

UC San Diego

Biomarkers Symposium 2026

Title

Non-Contact Home Bed Sensing for Continuous, Personalized, Automated Detection of Clinical Events

Permalink

<https://escholarship.org/uc/item/7tn76435>

Authors

Gupta, Keshav

Padros-Valls, Raimon

Wong, Ashley

et al.

Publication Date

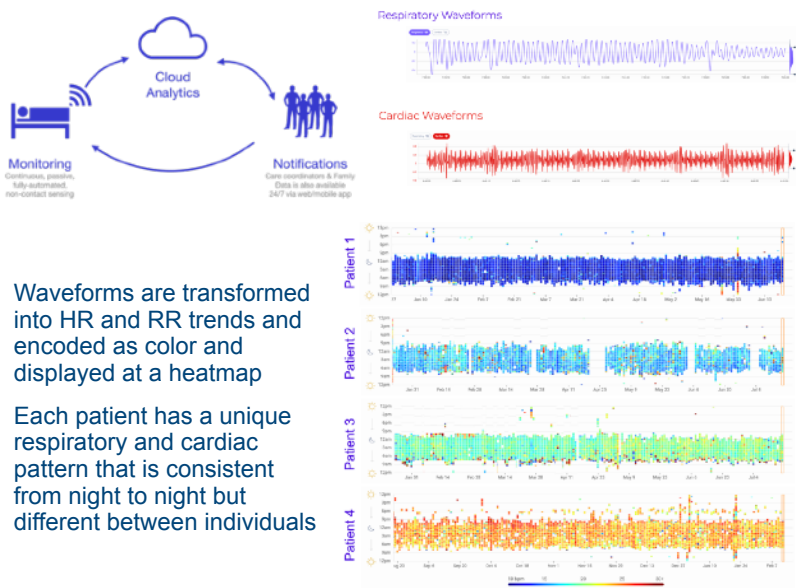
2026-05-15

INTRODUCTION

- Early recognition of clinical deterioration at home can enable interventions that can reduce severity and duration of hospitalizations and in some cases fully avoid them
- Home monitoring technologies like scales and implanted CardioMEMS are helpful but are limited by the need for adherence to self-measurement
- We are testing the hypothesis that continuous passive monitoring of cardiopulmonary physiology during sleep using non-contact bed sensors can detect clinically actionable changes at home.

NON-CONTACT MONITORING IN THE HOME BED

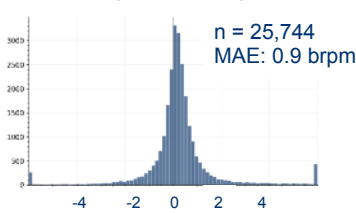
- A thin flexible non-contact electromechanical bed sensor is placed under the mattress.
- It continuously and automatically transmits respiratory and ballistocardiogram waveforms during sleep.
- Notifications upon changes from patient-specific baselines



- Waveforms are transformed into HR and RR trends and encoded as color and displayed at a heatmap
- Each patient has a unique respiratory and cardiac pattern that is consistent from night to night but different between individuals

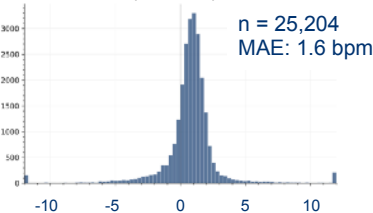
VALIDATION: BED SENSORS VS SLEEP STUDIES

Respiratory Rate
(vs chest belt)



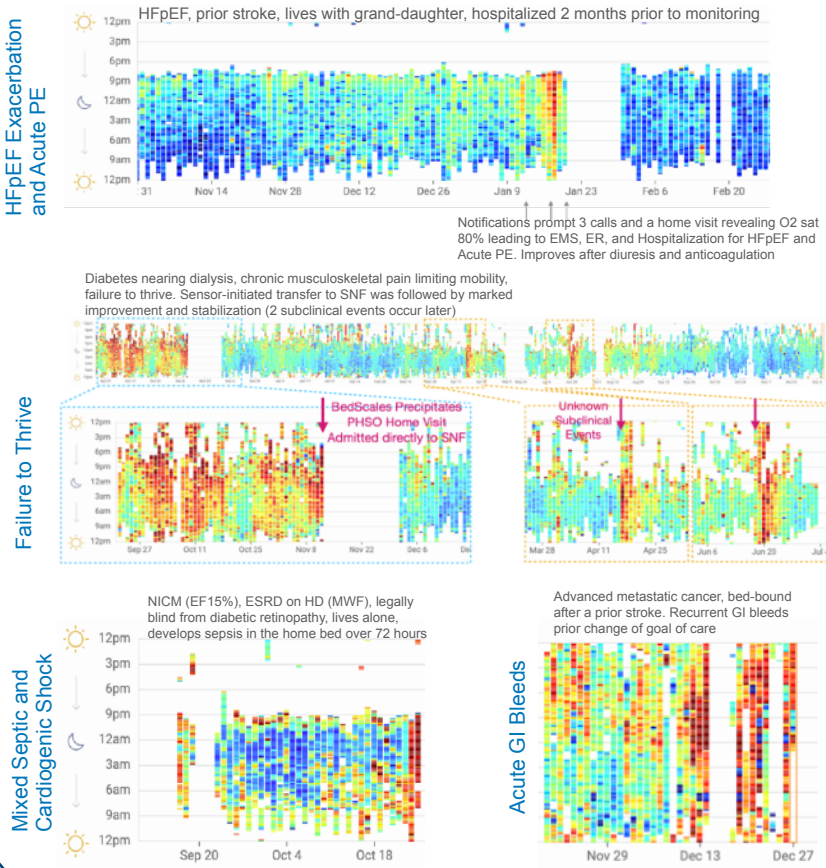
MAE = Mean Absolute Error

Heart Rate
(vs ECG)



n = 25,204
MAE: 1.6 bpm

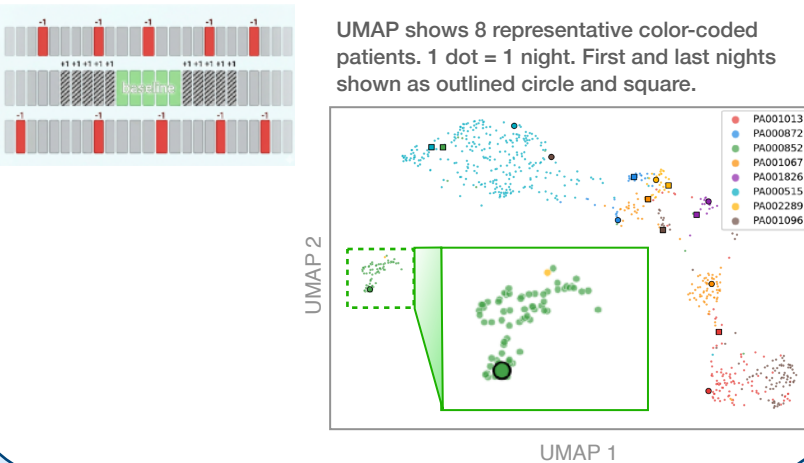
BED SENSORS DETECT CLINICAL EVENTS



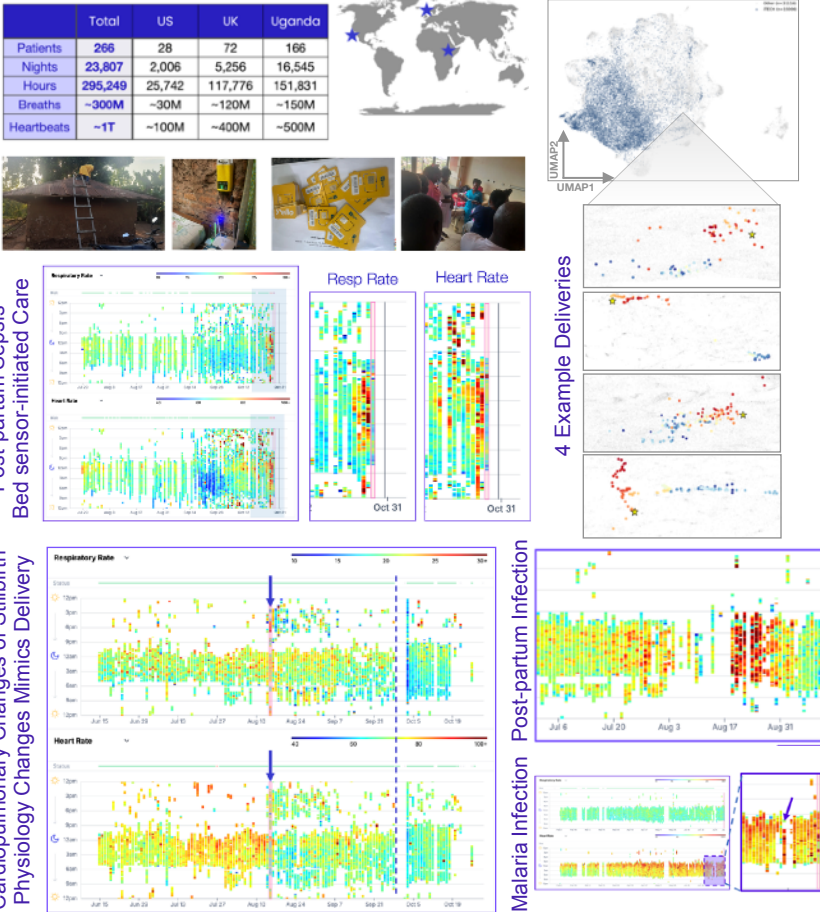
CONTRASTIVE LEARNING AI MODEL FOR GENERALIZED CLINICAL CHANGE DETECTION

Transforms the pattern of HR and RR into a 16-element vector (an "embedding") representing each night. Each night can be compared to all others in UMAP space.

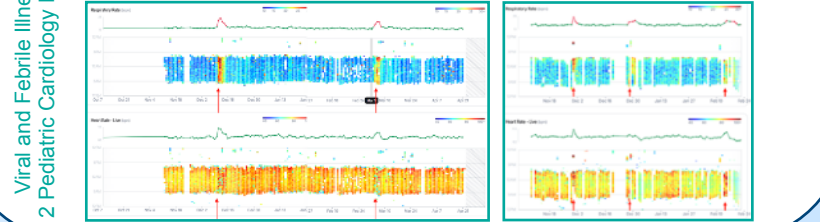
Observation: Nights that are closer temporally to each other are physiologically close to each other



BED-BASED MONITORING IN PREGNANCY FROM US TO RURAL UGANDA



BED-BASED MONITORING IN PEDIATRICS SINGLE VENTRICLE CLINIC (RCHSD)



AI VOICE AGENTS SOLICIT PATIENT HISTORIES

Real-time voice-based conversational AI adds subjective symptoms and context when bed sensors detect cardiopulmonary changes

REFERENCES

- (1) Harrington, N., Bui, Q.M., Wei, Z. *et al.* Passive longitudinal weight and cardiopulmonary monitoring in the home bed. *Sci Rep* 11, 24376 (2021). <https://doi.org/10.1038/s41598-021-03105-1>
- (2) Recmanik, M.; Martinek, R.; Nedoma, J.; Jaros, R.; Pelc, M.; Hajovsky, R.; Velicka, J.; Pies, M.; Sevcakova, M.; Kawala-Sterniuk, A. A Review of Patient Bed Sensors for Monitoring of Vital Signs. *Sensors* 2024, 24, 4767. <https://doi.org/10.3390/s24154767>