

# Digital Phenotyping in Serious Mental Illness

## Using Smartphones to Understand Relapse in Schizophrenia

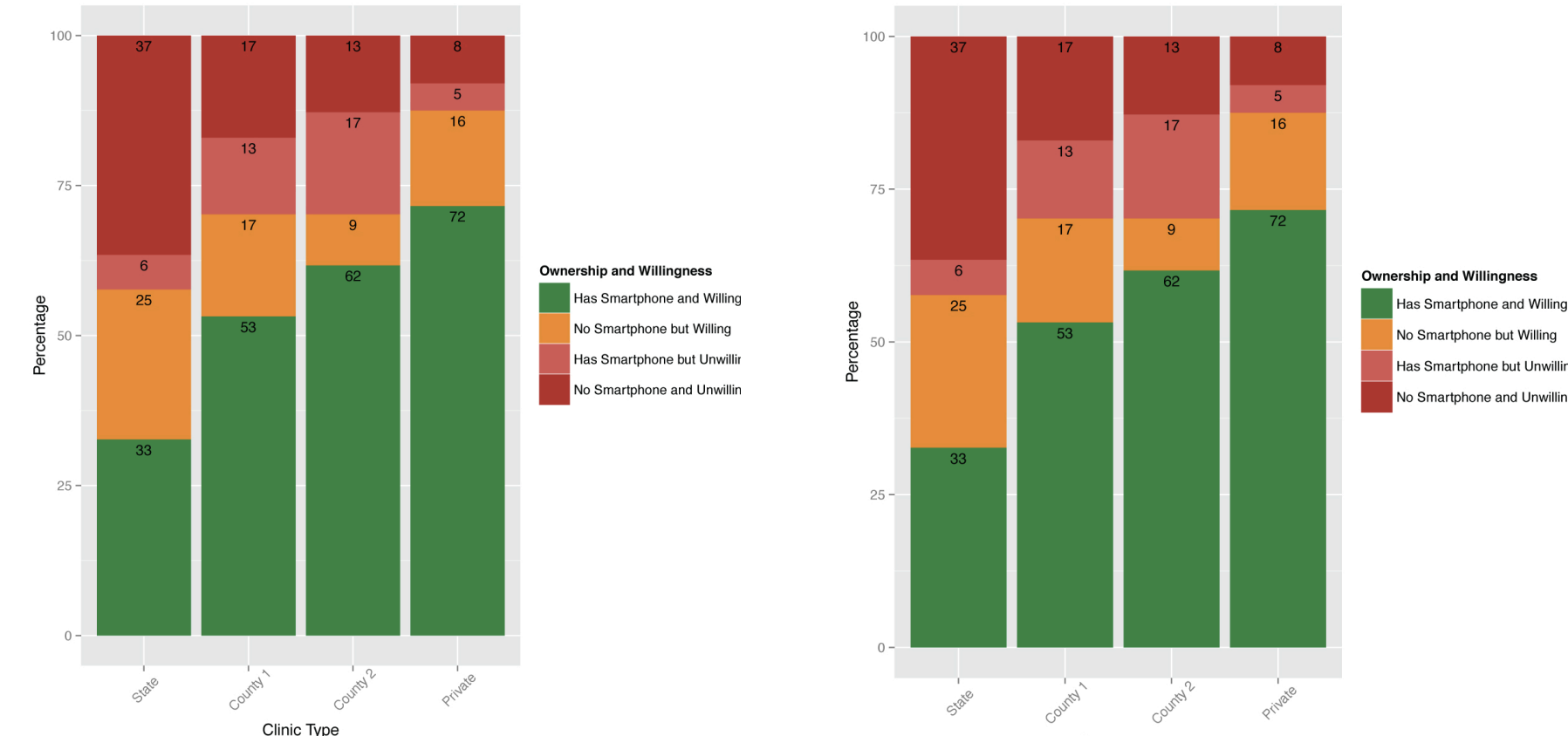


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### Introduction

**Background:** The data generated by increasingly sophisticated smartphone sensors and phone use patterns appear ideal for capturing various social and behavioral dimensions of psychiatric and neurological diseases. Like the rest of the population, those with serious mental illness both own smartphones and are interested in using them to improve their mental health outcomes.



**Hypothesis:** Smartphone surveys and smartphone passive data will be acceptable to patients and offer both clinicians and patients valuable data in understanding personal risk of relapse.

### Methods

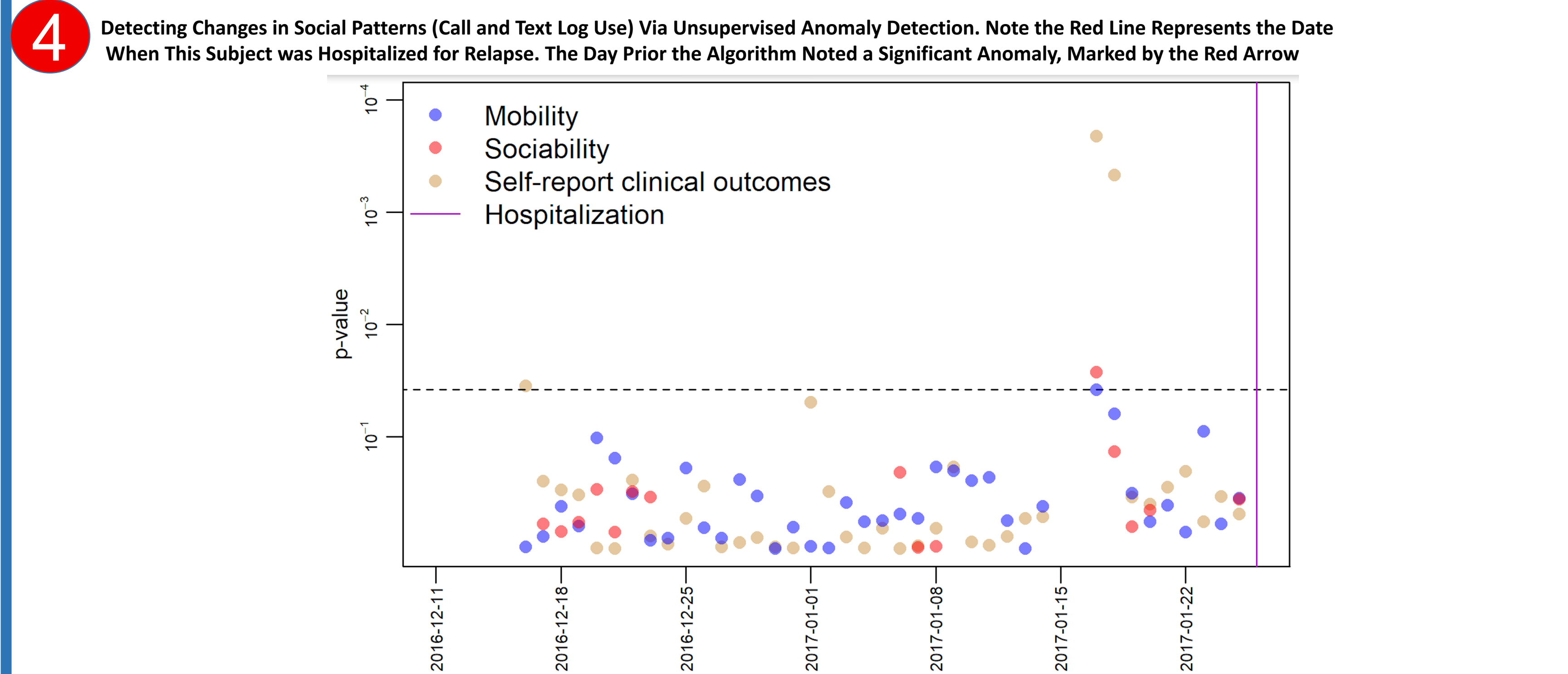
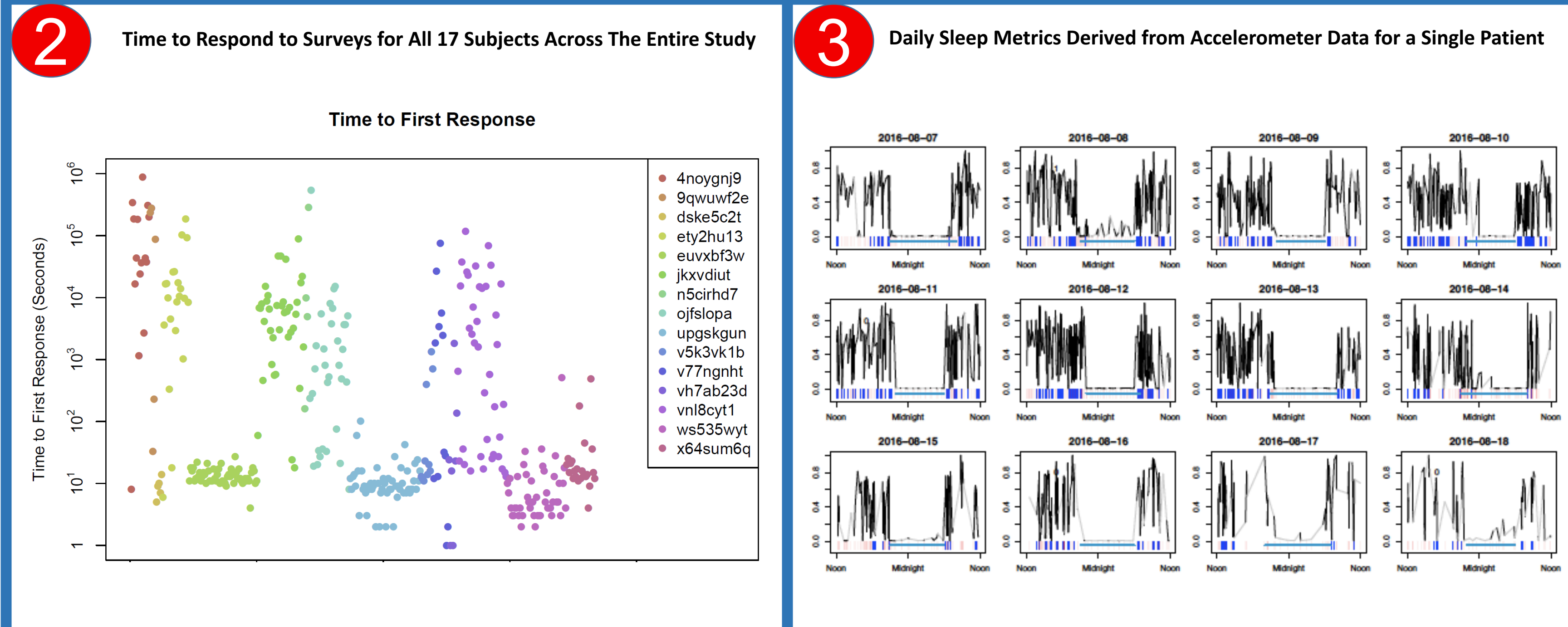
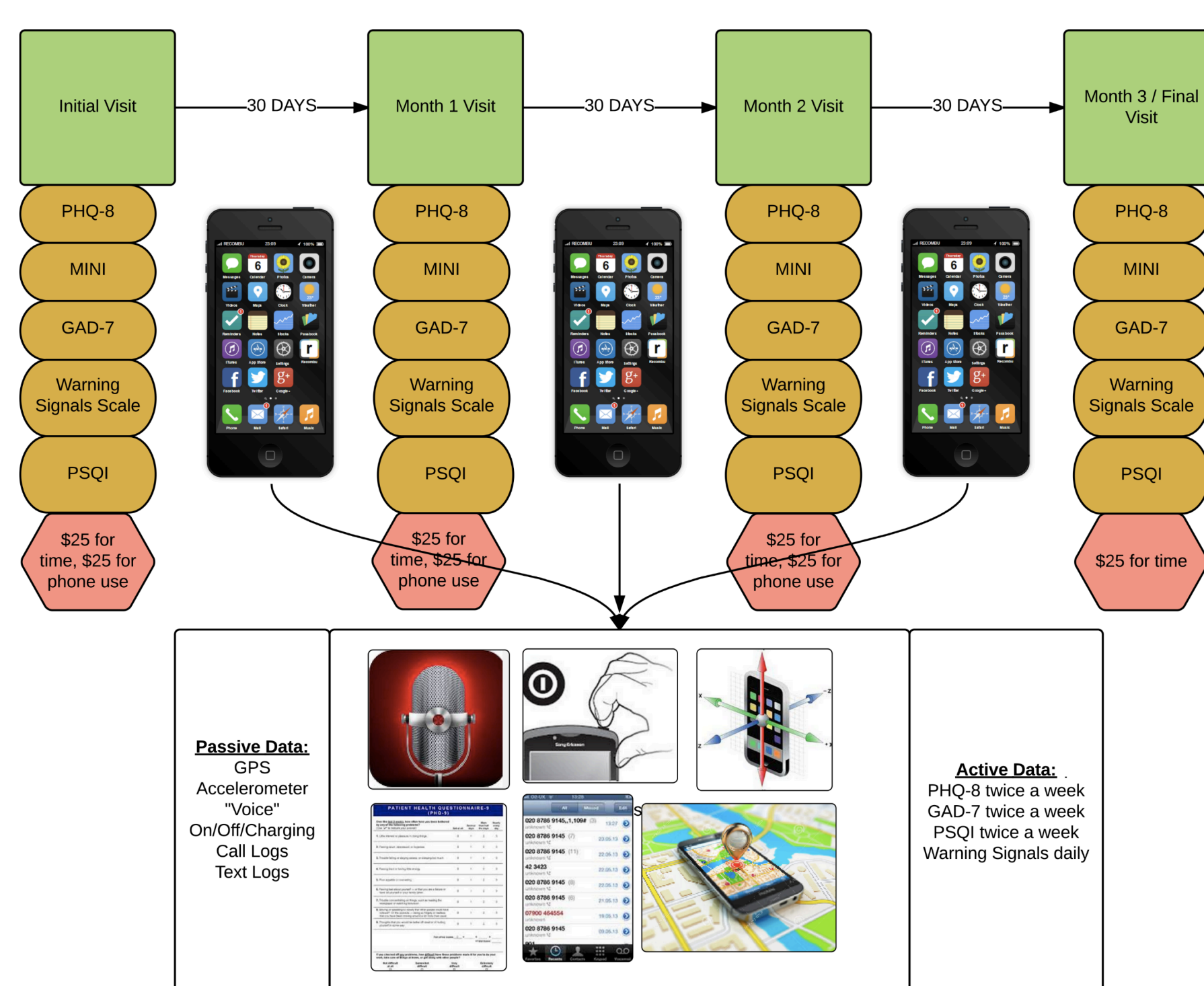
**Subjects:** 17 patients, to date, with clinical diagnosis of schizophrenia, who own a smartphone, and are in active treatment.

**Clinical:** PHQ-9, GAD-7, MINI, Warning Symptoms Scale, and PSQI were obtained at baseline and follow up visits at month 1, 2, and 3

**Smartphone App:** The Beive app, developed by JP Onnela, collects constant passive data from the smartphone including GPS, accelerometer, anonymized call logs, anonymized text logs, screen use, and charging status. The app also collects voice samples and offers preprogrammed on screen symptom surveys x3 week.

**Study Outline:** 90 day duration with subjects using the Beive for all 90 days. The app offered bi-weekly symptom surveys and constantly collects passive data. Four in clinic assessments, each 30 days apart, collected the same battery of clinical batteries as outlined above.

Schematic of Smartphone Study Protocol



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### Results

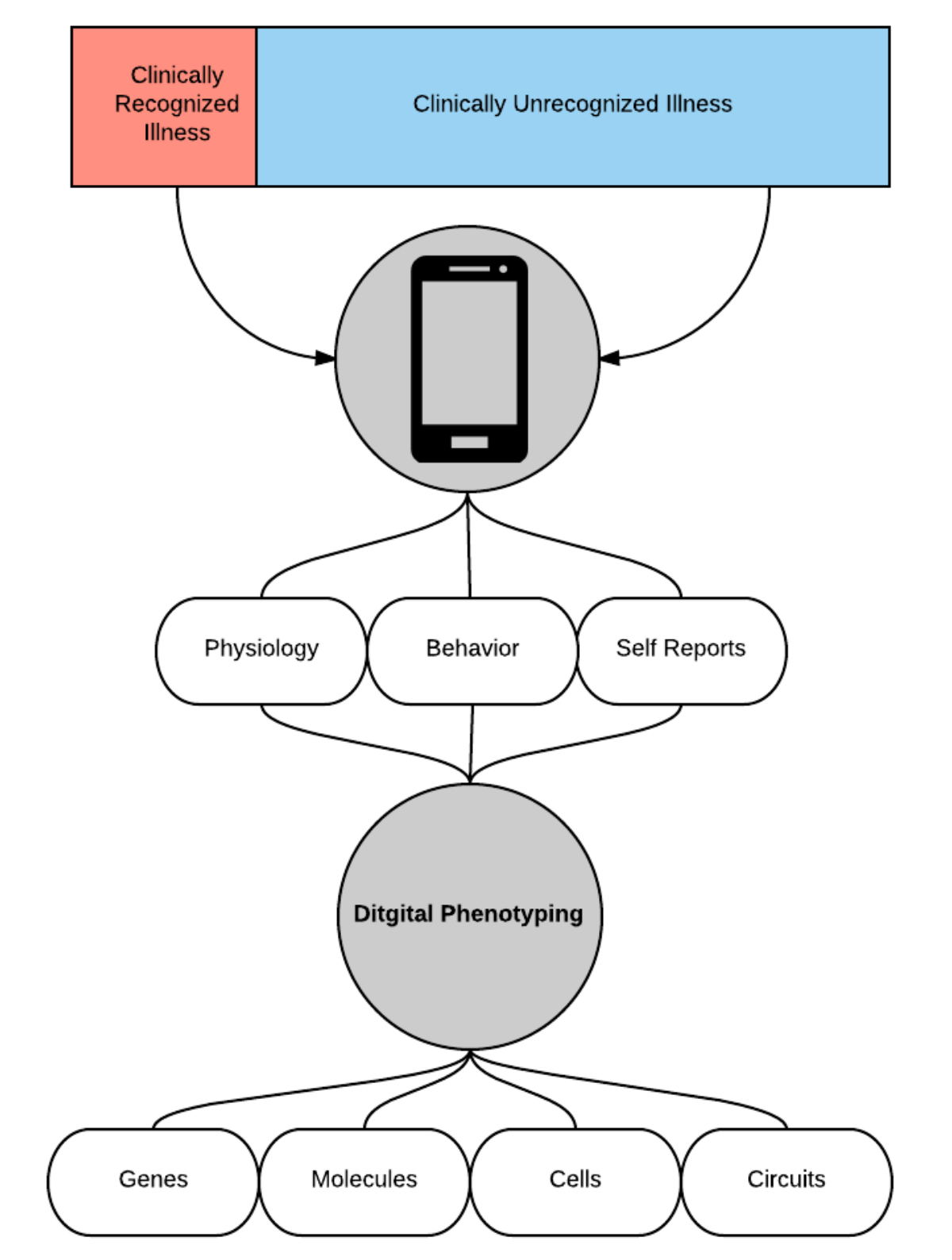
- Patients with schizophrenia find using the smartphone app acceptable and none reported any adverse effects with use.
- Smartphone passive data allows quantification of previously difficult to capture metrics like socialness, sleep, and activity.
- Anomaly detection offers a promising method to transform smartphone data in clinically actionable information about relapse risk

### Conclusions

**Digital Phenotyping:** is feasible in patients with serious mental illnesses, using their own phones.

**Quantification of Longitudinal Risk Factors:** is associated with relapse like sleep, socialness, and activity may represent digital biomarkers for schizophrenia and other mental illnesses.

**Smartphone Surveys of Symptoms** are highly correlated with in clinic assessments for mood, anxiety, sleep, and psychotic symptoms.



### Implications

- **Prediction:** Future studies will examine the value of digital biomarkers in predicting the relapse in patients with schizophrenia.
- **Mechanism:** Future investigations will assess whether digital biomarkers may serve as a link between the personal experience of mental illness and the neurological basis of these brain disorders.
- **Prevention/Treatment:** Future studies will determine the potential value of digital biomarkers in identifying those at risk of relapse, and using this information to triage patients towards early interventions that may prevent or ameliorate relapse.

**References:**  
1. Barnett I\*, Torous J, Staples P, Sandoval L, Keshavan M, Onnela JP. Relapse prediction in schizophrenia through digital phenotyping: a pilot study. *Neuropsychopharmacology*. 2018 Feb 22:1-\*. (Co-First Authors)  
2. Torous J, Kiang MV, Lorme J, Onnela JP. New Tools for New Research in Psychiatry: A Scalable and Customizable Platform to Empower Data Driven Smartphone Research. *JMIR mental health*. 2015 Dec;3(2):e16-3.