project. Some of the nursing staff had already used the CPOT in other healthcare facilities, and this allowed for an easier adoption of the practice change. Another strength of this project was that the education was provided during a mandatory ICU skills fair session, which ensured maximum knowledge dissemination to staff prior to implementation. Adequate time was allotted to educate the nurses on how to use the CPOT and complete practice exercises on videotaped patient case scenarios.
As a Magnet hospital with a nursing shared governance structure, an evidence-based practice (EBP) council was already in place. EBP champions were early adopters of this practice change and were key to the integration of the practice change. To promote sustainability, huddle-guide communication was sent to the ICU staff that the CPOT will be utilized for all ICU patients who are on ventilator and non-communicative. For sustenance of practice change, the ICU management team will update the organization’s “Pain assessment and Management Policy” to include the CPOT.

**Limitations of the Study**

The nursing staff education was completed in December 2017 and the study was approved by NorthBay’s IRB in April 2018. There was a delay of nearly four months between the delivery of nursing education and the actual implementation of the CPOT practice change due to necessary EHR changes that needed to be addressed before rolling out the CPOT project. Although NorthBay Medical Center is a Level II trauma center with neurosurgery, cardiothoracic, and other surgery services, the trauma patients accounted only for 5% (n=40) of the pre-implementation sample and 2.5% (n=40) of the post-implementation sample. Cardiothoracic patients were usually extubated within the first 24 hours and did not meet the criteria for the sample selection. Thus, the findings from this project cannot be generalized to ICU trauma patients and post-cardiothoracic patients.

Pain management practices differed between medical providers, and both the hospitals did not have a standardized pain management plan. ICU clinicians now have the CPOT available to use because of this DNP project. The next step would be to implement a standardized pain management algorithm. The ICU Medical Director has requested this DNP prepared nurse to research any evidence regarding the implementation of a standardized pain management algorithm for the ICU patient population. For future research, it will be interesting to study the impacts of the implementation of the CPOT with a standardized pain management practice on clinical
outcomes such as delirium, length of ventilator days, ICU length of stay, development of chronic pain, and ICU related PTSD. Dissemination of this project’s findings to other units such as the emergency departments of the organization will be beneficial since those departments also care for critically ill adult non-communicative patients.

**Conclusion**

Pain assessment and monitoring using a validated pain tool paired with adequate pain management is fundamental in successfully liberating patients from the ventilator. In order to achieve this, NBMC and VVH ICUs has successfully implemented evidence-based practice changes for spontaneous awakening and breathing trials, delirium assessment and management, and early progressive mobility. However, a very crucial component of the care of a patient on ventilator is accurate pain assessment and adequate pain management. This evidence-based project completed the last piece of the ABCDE bundle for the ICUs at VVH and NBMC. The findings from this study demonstrated a significant increase in pain reassessments and effective CPOT education. Implementation of the CPOT provided the healthcare team with a valid and reliable behavior-based pain scale for identifying and monitoring pain. As a DNP prepared nurse, this project provided me the opportunity to analyze and critique the existing body of research, synthesize evidence, identify gaps in knowledge, and translate the current evidence-based practices into clinical practice by utilizing dissemination and implementation science.
### APPENDIX A: The Critical-Care Pain Observation Tool (CPOT)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial expressions</td>
<td>Relaxed, neutral</td>
<td>No muscle tension observed</td>
</tr>
<tr>
<td></td>
<td>Tense 1</td>
<td>Presence of frowning, brow lowering, orbit tightening and levator contraction or any other change (e.g. opening eyes or tearing during nociceptive procedures)</td>
</tr>
<tr>
<td></td>
<td>Grimacing 2</td>
<td>All previous facial movements plus eyelid tightly closed (the patient may present with mouth open or biting the endotracheal tube)</td>
</tr>
<tr>
<td>Body movements</td>
<td>Absence of movements or normal position</td>
<td>Does not move at all (doesn’t necessarily mean absence of pain) or normal position (movements not aimed toward the pain site or not made for the purpose of protection)</td>
</tr>
<tr>
<td></td>
<td>Protection 1</td>
<td>Slow, cautious movements, touching or rubbing the pain site, seeking attention through movements</td>
</tr>
<tr>
<td></td>
<td>Restlessness/Agitation 2</td>
<td>Pulling tube, attempting to sit up, moving limbs/thrashing, not following commands, striking at staff, trying to climb out of bed</td>
</tr>
<tr>
<td>Compliance with the ventilator (intubated patients)</td>
<td>Tolerating ventilator or movement</td>
<td>Alarms not activated, easy ventilation</td>
</tr>
<tr>
<td></td>
<td>Coughing but tolerating</td>
<td>Coughing, alarms may be activated but stop spontaneously</td>
</tr>
<tr>
<td>OR</td>
<td>Fighting ventilator 2</td>
<td>Asynchrony: blocking ventilation, alarms frequently activated</td>
</tr>
<tr>
<td>Vocalization (extubated patients)</td>
<td>Talking in normal tone or no sound</td>
<td>Talking in normal tone or no sound</td>
</tr>
<tr>
<td></td>
<td>Sighing, moaning 1</td>
<td>Sighing, moaning</td>
</tr>
<tr>
<td></td>
<td>Crying out, sobbing 2</td>
<td>Crying out, sobbing</td>
</tr>
<tr>
<td>Muscle tension</td>
<td>Relaxed 0</td>
<td>No resistance to passive movements</td>
</tr>
<tr>
<td>Evaluation by passive flexion and extension of upper limbs when patient is at rest or evaluation when patient is being turned</td>
<td>Tense, rigid 1</td>
<td>Resistance to passive movements</td>
</tr>
<tr>
<td></td>
<td>Very tense or rigid 2</td>
<td>Strong resistance to passive movements or incapacity to complete them</td>
</tr>
<tr>
<td>TOTAL</td>
<td>____ / 8</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B: THE IOWA MODEL

Problem Focused Triggers
1. Risk Management Data
2. Process Improvement Data
3. Internal/External Benchmarking Data
4. Financial Data
5. Identification of Clinical Problem

Knowledge Focused Triggers
1. New Research or Other Literature
2. National Agencies or Organizational Standards & Guidelines
3. Philosophies of Care
4. Questions from institutional Standards Committee

Consider Other Triggers

Is the Topic a Priority For the Organization?
Yes

No

Form a Team

Assemble Relevant Research & Related Literature

Critique & Synthesize Research for Use in Practice

Is There a Sufficient Research Base?
Yes

No

Pilot the Change in Practice
1. Select Outcomes to be Achieved
2. Collect Baseline Data
3. Design Evidence-Based Practice (EBP) Guidelines(s)
4. Implement EBP on Pilot Units
5. Evaluate Process & Outcomes
6. Modify the Practice Guideline

Base Practice on Other Types of Evidence:
1. Case Reports
2. Expert Opinion
3. Scientific Principles
4. Theory

Conduct Research

Is Change Appropriate for Adoption in Practice?
Yes

Institute the Change in Practice

No

Continue to Evaluate Quality of Care and New Knowledge

Disseminate Results

= a decision point
## APPENDIX C: CPOT PAPER DOCUMENTATION (FRONT PAGE)

### CPOT PAIN DOCUMENTATION

<table>
<thead>
<tr>
<th>Time:</th>
<th>Facial Expressions</th>
<th>Facial Expressions</th>
<th>Facial Expressions</th>
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<tbody>
<tr>
<td></td>
<td>Body Movements</td>
<td>Body Movements</td>
<td>Body Movements</td>
</tr>
<tr>
<td></td>
<td>Compliance w/ Vent</td>
<td>Compliance w/ Vent</td>
<td>Compliance w/ Vent</td>
</tr>
<tr>
<td></td>
<td>Muscle tension</td>
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<td>Muscle tension</td>
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<tr>
<td>Total Score:</td>
<td></td>
<td>Total Score:</td>
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</tr>
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<table>
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<tr>
<th>Time:</th>
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## The Critical-Care Pain Observation Tool (CPOT)

(Adapted from Gélinas et al., AJCC 2006; 15(4):420-427)

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<td></td>
</tr>
<tr>
<td>Relaxed, neutral</td>
<td>0</td>
<td>No muscle tension observed</td>
</tr>
<tr>
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</tr>
<tr>
<td>TOTAL</td>
<td>___ / 8</td>
<td>CPOT Scores: 3-4=Mild pain, 5-6=Mod pain, 7-8=Severe pain.</td>
</tr>
</tbody>
</table>
APPENDIX D: FLACC Pain Assessment Tool Survey

Please check the box to answer each question.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The FLACC is a validated pain assessment tool for critically ill adults.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The FLACC pain assessment tool is easy to use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. FLACC helps me assess pain in critically ill adult patients on ventilator accurately.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I received adequate training for the pain assessment tool.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. FLACC pain assessment tool has positively influenced my practice.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX E: CPOT Pain Assessment Tool Survey

Please check the box to answer each question.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The CPOT is a validated pain assessment tool for critically ill adults.</td>
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<td>2. The CPOT pain assessment tool is easy to use.</td>
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<td>3. CPOT helps me assess pain in critically ill adult patients on ventilator accurately.</td>
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<td>4. I received adequate training for the CPOT.</td>
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<td>5. CPOT pain assessment tool has positively influenced my practice.</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Critical Care Pain Observation Tool (CPOT)

Huddle Guide #

Date: 4/18/2018

**S:** We are going live on April 25th 2018 with CPOT documentation in CERNER for assessing pain in critically ill adult patients on the ventilator and non-communicative adult patients.

**B:** In 2013, the Society of Critical Care Medicine and American College of Critical Care Medicine published the clinical practice guidelines for the management of pain, agitation, and delirium (PAD) in critically ill adults in the ICU. The PAD guideline for pain assessment recommends using a validated and reliable behavioral pain scale such as CPOT to assess pain in non-communicative ICU patients (Barr et al., 2013).

**A:** The current pain scale (FLACC) used in the ICU is not a validated pain tool in adults and was originally created for pediatric patient population.

**R:** Numeric Rating Scale (0-10) or FACEs scale should be used for alert/oriented patients. If the patient is unable to communicate their pain level by either of those scales, then CPOT should be used to assess pain in adult ICU patients. Pain should be assessed and documented q2hr or more often if needed for ICU patients.

**Q:** Please contact Kalsang Dorji, Jennifer Tudor, or Natalie Correll-Yoder with any questions or concerns.

Critical Care Pain Observation Tool (CPOT) for non-verbal ICU patients

**Huddle Guide #**

**Date: 4/23/2018**

**S:** Effective April 25th, Intensive Care Units at Northbay and Vacaville campus will be using Critical Care Pain Observation Tool (CPOT) to assess for pain in the adult critically ill patients on the ventilator and non-communicative patients.

**B:** The current pain scale (FLACC) used in the ICU is not a validated pain tool in adults and was originally created for pediatric patient population. Based on the clinical practice guidelines from the Society of Critical Care Medicine, CPOT will be used to assess pain in critically ill non-communicative adult patients in the ICU.

**A:** The score range for CPOT is from 0-8 and the pain value interpretation is different from the FLACC or Numeric Rating scale of 0-10. (Please see table below.)

<table>
<thead>
<tr>
<th>CPOT Scores</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>No intervention</td>
</tr>
<tr>
<td>3-4</td>
<td>Mild Pain</td>
</tr>
<tr>
<td>5-6</td>
<td>Moderate Pain</td>
</tr>
<tr>
<td>7-8</td>
<td>Severe Pain</td>
</tr>
</tbody>
</table>

**R:** CPOT will be used only for ICU patients and the pain scales for all other units will remain same. This information is to help you understand what the patient’s pain level and interpretation was when they were in the ICU.

**Q:** Please contact Kalsang Dorji, Jennifer Tudor, or Natalie Correll-Yoder with any questions or concerns.
REFERENCES


Gélinas, C. (2010). Nurses’ evaluations of the feasibility and the clinical utility of the Critical-


