

Help people get their most, best sleep by making mobile tech, wearables, and smart devices smarter

Clearly “Sleep” is of General Interest



why can|



why can't i sleep

why can't

The Current Problem

There has been a proliferation of devices that measure sleep and display sleep data

But

Such devices and systems do not provide science based, data driven, guidance about

- How to get more sleep, and/or
- What amount (and timing) of sleep is optimal for the individual

Existing “Sleep Coaching” is Limited

- Recommendations are not individually-tailored
- Recommendations are not actionable
- Recommendations are not feasible
- Recommendations are not self-correcting
- Recommendations are just tips

What if your wearable could actually tell you
how much sleep you need?

And was driven by an *individualized, self-correcting* set
of algorithms that actually worked and could
optimize your sleep?

And what if it talked to the IOT devices around you to
provide support?

What is Our Goal?



This is a lot like building a great bathroom scale

- You can tell someone how much they weigh
- But a scale cannot tell them **whether that weight is optimal** for them,
- Or **how to lose or gain weight** if they need to.

Imagine if you had a scale that not only gave you all kinds of information about your weight (and body fat distribution, etc.) but also was able to use that information to optimize a weight loss plan specifically tailored to you. Our system is able to tell people what their ideal weight should be, based on their own data.

The Hypknowledge Approach

Screen for sleep disorders (Screener)

via an online and/or smart phone based instrument

Positive results: provide information

Gather sleep data (Tracker)

via online and/or smart phone sleep diary interface

via passive trackers (e.g., Fitbit, Sleep Cycle, etc.)

via voice interface / smart speakers (e.g., Amazon Alexa)

Display data (Reporter)

In tables and graphs on user page & phone app

Process data (Optimizer)

via Hypknowledge sleep extension algorithm

via Hypknowledge sleep optimization algorithm

Provide recommendations re: sleep scheduling

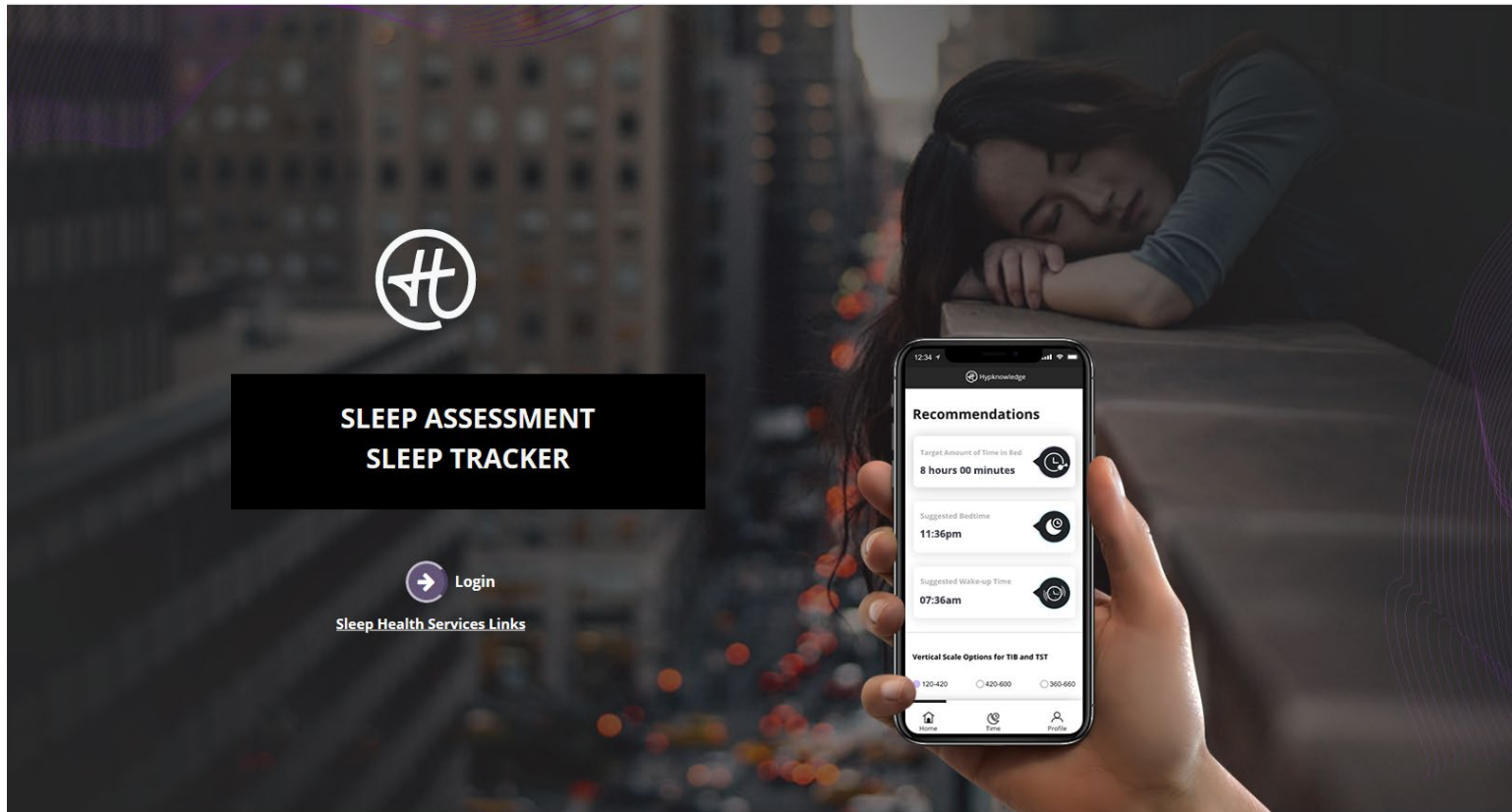
via email and texts

via on-line dashboard

via voice interface / smart speakers

via device screens

Presently Developed (2.0)



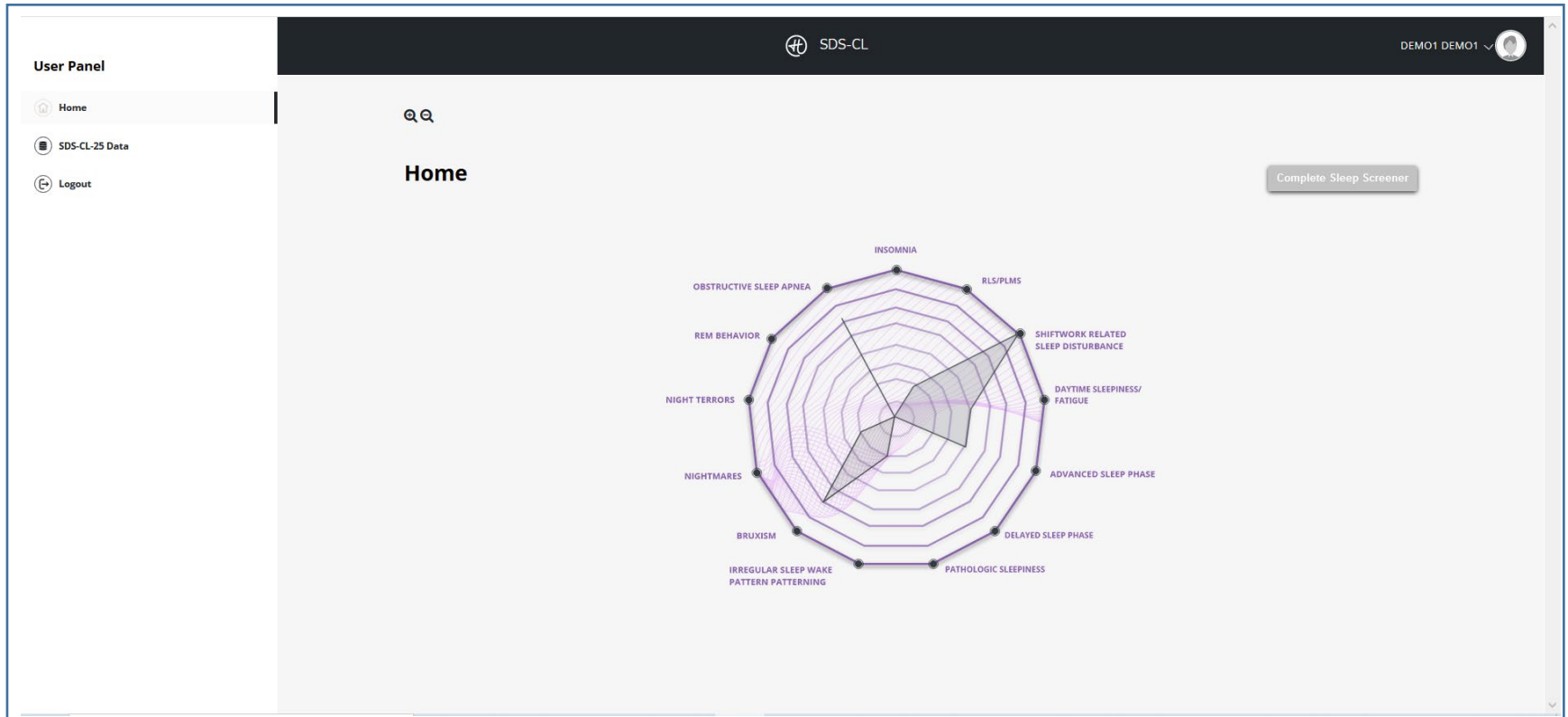
Presently Developed

SDS-CL-25					
Date: __/__/__ ID/Initials __ Age: __ Sex: __ Height __ Weight __					
H1: Work Shift: n/a First (9-5pm) Second (4-12am) Third (12to 8am)					
H2: Work Hours: __0 __10-19 __20-40 __ > 40 Hours per week					
H3: Do you regularly have a bed partner? (3 or more days/week) (Yes/No)					
H4: How much sleep do you typically get per night? __ hours (e.g., 8.5 hrs.)					
H5: How much time do you typically spend in bed per night? __ hours (e.g., 9.0 hrs.)					
Answer all questions for what has been typical for you for the last 3 months					
	0 NEVER	1 ONCE A MONTH	2 1-2 TIMES A WEEK	3 3-5 TIMES A WEEK	4 >5 TIMES A WEEK
1. My work or other activities prevent me from getting at least 6 hours of sleep					
2. My bedtime or waketime varies by more than 3 hours					
3. It takes me 30 minutes or more to fall asleep					
4. I am awake for 30 minutes or more during the night					
5. I wake up 30 or more minutes before I have to and can't fall back asleep					
6. I am tired, fatigued, or sleepy during the day					
7. I sleep better if I go to bed before 9pm and wake up before 4:30am					
8. I sleep better if I go to bed late (after 1am) and wake up late (after 9am)					
9. I am prone to fall asleep at inappropriate times or places					
10. I snore					
11. I wake up with a dry mouth in the morning (cotton mouth)					
12. My snoring is so loud, that my bed partner complains					
13. I have to been told that I stop breathing in my sleep					
14. I wake up choking or gasping for air					
15. I feel uncomfortable sensations in my legs, especially when sitting or lying down, that are relieved by moving them					
16. I have an urge to move my legs that is worse in the evenings and nights					
17. I wake up frequently during the night for no reason					
18. When angered, humored, frightened, I experience sudden muscle weakness					
19. When falling asleep or waking up, I experience scary dream like images					
20. When I am first awakening, I feel like I can't move					
21. I have nightmares					
22. For no reason, I awaken suddenly, feeling startled and afraid					
23. I have been told that I walk, talk, eat, act strangely or violently when asleep					
24. I grind my teeth or clench my jaw while I sleep					
25. My sleep difficulties interfere with my daily activities					

Klingman K, Jungquist C, Perlis M. Introducing the Sleep Disorders Symptom Checklist-25: A Primary Care Friendly and Comprehensive Screener for Sleep Disorders. 2017. *Sleep Med Res*; 8(1): 17-25.

Sleep Disorders Symptom Screener

Presently Developed



Sleep Disorders Symptom Screener

Presently Developed

User Panel

Home

SDS-CL-25 Data

Logout

SDS-CL

DEMO1 DEMO1

Search

Sleep Disorders Symptom

Checklist -25

Answer all questions for what has been typical for you for the last 3 months.

Date:

mm / dd / yyyy

ID/Initials

Enter initials

Age

Sex

Male

Female

Height

inch

Weight

pound

I identify my Race/Ethnicity as (pick all that apply)

White

Black

Asian

Hispanic/Latino

Other

Work Shift

Work Hours:

Do you regularly have a bed partner (3 or more days/week)?

Yes

No

How much sleep do you typically get per night?(Enter the number of minutes)

Time in minutes

I typically sleep for 0 hour/s and 0 minute/s a night.

How much time do you typically spend in bed per night?(Enter the number of minutes)

Time in minutes

I typically spend 0 hour/s and 0 minute/s in bed a night.

My highest degree is (pick just one)

High School Diploma / GED

AA

BA/BS

MA/MS

Sleep Disorders Symptom Screener

Presently Developed

User Panel

Home

SDS-CL-25 Data

Logout

Answer all questions for what has been typical for you for the last 3 months.

To remove an answer double click the response.

Switch View

1. My work or other activities prevent me from getting at least 6 hours of sleep

0

NEVER

1

ONCE A MONTH

2

1-5 DAYS A WEEK

3

5-5 DAYS A WEEK

4

5 DAYS A WEEK

2. My bedtime or waketime varies by more than 3 hours

0

NEVER

1

ONCE A MONTH

2

1-5 DAYS A WEEK

3

5-5 DAYS A WEEK

4

5 DAYS A WEEK

3. It takes me 30 minutes or more to fall asleep

0

NEVER

1

ONCE A MONTH

2

1-5 DAYS A WEEK

3

5-5 DAYS A WEEK

4

5 DAYS A WEEK

Sleep Disorders Symptom Screener

Presently Developed

User Panel

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SDS-CL-25 Data

Logout

Preview

Age:	25	I sleep better after 1am to after 9 am:	> 5 /wk
Initials:	FAKE	I fall asleep at inappropriate times or places:	1 /mon
Sex:	Female	I snore:	Never
Race/Ethnicity:	["Asian"]	I wake up with a dry mouth:	Never
Work Shift:	First (9-5pm)	My snoring is so loud, that my bed partner complains:	Never
Work Hours:	20-40	I have been told that that I stop breathing in my sleep:	Never
Bed Partner:	No	I wake up choking or gasping for air:	Never
Sleep per night:	420	I feel uncomfortable sensations in my legs, when sitting or lying down, that are relieved by moving:	Never
Time in bed:	480	I have an urge to move my legs that is worse in the evenings and nights:	1 /mon
School Degree:	GED	I wake up frequently during the night for no reason:	Never
Height:	60	When angered, humored, frightened, I experience sudden muscle weakness:	1 /mon
Weight:	115	When falling asleep or waking up, I experience scary dream like images:	1 /mon
Work prevents me from getting at least 6 hrs of sleep:	3-5 /wk	When I am first awakening, I feel like I can't move:	Never
My bedtime or waketime varies by more than 3 hrs:	3-5 /wk	I have nightmares:	3-5 /wk
It takes me 30 min or more to fall asleep:	> 5 /wk	For no reason, I awaken suddenly, feeling startled and afraid:	Never
I am awake for 30 min or more during the night:	Never	I have been told that I walk, talk, eat, act strangely or violently while asleep:	Never
I wake up 30 or more min before I have to and can't fall back asleep:	Never	I grind my teeth or clench my jaw while I sleep:	1 /mon
I am tired, fatigued, or sleepy during the day:	> 5 /wk	My sleep difficulties interfere with my daily activities:	> 5 /wk
I sleep better from before 9 pm to before 4:30 am:	Never		

Submit

Edit

1
5 DAYS A WEEK

2
5 DAYS A WEEK

3
5 DAYS A WEEK

4
5 DAYS A WEEK

Sleep Disorders Symptom Screener

Presently Developed

User Panel

Home

SDS-CL-25 Data

Logout

Results

Results

Attached is a copy of the Sleep Screen you took on

2021-03-02

You screened positive for some sleep issues (have symptoms of sleep disorders).

Because you screened positive, you should delay using Hypknowledge until your sleep issues are addressed.

In order to access information on sleep disorders, please visit

<https://www.sleepfoundation.org/>
<http://sleepeducation.org/find-a-facility>

In order to identify sleep centers in your area, please visit.

<http://sleepeducation.org/find-a-facility>

In order to identify Behavioral Sleep Medicine specialist in your area (those that treat insomnia), please visit

<https://cbti.directory/>
SBSM Directory

Show Report

Report

Send results via e-mail

Export to PDF

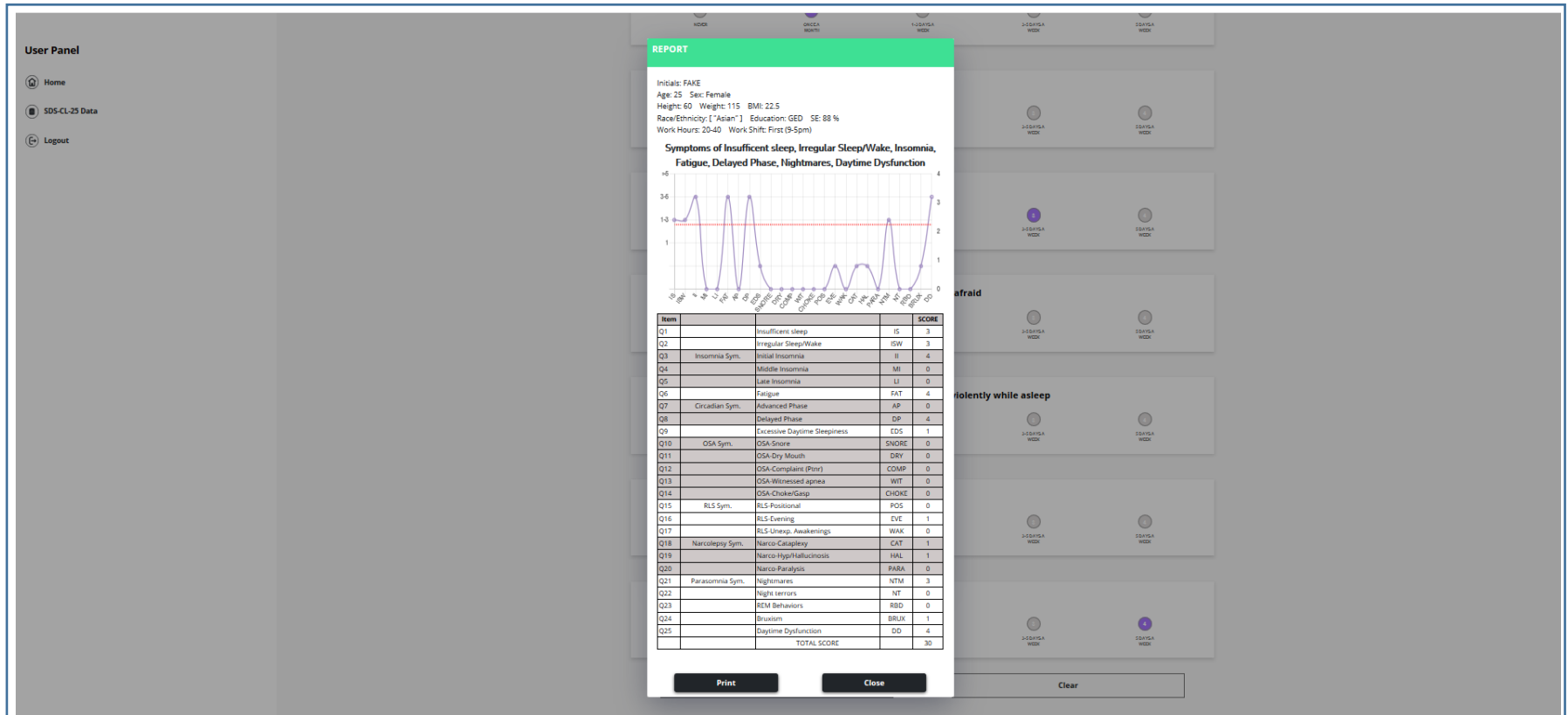
E-mail

Send

Cancel

Sleep Disorders Symptom Screener

Presently Developed



Sleep Disorders Symptom Screener

Presently Developed

Email with PDF of Screener

Subject:

FW: FW: Sleep Disorders Screener

SDS-CL-25 (V6)

Thank you for your interest in your sleep health. Thank you for taking the time to complete the screener. A PDF of the screener is attached to this email. The items in the last two columns (highlighted in gray) indicate that you are experiencing one or more symptoms of one or more of 13 sleep disorders. If you have such “positive signs”, you may wish to share the PDF of the screener with your primary care provider. Alternatively, or additionally, you may wish to seek out information or specialty care.

For information on sleep disorders, please visit

<https://www.sleepfoundation.org/>

In order to identify sleep centers in your area, please visit.

<http://sleepeducation.org>

In order to identify Behavioral Sleep Medicine specialist in your area (those that treat insomnia), please visit

<https://cbti.directory/>

<https://www.behavioralsleep.org/>

We hope this information is helpful.

Sleep well

Sleep Disorders Symptom Screener

Presently Developed

On-Line Sleep Diary

Hypknowledge

Sleep Diary

1. What time did you get into bed? (TTB)

10:00 pm

2. When did you start trying to fall asleep? (TTS)

10:00 PM

3. How long did it take you to fall asleep? (SL)

0

4. How many times did you wake up not counting your final wake time? (NWAk)

0

5. What time did you wake for good? (TFA)

7:00 am

6. Was this earlier than you wanted to wake up? (TE)

☐ Yes

7. What time did you finally get out of bed? (TOB)

7:00 am

8. How would you rate the quality of your sleep (last night)? (Poor 0 - 1 - 2 - 3 - 4 - 5 Excellent) (SQ)

☒ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

9. How rested or refreshed did you feel this morning? (Not very 0 - 1 - 2 - 3 - 4 - 5 Very) (REST)

☒ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

10. Yesterday, how many times did you nap or doze? (NAPS)

0

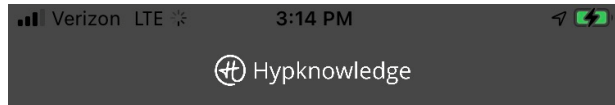
11. Was this an unusual night of rest? (This will omit this record from your sleep suggestions)

☐ Yes

Submit Diary Responses

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iPhone Sleep Diary



Questions

1/17



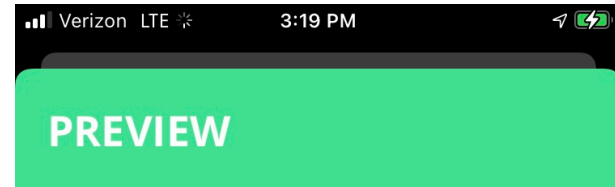
What time did you get to bed last night?

10:45

AM

PM

Next



Yesterday

I napped during the day for
I dozed in the evening for

Last night

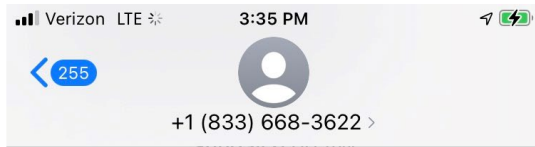
I started trying to sleep at	11:00 PM
I took minutes to fall a sleep	5 minute(s)
I was awake during the night for	10 minute(s)
I awoke for good at	06:30 AM
I awoke minutes before wanted to	0 minute(s)
I got out of bed at	06:35 AM

Edit

Submit

Presently Developed

SMS and Email Notifications

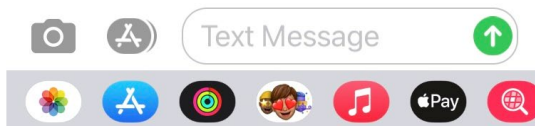


Yesterday 6:00 AM

Good Morning! Remember to complete your daily sleep diary today.

Today 6:00 AM

Good Morning! Remember to complete your daily sleep diary today.



Perlis, Michael L.

To: Hypknowledge Sleep Manager; mperlis61@gmail.com
Subject: RE: Diary Reminder

From: Hypknowledge Sleep Manager <notify@hypknowledge.com>
Sent: Tuesday, March 2, 2021 12:05 PM
To: mperlis61@gmail.com
Subject: Diary Reminder

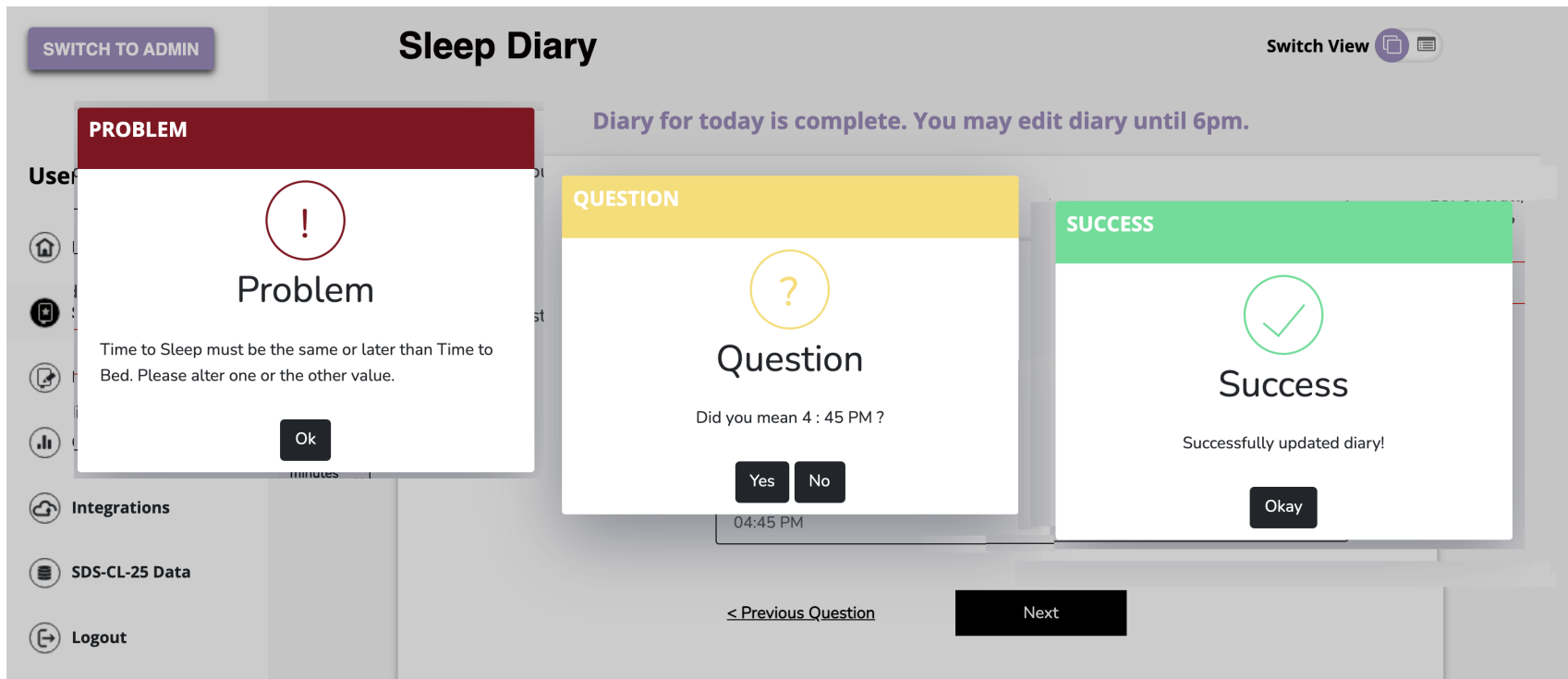
Hello there.

If you have not done so already, please remember to fill out your sleep diary for today.

Thanks.

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Out of Range and Invalid Response Notifications



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Diary Data Database

SWITCH TO USER

Admin Panel

Home

Communications

Sleep Diary Records

Other data

SSE

Manage/Add Users

Manage/Add Group

Import

Unit Testing

Sleep Diary Records

Export to Xls

Show 10 entries

Search

Email	Log Date	Log Time	Bad Night	TTB	TTS	SL	NWAK	WASO	TFA	EMA	TOB	TST-C	SQ	REST	NAPS	NA
@upenn.edu	03-02-2021	06:50:55	Good Night	22:45:00	23:00:00	5	2	10	06:30:00	0	06:35:00	435	3	2	0	
@email.arizona.edu	03-02-2021	07:31:59	Average Night	23:00:00	23:15:00	8	2	1	07:20:00		07:40:00	476	2	3	0	
@email.arizona.edu	03-02-2021	07:42:06	Good Night	23:00:00	23:10:00	5	1	15	07:36:00		07:36:00	486	3	4	0	
@sleepwellconsultants.com	03-02-2021	09:48:34		22:45:00	23:15:00	5	2	5	06:30:00	0	07:00:00	425	3	3	0	
r@email.arizona.edu	03-02-2021	08:19:42	Average Night	22:00:00	22:00:00	2	5	1	07:30:00	60	07:37:00	567	2	3	0	
@psychiatry.arizona.edu	03-02-2021	09:34:20	Average Night	00:00:00	00:00:00	0	0		08:35:00		08:40:00	515	3	3	0	
@email.arizona.edu	03-02-2021	09:58:37	Bad Night	22:30:00	22:30:00	30	2	180	06:30:00		06:30:00	270	0	1	0	
@email.arizona.edu	03-02-2021	13:27:07	Bad Night	22:00:00	23:30:00	40	6	90	07:00:00	60	07:15:00	320	1	0	0	
@quantox.com	03-01-2021	05:32:37	Good Night	00:00:00	01:00:00	6	3	2	07:00:00	0	07:30:00	352	4	4	3	
@upenn.edu	03-01-2021	07:28:13		23:15:00	23:30:00	5	3	10	06:30:00	0	06:35:00	405	3	3	0	

Presently Developed

Sleep Data Graphics

SWITCH TO USER

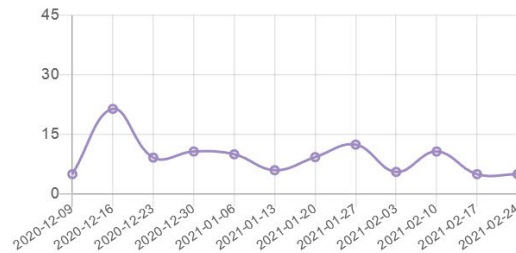
Admin Panel

- Home
- Communications
- Sleep Diary Records
- Other data
- SSE
- Manage/Add Users
- Manage/Add Group
- Import
- Unit Testing

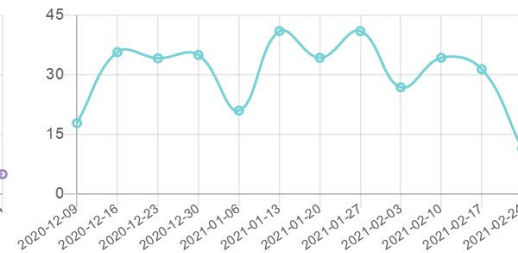
PERFORMANCE GRAPHS

Michael Perlis

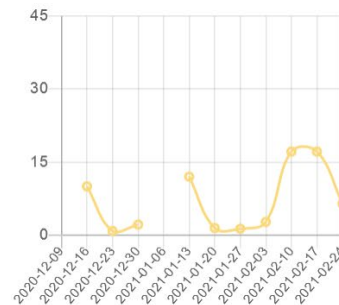
SL
SLEEP



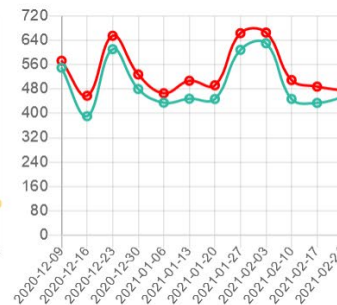
WASO
WAKE TIME AFTER SLEEP ONSET



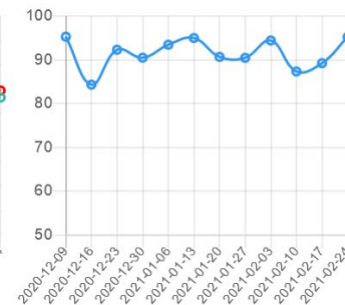
EMA
TIME IN BED



TST & TIB
TOTAL SLEEP TIME & TIME IN BED



SE%
SLEEP EFFICIENCY



Presently Developed Fitbit API interface



for data acquisition
for the provision of recommendations

Presently Developed

Fitbit API interface

SWITCH TO USER

Admin Panel

Home

Communications

Sleep Diary Records

Other data

SSE

Manage/Add Users

Manage/Add Group

Import

Unit Testing

SDS-CL-25 Data

Other Data

Export to Xls

Fitbit

Alexa

Apple watch

Philips Actiwatch

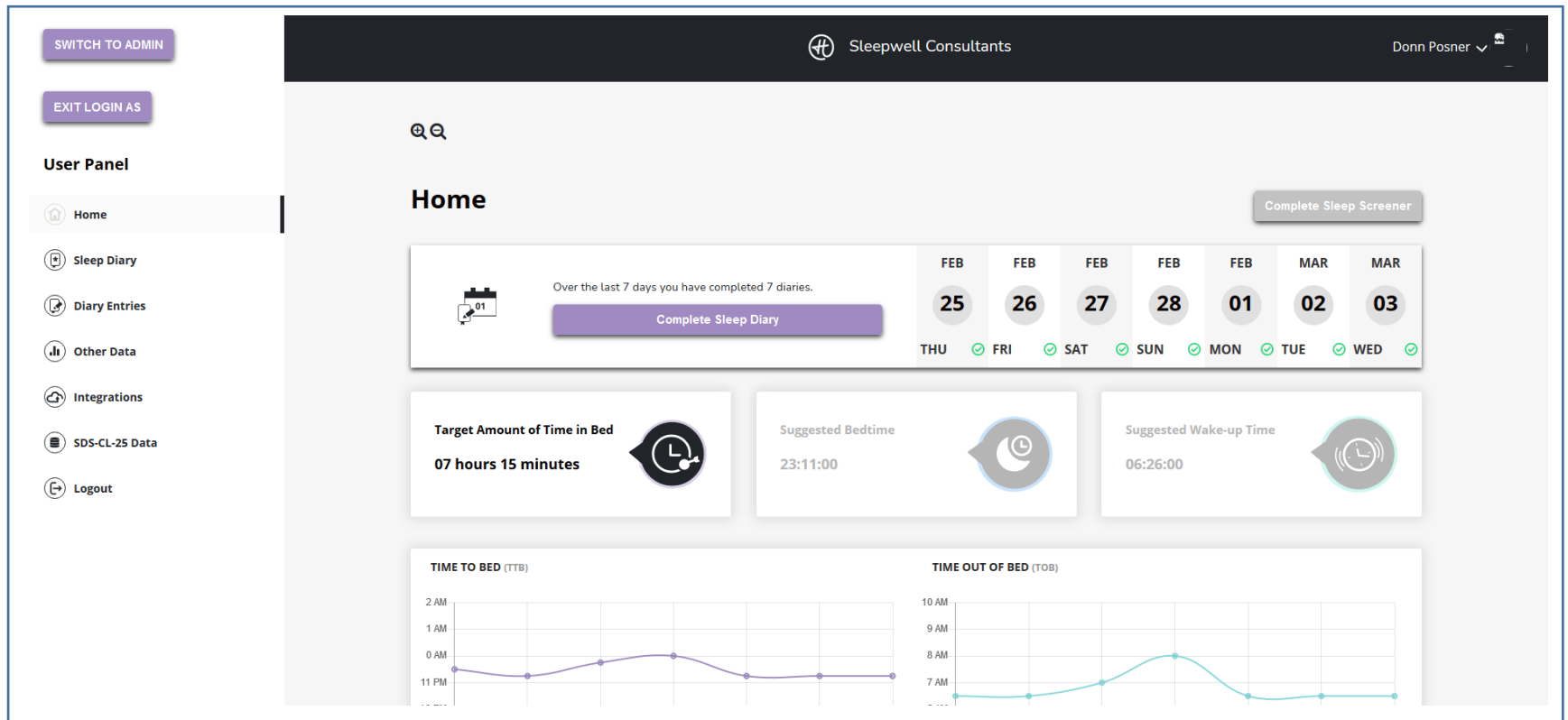
Show 10 entries

Search

Email	Log Date	TIB	TTS	SL	WASO	TFA	EMA	TOB	TIB	TIB-C	TST	TST-C	FitBit SE%	SE%	Heart rate at Noon	Heart rate at Noon
mperlis@upenn.edu	10-16-2020	23:20:00	23:20:00	0	27	05:42:30	0	05:42:30	382.00	383	355.00	356	93.00	92.93 %		
mperlis@upenn.edu	10-17-2020	22:21:30	22:21:30	0	73	08:08:30	0	08:08:30	587.00	587	514.00	514	95.00	87.56 %		
mperlis@upenn.edu	10-18-2020	22:43:30	22:43:30	0	93	08:19:30	0	08:19:30	576.00	576	483.00	483	90.00	83.85 %		
mperlis@upenn.edu	10-19-2020	23:48:00	23:48:00	0	44	07:04:30	0	07:04:30	436.00	437	392.00	393	98.00	89.91 %		
mperlis@upenn.edu	10-24-2020	00:14:30	00:14:30	0	76	08:22:30	0	08:22:30	488.00	488	412.00	412	88.00	84.43 %		
mperlis@upenn.edu	10-25-2020	23:52:00	23:52:00	0	68	09:17:00	0	09:17:00	565.00	565	497.00	497	92.00	87.96 %	88.93	
mperlis@upenn.edu	10-26-2020	21:49:30	21:49:30	0	64	07:36:30	6	07:42:30	593.00	593	523.00	523	89.00	88.20 %	94.05	
mperlis@upenn.edu	10-28-2020	22:56:00	22:56:00	0	47	07:18:30	0	07:18:30	502.00	503	455.00	456	91.00	90.64 %	99.85	
admin@hyp.local	10-28-2020	22:56:00	22:56:00	0	47	07:18:30	0	07:18:30	502.00	503	455.00	456	91.00	90.64 %		
mperlis@upenn.edu	10-29-2020	22:43:30	22:43:30	0	52	07:07:00	0	07:07:00	503.00	504	451.00	452	96.00	89.66 %	85.07	

Presently Developed

Dashboard Recommendations



In Development / Planned Development

Screeners

- Enhance aesthetics

- Allow email to have a report attachment

Tracker and Reporter

- Free standing tracker (for use by clinicians, researchers, & industry)

- Expand data capture from multiple passive trackers

Process data (Optimizer)

- via Hypknowledge sleep extension algorithm (Beta version running)

- via Hypknowledge sleep optimization algorithm

Provide recommendations re: sleep scheduling (Optimizer)

- via email and texts (Beta version running)

- via on-line dashboard (Beta version running)

- via voice interface / smart speakers (in development)

Hypknowledge

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Director Behavioral Sleep Medicine Clinic
Assistant Professor of Psychiatry
University of Arizona College of Medicine*

Michael L. Perlis PhD

*Director, Behavioral Sleep Medicine Program
Associate Professor of Psychiatry & Nursing
Perelman School of Medicine
University of Pennsylvania*

Donn Posner PhD

*Adjunct Clinical Associate Professor,
Psychiatry and Behavioral Sciences
Stanford University School of Medicine
Clinical/Research Psychologist, Palo Alto
Institute for Research*

Dr. Michael Perlis



- Director of the Behavioral Sleep Medicine Program and Tenured Associate Professor of Psychiatry at the University of Pennsylvania
- Internationally recognized expert in sleep medicine with over 30 years of experience, especially in the domain of Behavioral Sleep Medicine
- Leading authority on treatments for insomnia
- Lead author/editor of the two primary textbooks in the field of Behavioral Sleep Medicine. Note: These texts have been translated into multiple languages.
- Lead lecturer and course developer for two CE three day workshops on CBT-I. These courses have provided training to more than 2000 individuals worldwide.
- > 165 publications on sleep
- An established track record of funding from the NIH
- Editorial Boards of SLEEP, Journal of Sleep Research, Behavioral Sleep Medicine, Sleep Medicine Reviews, Sleep Medicine Research, Health Psychology, and Behavioral Research and Therapy.
- Many national committee memberships and chairships, including being the founding President of the Society of Behavioral Sleep Medicine

Dr. Michael Grandner



- Director of the Sleep and Health Research Program at the University of Arizona
- Licensed clinical psychologist and Director of the Behavioral Sleep Medicine Clinic at the Banner-University Medical Center in Tucson
- Internationally recognized expert in sleep health with over 15 years of experience in the field
- Research focuses on real-world implications of sleep and health
- Published >100 scientific articles on sleep
- Editor of “Sleep and Health” – the first textbook in this field of research
- Editorial Board of SLEEP, Sleep Medicine, Journal of Clinical Sleep Medicine, Behavioral Sleep Medicine, Journal of Sleep Research, and Frontiers in Neurology; and Associate Editor of Sleep Health
- Many awards for his work from scientific and professional organizations
- Several national committee memberships and chairships
- Some work with FitBit, including presence on Scientific Advisory Panel
- Work with other organizations, including technology, athletics, and health companies

Dr. Donn Posner



- Nationally recognized master CBT-I therapist with over 30 years of experience
- Leading authority on treatments for insomnia
- Author/editor of the two CBT-I treatment manuals
- Lecturer and course developer for two CE three day workshops on CBT-I. These courses have provided training to more than 2000 individuals worldwide.
- One of the first certified behavioral sleep medicine specialists
- Founding member of the Society of Behavioral Sleep Medicine
- Recipient of the SBSM society's Peter Hauri Career Distinguished Achievement Award.

Where we stand

- First patent pending, second in preparation
- Expert-led scientific team
- Extensive sleep tech industry connections
- University backing
- Preliminary data showing proof-of-concept (Sleep Extension)
- 2nd generation platform (up and running)