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

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Sleep Problems and Mental Health Disorders

DIFFICULTY FALLING ASLEEP



FREQUENT AWAKENINGS



EXCESSIVE DAYTIME SLEEPINESS



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

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

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

• Wrist actigraphy sensors

- Low burden
- Continuous and remote assessments at home









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





Duration: 12 hours



Measurement consequences

- **Under**estimate of sleep **latency**
- **Over**estimate 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

<u>Over</u>estimate of sleep <u>efficiency</u>



Scenario 3: Prolonged Waking Stillness Prolonged sitting/sedentary behavior

Duration: 24 hours

Measurement consequences

Overestimate of sleep duration

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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

Thanks for your participation in the DREAM-Zzz study Below is a summary of your sleep based on the data collected from the athome sleep apnea testing you completed and the wrist-worn accelerometer you wore for one night. We hope this summary can help you learn more about your own patterns of sleep. Sleep Duration You slept for a Recommended hours of sleep needed total of 5 hours Hours: 0 1 2 3 12 13 14 15 16 Sleep Patterns Time in bed Sleep Metrics Wake events (:, 3 Throughout the night, you woke up 3 times Efficiency Of the time you were in bed, you were asleep 59% for 59% of the time Recommended: >80% Sleep Latency It took you 60 minutes to fall asleep 60 minutes Recommended: 10-20 min (888) (888) Your participation matters. Vivo Sense We thank you again for your participation in this study.

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