SleepRate's Sleep Improvement Service

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Although most of sleep medicine is focused on detecting Sleep Apnea and other physiological conditions, surprisingly, only 15% of consumer sleep issues are related to such problems. The causes of poor sleep fit into 3 categories:

1. **Physiological problems:**

Problems constitute 15% of sleep problems and include Sleep Apnea, RLS and more rare sleep disorders (e.g. Narcolepsy).

2. **Sleep environment problems:**

Constitute another 15% of sleep problems, and include light and sound noises that disrupt sleep (traffic, snoring bed partner, pets, TV)

3. **Psycho-physiological problems:**

Constitute another 15% of sleep problems, and include light and sound noises that disrupt sleep (traffic, snoring bed partner, pets, TV)

To address all these issues, SleepRate's Sleep Improvement Service combines a set of technologies to allow it to measure sleep, provide sleep assessment based on measured data, and guide the user through a sleep improvement plan based on the assessment.

The main technologies are:

1. Sleep Analysis based on heart rate (HRV)

2. Snore Analysis

3. Detection of sleep disruptions by noises in the sleep

4. Sleep treatment protocols based on Cognitive Behavioral Therapy for Insomnia (CBTI), exclusively licensed from Stanford University

SleepRate's Sleep Analysis Technology:

The physiological interconnections between the central nervous system and the autonomic nervous system, specifically autonomic cardiovascular control (at the sinus node level, the natural built-in cardiac pacemaker) allow the uncovering of information concerning sleep structure based on noninvasive analysis of the heart rate variability, as detected from the electrocardiogram.

Power spectral analysis of instantaneous heart rate fluctuations reveal three energy components: high frequency, low frequency and very low frequency, which are correlated to autonomic nervous system functions. Time-Frequency decomposition of these fluctuations allow quantitative evaluation of transient physiological phenomena as they occur during sleep or wakefulness. These components display differential profiles in the different sleep stages, allowing for classification of sleep stages from the heart rate signal. SleepRate's algorithms permit conducting a sleep study based on a single ECG channel. Data from this channel is automatically scored to obtain information on sleep architecture and efficiency, arousals and autonomic nervous function during sleep.
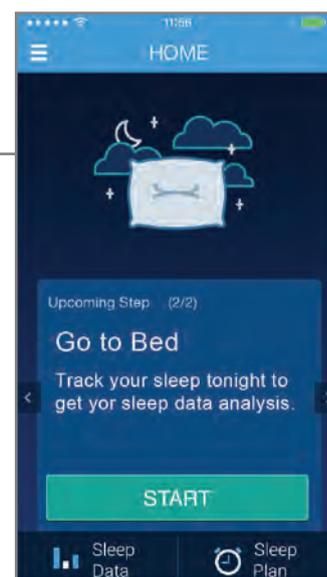
SleepRate's Snore Analysis Technology

SleepRate uses a mobile phone for user interaction. Since every mobile phone has a microphone, we have opened it to monitor noises in the sleep environment. A signal processing algorithm that runs on the phone detects snore, its intensity and duration. People see in the morning a map of the snore events during the night, including severity and duration, and they can also hear sample sound recording of the snore.

Detection of sleep disruptions by noises in the sleep environment

SleepRate's Sleep Analysis technology allows us to detect awakenings during the night. We have opened the mobile phone sensors (microphone, camera) to detect events in the sleep environment and correlate them with awakening. This allows us to give people information about environment noises that disrupt their sleep, and help them eliminate them.

SleepRate's Snore Analysis Technology

Using our sleep analysis technology, after 5 nights of sleep monitoring, SleepRate conducts a sleep assessment based on people's sleep patterns. This is an expert system that looks at arousals, awakenings, sleep onset, sleep efficiency, snore and environmental noises to decide what would be a good sleep improvement approach. Since SleepRate is not a medical device, if we sense that there is a lot of snore, or a high arousal index, we recommend seeking medical help. If we detect a lot of environmental related disruptions, we recommend they improve their sleep environment. If we detect Insomnia and/or DSPS, we kick off the CBTI sleep treatment protocol, which guides people through a series of changes in sleep-related behaviors. The goal is to align the three systems that control our ability to sleep:

1. Sleep Drive – How tired we are, which is related to the number of hours of being awake.
2. Circadian Clock – Tune our internal biological clock to direct us to go to sleep at the right time.
3. Flight-or-Fight system – Reduce stress to avoid being hyper-aroused when we need to go to sleep.

The CBTI protocol aligns these systems through a set of behavioral modifications that changes bedtime, wake-up time and activities around bedtime and wake-up time.

The majority of people respond to this treatment fairly quickly. Some experience significant changes after only two weeks of treatment. Most improve after four to six weeks.

As phones and sensors become more powerful, we will see even more innovation in mobile health. With advancements in technology, people will be able to get help for common health issues in the comfort of their own home at an increasing rate in the next 3-5 years. Something as simple as improving sleep will help drive down the cost of medicine and prevent many serious illnesses. We look forward to continuing to improve SleepRate's core technology as advancements continue in this space and help millions of people with poor sleep get the rest they need.