

Multimodal Sensor and EMA Biomarkers for Ecologically Valid Digital Phenotypes of Neuropsychiatric Symptoms Across the Full Clinical Spectrum of bvFTD and AD

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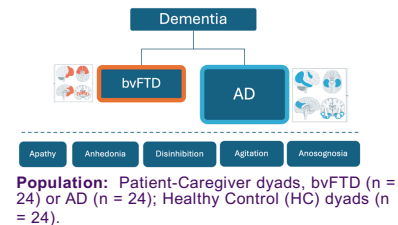
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ECOCAPTURE@HOME V2 provides a novel framework for remote monitoring of neuropsychiatric symptoms in Alzheimer's disease (AD) and behavioral variant frontotemporal dementia (bvFTD).

- Continuous home-based monitoring captures neuropsychiatric symptoms (NPS) under real-life conditions.
- A rigorous two-step framework (EMA contextualization followed by clinical validation) transforms sensor-derived metrics into ecologically valid and clinically meaningful digital biomarkers (DBMs).
- These DBMs are integrated into symptom-specific digital phenotypes, paving the way for more precise characterization and monitoring of NPS in bvFTD and AD.

INTRODUCTION

Identification of digital biomarkers (DBMs) of neuropsychiatric symptoms (NPS) for ecologically valid phenotyping in AD and bvFTD



Data collection at Home



- Construct **NPS digital phenotypes**
- Compare NPS digital phenotypes in **bvFTD and AD**
- Early detection** and staging via digital phenotypes
- Examine the relationship between **Patient NPS and Caregiver outcomes**.
- Investigate the role of **protective factors** (cognitive reserve, lifestyle, physical activity, creativity) in modulating NPS and caregiver outcomes.

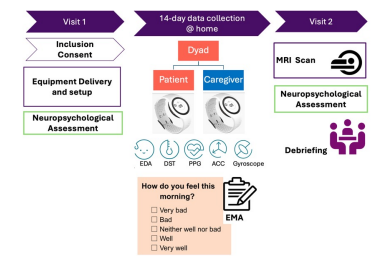
METHODS

Study protocol

Visit 1 (ICM): Neuropsychological assessment + equipment deployment

14-day at-home digital monitoring: Continuous monitoring using wearable sensors and EMA

Visit 2 (ICM): Complementary assessments + device return + debriefing



Sensor-based metrics extraction

Sensors	Derived digital metrics
EDA	Electrodermal activity
DST	Digital skin temperature
PPG	Heart rate, interbeat interval, variability
ACC	Accelerometer
Gyro	Gyroscope

Neuropsychological Assessment

NPS	Clinical Anchor Scales for NPS
Apathy	SAS (Barakovich, 1992) DAS (Radakovic, 2014)
Anhedonia	SHAPS (Smith, 1996) TERS (Sard, 2006)
Agitation	CHAI (Cohen-Mansfield, 1998) PAS (Rosen, 1994)
Anosognosia	HASC-M (Monahan, 2014)
Disinhibition	HSCIT (Burgess, 1997) STROOP (Stroop, 1938)

RESULTS

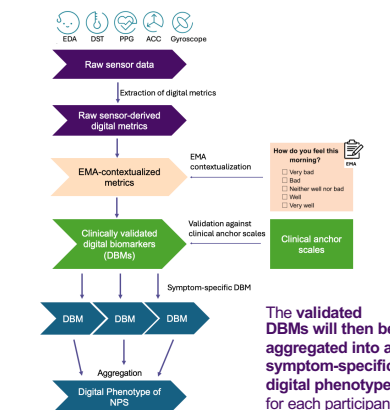
Two-step approach for deriving digital phenotypes of neuropsychiatric symptoms (NPS)

Step 1. Ecological contextualization

Sensor-derived digital metrics are contextualized and refined using EMA responses to ensure ecological validity and symptom specificity

Step 2. Clinical validation

Refined metrics are validated against clinical anchor scales to ensure their clinical relevance and interpretability, enabling their transformation into clinically meaningful DBMs of NPS.



CONCLUSIONS

- Lay the foundation for deriving ecologically valid and clinically meaningful digital phenotypes of neuropsychiatric symptoms (NPS), supporting disease characterization and monitoring across the full clinical spectrum of bvFTD and AD.
- Address key limitations of current NPS assessment by reducing reliance on subjective reporting and infrequent clinic-based evaluations through continuous, real-world monitoring.
- Integrate the caregiver perspective by identifying digital biomarkers of dyadic nature of dementia and supporting interventions targeting both patients and caregivers.
- Create new opportunities for the early detection, clinical staging, and longitudinal monitoring of dementia.
- Advance precision medicine by enabling individualized, data-driven assessment of NPS and supporting personalized care.

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