



Developing Novel Patient-Centric Digital Sleep Assessment Tools for People with Short and Disrupted Sleep

Jen Blankenship, PhD

Senior Research Scientist

Sleep Problems and Mental Health Disorders

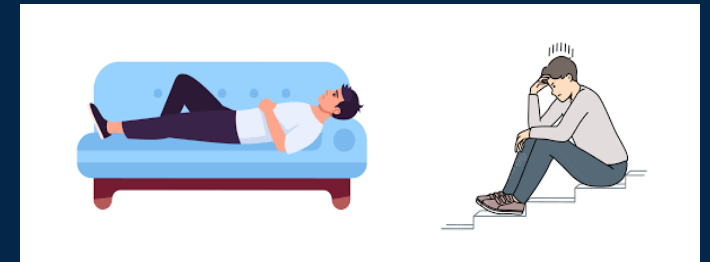
DIFFICULTY FALLING ASLEEP



FREQUENT AWAKENINGS



EXCESSIVE DAYTIME SLEEPINESS



Patients with high anxiety (n=15) vs. age-matched controls (n=15)

	Sleep Latency (min)	Awakenings (n) during first half of sleep
Patients with anxiety	51.03 ± 13.51	37.47 ± 18.52
Age-matched controls	19.03 ± 12.13	24.27 ± 10.72

Data from Fuller et al., Sleep, 1997

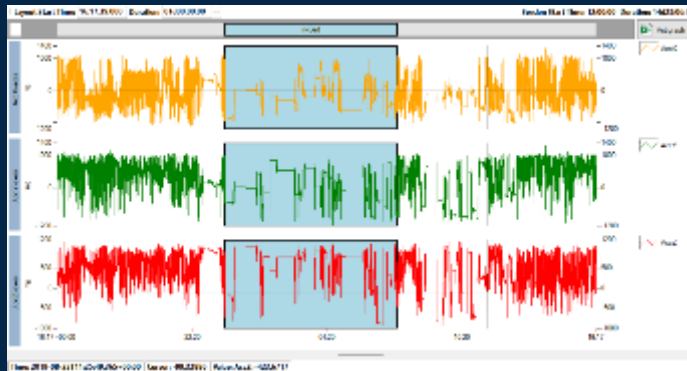
Patient with depression

“When you are depressed you kind of always want to be asleep . . . but you can’t really get to sleep and then you’re tired and you don’t want to do stuff...So it is like this never ending cycle.”

Conroy et al., Behav Sleep Med., 2017

Bridging the Gap of Sleep Assessments with Digital Health Technologies (DHTs)

- Wrist actigraphy sensors
 - Low burden
 - Continuous and remote assessments at home



Algorithm



→ Meaningful sleep metrics

Challenges of Measuring Sleep with DHTs



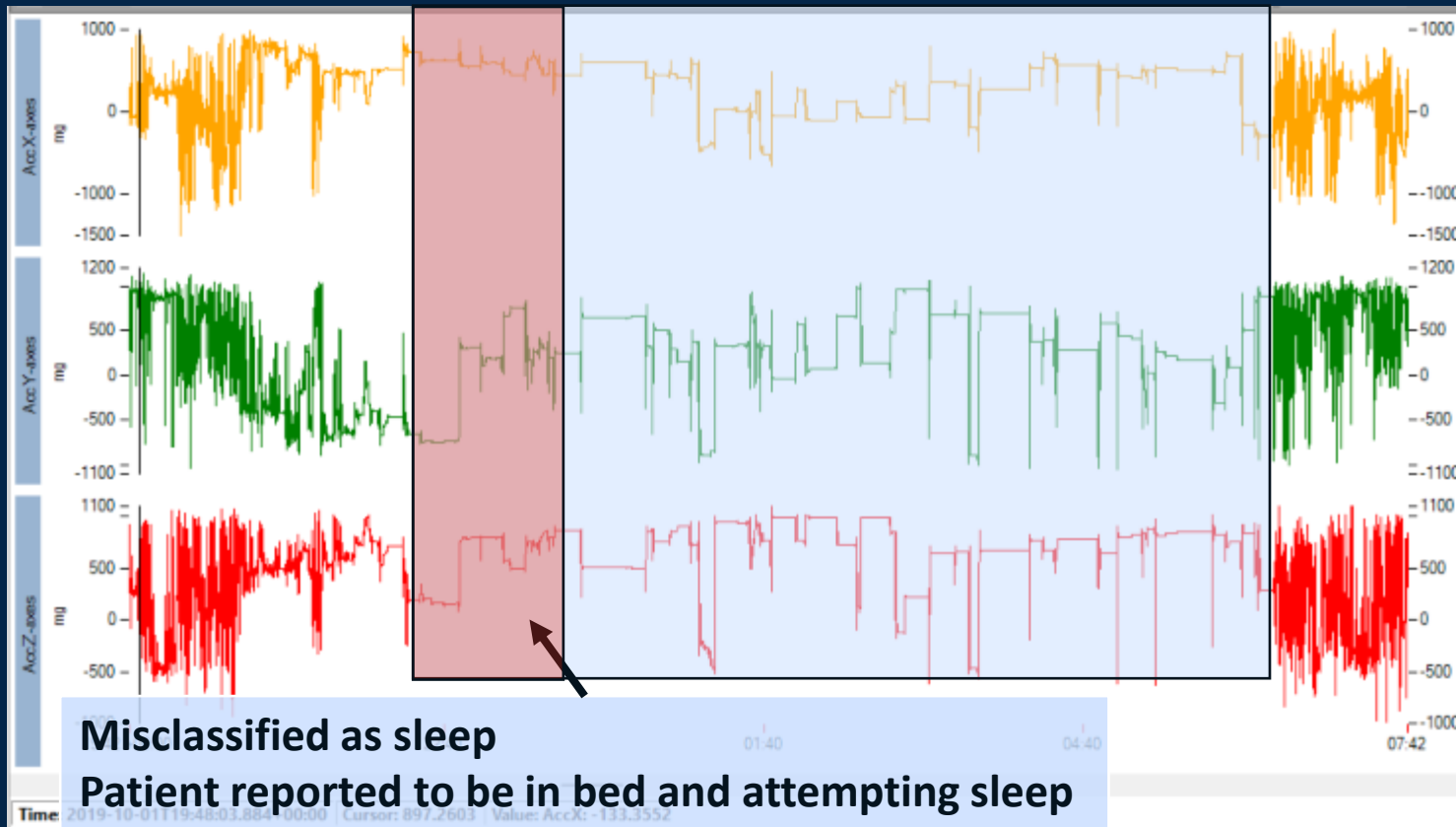
- Methods optimized to detect sleep
- Low specificity to detect wake during sleep
- Consequences when algorithms applied to 24-hour data
 - Misclassifications of sleep/wake
 - Poor sleep estimates in clinical populations

Scenario 1: Difficulty Falling Asleep

Prolonged Sleep Latency (lying still, but awake)



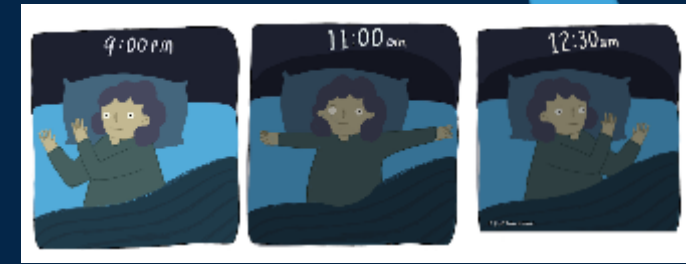
Duration: 12 hours



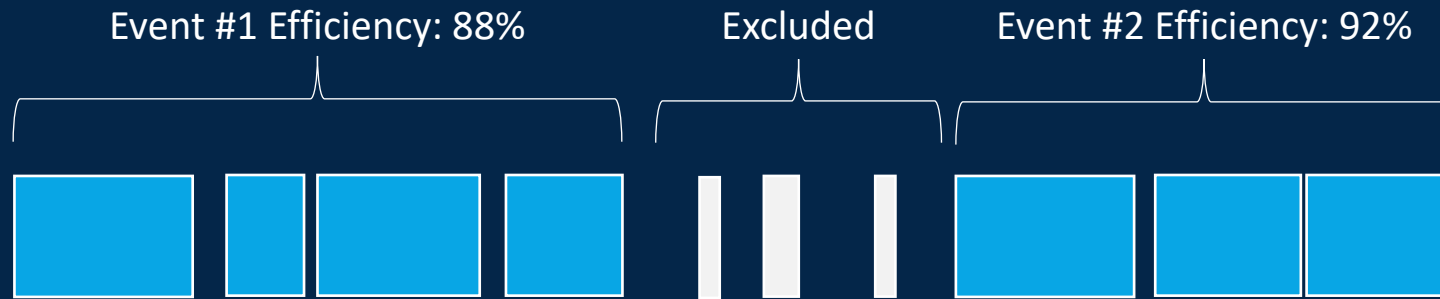
- Measurement consequences**
- Underestimate of sleep latency
 - Overestimate of sleep duration

Scenario 2: Frequent Awakenings

Disturbed sleep (tossing and turning)

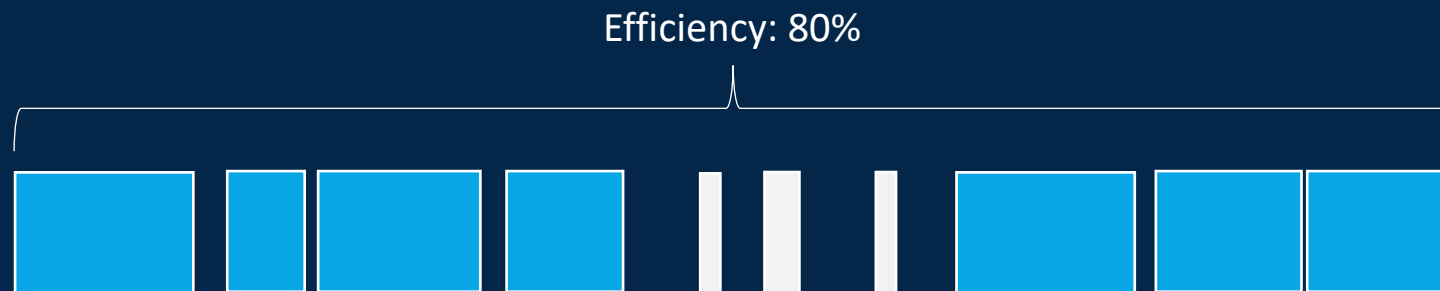


Substantial activity during sleep period can break sleep into multiple events



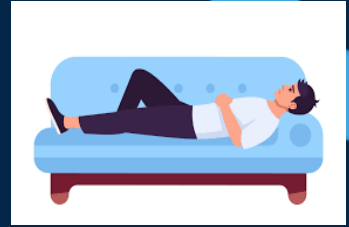
Measurement consequences

- Overestimate of sleep efficiency

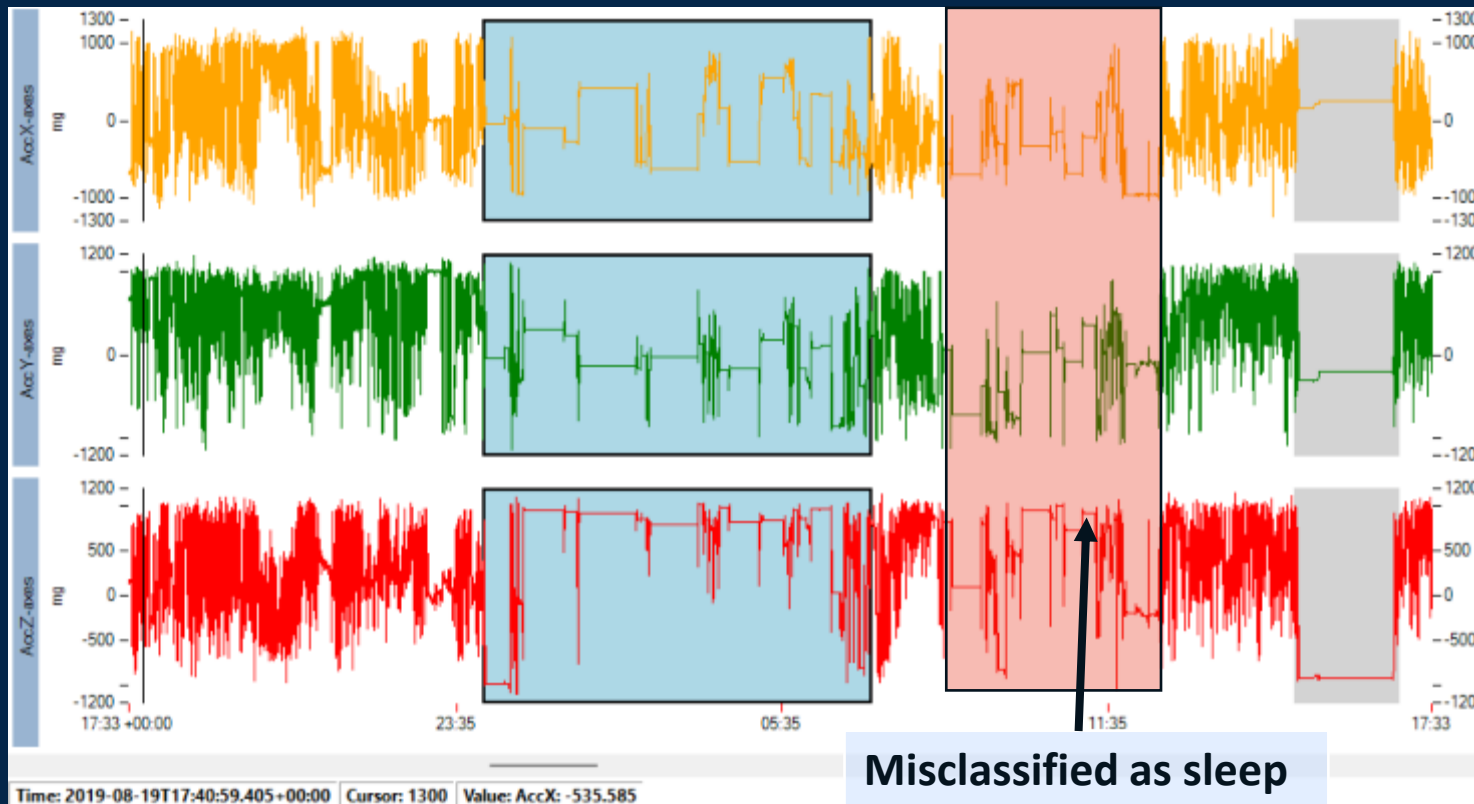


Scenario 3: Prolonged Waking Stillness

Prolonged sitting/sedentary behavior



Duration: 24 hours

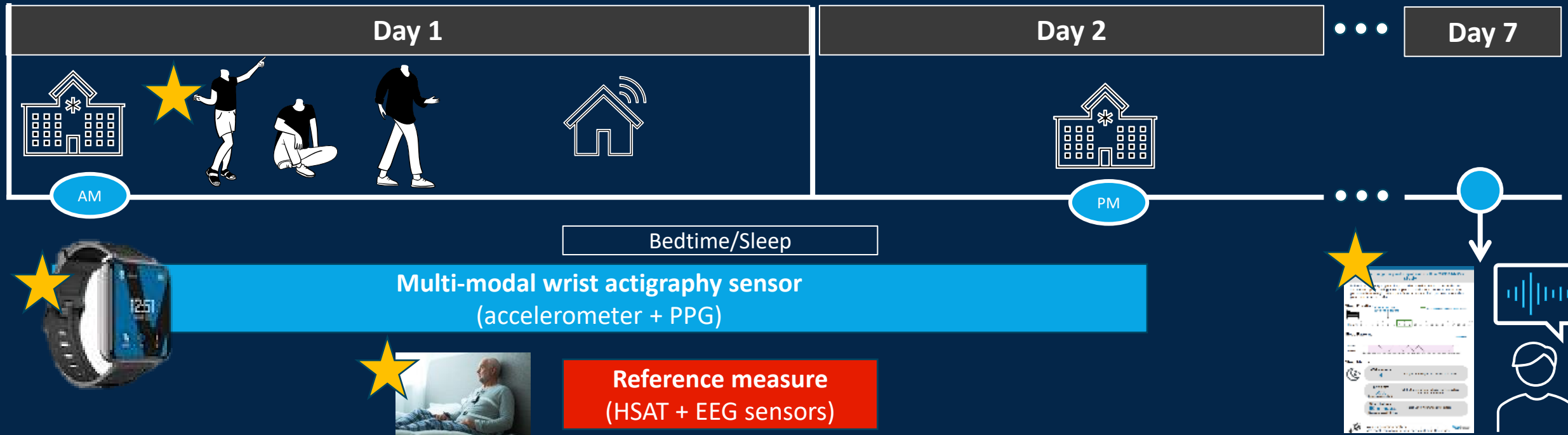


Measurement consequences

- Overestimate of sleep duration

Approach to Developing Improved Actigraphy Sleep Detection Methods

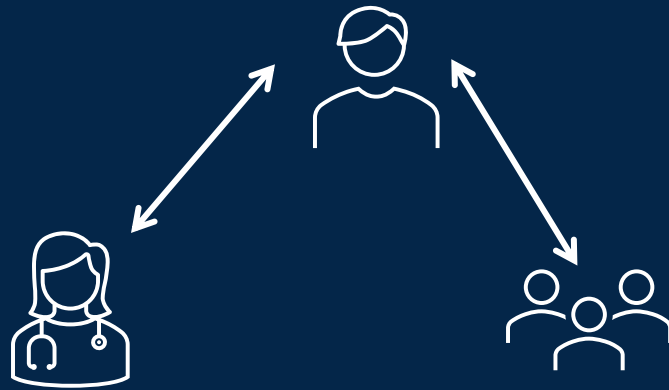
Conducting an analytical validity study at home



Re-Engaging with Patients

Evaluating the Meaningfulness of DHT-Derived Sleep Data

The vision:



The process:

