

EMOCARE · PASSIVE MULTIMODAL MONITORING

# Continuous Multimodal Passive Monitoring of Depressive Symptoms via Smartphone

Clinical validation of EMO CARE — a novel digital health technology for objective, low-burden, between-visit symptom tracking.

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KEY RESULT

Within-person concordance vs. clinician-rated MADRS

**r = 0.895**

repeated-measures correlation · p = .016

Sensitivity to symptom change vs. PHQ-9

**p = 0.834**

consecutive-visit Δ · p < .001

Concurrent association across all reference scales

**0.61–0.83**

Spearman ρ · MADRS · HAM-D<sub>17</sub> · PHQ-9 · GAD-7

Pooled across 3 prospective observational studies

**n = 45**

adults with MDD or Bipolar Disorder

01 · BACKGROUND

## The gap between visits

Episodic clinician-rated assessments place a high burden on patients and miss the inter-visit symptom dynamics that signal relapse and treatment response.

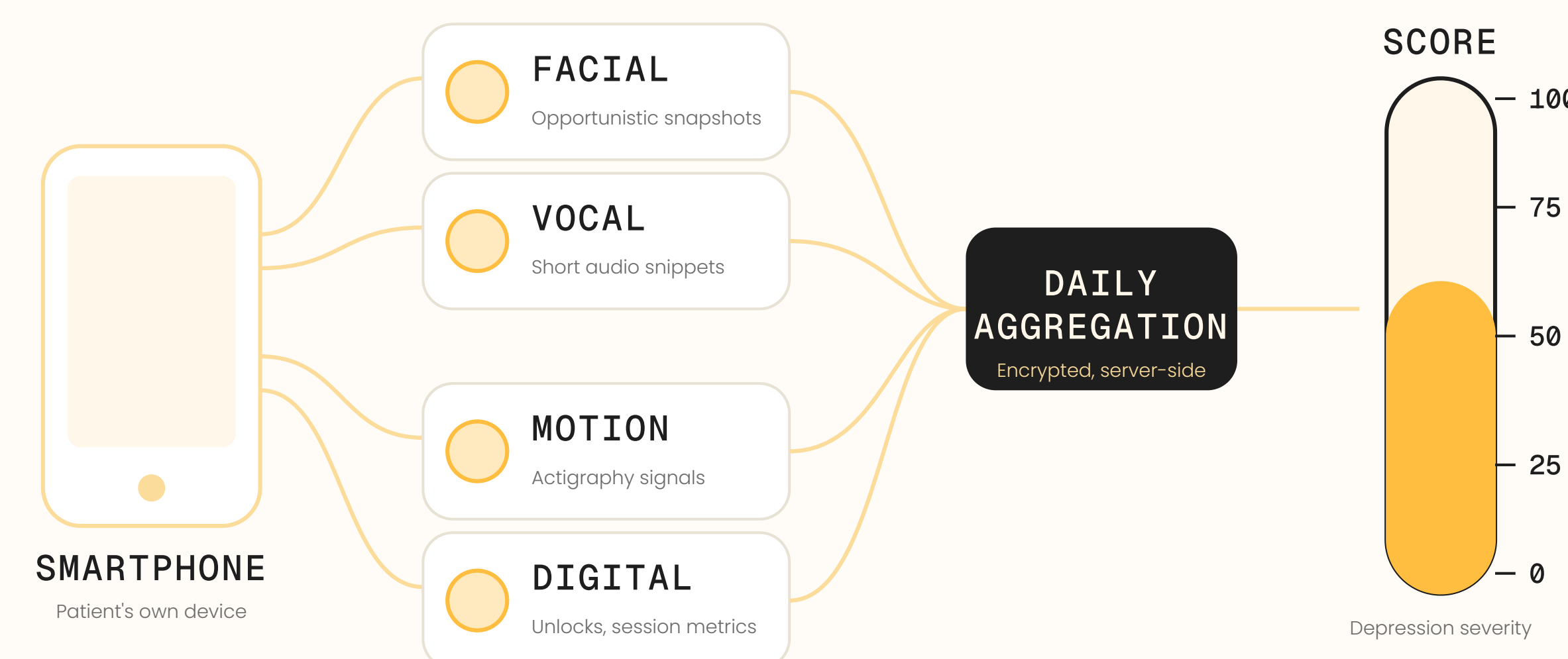
Passive, smartphone-based digital health technologies offer a continuous, objective, low-burden alternative — tracking disease trajectories in the real-world settings where patients live *between visits*.

- **Clinical need.** Approximately half of treatment-resistant depression patients relapse within 6–12 months; relapse is rarely detected at the moment it begins.
- **Measurement limit.** MADRS, HAM-D<sub>17</sub> and PHQ-9 are gold-standard but episodic — typically administered every 2–4 weeks.
- **Opportunity.** The smartphone is already in the patient's hand. Passive signals — face, voice, motion, digital behavior — can be transformed into a daily severity score.

This poster presents the interim clinical validation of **EMOCARE**, Emobot's passive multimodal Depression Thermometer.

02B · SIGNAL PIPELINE

## From phone to Depression Thermometer



**Figure 1.** EMO CARE signal pipeline. Four passive modalities are captured opportunistically on the patient's own smartphone and aggregated server-side into a daily 0–100 severity score — the Depression Thermometer.

02A · METHODOLOGY

## A passive, multimodal signal pipeline

EMOCARE runs on the patient's own smartphone during routine use — no active input, no scheduled prompts.

- 1 **Passive acquisition.** Opportunistic facial snapshots and short audio snippets during normal phone use, plus actigraphy and digital-behavior patterns (screen unlocks, session metrics).
- 2 **On-device extraction.** Mood biomarkers are derived locally from each modality, preserving privacy.
- 3 **Server-side aggregation.** Encrypted features are aggregated to produce a daily severity score on a **0–100** scale.
- 4 **Clinician anchoring.** Scores compared against MADRS and HAM-D<sub>17</sub> (clinician-rated) and PHQ-9, GAD-7 (self-report).

### Study design

Interim pooled analysis across **3 prospective observational studies** in adults with **Major Depressive Disorder** or **Bipolar Disorder**. EMO CARE scores were compared with established reference scales:

MADRS · HAM-D<sub>17</sub> · PHQ-9 · GAD-7

*Peach = clinician-rated · Soft peach = self-report.*

02C · MODALITIES CAPTURED

## Four passive signals

<p><b>SIGNAL 01</b> <b>Facial</b> Opportunistic snapshots · on-device feature extraction · mood biomarkers</p>	<p><b>SIGNAL 02</b> <b>Vocal</b> Short audio snippets · ephemeral processing · prosody &amp; affect</p>
<p><b>SIGNAL 03</b> <b>Actigraphy</b> On-device motion &amp; activity rhythms · circadian markers</p>	<p><b>SIGNAL 04</b> <b>Digital behavior</b> Screen unlocks, session length, cadence of routine smartphone use</p>

### Measurement integrity

- **Data-density criterion.** ≥ 7 valid days per 14-day window confirmed signal robustness for longitudinal analysis.
- **Signal redundancy** across four modalities mitigates per-channel data sparsity.
- **Dynamic tracking.** Passive scores tracked symptom trajectories *between* clinic visits, not only at them.

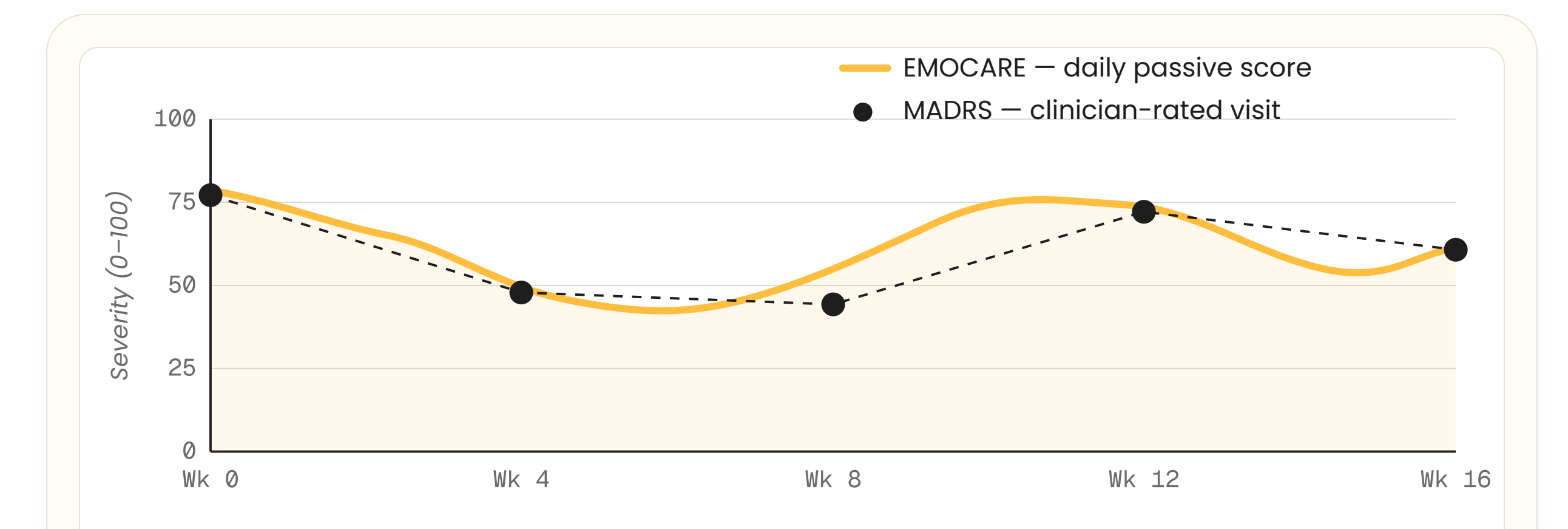
03 · RESULTS

## Clinical alignment, in the real world

An interim pooled analysis across three prospective observational studies in adults with MDD or Bipolar Disorder.

- **Concurrent validity.** EMO CARE scores showed moderate-to-strong association with every reference symptom scale tested — clinician-rated and self-report (ρ = **0.61–0.83**).
- **Within-person concordance.** Repeated-measures correlation against clinician-rated MADRS reached **r = 0.895** (p = **.016**).
- **Sensitivity to change.** Consecutive-visit change on PHQ-9 was tracked with **p = 0.834** (p < **.001**) — the score moves when the patient moves.
- **Feasibility at scale.** Continuous EMO CARE scores were generated across the full follow-up window in the pooled cohort.

### Within-person trajectory · EMO CARE vs. MADRS



**FIGURE 2.** Representative within-person trajectory — continuous EMO CARE score (amber) tracks discrete clinician-rated MADRS ratings (black) across a 16-week follow-up window. Repeated-measures correlation in the pooled analysis: **r = 0.895**. *Illustrative; data points are schematic.*

06 · LIMITATIONS & NEXT STEPS

## What we're watching

- **Adherence at scale.** The ≥ 7 valid days / 14-day window criterion confirmed integrity here; real-world deployment will need to characterise drop-off in broader cohorts.
- **Generalisation.** Current cohorts are MDD and Bipolar Disorder in interventional psychiatry; further work will extend to TRD subgroups and primary care.
- **Final pooled analysis & pre-registered replication** are planned with extended follow-up and event-level relapse endpoints.
- **Prospective utility study.** Evaluating whether continuous EMO CARE alerts shorten time-to-intervention in clinical workflows.

04 · CONCLUSION

## Interpretable severity, between every visit.

*Continuous, passive, multimodal smartphone monitoring can generate interpretable severity estimates that align closely with gold-standard episodic scales.*

By passively capturing facial, vocal, motion, and digital-behavior markers, EMO CARE extends clinical visibility into the weeks **between visits** — a **depression thermometer** rather than a snapshot.

05 · CLINICAL VALUE

## What this unlocks

- **Early relapse detection** — baseline drift between visits surfaces before the next scheduled clinical contact.
- **Objective treatment-response assessment** for interventional psychiatry — TMS, esketamine/Spravato, and pharmacotherapy.
- **High-fidelity monitoring at scale** — clinic-grade severity tracking without adding visits, surveys, or wearables.
- **Patient-respectful by design** — passive in the background, requires no engagement to deliver value.

07 · PRIVACY & ETHICS

## Built for the clinical setting

- **On-device feature extraction** for facial signals — raw images never leave the phone.
- **Ephemeral audio processing** — short snippets are transformed to biomarkers and discarded.
- **Encrypted server-side aggregation** of derived features only, never raw multimedia.
- **IRB-approved protocols** across all three studies; written informed consent obtained from every participant.

DISCLOSURES & FUNDING

A. Perzo<sup>1</sup>, T. Petelot<sup>1</sup>, R. Séguier<sup>3</sup>; shareholders of Emobot.

M.T. Sapko<sup>2</sup>, J.C. Javitt<sup>4</sup>; declare no competing financial interests.

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