Spring 2015

Review of the Accuracy of Two Pain Assessment Tools in Nonverbal Adult Patients

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Abstract

Intensive care units frequently have patients that are unable to verbally communicate their pain, thus negating conventional pain assessment techniques and making pain assessment difficult. Pain management is often a priority in all patients' circumstances and therefore, assessment and reassessment are included in the plan of care. Different observational pain scales have been used in intensive care units, but often times these scales must be adapted to fit the patient's circumstances. Pain scales that are used for nonverbal patients typically include behavioral indicators and some are adapted to incorporate physiologic indicators such as vital signs. The aim of this review is to determine if the use of the Critical-Care Pain Observation Tool (CPOT), an assessment tool that is strictly observational, leads to more accurate pain assessment scores for nonverbal adult patients in comparison to the Adult Nonverbal Pain Scale (NVPS), a tool that incorporates vital signs. A search was conducted using five databases and the key words included, but are not limited to, Critical-Care Pain Observation Tool, Adult Nonverbal Pain Scale, nonverbal patients, and pain assessment. It was found that the CPOT was more accurate in determining pain assessment scores due to a discrepancy regarding the inconsistency of vital signs.

Review of the Accuracy of Two Pain Assessment Tools in Nonverbal Adult Patients

Unlike general medical floors where pain is measured with verbal scales, measuring pain in non-communicative patients usually found in intensive care units poses unique challenges. When applicable, pain is evaluated using the numeric pain intensity rating scale in which patients are asked to report their pain on a scale of one to ten. Self-report of pain using a numeric rating is often referred to as the "gold standard" of pain assessment and is the most common method for pain assessment (Wysong, 2014). The patients admitted to an intensive care unit are special due to their critical condition and are often unable to self-report their pain. When caring for patients in this situation, healthcare providers, especially nurses, must find other means to assess the pain of their patients. There are a number of pain assessment tools that have been created in order to assist with this problem; however, none of these scales have been standardized to accurately assess the pain of nonverbal patients.

Pain assessment is a subjective, sensory, and emotional response that can be caused by a variety of stressors (LeMone, Burke, & Bauldoff, 2011). The physiology of pain involves a stress response in the body which activates a response from the sympathetic nervous system (SNS). The relationship between painful stimuli and the sympathetic nervous system is well characterized (Pertovaara, 2013). According to Marmo and Fowler (2010), hormones such as catecholamines and steroids are released during the SNS response, triggering an increase in heart rate, blood pressure, and oxygen requirements. Despite similar pathological processes, many different types of pain can be felt by individuals. The two main categories of pain are physiological and pathological pain.

Pathological pain is due to damage or abnormal functioning of the nervous system (Porth, 2009). In these instances, the nervous system is hyperactive leading to a decrease in pain

inhibition. Neuropathic pain is a type of pathological pain that can be felt in patients with neurological injuries such as spinal cord damage or infection to the neuronal tissue. These types of patients are commonly cared for in neurological intensive care units.

Physiological pain is another type of pain that results from the inflammatory processes of the body and is characterized by stimulation of the body's pain receptors (nociceptors) or by tissue injury (LeMone, et al, 2011). When these receptors are stimulated by noxious stimuli, pain is felt. These physiologic types of pain are the types of pain that are most commonly felt by patients in other intensive care units, such as surgical and medical intensive care units. Pain receptors are often over sensitized after an injury occurs because the body uses pain as a safety mechanism. When the body needs to heal, pain can directly affect a person's behavior. Pain encourages the individual to immobilize and rest the affected body part to promote optimal healing (Fong & Schug, 2014).

Unfortunately, optimal healing does not usually take place in intensive care units due to the body's stress response continuously being activated by pain. Because patients in intensive care units are critically ill and often confined to the hospital bed, their plan of care includes more interventions due to their dependence on care providers. Typically, patients in this situation are turned every two hours, and suctioning and mouth care is performed a minimum of every four hours. Those two actions alone can cause significant discomfort to the patient and initiate a pain response. Since pain is a significant stimulator of the sympathetic nervous system, it needs to be controlled and managed in intensive care patients. If not managed, all body systems will suffer due to an imbalance in the body's homeostasis (Porth, 2009).

In the cardiovascular system, blood pressure, heart rate, and systemic vascular resistance all increase which may indicate an increase in pain (Porth, 2009). When an elevation in these

cardiac components occurs, the myocardial cells require more oxygen to sustain cardiovascular function. If the oxygen demand is not met ischemia to the heart muscle will occur. These three physiologic processes also affect coagulation processes in the body. If all of these components are elevated in the presence of other disease processes, hypercoagulability can occur and increase clot development in patients who stay in hospitalized settings (Porth, 2009). This is a particular problem in intensive care patients due to their lack of mobility.

Increased sympathetic nervous system activity related to pain can also lead to gastrointestinal complications and genitourinary problems. When pain stimulates the sympathetic nervous system, the gastrointestinal system loses blood supply due to the body's natural mechanism to shunt blood to the body's vital organs. If this happens, peristalsis in the bowels becomes diminished which increases patients' risk for the development of an ileus. Also, if a patient is unable to use their gut to meet their nutritional needs, they are more likely to develop ulcers due to inactivity. The genitourinary system is affected in a multitude of ways as well. When pain is unresolved, the kidneys release antidiuretic hormone (ADH) and activate the renin-angiotensin-aldosterone system to regulate urinary output. These hormones are secreted to maintain fluid balance and circulation in the body. They work by pulling fluids into the vasculature and also by retaining and excreting specific electrolytes. The activation of these regulatory hormones results in urinary retention, increased secretion of potassium, increased cardiac workload and hypertension (Porth, 2009).

The respiratory system may also be impaired when pain is unresolved for patients. When individuals experience thoracic or abdominal injuries, their pain can restrict chest wall movement. A restriction in chest wall movement can lead to multiple respiratory issues. Some examples are increased respiratory secretions, atelectasis, pneumonia, decrease in vital lung

capacity, reduced ventilation and perfusion, and hypoxia (Porth, 2009). Negative responses to pain by the body, such as those listed, support the need for a quality pain scale to assess pain appropriately.

Pain assessment and management is a crucial aspect of patient care as supported above, especially in populations that cannot verbalize their pain. Intensive care unit (ICU) nurses are accustomed to assessing nonverbal patients for pain and maintaining high surveillance for stimuli that could potentially contribute to or increase a patient's pain level. Nurses frequently utilize changes in activity, vital signs, and pain assessment tools that have been adapted to address patients that cannot verbally assert their pain in order to competently assess their patient's pain rating. Methods such as these allow nurses to use their judgment to help make decisions for their patients regarding pain. They can consider medication administration or contacting the physicians for analgesic orders. However, pain assessment in non-communicative ICU patients poses unique challenges compared to other hospitalized patient populations. Non-communicative patients are common in ICU settings and are usually intubated and sedated. Pain assessment of these patients may pose challenges to ICU nurses because patients are unable to verbalize a pain level using a numeric rating scale (0-10). It is important that when assessing pain in this patient population, the nurse and other health care professionals use a pain scale that is valid and feasible (Wysong, 2014).

The Critical-Care Pain Observation Tool (CPOT) is a common assessment tool when addressing the pain of nonverbal adult patients (appendix A). All of the elements incorporated in the tool are visual cues the nurse observes. The nurse looks at four different components when using the CPOT in the clinical setting: facial expression, body movements, muscle tension, and

compliance with the ventilator or vocalization. Each part of the tool is accompanied with a description and a matching numerical score that totals eight.

The Adult Nonverbal Pain Scale (NVPS) is also a common assessment tool that may be used in ICUs for nonverbal patients (appendix B). This scale scores an individual's pain through the use of visual cues and includes physiologic indicators. Just as with the CPOT, the NVPS has the nurse observe the patient in different categories with parameters that correspond with a numerical value that totals a pain score. The NVPS assessment includes facial expression, activity or movement, guarding tendencies, physiology, and respiratory status. The major difference between the NVPS and the CPOT is that the NVPS uses physiologic indicators such as blood pressure, heart rate, and respiratory rate in addition to the visual cues to indicate the patient's pain level. Some research has shown that physiologic indicators may be helpful in accurately assessing the pain of a nonverbal patient but that nurses should use caution when evaluating them for the purpose of pain assessment. Other triggers such as agitation, anxiety, or even infection can cause changes in physiological processes (Arbour & Gélinas, 2010).

The purpose of this review is to determine if the use of the Critical-Care Pain Observation Tool (CPOT), an assessment tool that is strictly observational, is an adequate way to assess pain. The Adult Nonverbal Pain Scale (NVPS), a tool that incorporates vital signs, will also be reviewed to determine if the tool is adequate for practice. Lastly, a comparison between these two scales will be done to determine which tool is recommended for practice.

Methods

A search was conducted using five databases: the Cumulative Index of Nursing and Allied Health Literature (CINAHL), Medline, PsycInfo, ProQuest, and Google Scholar. The databases were searched using the key words, alone and in combination, including pain

assessment, pain management, nonverbal patients, adult nonverbal pain scale, critical care pain observation tool, physiologic indicators, and vital signs. The search was also limited to research published from 2003 to 2015. The publications found were reviewed and included or excluded based on the relevance to the problem being investigated and the quality of the material. The articles were reviewed and summarized to identify pertinent information. A majority of the research used is from the last five years and addresses the use of the CPOT and the NVPS in the clinical area.

Review of Literature and Critical Appraisal

Many research studies have been performed to analyze the effectiveness of pain scales in nonverbal patients. The research conducted distinguishes multiple pain scales that could be used to assess pain. These studies have been done to validate and determine the reliability of these scales individually and comparatively. Multiple tools were studied, but the focus of this review is the comparison between the Adult Nonverbal Pain Scale (NVPS) and the Critical-Care Pain Observation Tool (CPOT).

The CPOT was developed using a study that began in 2002 (Gélinas, Fillion, & Puntillo, 2009). The initial tool included both behavioral and physiologic indicators, but after much criticism, the physiologic indicators were removed because of a lack of specificity. The study used to adapt the CPOT relied on both objective and subjective data. Using a mixed methods study, researchers conducted a review of literature, reviewed medical records, and surveyed physicians and critical care nurses in order to determine which items would be used in the CPOT in order to obtain the most accurate pain assessment in non-communicative patients. Results showed that physiological indicators were not supported and that behavioral indicators such as facial expression, body movements, muscle tension, and compliance with the ventilator were the

best parameters to be included. According to Gélinas, et al. (2009), facial expression is one of the best indicators for determining if a person is experiencing pain. Physiologic indicators are not specific to pain and changes in those parameters are more likely to suggest anxiety.

The limitations of this study are minimal and stem from the fact that the medical professionals that participated in the study were responsible for both evaluation of the content validity and the qualitative consultation (Gélinas et al., 2009). The clinicians were also expected to rate the feasibility of the CPOT, but none of those asked to evaluate it had used it in the clinical setting (Gélinas et al., 2009).

Arbour and Gélinas (2009) performed a study to determine if vital signs are valid indicators of pain assessment in cardiac ICU patients. A repeated measure within subject design was used for this study and included 105 cardiac patients. The data was collected using the same patient sample for both groups including the control and the variable in order to make comparisons. The methodology used for this study may be used in experimental designs and supports the reliability of the study's methods. The results of this study indicate that the use of pain scales which include vital signs should be used with caution in adult populations. Few associations between patient reported pain scores and vital signs were noted, indicating that they are not fully supported for clinical use for pain assessment. It was concluded that other variables present in the clinical setting such as medications, cardiac surgery, and anxiety would affect physiologic indicators similarly and it is too difficult to attribute changes solely to pain. Researchers noted that behavioral indicators should be considered, but not relied on, when assessing pain in nonverbal patients (Arbour & Gélinas, 2009).

The limitations of this study included varying cardiac surgical procedures and varied timing of interventions post-operatively. The sample size was determined through convenience

sampling and only incorporated cardiac patients. Interventions performed varied from patient to patient depending on their needs. Patients that experienced more than one painful stimulus such as turning and suctioning may have had higher levels of pain. Because the needs of each individual are dependent on their circumstances, it created too many inconsistencies when evaluating patients' pain using vital signs. This also makes it difficult to generalize the findings of this study to all patient populations (Arbour & Gélinas, 2009).

Another study that researched the effectiveness of vital signs was performed by Chen and Chen (2014). The intention of this study was to validate the CPOT and physiological signs as accurate indicators of pain. The methodology used for this study was a repeated measures design and observational method. This type of design is reliable because the same patients are being assessed more than once to create data that can be compared. With a convenience sample of 120 ventilator dependent patients in Taiwan, researchers evaluated patients using the CPOT, heart rate, and mean arterial pressure (MAP) before, during, and after a nociceptive (suctioning) and a non-nociceptive nursing action (noninvasive blood pressure). By comparing the effects of both painful and non-painful stimuli, researchers are able to identify associations that would help make a determination regarding the usefulness of vital signs in pain assessment. The results indicated that there was no significant correlation between the increase in heart rate and blood pressure and the presence of pain. Researchers concluded that behavioral indicators are better for assessing patients for pain and that changes in vital signs should not be relied upon for pain assessment, but can be used to cue health care professionals to further investigate pain.

There were significant design limitations noted in this study that may have affected the results (Chen & Chen, 2014). Patient participants were recruited from medical and trauma ICUs which would make it difficult to apply the results to other patients. The painful procedure chosen

for this study was suctioning which inevitably affects a patient's respiratory rate and oxygen saturation. Those vital signs were excluded from this study, even though it is believed that a procedure such as suctioning could potentially affect all vital signs. Another limitation of this study is the lack of consideration related to the reasons for changes in physiologic indicators throughout patient visits. Disease processes other than pain could have caused a shift in physiologic indicators and were not controlled, leading to skewed results. One concern expressed by researchers was that the sympathetic nervous system can be stimulated by other physiologic processes, not just pain. Therefore, using vital signs as the only parameter can be misleading as an indicator for pain if these are the only parameters being utilized.

Gélinas and Arbour (2009) conducted a study that evaluated the behavioral indicators of the CPOT and physiologic indicators in order to identify correlations between two types of indicators and patient self-reports of pain. The study used a descriptive correlational design in which 144 conscious ventilated patients and 113 unconscious ventilated patients from four separate university health centers in Quebec were evaluated. Subjects all had a Glasgow Coma Score (GCS) less than or equal to eight. Researchers also collected comparative data from 154 patients who had participated in a previously published study that validated the CPOT. Both a painful and non-painful stimuli were administered to each patient. The behavioral indicators that compose the CPOT were evaluated and vital signs were used as physiologic indicators. Those subjects who were conscious also self-reported pain levels. Collecting complimentary data as well as using patient self-report when applicable allowed researchers to compare if the CPOT and vital signs adequately assess pain. Final results suggest the CPOT to be most appropriate in predicting the presence or the absence of pain. The CPOT showed higher levels of validity and reliability of pain scores in comparison with the vital sign readings (Gélinas & Arbour, 2009). It

was recommended that vital signs should be used with caution, as an elevation in vital signs can often indicate other physiological processes occurring in the body unrelated to pain.

Several limitations were noted in this study (G□linas & Arbour, 2009). Not all participants were monitored with the appropriate equipment to measure some of the physiologic indicators researchers felt were necessary for inclusion. Those assessing the patients' pain were also responsible for performing the painful procedures, which may have created a bias in that the raters anticipated pain of their subjects instead of objectively using the pain tool. Interventions for patients could not be standardized for the entire sample due to varying patient conditions. One major inconsistency in this study is that some patients received a sedative or analgesic prior to the nociceptive procedure while others did not.

Arbour, Gélinas, and Michaud (2011) analyzed the impact of CPOT implementation on mechanically ventilated trauma ICU patients. This was a pilot study in which 30 charts were analyzed. Fifteen charts from before implementation of CPOT and 15 charts after implementation were reviewed one year prior and up to six months after the established use of the CPOT. Analysis looked at the frequency of pain assessment and medication regimens. Validity of the methods were appropriate because researchers collected data pre-implementation and post-implementation of the pain scale. Results showed that identification of pain was more prevalent in nonverbal patients once the CPOT was implemented and that fewer complications were observed. Although the CPOT is recommended by these researchers, further research is suggested (Arbour, Gélinas, & Michaud, 2011).

Limitations included a small sample size of only 30 patients, so the results cannot be generalized to all ICU patients. Understanding that experienced nurses were used for the study can reflect a bias due to the familiarity with other pain assessment tools commonly used in ICU

settings, such as the FLACC (Face, Legs, Activity, Cry and Consolability) scale. Pain medication orders for varying levels of pain were not consistent among all patients. Several patients demonstrated a high Glasgow Coma Scale (GCS) score, meaning these patients could have easily self-reported pain. This may have altered certain parameters of the CPOT such as body movements and facial expressions (Arbour, Gélinas, & Michaud, 2011).

The CPOT was found to be a valid and reliable tool when used for pain assessment in the clinical setting (Stefani, Nardon, Bonato, Modenese, Novello, & Ferrari, 2011). This study included 50 nurse participants and 121 patient participants, those that were able to verbalize pain ratings and those that were nonverbal, in three different critical care settings. Nurses were asked to perform a pain assessment using the CPOT and the Non-Communicative Patient's Pain Assessment Instrument (NOPPAIN) Tool to allow for comparison before and after usual nursing care. In addition, patients able to use a numeric pain rating were asked to give a pain rating for comparative purposes. The study's methods were valid in that there was enough comparative data to determine the validity and the reliability of the CPOT when used in nonverbal patients. Results showed the CPOT has strong psychometric properties and strong validity and reliability as evidenced by the trends researchers identified between the CPOT scores and the numeric pain scale scores.

Limitations of this study were minimal. The main concern researchers had with this study was the subjectivity associated with the interpretation of the pain scales. Nurses that were not familiar with the pain assessment tools could have allowed for inconsistent data collection (Stefani, Nardon, Bonato, Modenese, Novello, & Ferrari, 2011).

Buttes, Keal, Cronin, Stocks, and Stout (2014) set out to examine the reliability and validity of the CPOT in general ICU adult populations. They looked to mimic a previous study

completed regarding the use of the CPOT in practices and compared it with the FLACC scale and the Pain Intensity Numeric Rating Scale. The study assessed 75 patients three times a day; once during rest, once during repositioning, and once during recovery. Researchers incorporated the numeric pain scores from patients when applicable. It was found that the CPOT scores mirrored the numerical scores, therefore supporting its use in patients that are unable to self-report pain. The results confirmed strong correlations among the scores of the CPOT, the FLACC scale and the Pain Intensity Numeric Rating Scale.

Limitations for this study include the absence of a random sample and the small number of pain observers responsible for the pain assessment of patient participants. It is possible that if a full nursing staff uses the CPOT in the clinical setting that it could affect the reliability. Researchers suggest further research be conducted with a larger sample size and additional nurse involvement.

Rijkenberg, Stilma, Endeman, Bosman, and Oudemans-van Straaten (2015) focused on the comparison between the CPOT and BPS in mechanically ventilated patients. The study trained nurses on the pain scales that were being tested. The nurses were paired and evaluated 68 mechanically ventilated patients that were unable to assert their pain rating. The nurse pairs assessed the patients before and during a painful procedure and a non-painful procedure using the CPOT and the BPS. Researchers had data that they were able to compare and identify trends between the CPOT and the BPS. A positive inter-rater agreement between the two scales was revealed. Pain scores changed as expected when patients underwent the perceived painful procedure. The findings of this study indicate that both the CPOT and the BPS are valid and reliable tools that are recommended for practice.

There were many limitations associated with this study. Given that the nursing staff members were responsible for completing the assessments, they were not blinded. When pain assessments were performed, the assessors were aware of which procedures were to be performed. This may have led them to perceive more behavioral changes during events, leading to higher scores during painful procedures. Other limitations of this study include the relatively small sample size and the BPS was always completed first. The researchers state that randomizing the order of the pain assessments would have increased the reliability of results (Rijkenberg et al., 2015). This study was conducted in the Netherlands and required the pain scales to be translated from English to Dutch. There may have been language misconceptions that occurred when completing the translations of the scales used in this study. It is also possible that delirium may interfere with behaviors and therefore affect the scores of the CPOT and the BPS (Rijkenberg, et al., 2015).

Li, Wan, Gu, Yu, Huang, Li, and Zhang (2014) conducted a study that investigated the psychometric properties of the CPOT in a general intensive care unit in China. The study assessed 63 conscious ventilated adult patients using the CPOT. Two raters used the CPOT to rate patients' pain during rest, during a nociceptive procedure such as turning and during a non-painful procedure such as a non-invasive blood pressure reading. The results showed that the CPOT scores were higher during the nociceptive procedure and therefore, validate the psychometric properties of the CPOT as this is an expected finding. The methods used for this study were valid and followed models similar to other studies completed previously.

One major limitation of this study is that the CPOT and other pain scales have not been validated when translated into the Chinese language making it difficult to determine if there is a relationship between self-reported pain ratings and the pain ratings scored using the CPOT (Li et

al., 2014). Researchers suggest that educating the raters before the formal test may not allow results to be generalized. This study did not test if the CPOT helped implement interventions and further research is necessary to determine if using the CPOT can facilitate better use of analgesics and shorten the length of time needed for mechanical ventilation (Li et al., 2014).

Keane (2013) looked at determining the reliability of the CPOT and to support its use in the clinical setting. The study was a replication study and evaluated 21 open-heart surgery patients using the CPOT three times a day. When comparing the mean CPOT scores during non-nociceptive periods and periods of nociception, significant changes were noted. This allowed those performing this study to compare data and determine any associations between the CPOT scores and those asserted by patients. When comparing the CPOT scores to patient self-report scores, the correlation was weak. This study concludes that even though CPOT is a good tool for evaluating pain, further research is needed to refine the tool.

The limitations in Keane (2013) include the potential for the presence of a confounding variable. It is possible that some behaviors measured are related to anxiety and not pain. The study used a small sample size and there was a potential for bias from the nurse participants due to nursing judgement subjectivity and varied interpretation of the scales. In addition, the study was limited to only patients that received open heart surgery.

The CPOT was found to accurately assess pain in nonverbal patients given that all patients, regardless of their level of consciousness, respond to noxious stimuli that illicit behaviors that are associated with pain (Gélinas, Fillion, Puntillo, Viens, & Fortier, 2006). This study evaluated 105 cardiac surgery patients while they were unconscious and intubated, conscious and intubated, and following extubation. The painful procedure chosen for this study was positioning. Raters evaluated the patients during the procedure and twenty minutes after the

procedure was completed. Nine separate assessments were done per patient by both a principal investigator and a critical care nurse. Each was blinded to the other's scoring. Researchers found that there was a high inter-rater reliability and associations existed between the scores of the CPOT and the verbal numeric pain scores. Because researchers designed the study to have assessments completed for varying patient conditions, they created a large number of assessments to compare and identify trends. This allowed enough comparative data making the methods valid. This study claims the CPOT is valid and reliable in cardiac surgery patients. Although it is likely to work for all nonverbal patient populations, further research should be conducted before assuming it is valid and reliable in all patient populations.

Limitations of this study included a small sample size and the use of only two nurse raters. Using more nurse raters would have increased inter-rater reliability. Data collection was difficult when patients were unconscious and intubated. Data was only able to be collected on 33 of the 105 patients during the first phase (Gélinas et al., 2006). Drowsiness from anesthesia and medications posed problems to data collection as well. Cardiac surgery patients are considered a relatively healthy ICU patient group and do not represent all critically ill patient populations (Gélinas et al., 2006).

Echegaray-Benites, Kapoustina, and Gélinas (2014) completed a study to validate the effectiveness of CPOT in brain surgery patients in a neurological ICU. This study was a repeated measures study with a prospective design. A convenience sample size of 43 patients from a university affiliated ICU were included. Participants were video recorded during and after both a painful and non-painful stimuli. Self-report scores were noted as well for a total of six assessments. The validity of the methods was determined to be appropriate because the numeric pain scores and the scores from the CPOT were compared. Results showed correlation of scores,

therefore, researchers recommend the use of the CPOT as a pain assessment tool for nonverbal neurological ICU patients. The CPOT pain ratings were higher with higher levels of painful stimuli. The CPOT scores also correlated well with verbal pain ratings, which validate the pain tool and increase the reliability. The scores between the raters were consistent adding to the inter-rater reliability of the CPOT. The CPOT is highly recommended for use, although as with any small study, additional research should be completed to generalize the results.

Limitations of the study were evident. Due to the fact that a small subpopulation was used, results cannot necessarily be generalized to all brain surgery patients or all critically ill patients. Raters were blinded to the severity of the patients' injuries. Head bandages present on the patients could have interfered with facial expression assessment, which is a parameter of the CPOT. Researchers determined turning may not have been the most appropriate procedure used for this study due to the cranial location of the injury. A cranial injury may be too far from the body that something such as turning would not elicit a significant pain response (Echegaray-Benites, Kapoustina, & Gélinas, 2014)

Tousignant-Laflamme, Bourgault, Gélinas and Marchand (2010) conducted a pilot study that evaluated the CPOT to determine if it was an accurate pain assessment tool. However, instead of screening patients who were admitted to an ICU, this study looked at the use of the CPOT in healthy individuals. Patient participants underwent a perceived painful stimulus where they were videotaped and asked to give a verbal pain score following the stimulus. The tapes were reviewed and scored using the CPOT. The data was then compared to determine the validity and reliability of the CPOT when used in the clinical setting. The methods used for this study included a control, the numeric pain scale, and a variable, the CPOT. The results reflected validity and proved to be reliable when compared with the numeric pain scale, the "gold

standard" of pain assessment. In addition, the results indicated a moderate positive correlation between the CPOT scores and self-report of pain intensity.

There were few limitations associated with this study including a small sample size. The noxious stimulus chosen for this study was suspected to only evoke severe levels of pain. Raters that evaluated patient videotapes were aware of the patient's verbal pain rating. It is possible that raters could have scored the subjects higher based on the verbal score or attempted to match the verbal score which would skew results (Tousignant-Laflamme et al., 2010).

Linde, Badger, Machan, Beaudry, Brucker, Martin, and Roy (2013) completed a study to examine the validity of the CPOT in critical care settings and determine its reliability among raters. Results recommended this tool for use in critical care settings. This was a repeated measures-within-subject design in which 35 patients participated. Data collection was observational and collected by two nurses per assessment during both painful and non-painful stimuli. Assessments were then compared for inter-rater reliability. This was a reevaluation study and the validity and reliability of formerly used methods were previously supported. Overall, results show high reliability as inter-rater scores correlated. The results also show high feasibility as the nurses deemed the tool as quick, easy to use, and effective. This study supports the CPOT to be effective and valid in rating pain in nonverbal critical care patients.

This study posed several limitations. Nurse raters were aware of the patient's history and procedures, which could have influenced the expectation of pain with certain interventions, such as turning. Researchers believe there could have been a greater variety of pairing between each set of two nurses had more nurses been involved in this study. More nursing involvement would allow for a greater number of pairings to complete assessments which would strengthen the

reliability (Linde et al., 2013). In addition, the CPOT has a focus on certain behavioral parameters, which could also indicate anxiety or agitation and not solely pain.

Gélinas, Ross, Boitor, Desjardins, Vaillant, and Michaud (2014) published a descriptive study in 2014 that focused on nurses' evaluation of the feasibility, clinical relevance, and nurse satisfaction of the CPOT twelve months after implementation in a medical-surgical ICU. Nurses that had previously received training in the use of the CPOT were invited to complete a survey regarding their feelings about its use. The validity and reliability of the methods were fair, but the reliability of the overall results was poor due to a low number of surveys completed. Although nurses were highly satisfied with the tool, inter-rater scores did not correlate as highly as expected, and scores could not be interpreted by the physicians prescribing pain medications. This may have been a result of the physicians not receiving any education on the CPOT as opposed to the staff nurses who were trained using the CPOT regularly in the clinical setting. Further education regarding the CPOT is recommended for all healthcare providers involved in patient care before implementation in the clinical setting.

Several limitations were present in this study. A small sample size of only 38 nurses was used, and of these, only 63 percent completed the final questionnaire (Gélinas et al., 2014). This was due to a high turnover rate at the facility. Although all nurses were trained on the use of CPOT, certain parameters of the tool such as body movements were deemed subjective assessment measures and could have been interpreted differently between nurses. The design of the study limited researchers understanding of the nurses' feelings because they administered surveys where incorporating focus groups may have been more appropriate. Implementation strategies only incorporated the nursing staff and should have considered including physicians to ensure consistency across different disciplines.

The study completed by Topolovec-Vranic, Gélinas, Pollmann-Mudryj, Innis, McFarlan, and Canzian (2013) looked at the use of the NVPS and the CPOT in the clinical setting and considered both communicative and non-communicative patients. A total of 66 patients, 34 communicative and 32 non-communicative patients, were used. Nurses were trained on the use of each tool and patients were assessed before, during, and after both painful and non-painful stimuli. The inter-rater reliability, validity and feasibility between the CPOT and the NVPS were compared. Similar to other studies the inter-rater reliability was high with both the CPOT and the NVPS, however the CPOT's reliability prevailed as evidenced by a consistent increase in pain scores from before the painful procedure to during the painful procedure. This indicates the scale is measuring what it is intended to measure. The trend was frequently observed throughout the data. In terms of validity and feasibility, although both tools were determined to be valid, the CPOT was considered to be more user-friendly (Topolovec-Vranic et al., 2013).

The use of a convenience sample at only one facility was a limitation of this study but there was a variety of diagnoses that were able to be incorporated. Despite educating the nurses, nursing judgement is subjective and pain ratings, especially those of the non-communicative patients, varied significantly. Researchers do not identify any other limitations.

Chanques, Pohlman, Kress, Molinari, Jong, Jaber, and Hall (2014) compared the Behavioral Pain Scale (BPS), the CPOT, and the NVPS. This study compared the psychometric properties of three separate pain scales commonly used in nonverbal ICU patients. The 16 bed medical intensive care unit used to compare these tools had already implemented the NVPS as their primary choice to assess pain in nonverbal patients. The sample size in this study was 30 patients with 24 observers documenting pain assessments based on patient behaviors. This study's primary focus was on inter-rater reliability among the three scales, meaning that

agreement between individual raters was assessed. Researchers were looking for a correlation among the pain scores recorded for each scale in order to validate the other scales being tested. If there were no associations made between the scores of the three scales, it could indicate that they were not appropriately measuring the pain level of the patients. The methods used for data collection were valid, reliable and yielded results that researchers were able to compare and formulate conclusions. The findings of this study noted that the BPS and the CPOT had higher inter-rater reliability than the NVPS. The factor that contributed to these findings was the use of physiological indicators that are included in the NVPS such as heart rate and respiratory rate. When assessing pain in this patient population, it is recommended to use the CPOT or the BPS (Chanques et al., 2014).

Limitations in this study were minimal but still present. Researchers presented rater participants with education regarding the use of the scale to eliminate bias. It is possible that some of the staff participants were more experienced with the pain scales being investigated. Given that pain assessment in nonverbal patients relies heavily on nursing judgment, it is possible that the subjective interpretation of the scales by the nurse participants could have caused a variation in results.

Marmo and Fowler (2010) compared the NVPS, the CPOT, and the FLACC scales, to determine each scales' consistency and reliability. The study indicated that the CPOT was more reliable when evaluating pain in post-operative open heart surgery patients that were intubated and unable to self-report pain (Marmo & Fowler, 2010). Twenty-five patients from a post-anesthesia care unit were studied using a descriptive repeated measures design. Nurse raters were educated on the pain assessment scales and then assessed the patient participants during three study periods (before, during, and after a painful stimulus). The findings indicated that all

scales demonstrated high reliability; however the CPOT was the best of the three tools evaluated. This is evidenced by better agreement among the nurse raters (Marmo & Fowler, 2010). Inter-rater reliability was analyzed between the FLACC scale, the NVPS and the CPOT and it was determined the CPOT had the highest agreement among the raters. The nurses found it easy to use because of the clear descriptions for each category which allowed them to assess consistently and in a timely manner (Marmo & Fowler, 2010).

Limitations of this study included the use of a convenience sample, which only incorporated the assessment of patients at one institution during day shift (Marmo & Fowler, 2010). In addition, the study only included patients recovering from open heart surgery. Just as in several other studies similar to this one, there is also the subjectivity associated with nursing judgment that can be considered a limitation when assessing a patient that is unable to assert their pain rating. There were discrepancies among individual rater assessments of facial expressions, body movements, muscle tension and respirations that are incorporated within the NVPS (Marmo & Fowler, 2010).

A research study that incorporated holistic patient care was completed by Pudas-Tähkä, Axelin, Aantaa, Lund, and Salanterä (2014) in which researchers addressed the need for a pain scale that not only accurately assesses pain, but also addresses cultural variations among intensive care patients. A small sample size of 20 patients and translators from a small hospital in Finland were the subjects for this study. A ten step translation process was used in which both the CPOT and NVPS assessment tools were translated from English to Finnish and back to English. The purpose was to determine if these tools are valid and able to transfer effectively between languages. The validity of the methods were appropriate; however, results show the reliability of the study as a whole was poor due to the inconsistency between scores from

different translators. The results supported the validity of the CPOT but improvements in both scales are needed to improve cultural competence (Pudas-Tähkä et al., 2014). Researchers found the CPOT was the most valid because it had the clearest translation, although all tools could be adapted better to different cultures and languages. A more culturally diverse pain assessment tool is necessary for consistent pain ratings.

A major limitation of this study is that the translators were not all familiar with intensive care context, words, and phrases used within each tool (Pudas-Tähkä et al., 2014). This poses a problem because the context of the tools could have been translated differently among different translators. The study used a small sample size and only tested the Finnish language. This study should be repeated using a larger sample and incorporation of more languages.

Wibbenmeyer, Sevier, Liao, Williams, Latenser, Lewis, and Rosenquist (2011) conducted a study to evaluate the use of both the CPOT and the NVPS in burn patients. A 16 bed burn unit was the setting of this study in which 38 participants were studied. While these patients were not necessarily nonverbal, they were critically ill. The nurses involved were briefly educated on the use of the NVPS and the CPOT before the study was conducted. Educating the nurse participants prior to beginning the study would allow for more consistent evaluation of the patient participants. Pain was assessed every four hours by the staff nurses. The nurses completed individual pain assessments using both the CPOT and the NVPS. In addition, patients were asked to give a numerical pain rating. The values of all three pain evaluations were then compared to determine if the values correlated. The pain scores obtained using the CPOT and the NVPS did not correlate with the scores obtained using the numeric pain scale which was used when patients were able to verbalize their pain rating. Both the validity and reliability of the methods were shown to be appropriate; however, the overall reliability of the results was poor.

Researchers had enough comparative data by using the numeric pain scale to compare the scores of the CPOT and the NVPS. Because there were no correlations present, the observational scales do not accurately assess the pain of burn patients and therefore may not be accurate when using it for any patient population. Results support the use of the numeric pain scale as the gold standard for pain assessment (Wibbenmeyer et al., 2011).

This study posed several limitations (Wibbenmeyer, et al., 2011). A major limitation of this study is that the sample only included 38 patients. Although there were a large number of assessments completed, it does not reflect the pain of all burn patients. The chosen participants had varying lengths of stay, showing inconsistency with the severity of their injuries. Also, a large number of staff nurses were chosen as observers. The staff nurses were paired with only one consistent observer which could have led to distorted results when evaluating inter-rater reliability. This may have affected the consistency of the study due to the small number of patient participants.

Odhner, Wegman, Freeland, Steinmetz, and Ingersoll (2003) further addressed the need to find a pain scale that would accurately assess the pain in nonverbal patients by comparing the NVPS and the FLACC scale. The FLACC scale is a behavioral pain assessment tool typically used in young children. This research used a convenience sample and took place in a 15 bed trauma ICU with a sample of 59 intubated and sedated patients, and 53 nurse raters. The study compared the nurses' pain assessments when using the NVPS and the FLACC scale to treat their patients' pain. The methods used for this study were appropriate, but it is stated that the study should have increased staff involvement for the purpose of data collection (Odhner et al., 2003). It was found that the scores were similar, supporting the validity of the scales, but also that the physiologic indicators incorporated in the NVPS affected the overall scores (Odhner et al.,

2003). The NVPS was deemed the superior of the two scales because components of the FLACC scale were not applicable to most adult patients, thus making it difficult to use for pain assessment in adults (Odhner et al., 2003). Vital signs were determined to be good indicators of pain as part of the NVPS. This study produced results that are valid but the study should be repeated to help determine the reliability of the NVPS in adult nonverbal patients.

This was a pilot study and only included patients that were admitted for few diagnoses, which may have limited the results. Researchers found that it was difficult to incorporate staff nurses into the data collection and that future research should aim to have increased involvement by staff members (Odhner, et al., 2003).

Topolovec-Vranic, Canzian, Innis, Pollmann-Mudryj, McFarlan, and Baker (2010) continued to address the concern for a pain scale that accurately addresses the needs of nonverbal ICU patients. Those involved in this study looked at both the raters and patients' perspective when implementing the NVPS for pain assessment. The study was conducted using a mixed methods design and through convenience sampling. A series of questionnaires was developed for nurses and patients that participated in this study and researchers reviewed patient charts (Topolovec-Vranic et al., 2010). The research supported the use of the NVPS in nonverbal patients in the ICU, but also suggests more research is needed to further support the use of the tool due to potential biases present during various phases of the study, such as patient selection and patient recall (Topolovec-Vranic et al., 2010). Nursing and patient attitudes regarding pain assessment were analyzed through a series of questionnaires. Nurses ranked the NVPS as an easy tool to use and found that it improved patient's rating of their pain experience. The scale also improved nursing documentation of pain and increased the nurses' confidence when assessing nonverbal patients' pain.

One major limitation of this study was that there was bias in patient selection. Many patients selected to complete questionnaires were chosen because they would be able to complete the survey 24 to 48 hours after discharge from the ICU. This caused a subsequent concern that patients were less likely to criticize the caregivers due to the fact that they were still receiving care in the hospital (Topolovec-Vranic et al., 2010). Researchers ensured that surveys remained anonymous throughout this study which made it impossible to identify specific changes in attitudes regarding pain assessment.

In a study conducted by Kabes, Graves, and Norris (2009), the NVPS was found to be a potentially valid tool to assess pain in mechanically ventilated patients and concluded more research was needed to support the use of the NVPS. This study used a non-experimental design in which nurse raters were trained to use the NVPS, who then went on to collect data on patient participants in three phases; before, during, and after a painful nursing procedure. Results yielded 90 percent inter-rater reliability (Kabes et al., 2009). This means that the scores recorded by the nurse participants were in agreement when compared and suggest that the NVPS could be a valid tool for pain assessment and management in nonverbal patient populations. The researchers' approach for this study was valid because it allowed for identification of trends in data and determined any associations among the assessments. Researchers determined the results were not as reliable as expected due to the fact that the data being compared only came from the NVPS scores and was not compared with that of another pain scale. It was concluded that more research on pain and nonverbal patients would be useful in standardizing a pain scale for the patient population as well as more research to support the use of the NVPS in nonverbal patients.

Due to the complexity of patient conditions and the clinical area there are several limitations present. It is difficult to standardize a study such as this because pain and nursing

judgement are subjective. Data collectors knew when each phase of data collection occurred which may have led to increased pain ratings because they were expecting patients to be experiencing a higher level of pain, which could have falsely elevated the pain scores. This study used a small sample size and it was only tested at one hospital (Kabes, et al, 2009).

Synthesis of Evidence

This review of research indicates that the Critical-Care Pain Observation Tool is a recommended tool for pain assessment in nonverbal adult patients. Research shows that the tool demonstrates validity, reliability and that a majority of health care providers found the tool to be easy to use. When comparing the CPOT with the Adult Nonverbal Pain Scale, it was found that the Adult Nonverbal Pain scale is less reliable when assessing nonverbal patients. One major factor that influences the reliability of the NVPS is the inclusion of vital signs when determining pain scores. Changes in vital signs can be an indicator that a patient is experiencing pain, but can also indicate other physiologic processes such as agitation, anxiety, or stress. Physiologic indicators are not specific to a pain response. Therefore, both vital signs and the NVPS need to be investigated further to determine their validity for measuring different levels of pain. In contrast, the CPOT demonstrates appropriate assessment parameters that allows for consistent assessments among various nonverbal patients.

Recommendations

After conducting this review of research, it is recommended that healthcare providers utilize the Critical-Care Pain Observation Tool when assessing pain in nonverbal adult patients. Research suggests the CPOT to be more appropriate, as compared to other common pain assessment tools such as NVPS. Behavioral indicators are more accurate compared to physiologic indicators, as physiologic indicators are not specific to the body's pain response. If

the NVPS is used in the clinical setting, it is suggested that further research be conducted to address its validity and reliability. When introducing a new pain scale to the clinical area, such as the CPOT, it is important to educate the nurses, physicians, and other health care professionals who may be using the scale. All health care personnel involved in patient care need to understand the assessment and how to score its parameters. A universal code for assessing subjective parameters, such as facial expression, is recommended as well to prevent possible inconsistency. When pain assessment for nonverbal adult patients is accurate it allows those members of the health care team to treat the problem which will lead to better healing and positive outcomes.

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Appendix A
Critical-Care Observational Tool (CPOT)

Indicator	Description	Score	
Facial expression	No muscular tension observed	Relaxed, neutral	0
	Presence of frowning, brow lowering, orbit tightening, and levator contraction	Tense	1
	All of the above facial movements plus eyelid tightly closed	Grimacing	2
Body movements	Does not move at all (does not necessarily mean absence of pain)	Absence of movements	0
	Slow, cautious movements, touching or rubbing the pain site, seeking attention through movements	Protection	1
	Pulling tube, attempting to sit up, moving limbs/ thrashing, not following commands, striking at staff, trying to climb out of bed	Restlessness	2
Muscle tension Evaluation by passive flexion and extension of upper extremities	No resistance to passive movements	Relaxed	0
	Resistance to passive movements	Tense, rigid	1
	Strong resistance to passive movements, inability to complete them	Very tense or rigid	2
Compliance with the ventilator (intubated patients)	Alarms not activated, easy ventilation	Tolerating ventilator or movement	0
	Alarms stop spontaneously	Coughing but tolerating	1
OR	Asynchrony: blocking ventilation, alarms frequently activated	Fighting ventilator	2
Vocalization (extubated patients)	Talking in normal tone or no sound	Talking in normal tone or no sound	0
	Sighing, moaning	Sighing, moaning	1
	Crying out, sobbing	Crying out, sobbing	2
Total, range			0-8

Appendix B
Adult Nonverbal Pain Scale (NVPS)

Categories	0	1	2
Face	No particular expression or smile	Occasional grimace, tearing, frowning, wrinkled forehead.	Frequent grimace, tearing, frowning, wrinkled forehead
Activity (movement)	Lying quietly, normal position.	Seeking attention through movement or slow, cautious movement	Restless, excessive activity and/or withdrawal reflexes.
Guarding	Lying quietly, no positioning of hands over areas of body.	Splinting areas of the body, tense.	Rigid, stiff.
Physiology (vital signs)	Stable vital signs.	Change in any of the followng: SBP > 20 mm Hg HR > 20/min	Change in any of the followng: SBP > 30 mm Hg HR > 25/min
Respiratory	Baseline RR/SpO2 Compliant with ventilator	RR > 10 above baseline, or 5% ↓SpO2 mild asynchrony with ventilator	RR > 20 above baseline, or 10% ↓SpO2 mild asynchrony with ventilator

Appendix C
Research ROL Summary Table

Author(s), (Year). Title of article.	**Problem. Research Purpose &/or Research Question**	**Theoretical Framework What is it and how is it used?**	**Design of study: Sample and sampling procedure**	**Variables and measures/tools. Reliability and validity of measures/tools**	**Findings Conclusions**	**Implications**	******Limitations of findings**
Kabes, Graves, & Norris 2009 Further validation of the nonverbal pain scale in intensive care patients	There have been few nonverbal scales developed for assessing pain in adult nonverbal patients. There are also few studies that test the validity and reliability have been published. The authors compare the original and revised versions of the Nonverbal Pain Scale in sedated patients receiving mechanical ventilation in an ICU and present the results.	None stated	Non-experimental design Convenience sample, ICU at Creighton University Medical Center Hospital, a 25-bed unit Subjects were at least 19 years old, unable to indicate pain by using a traditional scale.	Researchers compared data when using the NVPS and the NVPS-R Nurse raters assessed patient before during and after a perceived painful procedure and compared results	The study supports the revised NVPS as a potentially valid and reliable observational tool for assessing pain ICU patients who are sedated and mechanically ventilated.	This study supports the use of the NVPS in the clinical setting when addressing pain of nonverbal patients, but required further evaluation of validity and reliability beyond this study.	Data collectors were aware of the stage (before, during, or after the intervention) when they completed their ratings which could have influenced their scoring due to the expectation that the scores should be higher during the intervention. Small sample size Only used one facility
Topolovec-Vranic, Canzian, Innis, Pollmann-Mudryj, McFarlan, Baker	There is no widely accepted pain assessment tool currently in place to assess nonverbal	None stated	Mixed methods design Convenience sample, 17 bed	A series of questionnaires was developed for nurses and patients that	Implementation of the NVPS in a critical care setting improved patients' ratings	Further research may be necessary in finding a valid, effective and	Patients may have been less likely to criticize their care providers. It is

2010 Patient satisfaction and documentation of pain assessments and management after implementing the adult nonverbal pain scale	ICU patients. The goal of this study is to evaluate the use of the NVPS in trauma and neurosurgery patients and determine its effect on patient satisfaction and nursing documentation		neurosurgical and trauma ICU at St. Michael's in Toronto, Canada; included 64 patients and 53 nurses; no restrictions on age, gender, or ethnicity; patient must be nonverbal, excludes patients with PCA analgesia Neuro patients with a diagnosis of a brain tumor, subarachnoid hemorrhage, subdural hemorrhage, intracranial hemorrhage, spinal fracture, spinal fusion and trauma patients with a diagnosis of a blunt or penetrating injury	participated in this study and researchers reviewed patient charts. Questionnaires responses were compared with patient chart data.	of their pain experience, improved documentation by nurses, and increased nurses' confidence in assessing pain in nonverbal patients.	universal tool for assessing pain of nonverbal hospitalized patients.	possible that neurosurgery patients have lower levels of pain than trauma patients.
Odhner, Wegman, Freeland, Steinmetz, Ingersoll 2003 Assessing pain control in nonverbal critically ill adults	Pain assessments are designed for patients that are able to verbalize their pain rating. Pain assessment is difficult and inaccurate in nonverbal patients. This study evaluates the use of the NVPS	None stated	Convenience sample, 15-bed critical care facility that primarily admits patients for the management of trauma; 53 nurse raters, 59 patients between the ages of 16 and 99 were used who had an	FLACC and NVPS were compared by individual assessments by nurse pairs	The assessment components of the NVPS that are similar to the FLACC scale showed agreement among raters. Physiologic indicators within the NVPS	This study should be repeated as it was only a pilot study.	This study was only a pilot study that incorporated the NVPS. There was no involvement of the nurses who actually assessed the patients in the study.

	in adult patients who are intubated and sedated.		admitting diagnosis of trauma, major abdominal surgery and major burn injury, unable to indicate their pain rating		impacted pain scores. Results support the use of the NVPS due to its incorporation of vital signs, which are determined to be good indicators of pain.		
Chanques, Pohlman, Kress, Molinari, de Jong, Jaber, & Hall 2014 Psychometric comparison of three behavioral scales for the assessment of pain in critically ill patients unable to self-report	Accurate pain assessment is important to the healing process for ICU patients but is complicated by mechanical ventilation and sedation. This study compared psychometric properties using three different pain scales.	None stated	University of Chicago Hospitals, 16 bed medical ICU The sample size in this study was 30 patients with 24 observers documenting pain assessments Patients were at least 18 years old, had a RASS score above -4 and were unable to self-rate their pain	This study compared the psychometric properties of the BPS, the NVPS, and the CPOT focusing primarily on inter-rater reliability	The BPS and CPOT showed higher inter-rater reliability and consistency than NVPS in ICU patients. The physiologic properties of the NVPS made it less consistent.	The BPS or the CPOT should be used in nonverbal ICU patients.	Some investigators may have been more experienced in using the NVPS or the BPS which could have impacted the results. The nurses' interpretations of the scales may have affected the results.
Marmo & Fowler 2010 Pain assessment tool in the critically ill post–open heart surgery patient population.	Pain assessment in nonverbal patients is often challenging for nurses and leads to poor patient outcomes when pain is not controlled. Researchers compared the	None stated	Repeated measures design 25 subjects observed, 6 times each by 2 different observers Subjects were at	There were three study periods each involving the use of the NVPS, the CPOT and FLACC scales. Raters evaluated patients response	Both the CPOT and the NVPS were found to be reliable. Raters agreed 78-79% of the time when assessing patients with the NVPS and	The CPOT appears to be a better tool to detect pain in intubated post–open heart surgery adults compared with the NVPS	Study findings are limited due to the use of a convenience sample of patients recovering from open heart surgery at only

	reliability and consistency of three pain scales commonly used when patients are unable to verbalize a pain rating.		least 18 years of age, admitted to the CPACU for CABG, aortic valve replacement, or mitral valve replacement surgery and intubated	to a painful stimulus	agreed 80-85% of the time when using the CPOT. They agreed 78-84% when using the FLACC scale.	as evidenced by better agreement between nurse raters.	one institution. Data was only collected during day time hours.
Topolovec-Vranic, Gélinas, Li, Pollmann-Mudryj, Innis, McFarlan, & Canzian 2013 Validation and evaluation of two observational pain assessment tools in a trauma and neurosurgical intensive care unit	To evaluate the use of the CPOT and the NVPS in the clinical setting to determine its validity among trauma and neurosurgical patients unable to verbalize their pain ratings	None stated	Repeated measures, descriptive design Convenience sample of a 19 bed ICU in Toronto, included 23 nurses, 34 communicative patients and 32 non-communicative patients Patients were included if they were admitted for traumatic injuries or neurosurgical indications	Inter-rater reliability, validity and feasibility between CPOT and NVPS were compared. Verbal pain ratings were included for comparison. Each patient was exposed to both a nociceptive and non-nociceptive procedure. Assessments using both scales were done before, during and after the procedures.	The CPOT and the NVPS scores were higher during the turning procedure for patients who had indicated that they were in pain versus those who were not. Inter-rater reliability was higher for the CPOT than the NVPS. Nurses rated the feasibility of the two tools as comparable but provided higher ratings of acceptability for the CPOT.	The study supports the use of the CPOT and the NVPS for critically ill trauma and neurosurgical patients, further research should explore the role of vital signs in pain response.	The study was limited by the inclusion of only a single site and a convenience sample. Subjectivity of nursing judgement is also a limitation of this study.
Pudas-Tähkä,Axelin, Aantaa, Lund, Salanterä	Pain assessment is difficult in patients that are unable to communicate a verbal pain rating.	None stated	A sample size of 20 patients and translators from a small hospital in Finland. A	A 10 step translation process was adapted and applied to each	The results of this study indicate that the tools are able to be translated, but	Culturally competent care is extremely important in the health care	A major limitation is that the translators that participated in this study were

2014 Translation and cultural adaptation of an objective pain assessment tool for Finnish ICU patients.	Pain assessment tools adapted for nonverbal patients are not easily translated among different cultures. The purpose of this study is to culturally validate pain assessment tools used for nonverbal patients.		translation process was adapted and used for each scale used in this study. Evaluations were completed on the patient participants using the newly translated pain assessment tools.	pain assessment tool. After the tools underwent the translation process, they were used to assess patient participants. The study included the NVPS, the CPOT, and the BPS.	the CPOT had the most clear translation of the 3 scales. All of the scales can be adjusted to better serve patients of different cultures. The lack of clear translation decreases the validity and reliability of the scales.	setting. Certain words, phrases, and assessment measures did not translate perfectly from one language to the other. This creates a barrier in care and calls for the pain scales to be adjusted from the original format.	not familiar with the intensive care context of the pain assessment tools. This may have led to misinterpretations and incorrect original translations from English to Finnish.
Wibbenmeyer, Sevier, Liao, Williams, Latenser, Lewis... Rosenquist 2011 Evaluation of the usefulness of two established pain assessment tools in a burn population.	A pain assessment tool that accurately assesses the pain in nonverbal burn patients has not been validated. The purpose of this study is to evaluate the use of the CPOT and the NVPS for burn patients in comparison with the numerical pain scale.	None stated	Prospective study The study involved nurses and patients, both verbal and nonverbal. It took place in a 16 bed referral burn unit All participants were at least 18 years of age with an anticipated stay greater than 48 hours.	Pain was assessed every 4 hours by staff nurses and a facilitator using the CPOT and the NVPS. The numeric pain scale was used when applicable to allow for comparison. Assessments were also performed at rest, before daily activities, and after noxious stimuli	The pain scores obtained using the CPOT and the NVPS did not correlate with the scores obtained using the numeric pain scale. Because there were no correlations present, the observational scales do not accurately assess the pain of burn patients and therefore may not be accurate when using it for nonverbal patients.	The scores recorded using the CPOT and the NVPS did not correlate with the scores obtained using the numeric pain scale. More research should be done to determine the validity and reliability of the two pain scales, or another pain scale should be considered.	A small sample size of only 38 burn patients was used. The patients chosen had varying lengths of stay, and the large number of staff nurses chosen as observers might have affected the consistency of the study.

Gélinas, Ross, Boitor, Desjardins, Vaillant, & Michaud 2014 Nurses' evaluations of the CPOT use at 12-month post-implementation in the intensive care unit.	There is little research regarding the use of the CPOT in nonverbal intensive care patients. The purpose of this study is to evaluate the nurse satisfaction of the scale 12 months after it has been implemented.	None stated	Descriptive design This study was conducted in the medical-surgical ICU in a university setting in Quebec, Canada. ICU nurses were trained on the use of CPOT and given questionnaires 12 months after implementation. The questionnaires were anonymous and 38 nurses returned the surveys.	The questionnaires were designed to evaluate feasibility, clinical relevance, satisfaction, and socio-demographic information.	Results indicate that the CPOT is quick and easy to use, easy to understand, and influenced the nurses' practice effectively, but the pain assessment tool could not be easily translated and understood by the physicians.	The CPOT was valued by the nurses; however, all team members need to be trained in order for this assessment tool to be effective between all members of the health care team.	A small sample size was used because only 63% of the original nurse participants returned their surveys. Nursing judgement plays a major role in behavioral pain scales and interpretation may vary among nurses.
Echegaray-Benites, Kapoustina, & Gélinas 2014 Validation of the use of the Critical-Care Pain Observation Tool (CPOT) with brain surgery patients in the neurosurgical intensive care unit	There currently is no pain assessment tool implemented for nonverbal patients. The purpose of this study is to validate the effectiveness of the CPOT in brain surgery patients in a neurological ICU.	None stated	Repeated measure within subject design. Convenience sample, university affiliated hospital in Canada, sample size of 43 patients used. Participants were video recorded and assessed using the CPOT before, during, and after both a non-painful and painful stimuli for a total of 6 assessments. Self-	Participants were video recorded during and after both a painful and non-painful stimuli. Self-report scores were noted as well for a total of six assessments.	Results recommend the use of the CPOT as a pain assessment tool for nonverbal neurological ICU patients. The CPOT pain ratings increased with painful stimuli. The CPOT scores correlated with verbal pain ratings. The scores between the raters were consistent as	This tool shows to be effective in the pain management of brain surgery patients in a neuro ICU. Proper pain management is difficult in non-communicative patients, and it is crucial to validate effective pain assessment tools in various areas of ICU practice.	A small subpopulation was used, so this study cannot be generalized to all patients. Head bandages may have interfered with facial expression assessment. Turning might not have been the most appropriate painful stimuli used. Raters were blinded to the severity of the procedure these

			report scores noted as well.		well.		patients underwent.
Arbour, Gélinas, & Michaud 2011 Impact of the Implementation of the Critical-Care Pain Observation Tool (CPOT) on Pain Management and Clinical Outcomes in Mechanically Ventilated Trauma Intensive Care Unit Patients: A Pilot Study.	There is no standardized pain assessment tool established for nonverbal patients which creates a challenge for care providers. The purpose of this study is to evaluate the use of the CPOT for pain assessment for mechanically ventilated ICU patients.	None stated.	Pre-experimental before-and-after design Sample of 30; patient charts were reviewed pre-implementation and post-implementation of the CPOT	Patient charts were reviewed for frequency of pain assessments and medication regimens implemented based on those assessments. Charts from before implementation and charts after implementation of the CPOT were reviewed for this study.	Results show that identification of pain and intervention was more prevalent once the CPOT was put into place. Fewer analgesics were administered after implementing the CPOT, and less complications were observed.	This study emphasizes the importance of using an effective tool such as the CPOT to analyze pain in non-communicative patients. Pain management is a major aspect of patient care. Although more research is necessary the CPOT is effective in evaluating pain in nonverbal patients.	The sample size was small and cannot be generalized to all ICU patients. Experienced nurses may have been biased towards other pain assessment tools. Medication orders for pain were not consistent throughout the entire study. Some patients exhibited a high GCS score and could have self-reported pain ratings.
Linde, Badger, Machan, Beaudry, Brucker, Martin, & ... Roy 2013 Reevaluation of the critical- care pain observation tool in intubated adults after cardiac surgery	There is not a universal pain assessment tool in place for critical care non-communicative patients. The purpose of this study is to examine the validity of the CPOT when it is used in critical care settings.	None stated.	Repeated measures-within-subject design Sample of 35 nonverbal patients and involvement from nurse who served as raters.	Data collection was observational and collected by a pair of two nurses per assessment during both painful and non-painful stimuli. Assessments were then compared for	Results show that the CPOT scores increased with a painful stimulus. Inter-rater reliability was high among the nurse raters. Nurse raters also found the tool easy to use.	This study further emphasizes the effectiveness of the CPOT in clinical practice. It is important for the nurses using pain assessment tools to feel comfortable using the tool.	The nurses were aware of the patient's history and procedure, which could have led to them anticipating their patients' pain. There could have been a greater variety of nurses with mixed pairing. The

				inter-rater reliability.			researchers also believe that the CPOT does not distinguish pain from anxiety or agitation based on the behavioral aspects of the assessment.
Stefani, Nardon, Bonato, Modenese, Novello, & Ferrari 2011 The validation of C-POT (Critical-Care Pain Observation Tool) scale: a tool for assessing pain in intensive care patients	To determine the validity and reliability of the Critical Care Pain Observation Tool (CPOT).	None stated	50 nursing staff members from three different critical care settings of an Italian hospital administered the CPOT to 121 in patients. The tool was put to use when patients were at rest and after usual nursing care tasks.	Nurses were asked to complete NOPPAIN forms during nursing activities as well as evaluate patients using the CPOT. Verbal ratings were also recorded when applicable. Reliability, with Cronbach's alfa and inter-rater agreement (Spearman's non parametric rank correlation), as well as criterion, concurrent and discriminant validity were determined.	Moderate correlations between the CPOT and numerical rating scale and between the CPOT and NOPPAIN were found. The CPOT scores varied from rest to activities, and from non-painful to painful procedures.	The CPOT showed good psychometric properties in terms of reliability and validity. These results validate the use of the CPOT tool to assess pain in the clinical setting.	Nursing judgement was involved in data collection. The samples only came from certain nurses and from a one hospital.
Gélinas, Fillion, Puntillo, Viens, & Fortier	Little research has been conducted to validate pain assessment tools in	None stated	Repeated measures design Convenience sample	This study evaluated cardiac surgery patients while they were	Researchers found that there was a high inter-rater reliability	This study claims the CPOT is valid and reliable in	Data was collected by only 2 raters. More raters should be

2006 Validation of the critical-care pain observation tool in adult patients	critical care, especially for patients who cannot communicate verbally. The goal of this study was to assess the validity of the CPOT.		of 105 cardiac surgery patients in the intensive care unit	unconscious and intubated, conscious and intubated, and following extubation. Nine separate assessments were done per patient by both a principal investigator and a critical care nurse. Each was blinded to the other's scoring.	and there were associations between the scores of the CPOT and the verbal numeric pain scores. There was enough comparative data making the methods valid.	cardiac surgery patients. Although it is likely to work for all nonverbal patient populations, further research should be conducted before assuming it is valid and reliable in all patient populations.	used in tests of inter-rater reliability in subsequent evaluations of the CPOT. Data could be collected for only 33 of the 105 patients while the patients were unconscious. Postoperative drowsiness led to missing data for some patients. Cardiac surgery patients are a relatively healthy ICU group and may not represent most ICU patients.
Gélinas, Fillion, & Puntillo 2009 Item selection and content validity of the Critical-Care Pain Observation Tool for non-verbal adults	This paper is a report of the item selection process and evaluation of the content validity of the Critical-Care Pain Observation Tool for non-verbal critically ill adults.	None stated	A mixed method study design Specifically, a four-step process was used including a literature review, review of 52 patients' charts, focus groups with 48 critical care nurses and interviews with 12 physicians, and evaluation of	The study used to adapt the CPOT relied on both objective and subjective data. The study included substantial review of patient charts as well as surveys of healthcare professionals familiar with ICU patients.	Results show that physiological indicators were not supported and that behavioral indicators such as facial expression, body movements, muscle tension, and compliance with the ventilator were	More research on the implementation of the CPOT in the clinical setting is needed. The CPOT appears to be useful for pain assessment in nonverbal patients. Problems with the use of physiologic	Evaluation of the CPOT was limited because clinicians had not yet used it in clinical practice. In future evaluations, the tool should be evaluated by nurses who have used it in clinical practice. The medical professionals that

			validity with 17 clinicians using a questionnaire.		the best parameters to be included.	indicators stem from the fact that they are not specific to a pain response. It was also suggested that three levels in the scale of muscle tension be included: relaxed (0), tense (1), and very tense.	participated in the study were responsible for both evaluation of the content validity and the qualitative consultation.
Tousignant-Laflamme, Bourgault, Gélinas, & Marchand 2010 Original Report: Assessing Pain Behaviors in Healthy Subjects Using the Critical-Care Pain Observation Tool (CPOT): A Pilot Study	The goal of this study was to determine the relationship between the CPOT scores and self-report pain ratings among healthy individuals.	None stated	A total of 18 healthy subjects participated in the study, no participants were suffering from any known diseases and none were taking any medications that could alter results.	Participants received a noxious stimulus. A cold pressor test was performed and subjects gave a verbal pain rating in response to the test. Subjects were also videotaped during the test and later scored by evaluators using the CPOT.	The results of this study showed a strong correlation between the self-report pain ratings and the CPOT pain ratings. These results support the validity of the tool and suggest it would be useful in a clinical setting.	The CPOT scores correlated with the self-report scores suggesting that the CPOT would be a valid tool to use in the clinical setting but more research should be done before making a finite conclusion.	This study used a small sample size would need to be repeated using a larger sample. The noxious stimulus chosen for this study was suspected to only evoke severe levels of pain. Raters that evaluated patient videotapes were aware of the patient's verbal pain rating. It is possible that raters could have scored the subjects higher based on the verbal score or attempted to

							match the verbal score which would skew results.
Li, Wan, Gu, Yu, Huang, Li, & Zhang 2014 Pain assessment using the critical-care pain observation tool in chinese critically ill ventilated adults	There is no pain scale that is universally accepted for the use in nonverbal patients. The CPOT is a behavioral pain scale that may accurately assess and help treat pain in intensive care patients. The purpose of this study is to evaluate the psychometric properties of the CPOT in general ICU patients.	None stated	Convenience sample, 19 bed general ICU, 63 conscious, ventilated Chinese adults participated in addition to 2 raters. A total of 12 assessments were included.	Two raters used the CPOT to rate patients' pain during rest, during a nociceptive procedure such as turning and during a non-painful procedure such as a non-invasive blood pressure reading.	The CPOT total score was significantly higher during the nociceptive procedure, indicating that it was correctly measuring a pain response. The CPOT has good psychometric properties and can be used as a valid instrument for pain assessment in Chinese critically ill ventilated adults.	The CPOT was found to appropriately assess critically ill Chinese patients. However, translation of the scale between different languages and cultures should be considered. More research should be conducted in order to generalize results to all intensive care patients.	The CPOT and other pain scales have not been validated when translated into the Chinese language making it difficult to determine if there is a relationship between self-reported pain ratings and the pain ratings scored using the CPOT. Researchers suggest that educating the raters before the formal test may not allow results to be generalized. This study did not test if the CPOT helped implement interventions.
Keane 2013 Validity and	The purpose of this study is to determine the validity and reliability of the	None stated	Quantitative study used a repeated measures design Convenience	Nurse raters assessed patients 3 times a day using the CPOT and obtained	Correlations between the CPOT scores and the self-report pain	The CPOT is a well-developed tool, but requires more research before	It is possible that some behaviors measured are related to anxiety and not pain. This

Reliability of the Critical Care Pain Observation Tool: A Replication Study	CPOT and to contribute to the research advocating for the use of the CPOT in the clinical setting.		sampled 21 open heart surgery patients in a teaching hospital located in the northeastern US	self-report pain ratings when possible.	scores were weak and suggest the CPOT is not a good tool for open heart surgery patients and more research should be done regarding the use of the CPOT in the clinical setting.	generalizing its use to all critically ill patients. There is a need for interdisciplinary education on pain assessment in the critical care setting. Further research on the psychometrics of the tool can help refine the tool.	study used a small sample size and it limits the generalizability of the results. The ratings relied on nursing judgement which is subjective and could have influenced results.
Buttes, Keal, Cronin, Stocks, & Stout 2014 Validation of the Critical-Care Pain Observation Tool in Adult Critically Ill Patients	The purpose of this study was to examine reliability and validity of the CPOT in a general population of critically ill, adult patients.	None stated	Nonrandomized prospective design Convenience sample 75 patients from the critical care units of a community hospital, patients were 18 years or older, able to hear, see, and understand English and displayed no evidence of delirium, Patients with a history of medical treatment for chronic pain were excluded from the study.	Nurse raters evaluated patients 3 times a day, once during rest, during repositioning and during recovery. Nurses evaluated patients using the CPOT, the FLACC scale, and the numeric rating scale.	Scores recorded with each of the pain scales were higher during the repositioning procedure than during rest or recovery. Correlations between raters were moderate to high at all 3 testing times. The CPOT scores were highly correlated with the FLACC scale scores and numeric pain rating scores for all 3 testing periods.	The CPOT is an acceptable behavioral pain assessment scale for use in the general critical care patient population. Results suggest that the CPOT is more appropriate for use in adult patients over the FLACC scale, which is more commonly used in pediatrics.	This study did not use a random sample. The study also used a limited number of pain observers. Because a full nursing staff was not used to test the CPOT, it could affect the tools reliability.

Rijkenberg, Stilma, Endeman, Bosman, & Oudemans-van Straaten 2015 Pain measurement in mechanically ventilated critically ill patients: Behavioral Pain Scale versus Critical-Care Pain Observation Tool	The BPS and the CPOT are behavioral pain assessment tools for non-communicative and sedated patients. This study compares the two pain assessment tools simultaneously in mechanically ventilated, general ICU patients to determine validity and reliability.	None stated	Prospective observational cohort study Sample size of 68 mechanically ventilated medical ICU patients who were unable to report pain	Pain assessment was completed by nurses at the bedside using the CPOT and the BPS. Assessments were done at rest before a painful procedure, during a painful procedure, at rest just before a non-painful procedure and during a non-painful procedure. Turning was chosen as the painful procedure and oral care was chosen for the non-painful procedure.	This study showed that the BPS and the CPOT are reliable and valid for use in a daily clinical setting. The BPS and the CPOT median scores increased by 2 on average between rest and the painful procedure. The BPS median scores showed an increase of 1 between rest and the non-painful procedure and the CPOT scores remained the same. Inter-rater agreement was good.	Both pain scales are valid and reliable making them suitable for use in the clinical setting. Due to the slight increase of scores using the BPS during the non-painful procedure could suggest that the CPOT is the better tool in nonverbal patients. Although oral care may be a perceived non-painful procedure, patient discomfort should be taken into account.	The assessments could not be blinded because they were performed by bedside nurses. The nurses knew which procedures were being performed and may have anticipated the patients' pain or perceived it to be higher. It is possible delirium could affect a patient's pain rating. The sample size was relatively small.
Arbour & Gélinas 2010 Are vital signs valid indicators for the assessment of pain in postoperative cardiac surgery ICU adults?	It is possible that changes in vital signs may be indicative of pain. The purpose of this study is to investigate if vital signs are valid indicators of pain.	None stated	Repeated-measure within-subject design Convenience sample of 105 patients from a cardiology health center; participants were 18 years of age or older, had been admitted to ICU after undergoing	All vital signs (MAP, HR, RR, SpO2 and end-tidal CO2) available by ICU monitoring were evaluated for their role in a pain response. The verbal descriptor scale and the faces	Vitals signs increased during the nociceptive procedure. During the recovery period, the decrease in vital signs was only observed in conscious patients. While patients were	Due to inconsistent findings, vital signs should not be relied on for pain assessment in nonverbal patients. It is possible that changes in vital signs indicate an increase in	The sample size for this study was relatively small and only evaluated cardiac patients. Patients underwent different procedures and postop interventions varied. Some

			cardiac surgery.	pain thermometer were used for comparison. Patients were assessed during 3 periods; when unconscious and mechanically ventilated, conscious and mechanically ventilated and when conscious after extubation. Vital signs were recorded at rest, during a painful procedure, and after the procedure.	mechanically ventilated MAP and HR decreased and following extubation MAP, HR, and RR also decreased. There were few associations found between vital signs' fluctuations and the patient's self-report of pain.	pain among nonverbal patients, but healthcare providers should use caution when considering vital signs as indicators of pain.	patients had multiple stimuli that could have increased pain scores. It is difficult to generalize the results of this study to all nonverbal populations.
Chen & Chen 2014 Pain Assessment: Validation of the Physiologic Indicators in the Ventilated Adult Patient	Pain assessment in non-communicative patients is challenging for healthcare providers. Research suggests that the use of a valid behavioral scale is crucial to assessing pain in nonverbal patients. The purpose of this study was to validate the English version of the CPOT and physiologic indicators in	None stated	Repeated measures design, observational method Convenience sample of 120 patients from medical, trauma, and respiratory ICUs in a hospital in Taiwan Patients were at least 18 years of age, admitted to the ICU, and ventilator dependent	Researchers evaluated patients using the CPOT, and HR and MAP before, during, and after a nociceptive and a non-nociceptive procedure. Suctioning was chosen as the painful procedure and noninvasive blood pressure was chosen as	The result of this study indicate that there is no significant correlation between an increase in BP and HR and the presence of pain. Inter-rater reliability was good. The CPOT scores were able to be correlated with self-report when applicable.	Relying on vital signs as a primary indicator of pain can be misleading because they may also indicate other disease processes. Vital signs may serve as a cue for care providers to investigate the presence of pain in patients.	The subjects used for this study were admitted to medical and trauma ICUs and it is possible surgical ICU patients would react differently. Suctioning was chosen as the painful procedure which would inevitably affect RR and SpO2, both of which were excluded

	critically ill ventilated adults.			the non-painful procedure.			from this study. Other disease processes could have contributed to changes in vital signs.
Gélinas & Arbour 2009 Behavioral and physiologic indicators during a nociceptive procedure in conscious and unconscious mechanically ventilated adults: similar or different?	The purpose of this study was to describe behavioral and physiologic symptoms to a nociceptive procedure in mechanically ventilated adults and to identify possible correlations with the patients' self-reports of pain.	None stated	Descriptive-correlational design Convenience sample of 144 conscious patients and 113 unconscious patients from 4 different university health centers in Quebec, Canada. Complementary data collected from 154 patients who had previously participated in a validation study of the CPOT. The patients were at least 18 years of age, admitted at the ICU and mechanically ventilated, and either conscious or unconscious.	Patients were conscious or unconscious, but relied on mechanical ventilation. The CPOT was used to evaluate behavioral indicators and vital signs were measured based on monitoring equipment available in the ICU. Patients were also asked if they were experiencing any pain; either the absence or presence of pain. Patients were evaluated by a principle investigator and ICU nurses.	When assessing behavioral indicators, CPOT scores were higher in conscious patients compared to unconscious patients. Scores increased during the nociceptive procedure. There were variations among the physiologic indicators between conscious and unconscious patients as well as during the painful procedure.	The use of behaviors is strongly recommended for pain assessment in unconscious patients. Vital signs should be used with caution for the detection of pain as they can be influenced by other factors besides pain.	Not all participants were wired with equipment to measure physiologic indicators consistently. Those assessing the patients' pain were also responsible for performing the painful procedures, which may have led to the raters anticipating the pain of their subjects instead of objectively using the pain tool. Interventions for patients could not be standardized for the entire sample. Some patients received an analgesic prior to procedure.