

Wearables for Objective Pain Assessment

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Introduction

Pain is subjective, physiology is not. Wearables stream HR/HRV, sleep, temperature, electrodermal activity (EDA), activity, EEG, and sEMG. Objective signals augment self-reports, especially for patients who cannot communicate pain.

Objective

Summarize 2021–2025 evidence on wearable signals for pain detection/prediction and clinical use.

Methodology

Narrative review (PubMed, Embase, Google Scholar; 2021–2025).
Search: pain biomarkers × HR/HRV, respiration, EDA, temperature, sleep, EEG, EMG, pupil, biochemical sensors. IRB waiver obtained.

Results

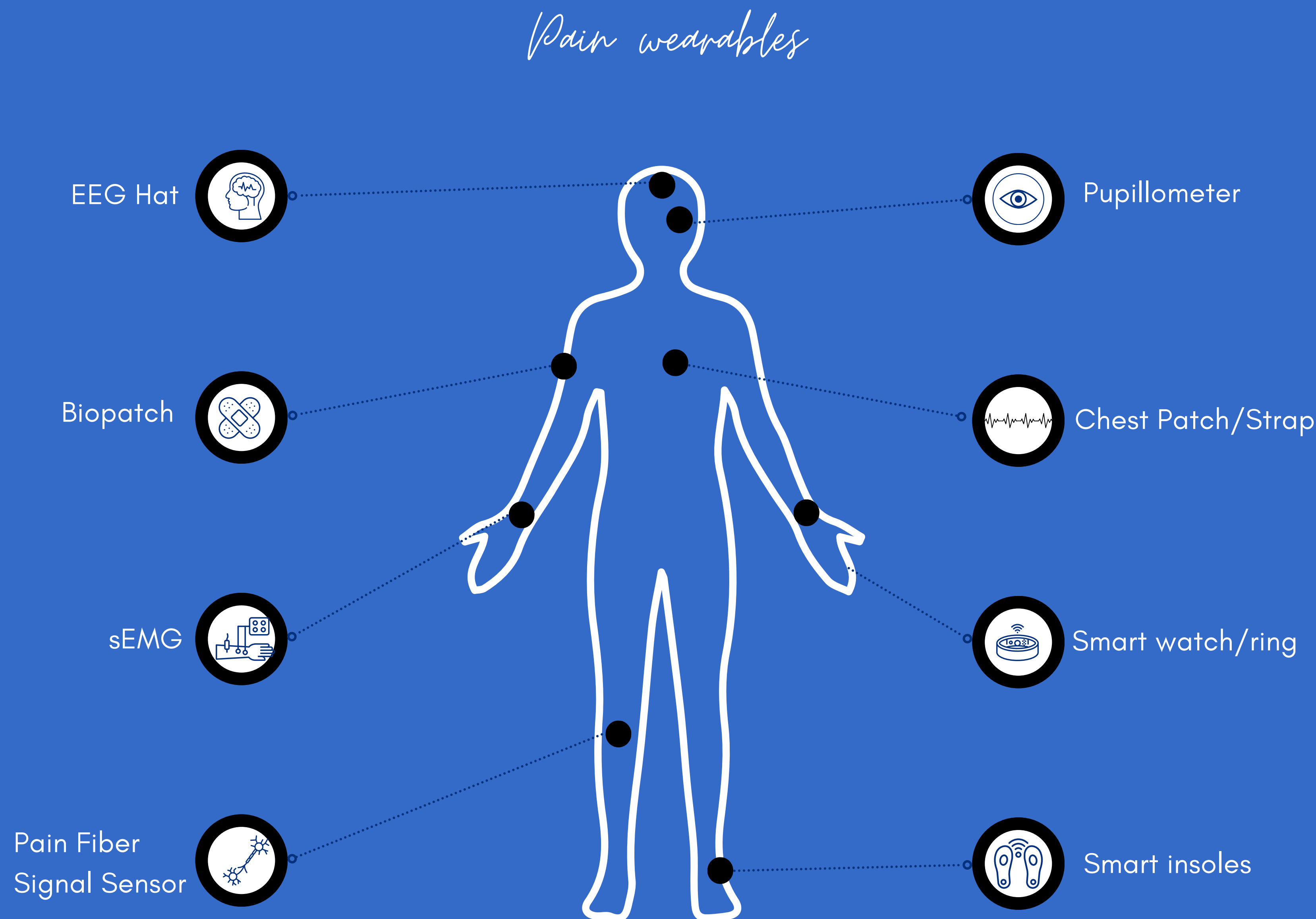
- HR/HRV: pain ↑HR and ↓HRV (acute & chronic).
- Sleep: bidirectional link; less REM & total sleep.
- Temperature: asymmetry flags CRPS activity.
- EDA: wrist EDA detects acute pain in real time.
- Activity: pain lowers steps; trackers help behavior change.
- EEG: objective signal in non-verbal patients; affective processing.
- sEMG: helpful in musculoskeletal pain and biofeedback.
- Pupillometry & chemical biomarkers: emerging

Conclusion

What do you do with wearable data to identify pain? Start with **HRV + EDA**; add sleep, temperature, and activity.
Use **EEG** when patients can't self-report; **sEMG** for MSK/biofeedback.
Trend multi-modal signals; avoid single-point decisions; document in EMR.

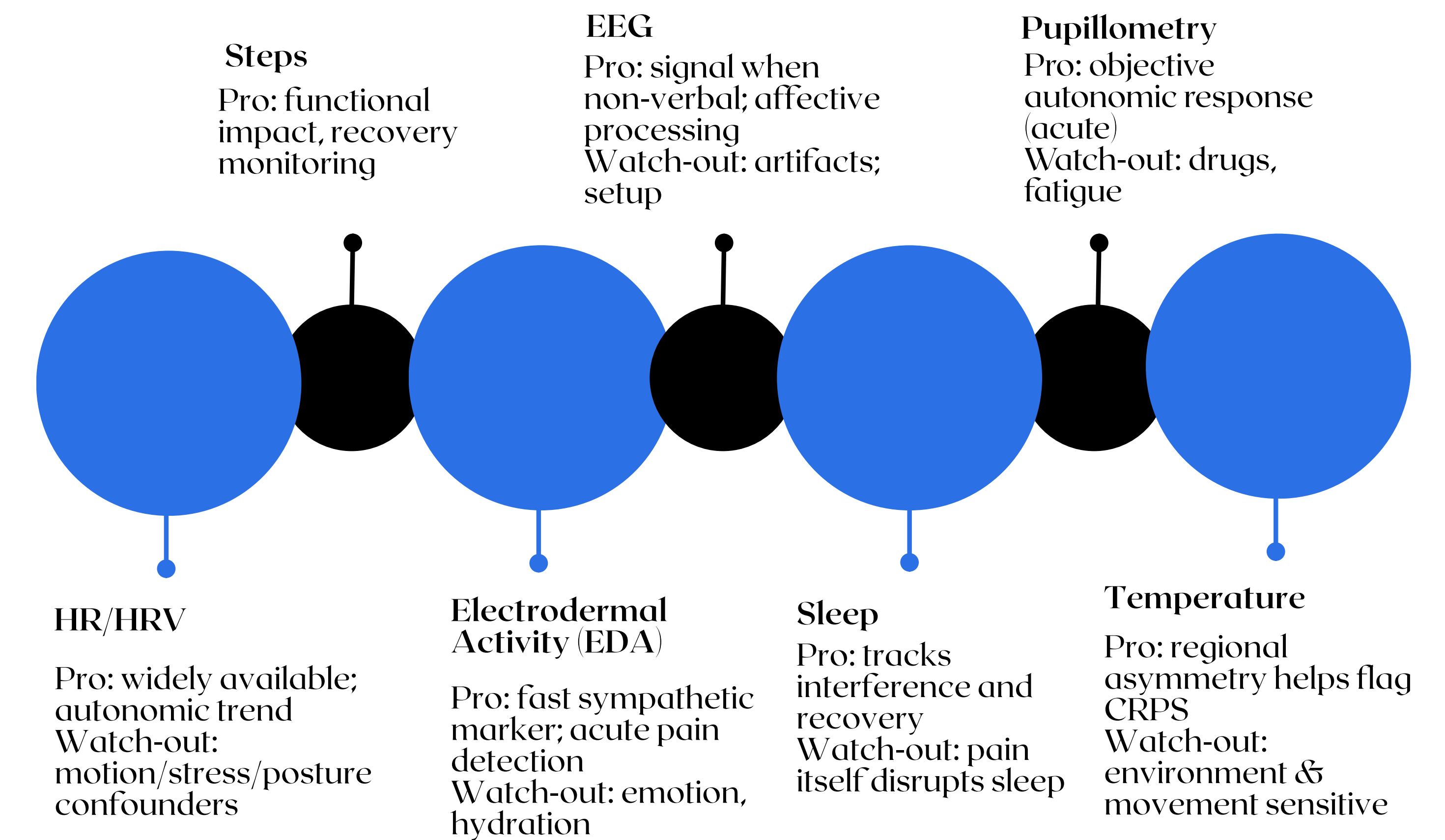
Wearables can **objectively** track pain when multiple signals are trended **together**.

Best practical panel now: HRV + EDA → add sleep, temperature, activity. EEG/sEMG help when patients can't self-report.



Analysis

Graph. Wearables Overview



Graph. Pillars of objective pain monitoring

