



DEVELOPMENT OF PAIN ASSESSMENT INSTRUMENT IN CRITICAL CARE NURSING BASED ON KOLCABA'S COMFORT THEORY: A SYSTEMATIC REVIEW

Kiki Ayu Kusuma^{1,2*}, Esty Yunitasari¹, Rifky Octavia Pradipta¹, Daniel Nong Danche¹

¹Faculty of Nursing, Universitas Airlangga, Mulyorejo, Surabaya, Jawa Timur 60115, Indonesia

²Aisyiyah General Hospital, Jl. Dr. Sutomo No.18 - 24, Bangunsari, Ponorogo, Jawa Timur 63419, Indonesia

*kikiayukusuma07@gmail.com

ABSTRACT

Pain is a common and complex problem among critically ill patients in the Intensive Care Unit (ICU), particularly those unable to communicate due to sedation, impaired consciousness, or mechanical ventilation. Several pain assessment instruments, including the Critical-Care Pain Observation Tool (CPOT) and the Behavioral Pain Scale (BPS), have been developed; however, they primarily assess behavioral and physiological indicators and do not comprehensively reflect patients' pain experiences from a holistic nursing perspective. This systematic review aimed to synthesize current evidence on pain assessment instruments for critically ill patients and identify research gaps supporting the development of a Kolcaba's Comfort Theory-based instrument. This systematic review followed the PRISMA 2020 guidelines. Literature searches were conducted in ProQuest, EBSCOhost, Sage Journals, and PubMed for studies published between 2019 and 2025. A total of 4,150 records were identified from four databases. After screening and eligibility assessment based on the PICOS criteria, 10 studies were ultimately included and analyzed using thematic synthesis. The included studies demonstrated that CPOT is a valid, reliable, and sensitive instrument for assessing pain in non-communicative critically ill patients. However, existing instruments primarily assess physical and behavioral responses and do not incorporate psychospiritual, sociocultural, or environmental dimensions.

Keywords: CPOT; critical care nursing; instrument development; kolcaba comfort theory; pain assessment

INTRODUCTION

Pain is one of the most frequently experienced problems by critically ill patients in the Intensive Care Unit (ICU), arising from both disease processes and diagnostic or therapeutic procedures, such as mechanical ventilation, endotracheal intubation, suctioning, and other nursing interventions. Inadequate pain assessment can trigger stress response activation, hemodynamic instability, increased oxygen consumption, delirium, prolonged mechanical ventilation use, and an extended length of stay in the ICU (Stollings et al., 2024; Suhariyanti & Pujiastuti, 2023). Therefore, accurate pain assessment is the fundamental first step in determining appropriate pain management interventions and improving the quality of critical care nursing.

Pain that is not properly identified will cause several complications, including an increase in infection rates, prolonged use of mechanical ventilation, and hemodynamic disturbances (Alves et al., 2023). Assessing pain in critically ill patients remains a challenge because most patients experience decreased consciousness, are under sedation, or require mechanical ventilation, rendering them unable to verbally express their pain. Various instruments have been developed to address these conditions, such as the Behavioral Pain Scale (BPS) and the Critical-Care Pain Observation Tool (CPOT).

However, the synthesized results from numerous studies indicate that existing instruments have not been able to comprehensively describe the patient's pain experience because they do not account for the psychospiritual, sociocultural, and environmental factors that influence pain perception (Zhai et al., 2020). These limitations indicate that pain assessment in critically ill patients is still dominated by physiological and behavioral approaches. Conversely, according to the Comfort Theory developed by Katharine Kolcaba, patient comfort is a basic need consisting of four primary contexts: physical

comfort, psychospiritual comfort, sociocultural comfort, and environmental comfort. The psychospiritual, sociocultural, and environmental aspects that influence the pain experience have not been comprehensively evaluated. Furthermore, most studies are still limited to testing the validity, reliability, and clinical implementation of existing instruments, while instrument development based on nursing theories remains highly limited (Hoshino et al., 2025).

The Comfort Theory developed by Katharine Kolcaba offers a holistic approach through four dimensions of comfort: physical, psychospiritual, sociocultural, and environmental comfort. These four dimensions interact with one another and influence the patient's experience of illness, pain, and the healing process. Therefore, this study aims to develop a comprehensive pain assessment instrument for critically ill patients based on Kolcaba's Comfort Theory by integrating the four dimensions of comfort into the assessment of pain, and to provide a more holistic approach to identifying patients' pain experiences. The results of this systematic review are expected to serve as a scientific foundation for the development of a more comprehensive pain assessment instrument based on Kolcaba's Comfort Theory, which would support patient-centered care and enhance the quality of evidence-based critical care nursing.

METHOD

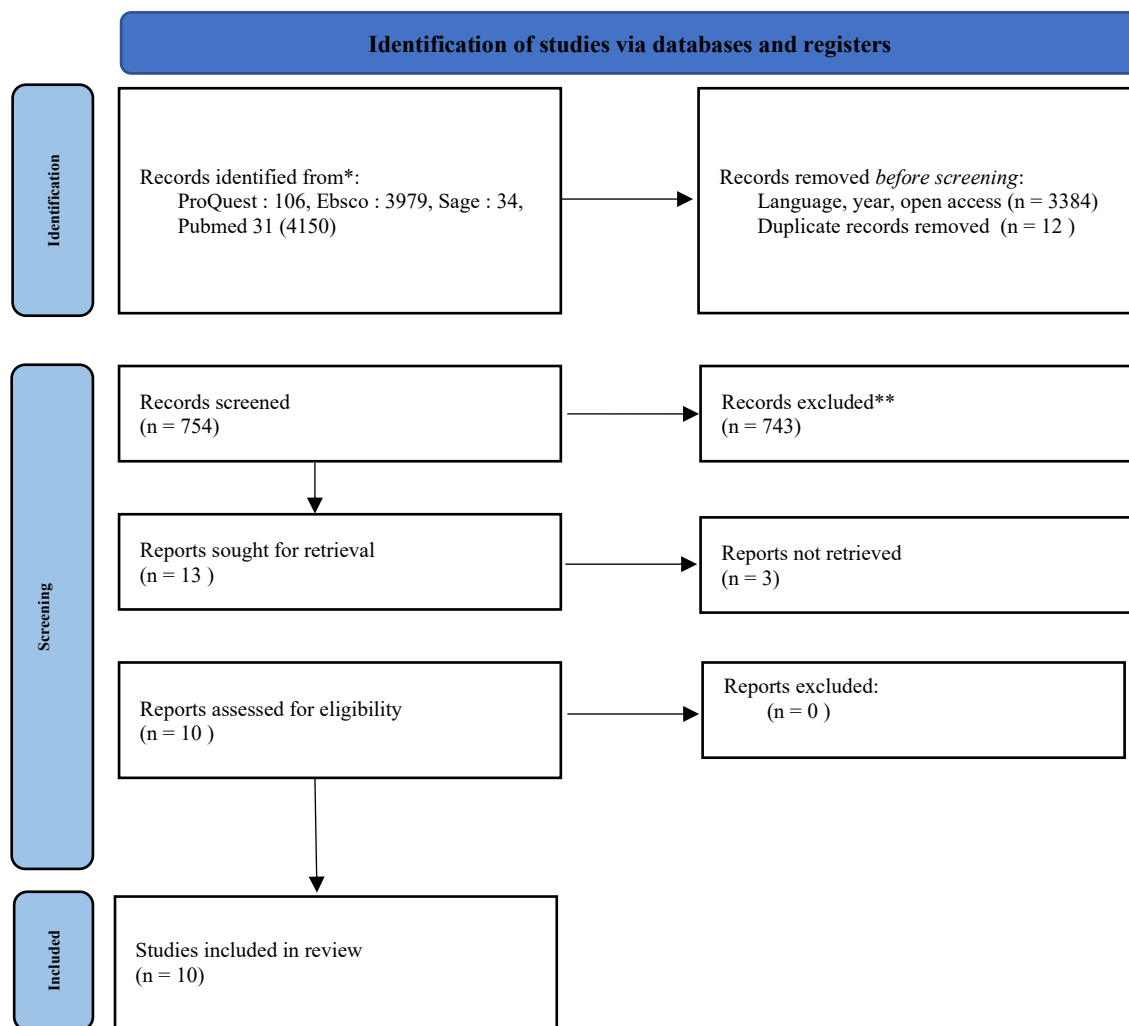
This study utilized a Systematic Review (SR) method to identify, evaluate, and synthesize scientific evidence regarding pain assessment instruments used in critically ill adult patients. The literature search was conducted across four databases: PubMed, ProQuest, EBSCOhost, and Sage Journals, targeting article published between 2019 and 2025. The search strategy employed a combination of Medical Subject Headings (MeSH) terms and free keywords with Boolean operators: ("pain assessment" OR "pain measurement") AND ("critical care" OR "intensive care unit" OR ICU) AND ("Critical-Care Pain Observation Tool" OR CPOT OR "Behavioral Pain Scale").

Article selection was based on predetermined inclusion and exclusion criteria using the PICOS (Population, Intervention, Comparison, Outcome, and Study Design) framework. Inclusion criteria comprised original research articles published in English or Indonesian, available in full-text formats, and relevant to the study's objectives. Reviews, editorials, conference abstracts, case reports, studies on pediatric populations, and articles with incomplete data were excluded. All duplicate articles were removed prior to screening, and the selection stages were presented according to the PRISMA 2020 flow diagram.

Table 1.
PICOT Framework

PICOT Framework	Inclusion Criteria	Exclusion Criteria
<i>Population</i>	Studies discussing nursing assessments performed by critical care nurses in the ICU.	Studies not discussing nursing assessments performed by critical care nurses in the ICU.
<i>Intervention</i>	Studies discussing critical care nursing assessments.	No discussion on critical care nursing assessments.
<i>Comparison</i>	Development of critical care nursing assessment.	No exclusion criteria.
<i>Outcomes</i>	Development of critical care nursing assessment.	No exclusion criteria.
<i>Publication years</i>	2019–2025	Before 2019
<i>Study desain</i>	Experimental, R&D, cross-sectional, cohort, RCT, and case reports.	No exclusion criteria.
<i>Language</i>	Indonesian and English	Languages other than Indonesian and English

Data were analyzed descriptively and qualitatively using a thematic synthesis approach. Study results were grouped based on instrument characteristics, validity, reliability, clinical implementation, advantages, and limitations. Subsequently, a synthesis of the similarities and differences across studies was conducted to identify current scientific evidence, research gaps, and the potential integration of Kolcaba's Comfort Theory in developing more holistic pain assessment instruments for critically ill patients. The following is the diagram:



RESULT

The initial literature search identified 4.150 articles from four databases: PubMed, ProQuest, EBSCOhost, and Sage Journals. After reviewing and matching against the criteria, 10 articles were selected for full-text review and further analyzed using a thematic synthesis approach

Tabel 1.
DSVIA

Title	Research Methods	Results
Nyeri Pasien Kritis pada Intervensi <i>Sleep Hygiene Care</i> di Intensive Care Unit (Suwardianto & Sari, 2019)	Design: Descriptive Sample: 170 critically ill patients in the ICU Variables: Independent: Sleep Hygiene Care intervention Dependent: Pain scale Instrument: Questionnaire Analysis: Frequency distribution statistical test	The results of the study showed that according to the CPOT pain scale, the majority of respondents (64 respondents) had mild pain. Critically ill patients with pain require continued attention through appropriate measurement methods and nursing care. The patient's condition can continually change to achieve optimal pain relief. The role of nurses in providing nursing care requires continued support to achieve optimal pain-reducing nursing care.
<i>Suitability of CPOT and BPS to Assess Pain response in Intubated Mohammad Hoesin Hospital Intensive Care Patients</i> (Darmanto et al., 2021)	Design: <i>Observational Analytic with Cross Sectional</i> Sample: 50 ICU patients at Muhammad Husein Hospital Variables:	The results of this study indicate that the CPOT score provides a more detailed assessment of patient pain than the BPS scale in mechanically ventilated patients. The BPS has more indicator items than

Title	Research Methods	Results
	Independent : CPOT (<i>Critical Pain Observation Tool</i>) and BPS (<i>behavioral Pain Scale</i>) Dependent: pain scale Instrument: pain scale assessment Analysis: Data were analyzed using kappa and pearson	the CPOT. Differences in assessor skills could be a bias factor in this study.
Hubungan Pengkajian Nyeri Menggunakan CPOT terhadap Perubahan Status Hemodinamik pada Pasien di ICU (Gaghauna & Santoso, 2022)	Design: Correlation Sample: 30 patients using mechanical ventilation in the ICU variables: Independent : Critical Pain Observation Tool (CPOT) pain assessment Dependent: Changes in hemodynamic status Instrument: CPOT pain scale assessment sheet and Hemodynamic Status Observation Sheet Analisis: Univariate and bivariate analysis	Measurement of pain levels using CPOT is associated with changes in hemodynamic status with varying increases depending on the level of pain felt by the patient.
Perbandingan <i>Behavior Pain Scale</i> dengan <i>Critical Care Pain Observation Tool</i> pada pengkajian Tingkat Nyeri pasien yang Terpasang Ventilator Mekanik di ICU RS Panti Wilasa DR Cipto Semarang (Suhariyanti & Pujiastuti, 2023)	Design: Non-experimental quantitative study with an analytical observational design Sample: 35 patients using mechanical ventilators in the ICU variables: Independent : Critical Pain Observation Tool (CPOT) and Behavioral Pain Scale (BPS) pain assessment during suctioning Dependent: pain level Instrument: BPS and CPOT during suctioning Analysis: Univariate analysis using Shapiro-Wilk and Mann-Whitney for bivariate analysis	The BPS and CPOT instruments can measure differences in pain levels during suctioning in critically ill patients. There are differences in pain assessments in patients on mechanical ventilators during suctioning. Further research is needed to determine whether differences in pain levels are related to patient diagnostic history.
<i>Validity and Reliability of the Critical-care Pain Observation Tool (CPOT) for Critically ill pediatric patient</i> (Hoshino et al., 2025b)	Design: prospective observational study Sample: 91 patient variables: Independent : CPOT, the Face, Legs, Activity, Cry, Consolability (FLACC) scale, and an Observational Visual Analog Scale (VAS obs) Dependent: pain level Instrument: observation Analysis: Mann-Whitney U test, and inter-rater reliability was assessed with Cohen's weighted	This study shows that CPOT is a tool that can be used as a pain assessment tool in children.
<i>Impact of Implementing the Critical Care Pain Observation Tool on Nurses's Performance in Assessing and Managing Pain in the Critically Ill Patients</i> (Modanloo et al., 2019)	Design: eksperimental Sample: 60 nurses and 240 patients variables : Independent : CPOT instrumen Dependent: <i>pain scale</i> Instrument: The study was conducted in several stages. The first stage involved extracting patient medical record data, then implementing the CPOT into the nurses' assessment process Analysis: chi-square and independent t-test p values	The implementation of the CPOT as an objective average pain assessment was effective in improving the performance of ICU nurses in assessing and managing patient pain. This implementation increased the amount and frequency of analgesic administration. Researchers recommend that the CPOT is a useful instrument for pain assessment and management in ICU patients and should be implemented in all ICUs.
<i>Correlation of the Critical care Pain Observation Tool and numeric Rating Scale in</i>	Design: Correlation Sample: 1302 patient Variables:	The NRS and CPOT should not be used interchangeably in critically ill adult patients. Administration of propofol, hydromorphone, fentanyl, pregabalin,

Title	Research Methods	Results
<i>Intensive Care Unit Patients</i> (Stollings et al., 2024)	Independent: CPOT instrument and NRS instrument Dependent: <i>pain scale</i> Instrument: observasi Analysis: Spearman correlation	oxycodone, oxycodone with acetaminophen, and hydrocodone with acetaminophen intravenously during hospitalization also modifies the relationship between the CPOT and the NRS. Behavioral scales such as the CPOT should be used as alternative pain measures.
<i>Incidence of Inadequate Pain Treatment among Ventilated, Critically Ill Surgical Patients in a Thai Population</i> (Thikom et al., 2021)	Design: <i>Prospective Observational Study</i> Sample: 118 patient Variables: Independent: factors influencing pain Dependent: effectiveness of pain management Instrument: CPOT, NRS, and RASS instruments Analysis: Deskriptif, Chi-square, Man-Whitney	Pain in mechanically ventilated patients in the ICU often goes untreated. The CPOT is a more sensitive instrument for detecting pain in patients who cannot verbalize their pain. Inaccurate pain assessment can potentially increase physiological stress, long-term complications, and impair quality of life.
<i>Intensive Care Nurses' Use of the Critical-Care Pain Observation Tool</i> (Kida & Akase, 2026)	Design: <i>Deskriptif, analitik, cross-sectional (online survey)</i> Sample: 277 adult ICU nurses at 55 healthcare facilities in Japan (460 respondents out of 3,334 invited nurses) Variables: Independent: formal education on the use of the CPOT-J (Japanese version of the Critical-Care Pain Observation Tool) and integration of the CPOT-J into electronic medical records Dependent: level of nurse use of the CPOT-J for patients unable to verbally report pain Instrument: self-administered questionnaire, using a Likert scale Analysis: exploratory and confirmatory factor analysis, single regression, and multiple regression	Nurses' use of the CPOT-J was significantly influenced by formal education and the instrument's integration into the electronic medical record ($p < 0.01$). These findings suggest that education and organizational support systems play a significant role in improving the consistency of pain assessment in critically ill patients.
<i>The Diagnostic Accuracy of Critical Care Pain Observation Tool (CPOT) in ICU Patients: A Systematic Review and Meta-Analysis</i> (Zhai et al., 2020)	Design: <i>Meta-analysis diagnostic studies</i> Sample: 1,920 subjects with 3,493 experimental outcomes Variables: Independent: Critical-Care Pain Observation Tool (CPOT) score Dependent: Pain diagnostic accuracy (sensitivity and specificity) in critically ill patients Instrument: QUADAS-2 quality assessment and STARD 2015 data extraction guidelines Analysis: Meta-analysis, heterogeneity test, and threshold analysis	The CPOT has good diagnostic performance with moderate accuracy in detecting pain in critically ill patients. It demonstrates higher diagnostic capability during nociceptive procedures compared to rest or non-nociceptive procedures, although further research in specific critically ill patient groups is needed to optimize its use.

All studies demonstrated that the Critical-Care Pain Observation Tool (CPOT) possesses good validity, reliability, and sensitivity in assessing pain in non-communicative critically ill patients. Several studies reported that CPOT is capable of detecting changes in pain responses during nursing procedures, such as suctioning, and exhibits strong congruence with changes in the patients' clinical conditions. Additionally, studies comparing CPOT with the Behavioral Pain Scale (BPS) showed that both instruments are applicable to mechanically ventilated patients; however, CPOT was considered more sensitive in identifying pain level changes across several clinical scenarios.

The last two articles further strengthen the findings in terms of implementation and diagnostic accuracy. Kida & Akase (2026) found that CPOT-J utilization by ICU nurses in Japan remained relatively low during pain-inducing interventions (e.g., suctioning and mobilization) compared to physiological changes. They highlighted that formal education and CPOT-J integration into electronic health records significantly correlated with the consistency of the instrument's use. Furthermore, a meta-analysis by Zhai, et al (2020) analyzing 25 diagnostic studies affirmed that CPOT possesses moderate diagnostic accuracy (Youden Index 1.56 at threshold 2) and is more accurate during nociceptive procedures than at rest, confirming that CPOT is a robust instrument but has yet to reach full optimality in holistic pain detection among critical patients.

Despite CPOT being the most widely recommended instrument, all studies pointed out that currently available tools are exclusively oriented toward behavioral indicators and physiological responses. None of the studies identified the development of a pain assessment instrument that integrates the dimensions of psychospiritual comfort, sociocultural comfort, and environmental comfort. All reviewed instruments strictly focused on the physical comfort dimension, thereby lacking the capacity to evaluate a patient's pain experience holistically in accordance with Kolcaba's Comfort Theory concepts.

DISCUSSION

The findings of this systematic review reveal that the Critical-Care Pain Observation Tool (CPOT) is the most frequently utilized instrument to assess pain in critically ill patients incapable of communication. The ten analyzed articles consistently reported that CPOT holds good validity, reliability, and sensitivity in detecting alterations in pain responses during nursing procedures and invasive interventions. These findings consolidate recommendations from prior studies asserting that CPOT is a suitable observational instrument for patients under mechanical ventilation, sedation, or impaired consciousness because it assesses pain through facial expressions, body movements, muscle tension, and compliance with the ventilator or vocalization (Hoshino et al., 2025; Stollings et al., 2024; Suhariyanti & Pujiastuti, 2023; Suwardianto & Sari, 2019).

These results underscore that the employment of a standardized pain assessment instrument is crucial in elevating the standard of critical care nursing services. This aligns with the principles of evidence-based nursing, which emphasize that clinical decisions must be rooted in the best scientific evidence, clinical expertise, and patient needs. Thus, implementing CPOT not only fortifies assessment objectivity but also champions patient safety and the overall quality of care in the ICU setting (Kida & Akase, 2026; Zhai et al., 2020).

However, the synthesis denotes that all the reviewed instruments, encompassing both CPOT and the Behavioral Pain Scale (BPS), are tethered predominantly to behavioral and physiological markers. Although they are effective at detecting pain in non-verbal patients, they fall short of encapsulating the complete pain experience. In reality, pain is a multidimensional phenomenon influenced by biological, psychological, social, cultural, and environmental parameters. Therefore, assessments solely hinged on behavioral and physiological responses run the risk of disregarding essential factors that modulate a patient's pain perception and their response to nursing interventions. This observation resonates with research demonstrating that pain experiences are influenced not merely by physical stimuli but also by psychological states, social support, cultural values, and the caregiving environment (Zhai et al., 2020).

According to Kolcaba's Comfort Theory, comfort is a holistic experience comprising four intertwined dimensions: physical, psychospiritual, sociocultural, and environmental comfort. The limitation of existing tools is that they only evaluate the physical dimension, whereas critically ill patients simultaneously experience profound psychological stress, constrained social interactions, and environmental discomforts that profoundly alter their pain perception. Consequently, developing a

pain assessment instrument that seamlessly integrates all four comfort dimensions possesses significant potential to yield a much more comprehensive measurement tool, bolstering evidence-based nursing practice, and advancing truly patient-centered care.

CONCLUSION

The systematic review of the ten articles demonstrates that CPOT is the most widely recommended pain assessment instrument, showcasing high validity, reliability, and sensitivity for adult critically ill patients in the ICU. It successfully enhances assessment objectivity, fosters inter-rater consistency among nurses, and supports clinical decision-making in pain management. Nevertheless, the synthesis concurrently highlights that currently available pain assessment instruments, including CPOT and BPS, remain heavily skewed towards behavioral indicators and physiological responses, thereby failing to capture the patient's holistic pain experience. They have not yet integrated the dimensions of physical comfort, psychospiritual comfort, sociocultural comfort, and environmental comfort as postulated in Kolcaba's Comfort Theory. Therefore, the development of a pain assessment instrument anchored in Kolcaba's Comfort Theory is imperative to forge a more comprehensive tool capable of evaluating the pain experience multidimensionally, reinforcing the implementation of patient-centered care, and elevating the quality of evidence-based critical care nursing.

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