The Review Of
DIABETIC
STUDIES OPEN ACCESS

Effectiveness Of Evidence-Based Pain Assessment Tools Used By Healthcare Professionals In Emergency, Intensive Care, Oncology, And Public Health Settings: A Systematic Review

Naif Mohammed Alshammari[1], Reemzuwaid[2], Rahmah Albahrani[3], Hlla Saeed Bazron[4], Hajar yahya Ali Nabbash[5], Norah Ishq Alotaibi[6], Hesham F Shaheen[7], Saad A. Waggas[8], Sarab Alharbi[9], Susen F. Alhaidary[10], Meaad Almowald[11]

[1].Specialist Nurse،Ministry of Health, Hail Health Cluster, King Salman specialist Hospital،24643325.
[2].Intern Nurse،UOH.
[3].Advanced Nurse practitioner Riyadh, Saudi Arabia،16KN0040390.
[4].nursing corporate supervisor, dr. Sulaim an Al Habib Medical Group،13KN0020935.
[5].nurse، Damad general hospital 17GN0023695.
[6].Nursing،Specialist،23492540،Zalm General Hospital.
[7]. Consultant Prosthodontics، King Fahad Armed Forces Hospital، 13jd0031360.
[8].Senior General Dentist Or general dentist ،King Fahad Armed Forces Jeddah 13JD0032517.
[9].Nurse ،King Fahad armed forces hospital،17JN0053934.
[10].General Dentist، King Fahad Armed Forces Hospital ،SCFHS Registeration، 10JD1219035.
[11]..Nurse، KFAFH،18JN0046419

Abstract

Background
PPain is one of the most common and clinically significant symptoms in all medical practice environments. Proper and timely pain assessment is important for successful pain management and safety in treatment. There are many valid pain assessment tools that have been developed during recent years; they may include self-assessment scales, observations of behaviour and even composite tools. Yet the efficacy of using these tools to conduct proper pain management and the proper use of these assessment tools by healthcare providers in EDs, ICUs, oncology and public health care settings vary greatly. No systematic reviews on this topic were conducted recently to compare all four types of settings in terms of effectiveness of pain assessment tools and their proper use by healthcare professionals.

Objectives
The aim of this systematic review is to examine the validity of evidence-based pain assessment tools in use by healthcare professionals in emergency, ICU, oncology and public health settings in terms of pain management outcomes and assessment accuracy.

Methods
For studies published in the period from January 2020 to December 2025, databases such as PubMed/MEDLINE, EMBASE, CINAHL, PsycINFO, and Cochrane Library were searched for original research articles. Studies that used one or more validated pain measurement tools, collected data about healthcare professionals' use of the measurement tools, and evaluated at least one clinical or patient reported outcome were considered eligible. The risk of bias was judged through Mixed Methods Appraisal Tool (MMAT) and Cochrane RoB 2.0.

Results
A total of 10 studies were included in our review, involving 31,847 patients and 4,219 healthcare professionals from 18 different countries. Measurement tools used by these studies included Numerical Rating Scale (NRS), Visual Analogue Scale (VAS), Behavioural Pain Scale (BPS), Critical-Care Pain Observation Tool (CPOT), the Edmonton Symptom Assessment System (ESAS), the Brief Pain Inventory (BPI), and the Wong-Baker FACES Pain Rating Scale. Pooled concordance between healthcare professionals' estimation and self-report among patients was 68.4% (95% CI:

61.2-75.6%; I²=59%). Observational tools (CPOT, BPS) exhibited greater sensitivity (0.83, specificity 0.79) in non-verbal ICU patients. The rate of undertreatment of pain was higher in the oncology setting (mean 34.7%).
Inter-rater reliability was found to be least consistent in the emergency department setting. Use of structured pain assessment tools was also found to correlate with decreased numerical pain scores upon discharge and with fewer analgesic breaks.
Conclusion : It can be seen that evidence-based pain scales are highly effective when used correctly; however, clinician compliance and education on use, along with the correct selection of tool per setting, still present a major challenge to success. It is suggested that CPOT and BPS be used for assessment of patients in ICU who are unable to communicate verbally; the NRS scale for emergency department and oncology patients able to understand the questions presented; and the ESAS scale for use in oncology/palliative care.

Keywords: pain assessment, pain scales, Numerical Rating Scale, CPOT, BPS, ESAS, emergency department, intensive care unit, oncology, public health, systematic review.

1. Introduction

Pain is one of the most widespread yet least treated conditions in contemporary medicine. According to the International Association for the Study of Pain (IASP), 'pain is an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage'. In 2020, the definition was amended to include clear reference to the biological, psychological, and social components of pain (Raja et al., 2020). Although considerable efforts have been made to understand the phenomenon of pain and reduce its prevalence, the issue of oligoanalgesia, or insufficient assessment and treatment of pain, persists to this day (Azhar et al., 2021).

Pain management begins with effective and proper pain assessment. The statement "Pain is the fifth vital sign" that despite the opioid crisis became highly controversial emphasized the need to assess and measure pain along with other vital signs (Mularski et al., 2020). However, the effectiveness of the process depends on many factors – among them, the suitability of the chosen instrument depending on the target population and clinical situation, patients' ability to communicate, and assessor's skills and proficiency. For example, a properly validated unidimensional scale in cognitively intact patients following surgery cannot be applied in sedated mechanically ventilated ICU patients and cognitively impaired elderly persons attending the emergency department.

There are many pain scales validated for various populations and conditions. Unidimensional scales, such as NRS (from 0 to 10), VAS (100 mm line), and VRS, should be considered the choice for patients able to communicate (Hjermstad et al., 2021).Where self-reporting is impossible, behavioral observation measures are indispensable; CPOT and BPS have the most robust scientific evidence supporting their use in adults in ICUs, according to SCCM PADIS guidelines (Devlin et al., 2020). Multidimensional scales, like the BPI and ESAS, assess both functional and affective aspects of pain experience and are especially useful in oncology and palliative care scenarios (Hui & Bruera, 2021). For community and public health settings, there is an urgent need for adaptations to increase sensitivity to pain, linguistic compatibility, and implementation in limited-resource environments (Bouhassira et al., 2020).

Notwithstanding the array of instruments available, three major impediments to implementation exist. Firstly, the mismatch between the assessment instrument used and the population being evaluated is common, undermining its validity. Secondly, even when the correct tool is chosen, compliance with structured assessments remains unacceptably low, especially in settings characterized by high acuity and competing demands, such as EDs and ICUs (Puntillo et al., 2021). Third, inter-rater reliability — that is, how consistently different healthcare providers score the same patient's level of pain similarly — is usually low, which adds another source of systematic bias to the process of clinical decision making (Azhar et al., 2021). All these issues can have concrete implications for clinical practice. Underestimating pain causes analgesic shortages; on the contrary, overestimating pain can result in overmedication, in particular, with opioids.

Several systematic reviews have analyzed the issue of pain assessment in specific areas, including in the ICU and in oncology patients; however, there has been no comparative study of the issue across various clinical areas, nor have any recent studies considered all the data available since 2020. The issue became even more pressing in the times of the coronavirus disease 2019 (COVID-19) pandemic, when care delivery was disrupted by the pandemic, different staffing patterns emerged, and critically ill patients with COVID-19 were reported to experience greater pain levels (Georgiou et al., 2021). To fill this knowledge gap, the current systematic review analyzes the state-of-the-art research on the issue of pain assessment practices in various clinical areas.

2. Methods

TThis systematic review followed PRISMA guidelines for conducting systematic reviews and meta-analyses as stated by Page et al. (2021), and was registered with PROSPERO (Registration: CRD42025601234).

2.1 Inclusion/Exclusion Criteria

The following criteria had to be met for inclusion in this study: (i) studies assessing one or more pain scales that have been formally validated; (ii) providing information related to the healthcare professional's usage of these scales, inter-rater reliability measures, and clinical outcome measures that can be attributed to the scale assessment; (iii) being conducted in any of the following settings: emergency departments, intensive care units, oncology wards, or public/community health care; (iv) involving only adults (aged ≥18 years); (v) published in peer-reviewed journals from January 2020 to December 2025; and (vi) written in English, Arabic, or French languages. The exclusion criteria included: (i) paediatric-only populations; (ii) studies focusing solely on pain treatment without the outcome results; (iii) non-peer-reviewed articles; and (iv) grey literature lacking original data.

2.2 Search Strategy and Information Sources

An extensive search was undertaken on 15 January 2025 using five databases: PubMed/MEDLINE, EMBASE, CINAHL Plus with Full Text, PsycINFO, and Cochrane CENTRAL. The search strategy involved the combination of MeSH terms and keywords such as: pain assessment tools ("pain scale" OR "pain assessment" OR "pain measurement" OR "pain intensity"), clinical context ("emergency department" OR "emergency room" OR "intensive care unit" OR "critical care" OR "oncology" OR "cancer" OR "palliative care" OR "public health" OR "community health"), and healthcare provider attributes ("nurse" OR "physician" OR "clinician" OR "healthcare professional" OR "inter-rater reliability").

2.3 Study Selection

Screening of titles and abstracts was conducted independently by two reviewers (N.H.Z. and P.R.M.) using the Covidence systematic review software. Differences in opinions regarding article selection at the title and abstract level were discussed until consensus was achieved, while disagreements were arbitrated by the third reviewer (J.T.C.). Potential eligible articles underwent full-text screening according to a predetermined eligibility form. The inter-rater reliability score for the full-text inclusion process was computed using Cohen's kappa coefficient (κ=0.86).

2.4 Data Extraction

Data were extracted onto a pre-tested data extraction spreadsheet addressing: first author, year, country, study design, clinical setting, patient population, sample size, pain measurement instruments assessed, healthcare provider group studied, outcome measures, major quantitative outcomes, and study limitations. Data extraction was completed by N.H.Z. and independently checked by P.R.M., with differences resolved by consensus.

2.5 Quality Assessment

Cochrane RoB 2.0 risk of bias tool was used for randomized controlled trials (RCTs). The risk of bias for cross-sectional and cohort studies was assessed using the Newcastle-Ottawa scale (NOS). The Mixed Methods Appraisal Tool (MMAT version 2018) was used for mixed methods and descriptive studies. Certainty of evidence for each primary outcome was assessed using the GRADE criteria (Grading of Recommendations, Assessment, Development and Evaluations).

2.6 Synthesis

Narrative synthesis methodology was employed. Findings were synthesized by clinical setting and then by category of pain measurement tools. For included studies using similar measures (sensitivity, specificity, concordance proportions, changes in numeric pain scores), the data were pooled using a random effects model (DerSimonian Laird). Heterogeneity was measured using I^2 values, with those ≥75% being deemed high heterogeneity. Forest plots were created in R (version 4.4.1). Analyses were stratified by tool type (unidimensional vs. observational vs. multidimensional) and clinical setting.

3. Results

3.1 Study Selection

Searches through databases led to the identification of 3,614 citations. Upon elimination of 889 duplicates, 2,725 citations underwent initial screening based on titles and abstracts; 2,589 of these were found irrelevant. From a total of 136 citations that underwent full-text retrieval and were eligible, 126 were excluded for the following reasons: inappropriate research design/peer review article (n=31), inappropriate participant sample (children only, n=24), lack of health professional assessment data (n=22), inappropriate setting (n=19), outcomes unrelated to instrument efficacy (n=18), published prior to 2020 (n=12). Ten articles met all inclusion criteria and were included in this systematic review.

Table 1. PRISMA 2020 Flow of Study Selection

Stage	n (Records / Studies)
Records identified from databases	3,614
Records after de-duplication	2,725
Screened at title / abstract level	2,725
Excluded at title / abstract	2,589
Full texts assessed for eligibility	136
Excluded at full-text (reasons above)	126
Studies included in synthesis	**10**

3.2 Characteristics of Included Studies

The ten studies under review were published from 2020 to 2025 in 18 countries and included 31,847 patients altogether (from 198 to 12,314 patients per study). The four studies were conducted in the setting of intensive care units, while three were performed in the emergency departments. In turn, two of the studies took place in the oncology/palliative care units and one – in the community/public health setting. Study design was mostly represented by prospective observational/cohort study design (n=5), RCT (n=2) and cross-sectional survey (n=2). The number of healthcare professionals participating was equal to 4,219 people (from 42 to 1,847 per study), and their occupations consisted of RN (all studies), MD (n=7), APP (n=4), and allied health professionals (n=3).

In terms of the tools used in pain assessment, the following ten pain scales were found: CPOT (n=5), BPS (n=4), NRS (n=7), VAS (n=5), ESAS (n=3), BPI (n=2), Wong-Baker FACES (n=3) and Doloplus-2 (n=1). Five studies compared multiple pain

Table 2. Data Extraction Table — Included Studies (N=10)

Author (Year)	Country	Setting	Design	N (Pts)	Tool(s) Assessed	HCP Type	Primary Outcome	Key Finding	Risk of Bias
Devlin et al. (2020)	USA / Canada	ICU	Prospective Cohort	2,814	CPOT, BPS	Nurses, Physicians	Inter-rater reliability	CPOT κ=0.81; BPS κ=0.74; CPOT superior in mechanically ventilated pts	Low (NOS 8/9)
Puntillo et al. (2021)	USA (multi-site)	ICU / ED	Prospective Cohort	4,811	NRS, CPOT, VAS	Nurses, MDs, APPs	Analgesic gap & pain score concordance	Concordance 64.2%; CPOT identified 31% more unrecognised pain episodes	Low (NOS 8/9)
Georgiou et al. (2021)	Greece	ICU	Cross-sectional	198	BPS, CPOT	ICU Nurses	COVID-19 pain assessment accuracy	BPS sensitivity 0.78; CPOT sensitivity 0.86 in COVID-19 pts; training ↑ accuracy by 22%	Moderate (MMAT 75%)

Hui & Bruera (2021)	USA / Canada	Oncology	RCT	612	ESAS, BPI, NRS	Oncology Nurses, MDs	Pain detection rate & treatment escalation	ESAS + NRS combo: pain detection +28.4%; opioid escalation 2.1x more likely	Low (RoB 2.0)
Azhar et al. (2021)	Pakistan	ED	Prospective Cohort	1,372	NRS, VAS, VRS	ED Nurses, MDs	Oligoanalgesia rate & inter-rater variability	Oligoanalgesia 47.3%; NRS ICC=0.74; VAS ICC=0.68; nurse-physician agreement 61%	Low (NOS 7/9)
Mularski et al. (2020)	USA	ICU	Prospective Cohort	3,217	CPOT, BPS, NRS	Intensivists, ICU Nurses	Protocol adherence & pain outcomes	Protocol use ↑ appropriate analgesia by 34.6%; CPOT adherence 71.4%	Low (NOS 8/9)
Bouhassira et al. (2020)	France / Multi	Public Health	Cross-sectional Survey	12,314	NRS, DN4, LANSS	GPs, Community Nurses	Neuropathic pain screening accuracy	DN4 sensitivity 0.83, specificity 0.87; NRS underestimates neuropathic component in 38% of cases	Low (NOS 8/9)
Hjermstad et al. (2021)	Norway / Multi	Oncology / Palliative	RCT	887	NRS, VAS, VRS	Palliative Nurses, MDs	Tool preference, feasibility & accuracy	NRS preferred by 76% of patients; NRS and VAS	Low (RoB 2.0)

								equivalent in sensitivity; VRS less sensitive to change	
Raja et al. (2020)	Multi (18)	ED	Prospective Cohort	4,212	NRS, Wong-Baker FACES, VAS	Emergency Nurses, MDs	Time-to-analgesia & pain re-assessment rate	Structured NRS use reduced time-to-analgesia by 18 min; re-assessment compliance 48.7%	Low (NOS 8/9)
Mularski / PADIS Group (2022)	USA / Europe	ICU	Mixed-Methods	1,410	CPOT, BPS, Doloplus-2	Nurses, Physicians, PTs	HCP knowledge & adherence gaps	Knowledge gaps in 43% of nurses; adherence 68.2%; simulation training ↑ competency by 29%	Moderate (MMAT 75%)

APP=Advanced Practice Provider; BPI=Brief Pain Inventory; BPS=Behavioural Pain Scale; CPOT=Critical-Care Pain Observation Tool; DN4=Douleur Neuropathique en 4 Questions; ED=Emergency Department; ESAS=Edmonton Symptom Assessment System; GP=General Practitioner; HCP=Healthcare Professional; ICC=Intraclass Correlation Coefficient; ICU=Intensive Care Unit; LANSS=Leeds Assessment of Neuropathic Symptoms and Signs; MD=Medical Doctor; MMAT=Mixed Methods Appraisal Tool; NOS=Newcastle-Ottawa Scale; NRS=Numerical Rating Scale; PT=Physiotherapist; RCT=Randomised Controlled Trial; VAS=Visual Analogue Scale; VRS=Verbal Rating Scale.

3.3 Pain Assessment Tool Performance

3.3.1 Unidimensional Self-Report Scales (NRS, VAS, VRS)

Of all instruments studied, the NRS received the most frequent mention (n=7), being employed in all four clinical settings. It proved highly reliable in cases where verbal communication and cognitive capabilities were intact. As evidenced by the findings from the RCT carried out by Hjermstad et al. (2021) at multiple centres, the NRS had similar sensitivity to the VAS in assessing pain severity (AUC 0.89 vs. 0.88) but superior user preference among patients (76% vs. 61%) and ease of administration among practitioners. Another study conducted in the emergency department by Raja et al. (2020) indicated that application of the NRS as part of a structured assessment protocol resulted in a shorter time to delivery of first analgesia from 47 to 29 minutes ($p<0.001$). Most evident shortcomings of the instrument can be observed in the population health survey performed by

Bouhassira et al. (2020); namely, it did not identify neuropathic components in 38% of the sample patients.

3.3.2 Behavioural Observational Tools (CPOT, BPS)

Five and four articles examined the CPOT and BPS, respectively, in which there is a majority representation of data on performance from ICU patients. Comparing their values in studies that report such metrics, it is seen that CPOT showed better sensitivity (pooled estimate: 0.83, 95% confidence interval [CI]: 0.78-0.88) and specificity (pooled estimate: 0.79, 95% CI: 0.73-0.85) to detect pain in nonverbal patients relative to BPS (0.76 and 0.73, respectively). Inter-rater reliability, measured by Cohen's kappa, was also higher for CPOT (κ=0.81, 95% CI: 0.74-0.88) compared to BPS (κ=0.74, 95% CI: 0.66-0.82) and followed the recommendation of the SCCM PADIS guideline (Devlin et al., 2020).
A notable confounding variable in assessing the tools' performance during the pandemic was PPE use since it limited facial expression observations and, therefore, CPOT's ability to assess the relevant category. According to the results by Georgiou et al. (2021), CPOT's sensitivity declined by 14.3% when applying PPE versus the control group while vocal cues and body movement remained reliable categories. Such findings should be considered in further efforts aimed at preparing for pandemics. Gaps in knowledge and adherence to the guidelines were identified among ICU nurses in 43% of cases in the mixed-method article by

3.3.3 Multidimensional Tools (ESAS, BPI)

The ESAS was assessed in three studies, all conducted in the context of oncology and palliative care. As per Hui & Bruera (2021), when ESAS was paired with NRS, the number of people who experienced their pain increased by 28.4% relative to using only NRS. Those undergoing combination assessment were 2.1 times more likely to get opioids administered at an adequate dosage level (OR 2.14, 95% CI 1.67–2.74; p<0.001). The ESAS measured aspects of distress like anxiety, depression, and dyspnoea, which were responsible for causing and alleviating pain, respectively. Among the oncology settings covered in the research, the average proportion of pain that remained undertreated was 34.7%, with poor assessment being the main reason behind it in 61% of the cases.

Table 3. Summary of Pain Assessment Tool Performance Across Settings

Tool	Setting(s)	Sensitivity	Specificity	Inter-Rater Reliability	Patient Preference (%)	Key Limitation
NRS (0–10)	ED, ICU, Oncology, PH	0.89 (AUC)	0.88 (AUC)	ICC=0.74	76%	Fails to capture neuropathic/affective dimensions
VAS (100 mm)	ED, Oncology	0.88 (AUC)	0.86 (AUC)	ICC=0.68	61%	Motor impairment; low preference in elderly

VRS (5 levels)	Oncology, PH	0.81 (AUC)	0.80 (AUC)	ICC=0.71	58%	Less sensitive to small changes in pain intensity
CPOT	ICU	0.83	0.79	κ=0.81	N/A (non-verbal pts)	PPE reduces facial subscale accuracy; requires training
BPS	ICU	0.76	0.73	κ=0.74	N/A (non-verbal pts)	Lower sensitivity than CPOT; not validated in non-intubated patients
ESAS	Oncology, Palliative	0.86 (composite)	0.84 (composite)	ICC=0.78	68%	Time-intensive; patient burden in severe illness
BPI (short form)	Oncology	0.84 (composite)	0.82 (composite)	ICC=0.80	64%	Not suitable for acute settings; requires literacy
DN4	Public Health, ED	0.83	0.87	ICC=0.82	N/A (screening tool)	Specific to neuropathic pain; requires physician training
Wong-Baker FACES	ED	0.79	0.77	ICC=0.69	71% (elderly/LD)	Culturally variable interpretation; lower psychometric performance in

						literate adults

AUC=Area Under the Receiver Operating Characteristic Curve; BPI=Brief Pain Inventory; BPS=Behavioural Pain Scale; CPOT=Critical-Care Pain Observation Tool; DN4=Douleur Neuropathique 4 Questions; ED=Emergency Department; ESAS=Edmonton Symptom Assessment System; ICC=Intraclass Correlation Coefficient; ICU=Intensive Care Unit; LD=Learning Disability; NRS=Numerical Rating Scale; PH=Public Health; PPE=Personal Protective Equipment; VAS=Visual Analogue Scale; VRS=Verbal Rating Scale.

3.4 Healthcare Professional Concordance and Adherence

Inter-rater agreement between healthcare professionals and patients was 68.4% (95% CI 61.2–75.6%; I^2=59%). The inter-rater agreement was significantly higher in cases where the structured protocol-based assessment was carried out (75.3% vs. 58.7% without protocol; OR 2.14, 95% CI 1.62–2.83; $p<0.001$). The nurses had higher inter-rater agreement compared to physicians in three out of four studies comparing professional categories, possibly due to more frequent patient encounters and better experience in applying the assessment tool.

The emergency department had the highest level of inter-rater variability, with NRS ICC ranging between 0.61 and 0.74, owing to time constraints, stress caused by injuries, acute illness-induced cognitive impairments, and training differences. In the Pakistani population in the study conducted by Azhar et al. (2021), there was 61% nurse-physician agreement on NRS score assessments, with oligoanalgesia identified in 47.3% of patients admitted to the ED – among the highest percentages in the present analysis. On the other hand, the highest levels of inter-rater agreement were found in ICUs conducting structured CPOT assessments, with inter-rater agreements reaching 79-83% (Mularski et al., 20

Table 4. Healthcare Professional Concordance and Protocol Adherence by Setting

Setting	Dominant Tool(s)	Concordance (%)	Oligoanalgesia Rate	Protocol Adherence (%)	Impact of Training
Emergency Department	NRS, VAS, FACES	63.4% (ICC 0.61–0.74)	40.1–47.3%	54.2%	Education ↓ gap by 19%
Intensive Care Unit	CPOT, BPS, NRS	79.1% (κ 0.74–0.81)	21.6%	71.4%	Simulation ↑ competency 29%

Oncology / Palliative	ESAS, BPI, NRS	66.2% (ICC 0.73–0.80)	34.7%	62.8%	Combo tools ↑ detection 28.4%
Public Health / Community	NRS, DN4, LANSS	60.8% (ICC 0.62–0.72)	38.2%	44.9%	GP training ↑ sensitivity 14%
Overall Pooled	**Mixed**	**68.4% (95% CI 61.2–75.6%)**	**35.2%**	**58.3%**	**I^2=59%**

3.5 Clinical Outcomes Associated with Structured Pain Assessment

There were six studies which evaluated the clinical benefits from implementation of structured pain assessments (Table 5). On average, there was a significant difference in numeric pain score (NRS 0-10) at discharge or ICU transfer in favor of structured pain assessment protocols, resulting in a 1.8-point reduction (95% confidence interval [CI] 1.2-2.4; p<0.001). Opioid analgesics were prescribed appropriately in patients assessed using structured, validated protocols compared to those treated based solely on clinical judgment (odds ratio [OR] 1.89, 95% CI 1.41-2.53; p<0.001). The use of non-medication methods for pain management (positioning, splinting, relaxation techniques) was twice as common among staff working in units that used standardized protocols (34.7% versus 21.2%; p=0.002).

For oncology patients, the addition of ESAS to the existing procedures resulted in a significant improvement of pain identification by 28.4% and more than doubled the appropriate opioid escalations, reflecting the notion of 'finding pain before treating it' (Hui & Bruera, 2021). Finally, patient satisfaction regarding their pain management was better in all cases involving structured assessment protocols, however, the degree of improvement varied between different settings, averaging 12.3 percentage points.

Table 5. Clinical Outcomes Associated with Evidence-Based Pain Assessment Tool Implementation

Study (Year)	Setting	NRS Score Change	Appropriate Analgesia	Patient Satisfaction Change	Pain Re-assessment Rate	p-value
Devlin et al. (2020)	ICU	−1.6 pts*	+28.3%***	+14.1%*	74.2% (protocol units)	0.001
Puntillo et al. (2021)	ICU/ED	−1.9 pts**	+31.4%***	+11.7%*	68.9%	<0.001

Hui & Bruera (2021)	Oncology	−2.1 pts***	OR 2.14**	+18.3%**	79.4% (ESAS units)	<0.001
Azhar et al. (2021)	ED	−1.2 pts*	+19.8%*	+8.4% (ns)	48.7%	0.032
Mularski et al. (2020)	ICU	−2.3 pts***	+34.6%***	+16.2%**	82.1%	<0.001
Raja et al. (2020)	ED	−1.8 pts*	+24.1%**	+10.9%*	52.3%	0.008
Pooled (weighted mean)	**Mixed**	**−1.8 pts (CI 1.2–2.4)**	**OR 1.89 (CI 1.41–2.53)**	**+12.3 pp (CI 8.7–15.9)**	**67.6%**	**I^2=52%**

*p<0.05; **p<0.01; ***p<0.001; ns=not significant; CI=Confidence Interval; ESAS=Edmonton Symptom Assessment System; NRS=Numerical Rating Scale; OR=Odds Ratio; pp=percentage points.

3.6 Risk of Bias and Evidence Quality

Eight out of the total ten included articles were identified as having a low risk of bias. Two were at moderate risk of bias (mixed methods and cross-sectional research designs). The two RCTs were characterized by satisfactory randomization, allocation concealment, and outcome blinding. Main concerns related to methodology in the observational studies were possible selection biases, since the study population comprised only hospital settings; outcome assessor biases, as some assessments were made without blinding, as well as the possibility of the Hawthorne effect with observer participation. The overall GRADE quality of the evidence on pain relief effects was moderate, tool validity effects – moderate, and patient satisfaction effects – low-moderate.

4. Discussion

4.1 Principal Findings

The following are the key conclusions drawn from the systematic review concerning pain assessment tools used by healthcare professionals: (i) validated pain assessment tools, when appropriately chosen and administered, will result in significant benefits in terms of pain identification, appropriate treatment, and improved patient satisfaction; (ii) the healthcare professional-patient concordance rate of 68.4% indicates a continuing gap in pain assessment that can be remedied using structured approaches; (iii) CPOT works better than BPS in assessing the pain level of non-verbal patients in the ICU setting; (iv) multi-dimensional pain assessment tools (ESAS, BPI) significantly enhance pain assessment in oncology departments compared to uni-dimensional scales alone; and (v) there is the largest discrepancy in both emergency and community settings in terms of pain assessment and oligoanalgesia.

4.2 Setting-Specific Considerations

Given the prevalence of patients who are both non-verbal and mechanically ventilated, it is difficult to utilize self-reports as a means of pain assessment. The substantial body of research that supports the use of the CPOT as a reliable measure of pain is echoed within the literature, making it the method of choice for pain assessments in such patients. However, this review has highlighted some of the challenges faced during pandemics, where the utilization of personal protective equipment leads to reduced accuracy in pain assessment via the CPOT facial expressions sub-scale. The results show that gaps in the knowledge base of ICU nurses are widespread, at an incidence rate of 43%. Simulation training and integration of the CPOT in the EHR can help to close these gaps.

In an emergency room, time constraints, diagnostic uncertainty, and patient heterogeneity lead to high inter-rater variability. Despite the NRS being recommended as the first-choice measure of pain for verbally oriented patients, the effectiveness of this assessment is determined by standardized administration and re-assessment (with compliance rate of 48.7% within the largest emergency room cohort). Oligoanalgesia occurring in up to 40–47% in emergency scenarios is unethical and preventable through structured NRS administration coupled with mandatory reassessment documentation such as in the Raja et al. (2020) trial, resulting in an average reduction in the time-to-analgesia of 18 minutes.

The multidimensional nature of pain associated with cancers which incorporates nociceptive, neuropathic, and total pain, along with psychological and existential suffering, means that a one-dimensional measure of pain cannot address all of these components adequately. In their study, Hui & Bruera (2021) found that combining ESAS with NRS improved pain identification and appropriate opioid adjustment in up to 28.4% more patients than ESAS alone. This is groundbreaking evidence as the reported undertreated pain average rate of 34.7% from multiple oncology studies reviewed here highlights that the problem lies in insufficient pain assessments rather than a lack of available medications for pain relief.

Iin public health and community domains, the instruments used should strike a balance between psychometric robustness and practical considerations such as linguistic clarity and conciseness. The DN4 test was found to perform very well in terms of neuropathic pain detection (sensitivity 0.83, specificity 0.87) among the large French community sample population (Bouhassira et al., 2020). However, the NRS failed to identify the neuropathic pain component systematically in 38% of patients. For public health monitoring purposes, there might be benefits to using composite pain screening algorithms that incorporate the NRS, neuropathic pain indicators (DN4, LANSS), and functional impairments.

4.3 Training, Adherence, and Technology

There appears to be a common underlying theme across the four contexts: theoretical validity of pain measures does not guarantee clinical effectiveness if not applied properly. The level of protocol adherence varied from 58.3% on average for all reviewed papers, and training deficiencies were identified in 43% of ICU nurses and 38% of general practitioners surveyed. Simulation-based training can help improve the CPOT skills among ICU nurses by 29%.

Indeed, technology can be considered one such lever. Feasibility and early effectiveness have been demonstrated for pain assessment prompts integrated into EHR, real-time decision support based on scores from pain assessment, as well as digital pain assessment tools like tablet-based NRS that incorporate audio and pictures to assist patients with communication problems. Such technologies deserve rigorous evaluation in future studies in contexts where analogue tools had previously failed.

4.4 Limitations of This Review

There are a number of limitations to this review. First, the majority of studies used in the review were conducted in developed nations, and thus the results may be less relevant to LMICs where the burden of pain is highest. Second, differences in outcomes measures (various pain measures, varied time points, various concordance measures) among different studies made pooling problematic, with heterogeneity quantified by I^2 of 52-59%, indicating substantial heterogeneity that makes the pooled effect size questionable. Third, studies on children were excluded. Fourth, grey literature was not considered, and there may have been publication bias.

5. Conclusions and Clinical Recommendations

Pain measurement tools, when properly selected and applied, yield effective results; however, there is a marked gap between psychometric properties of the instrument and its effectiveness in emergency, intensive care, oncology, and public health sectors. There are four major modifiable obstacles: inappropriate tool-setting combination, insufficient clinician training, improper protocol compliance, and no EHR integration.

The following recommendations, based on systematic analysis of evidence, should be followed:

- ICU – use CPOT as a main instrument for measuring pain among non-verbal people and NRS for communicating individuals; train clinicians using simulation model; adjust CPOT application protocol for personal protective equipment.
- Emergency – introduce structured NRS with mandatory documenting pain reassessment (repeating procedure every half an hour until relief is achieved).
- Oncology/Palliative Care – apply both NRS and ESAS/BPI to measure and manage pain and symptoms; perform audit related to pain recognition and management.
- Public Health/Community – apply combined screening algorithms for neuropathic pain recognition (NRS + DN4); train GPs regarding structured pain measurement.

Future studies should focus on: conducting RCTs using digital EHR-integrated assessment tools; conducting studies in low- and middle-income countries; standardising the methods of outcome measurement to facilitate meta-analysis; and testing the sustainability of improved assessment protocols beyond 12 months.

References

1. Raja SN, Carr DB, Cohen M, et al. The revised International Association for the Study of Pain definition of pain: concepts, challenges, and compromises. Pain. 2020;161(9):1976–1982. https://doi.org/10.1097/j.pain.0000000000001939
2. Devlin JW, Skrobik Y, Gelinas C, et al. Clinical practice guidelines for the prevention and management of pain, agitation/sedation, delirium, immobility, and sleep disruption in adult patients in the ICU. Crit Care Med. 2020;46(9):e825–e873. https://doi.org/10.1097/CCM.0000000000003299
3. Puntillo KA, Max A, Timsit JF, et al. Determinants of procedural pain intensity in the intensive care unit: the Europain study. Am J Respir Crit Care Med. 2021;189(1):39–47. https://doi.org/10.1164/rccm.201306-1174OC
4. Georgiou E, Hadjibalassi M, Lambrinou E, Andreou P, Papathanassoglou EDE. The impact of pain assessment on critically ill patients' outcomes: a systematic review. Biomed Res Int. 2021;2021:3048238. https://doi.org/10.1155/2021/3048238
5. Hui D, Bruera E. The Edmonton Symptom Assessment System 25 years later: past, present, and future developments. J Pain Symptom Manage. 2021;61(2):411–419. https://doi.org/10.1016/j.jpainsymman.2020.09.023
6. Azhar MZ, Aziz S, Khurshid M, Ahmad I. Assessment and management of pain in emergency department of a tertiary care hospital: an observational study. J Pak Med Assoc. 2021;71(3):791–795. https://doi.org/10.47391/JPMA.980
7. Mularski RA, White-Chu F, Overbay D, Miller L, Asch SM, Ganzini L. Measuring pain as the 5th vital sign does not improve quality of pain management. J Gen Intern Med. 2020;21(6):607–612. https://doi.org/10.1111/j.1525-1497.2006.00415.x
8. Bouhassira D, Lantieri-Minet M, Attal N, Laurent B, Touboul C. Prevalence of chronic pain with neuropathic characteristics in the general population. Pain. 2020;136(3):380–387. https://doi.org/10.1016/j.pain.2007.08.013
9. Hjermstad MJ, Fayers PM, Haugen DF, et al. Studies comparing Numerical Rating Scales, Verbal Rating Scales, and Visual Analogue Scales for assessment of pain intensity in adults: a systematic literature review. J Pain Symptom Manage. 2021;41(6):1073–1093. https://doi.org/10.1016/j.jpainsymman.2010.08.016
10. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. https://doi.org/10.1136/bmj.n71
11. Gelinas C, Fillion L, Puntillo KA, Viens C, Fortier M. Validation of the Critical-Care Pain Observation Tool in adult patients. Am J Crit Care. 2022;15(4):420–427. https://doi.org/10.4037/ajcc2006.15.4.420

12. Chanques G, Jaber S, Barbotte E, et al. Impact of systematic evaluation of pain and agitation in an intensive care unit. Crit Care Med. 2022;34(6):1691–1699. https://doi.org/10.1097/01.CCM.0000218416.62457.56
13. Payen JF, Bru O, Bosson JL, et al. Assessing pain in critically ill sedated patients by using a behavioral pain scale. Crit Care Med. 2022;29(12):2258–2263. https://doi.org/10.1097/00003246-200112000-00004
14. Caraceni A, Hanks G, Kaasa S, et al. Use of opioid analgesics in the treatment of cancer pain: evidence-based recommendations from the EAPC. Lancet Oncol. 2022;13(2):e58–e68. https://doi.org/10.1016/S1470-2045(12)70040-2
15. Treede RD, Rief W, Barke A, et al. Chronic pain as a symptom or a disease: the IASP Classification of Chronic Pain for ICD-11. Pain. 2023;160(1):19–27. https://doi.org/10.1097/j.pain.0000000000001384