ASRA PAIN MEDICINE



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Beyond Self-Report: Artificial Intelligence for Pain Assessment

A Systematic Review

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BACKGROUND

Pain assessment often relies on patient self-report, which can be unreliable or unavailable.

OBJECTIVE

To evaluate the performance, validation and clinical applicability of AI-based methods for pain detection and intensity assessment in adults.

METHODS

- Systematic review (PRISMA)
- PubMed, Scopus, Web of Science, Cochrane Library (2021–2026)
- AI-based methods for pain detection or intensity assessment
- Qualitative synthesis

STUDY SELECTION (PRISMA)

- **Records identified (n = 417 + 1)**
- Records screened after duplicates removed **(n = 214)**
- Full-text articles assessed for eligibility **(n = 87)**
- **Studies included (n = 45)**

RESULTS

45 STUDIES MET INCLUSION CRITERIA

Facial imaging and video (most frequent)

Physiologic signals (EEG, EMG, EDA, cardiovascular measures)

Multimodal approaches (facial + physiologic + behavioral)

1 PROMISING RESULTS IN CLINICALLY RELEVANT POPULATIONS

AI-based models have been investigated in populations where self-report is limited or unavailable.



Postoperative pain



Critically ill patients



Cognitively impaired patients



Noncommunicative patients

2 PERFORMANCE DECREASES WITH INCREASING CLASSIFICATION COMPLEXITY

Accuracy is higher for binary pain detection and decreases when more pain levels are classified.

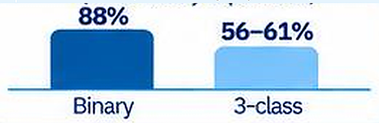
Imai et al., 2025
EEG – experimental pain
(25 healthy adults)



Albahdal et al., 2024
Multimodal physiologic signals
(86 healthy adults)



Wu et al., 2022
Facial video – clinical pain
(63 critically ill patients)



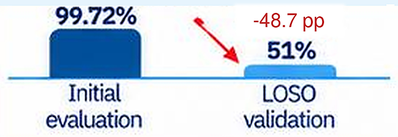
Gkikas et al., 2024
Facial video – heart rate
(87 healthy adults)



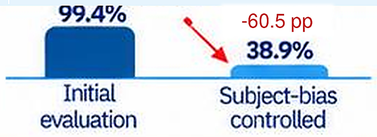
3 PERFORMANCE DECREASES WITH SUBJECT-INDEPENDENT OR EXTERNAL VALIDATION

Reported performance often decreases with subject-independent or external validation.

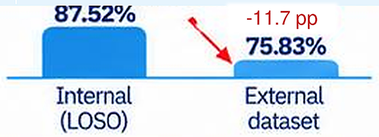
Tasci et al., 2024
EEG – neuropathic pain
(36 patients)



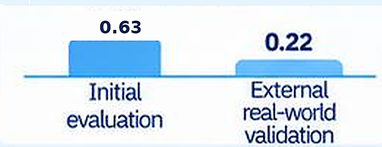
Kelati et al., 2022
Facial EMG – experimental
(85 healthy adults)



Farmani et al., 2025
EDA/ECG – multimodal
n=87 BioVid; external validation: AI4PAIN



Yang Y.C. et al., 2025
Facial video – clinical pain
(25 UNBC vs 931 real-world ED patients)



CLINICAL IMPLICATIONS

- Useful when self-report is limited or unavailable.
- Relevant for postoperative, critically ill, cognitively impaired and noncommunicative patients.
- May complement conventional assessment in clinical practice.
- Requires larger and more diverse populations and prospective external validation.

CONCLUSIONS

AI detects the presence of pain more reliably than its intensity, and performance often falls when models face new patients or datasets.

External validation remains the key barrier to clinical translation.