TECHNOLOGY & APPS IN SLEEP MEDICINE

Wisconsin Sleep Society
Alexander Villareal, MD – 9/23/2016
OUTLINE

• Definitions and introduction
• Insomnia / Circadian Disorders
• RLS
• Sleep Disordered Breathing
• Research & Education
• Delivery of Healthcare
TECHNOLOGY

- **Merriam-Webster Dictionary**
  
  1a: the practical **application** of knowledge especially in a particular area: `<medical technology>`
    - b: a capability given by the practical application of knowledge `<a car's fuel-saving technology>`
  
  2: a manner of accomplishing a task especially using **technical** processes, methods, or knowledge `<new technologies for information storage>`
  
  3: the specialized aspects of a particular field of endeavor `<educational technology>`
• Merriam-Webster Dictionary
• a computer program that performs a special function
EPOCRATES & PALM 1998
CHRONIC INSOMNIA

• Sleep disturbance > 30 days:
  1. Difficulty in initiating sleep
  2. Difficulty in maintaining sleep
  3. Waking up too early
• Adequate opportunity and circumstances for sleep
• Daytime disturbances
INSOMNIA UPDATES

• Cognitive behavioral treatment for insomnia is the preferred treatment for insomnia.

• Esmirtazapine being studied for insomnia in menopause – Phase II

• Melatonin 3 mg helped night shift workers with insomnia
  • Sadeghniiat-Haghighi, K. Work. 2016 Sep 7
Management of Chronic Insomnia Disorder in Adults: A Clinical Practice Guideline From the American College of Physicians

Amir Qaseem, MD, PhD, MHA; Devan Kansagara, MD, MCR; Mary Ann Forciea, MD; Molly Cooke, MD; and Thomas D. Denberg, MD, PhD; for the Clinical Guidelines Committee of the American College of Physicians*

Description: The American College of Physicians (ACP) developed this guideline to present the evidence and provide clinical recommendations on the management of chronic insomnia disorder in adults.

Methods: This guideline is based on a systematic review of randomized, controlled trials published in English from 2004 through September 2015. Evaluated outcomes included global outcomes assessed by questionnaires, patient-reported sleep outcomes, and harms. The target audience for this guideline includes all clinicians, and the target patient population includes adults with chronic insomnia disorder. This guideline grades the evidence and recommendations by using the ACP grading system, which is based on the GRADE (Grading of Recommendations Assessment, Development and Evaluation) approach.

Recommendation 1: ACP recommends that all adult patients receive cognitive behavioral therapy for insomnia (CBT-I) as the initial treatment for chronic insomnia disorder. (Grade: strong recommendation, moderate-quality evidence)

Recommendation 2: ACP recommends that clinicians use a shared decision-making approach, including a discussion of the benefits, harms, and costs of short-term use of medications, to decide whether to add pharmacological therapy in adults with chronic insomnia disorder in whom cognitive behavioral therapy for insomnia (CBT-I) alone was unsuccessful. (Grade: weak recommendation, low-quality evidence)

APPLE’S IPHONE

Night Shift Mode – iOS 9.3

Bedtime – iOS 10
INTERNET BASED CBTI

- Shuti - http://www.myshuti.com/
  - $135 – 156 for 16 – 20 weeks
- Sleepio - https://www.sleepio.com/
  - $ 300 for 1 year
- Somnio - http://www.somnio.org/
  - $149 for 8 weeks
- RESTore - http://restore.cbtprogram.com/
  - £ 99 – 199 for 7 weeks (UK)
  - Free / VA Developed – To be used with a therapist*
• Charles Morin, Ph.D
• University of Virginia
• Modular program
• 6 weeks
• No app available
• Robust evidence
• Healthcare version
Your lifestyle
Learn how to address lifestyle and environmental

Your thoughts
Master highly effective cognitive techniques, tailored

Your schedule
Build your personalized 24 hour schedule

Set your goals
You tell us what you want to improve

Test your sleep
You complete an in-depth questionnaire

Build your program
We build your program based on your goals

CBT lessons
You meet your virtual sleep expert, The Prof

![Sleepio Graph](image)

<table>
<thead>
<tr>
<th>SLEEPIO</th>
<th>PLACEBO</th>
<th>TREATMENT AS USUAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>80%</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td>60%</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>40%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>
Colin Espie, Ph.D
University of Oxford
Flexible program
8 weeks, but
1 year commitment
iOS app only
Shift work, jet lag, new parents, pregnancy
Healthcare version
CBTI COACH

- Augment face-to-face care
- Free – iOS & Android
- Collaboration between
  - VA’s National Center for PTSD
  - Stanford School of Medicine
  - DoD’s National Center for Telehealth & Technology
CBTI COACH

• KEY FEATURES
• Sleep diaries
• Ability to update a sleep prescription with provider recommendations
• Tools and exercises for quieting your mind
• Learn about sleep, the benefits of sleep hygiene and terms used in CBT-i
• Set reminder messages with tips, motivation and alarms to change sleep habits
PEDIATRIC INSOMNIA

• Johnson’s Bedtime Baby
• Jodi A. Mindell, Ph.D
• Unrestricted Educational grant by Johnson’s
• Infants and Toddlers
• Sleep logs
• Access to sleep panel for questions
• Free - $$$
PEDIATRIC INSOMNIA

- Kids Sleep Doctor
- Paul Gringras
- Head of Sleep Medicine
- Evelina Children’s Hospital in London
- Newborns to teenagers
- Personalised sleep tips
- Easy to digest weekly summary report
- Report sharing functionality
- Free - $$$
CERÊVE SLEEP SYSTEM
FDA Approved 05/13/2016
CERÊVE SLEEP SYSTEM

- Cooling device comprised of three components:
  - the bedside unit
  - forehead pad
  - headgear.

- The device pumps chilled fluid through the forehead pad, at patient selectable temperatures between 57 and 61 °F.

- Reduces sleep latency to Stage 1 and Stage 2 sleep in primary insomnia.

- Efficacy of other sleep measures associated with insomnia has not been established.

RESTLESS LEGS SYNDROME (RLS)

- Urge to move
- Rest induced
- Gets better with activity
- Evening and night accentuation
RLS AWARENESS DAY
SEPTEMBER 23, 2016
TARGETED PRESSURE FOR RLS

- Restiffic® - $299 pair
- Targeted Pressure on Abductor Hallucis and Flexor Hallucis Brevis Muscles to Manage Moderate to Severe Primary Restless Legs Syndrome

METHODS

Inclusion Criteria

• Ages of 18 and 75 years
• Moderate to severe primary RLS
• IRLSSG Rating Scale $\geq 15$
• Evening & nighttime symptoms with sleep impairment due to RLS
• RLS $> 6$ months with symptoms $\geq 2$ to 3 times per week.
• RLS Meds discontinued $> 30$ days

Exclusion Criteria

• Pregnancy
• Taking medications known to affect RLS (e.g., antidepressants).
• Disqualifying medical conditions:
  • claudication; diabetes mellitus; fragile, thin skin; impaired wound healing; foot injury, Parkinson’s, OSA
RESULTS

<table>
<thead>
<tr>
<th>Total IRLSSG Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline</strong></td>
</tr>
<tr>
<td>25.1 (5.3)</td>
</tr>
<tr>
<td><strong>Final</strong></td>
</tr>
<tr>
<td>7.8 (6.3)</td>
</tr>
<tr>
<td><strong>Follow up</strong></td>
</tr>
<tr>
<td>9.26 (0.33)</td>
</tr>
</tbody>
</table>

- Targeted pressure on the abductor hallucis and flexor hallucis brevis muscles with an external RLS device reduced the symptoms of moderate to severe primary RLS.

**Proposed mechanism of action:**
- Pressure induces relaxation of leg muscles through dopaminergic pathways.

SLEEP DISORDERED BREATHING

• Central sleep apnea (CSA)
• Obstructive sleep apnea (OSA)
• Snoring
• Hypoventilation
APNEA APP

- Developed by the University of Washington
- Contactless solution for detecting OSA, CSA & hypopneas
- Transforms the phone into an active sonar system
- Smartphone 3 feet away from the subject
- Emits frequency-modulated sound signals & listens to their reflections
- Monitors breathing chest & abdomen movements
- Can simultaneously identify and track breathing from multiple subjects

http://apnea.cs.washington.edu/#apneaapp
SONAR

- **SOund Navi**gation A**nd R**anging
- Technique that uses sound propagation to detect objects
- Active sonar emits pulses of sounds and listens for echoes
APNEA APP

- Harborview sleep center
- 37 patients - 296 hours
- Polysomnography as baseline
- AHI correlation 98%
  - Central apnea 99%
  - Obstructive apnea 98%
  - Hypopnea 95%

- http://apnea.cs.washington.edu/#apneaapp
PHRENIC NERVE STIMULATION FOR CSA

The Remedē System ®

PHRENIC NERVE STIMULATION FOR CENTRAL SLEEP APNEA (CSA)

Inclusion Criteria

• Polysomnography (PSG)
• AHI > 20/hour
• > 50% Central sleep apnea (CSA)
• Stable, optimal medical therapy for any comorbidity

Exclusion Criteria

• > 20% OSA
• Phrenic nerve palsy,
• SaO2 <90% on room air
• Severe COPD
• Creatinine >2.5 mg/dl
• Cardiac procedure in the 3 months

PHRENIC NERVE STIMULATION FOR CSA

• Implanted Remedē System
• The neurostimulator was implanted in the right pectoral area
• Stimulation lead (A) in the left pericardiophrenic vein
• Sensing lead (B) in the azygos vein

## EFFECTS ON SLEEP PARAMETERS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Baseline</th>
<th>3 Months</th>
<th>6 Months</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI</td>
<td>49.4 ± 14.9</td>
<td>22.8 ± 13.6</td>
<td>23.3 ± 13.3</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>CAI</td>
<td>28.1 ± 14.7</td>
<td>5.0 ± 8.8</td>
<td>4.5 ± 7.2</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>OAI</td>
<td>3.0 ± 2.8</td>
<td>3.9 ± 4.8</td>
<td>3.8 ± 5.2</td>
<td>0.0223</td>
</tr>
<tr>
<td>MAI</td>
<td>3.0 ± 3.7</td>
<td>0.3 ± 0.6</td>
<td>0.6 ± 1.5</td>
<td>&lt; 0.0002</td>
</tr>
<tr>
<td>HI</td>
<td>15.4 ± 12.4</td>
<td>13.5 ± 9.0</td>
<td>14.4 ± 8.3</td>
<td>0.0179</td>
</tr>
<tr>
<td>ODI4</td>
<td>46.0 ± 18.8</td>
<td>22.0 ± 13.8</td>
<td>22.9 ± 13.3</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Arousal Index</td>
<td>35.5 ± 18.4</td>
<td>23.4 ± 10.9</td>
<td>24.7 ± 12.3</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Sleep efficiency%</td>
<td>69.3 ± 16.8</td>
<td>76.9 ± 15.6</td>
<td>81.4 ± 12.5</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>REM sleep, %</td>
<td>11.2 ± 6.3</td>
<td>16.2 ± 8.1</td>
<td>17.4 ± 6.9</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

PULSE ARTERIAL TONOMETRY (PAT) IN ADOLESCENTS ≥ 12

- FDA Approved – July 26, 2016
- Itamar WatchPAT 200U
- 17 patients (11♂ and 6♀)
- Pooled from 3 prospective studies
- Simultaneous PSG & PAT
- AHI correlation R=0.92, p < 0.0001
- Correlation 100% with AHI > 10/hr

http://www.accessdata.fda.gov/cdrh_docs/pdf15/k153070.pdf
FIRST HSAT IN CHILDREN

- Embla Embletta Sleep Data Recording System (K122516)
- FDA approved 1/23/2013
- Type 2 device (Compass)
  - Adults & children
  - Neonates
  - Infants
- Type 3 device (Gold & MPR)
  - Adults & children
  - Not neonates nor infants

HYPOGLOSSAL NERVE STIMULATION IN ADOLESCENT WITH DOWN SYNDROME

Case Report

- Severe OSA [AHI]: 48.5 events/hour
- s/p adeno tonsillectomy
- CPAP intolerant
- Long-standing tracheotomy
- BMI 24.6 (95 percentile) - overweight

- Hypoglossal nerve stimulator therapy was well tolerated
- Overall AHI: 3.4
- Tracheotomy removed after 5 months after implantation
- Potentially, another group that could benefit from treatment.

PAP MOBILE APPLICATIONS

- DreamMapper (Philips Respironics)
- MyAir (ResMed)
- SmartLink (DeVilbiss)
- Nitelog (Z1)
CPAP Doesn’t Prevent Cardiovascular Events in Sleep Apnea, According to the NEJM, But Can That Be True?

Sleep apnea's CPAP machine doesn't cut heart risks, study says

CPAP machines don’t prevent heart attacks, strokes in some sleep apnea sufferers
CPAP for Prevention of Cardiovascular Events in Obstructive Sleep Apnea

R. Doug McEvoy, M.D., Nick A. Antic, M.D., Ph.D., Emma Heeley, Ph.D., Yuanming Luo, M.D., Qiong Ou, M.D., Xilong Zhang, M.D., Olga Mediano, M.D., Rui Chen, M.D., Luciano F. Drager, M.D., Ph.D., Zhihong Liu, M.D., Ph.D., Guofang Chen, M.D., Baoliang Du, M.D., Nigel Mc Ardle, M.D., Sutapa Mukherjee, M.D., Ph.D., Manjari Tripathi, M.D., Laurent Billot, M.Sc., Qiang Li, M.Biostat., Geraldo Lorenzi-Filho, M.D., Ferran Barbe, M.D., Susan Redline, M.D., M.P.H., Jiguang Wang, M.D., Ph.D., Hisatomi Arima, M.D., Ph.D., Bruce Neal, M.D., Ph.D., David P. White, M.D., Ron R. Grunstein, M.D., Ph.D., Nanshan Zhong, M.D., and Craig S. Anderson, M.D., Ph.D., for the SAVE Investigators and Coordinators*
METHODS

Inclusion Criteria

• 45-75 years
• CAD or CVD
• OSA REI $\geq$ 12/hour (HSAT)
• Use sham CPAP $\geq$ 3 hours x 1 week

Exclusion Criteria

• Epworth $\leq$ 15 / 24 (Sleepiness)
• Sats $<$ 80% for $>$ 10% of recording
• Cheyne Stokes Respiration

MCEVOY RD ET AL. N ENGL J MED 2016;375:919-931.
• 15,325 patients assessed
• 2,717 eligible patients
• 1,359 patients – CPAP + usual care
• 1,358 patients – usual care
• Mean age: 61 years
• Male 81%
• Asian ~ 63%
• White ~ 25%

• Mean BMI: 29
• Mean REI: 28/hour
• Mean Epworth 7.4
• Mean Follow up 3.7 years
• Adherence: 42% > 4 hours per night
  • 1 month: 4.4±2.2 hours per night
  • 1 year: 3.5±2.4 hours per night
  • Thereafter: 3.3±2.3 hours per night
• Residual AHI 3.7 per hour (machine)
Cumulative Event Curve of the Primary End Point.

![Graph showing cumulative incidence over follow-up in CPAP and Usual care groups.](image)

**No. at Risk**

<table>
<thead>
<tr>
<th>Group</th>
<th>0</th>
<th>12</th>
<th>24</th>
<th>36</th>
<th>48</th>
<th>60</th>
<th>72</th>
<th>84</th>
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</thead>
<tbody>
<tr>
<td>CPAP</td>
<td>1346</td>
<td>1222</td>
<td>1118</td>
<td>754</td>
<td>482</td>
<td>278</td>
<td>146</td>
<td>146</td>
</tr>
<tr>
<td>Usual care</td>
<td>1341</td>
<td>1211</td>
<td>1108</td>
<td>727</td>
<td>499</td>
<td>290</td>
<td>103</td>
<td>103</td>
</tr>
</tbody>
</table>
SECONDARY END POINTS WERE NOT DIFFERENT

- Death from cardiovascular causes, Myocardial infarction, Stroke, Hospitalization for heart failure, Hospitalization for unstable angina, Hospitalization for transient ischemic attack, Composite of ischemic cardiovascular events, Composite of major cardiovascular events, Composite of cerebral events, Composite of cardiac events, Revascularization procedures, Death from any cause, New-onset atrial fibrillation, Newly diagnosed diabetes, Blood pressure.
QUALITY OF LIFE IMPROVED WITH CPAP

- Epworth Sleepiness Scale score
- Hospital Anxiety and Depression Scale
- SF-36
  - Physical component
  - Mental Component
- EQ-5D utility score
• Therapy with CPAP plus usual care, as compared with usual care alone, did not prevent cardiovascular events in patients with moderate-to-severe obstructive sleep apnea and established cardiovascular disease.
CRITICAL APPRAISAL TOOL (CAT)

**PATIENTS**
- Secondary CV prevention
- Middle age / older Asian men
- “Leaner” for Wisconsin
- Non-sleepy
- Mild hypoxemia

**INTERVENTIONS**
- Usual Care
- CPAP + Usual care
- Poor adherence to CPAP

**COMPARISON**
- Both groups had similar characteristics

**OUTCOMES**
- Low / borderline CPAP adherence did not appear to improve secondary CV mortality / morbidity outcomes in non-sleepy, overweight Asian men with mild hypoxemia within 3-4 years.
- Quality of life appeared to improve
SHOULD WE TREAT OSA?

WHY BOTHER
It'll only come back and slap you in the face
CPAP AND PRIMARY CV PREVENTION IN MEN

Mortality

Morbidity

CPAP PRIMARY CV MORTALITY PREVENTION IN WOMEN


Patients at risk, n

<table>
<thead>
<tr>
<th></th>
<th>AHI &lt;10 (control group)</th>
<th>AHI of 10–29 and treated with CPAP</th>
<th>AHI ≥30 and treated with CPAP</th>
<th>AHI of 10–29 and untreated</th>
<th>AHI ≥30 and untreated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-up, mo</td>
<td>277</td>
<td>155</td>
<td>419</td>
<td>166</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>255</td>
<td>140</td>
<td>381</td>
<td>146</td>
<td>78</td>
</tr>
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<td></td>
<td>198</td>
<td>102</td>
<td>280</td>
<td>102</td>
<td>55</td>
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<td>102</td>
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<td>148</td>
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<td></td>
<td>23</td>
<td>18</td>
<td>48</td>
<td>12</td>
<td>7</td>
</tr>
</tbody>
</table>

Cumulative Mortality

- AHI <10
- AHI of 10–29 and treated with CPAP
- AHI of 30 and treated with CPAP
- AHI of 10–29 and untreated
- AHI of 30 and untreated

P < 0.001* 
P = 0.026*
TELEHEALTH

• e-health or m-health
• Delivery of health care services, health information services and health care education through telecommunications technologies
• Entails preventive, curative, and promotive aspects
• Encompasses telecare and telemedicine
TELECARE

• Mainly used to monitor people to get real-time emergency support via mobile phone, computer and other telecommunication technology

• Helps to manage a wide range of issues and risks associated with a person living alone
TELEMEDICINE

• Use of medical information exchanged from one site to another via electronic communications to improve a patient’s clinical health status

• Includes a growing variety of applications and services using two-way video, email, smart phones, wireless tools and other forms of telecommunications technology
Synchronous Live Interactions

• Offer real-time interactions between a patient and a clinician by means of online communication, phone conversations, home visits, etc.

• They’re usually applied to clinical interview, physical examination and discussion of assessment / plan

Asynchronous Interactions

• Convey medical data such as bio-signals and medical images to a clinician at a convenient time for assessment

• Does not need the presence of both parties
American Academy of Sleep Medicine (AASM) Position Paper for the Use of Telemedicine for the Diagnosis and Treatment of Sleep Disorders

An American Academy of Sleep Medicine Position Paper

Jaspal Singh, MD, MHA, MHS\(^1\); M. Safwan Badr, MD\(^2\); Wendy Diebert, RN\(^3\); Lawrence Epstein, MD\(^4\); Dennis Hwang, MD\(^5\); Valerie Karras, BS, RPSGT\(^6\); Seema Khosla, MD\(^6\); K. Nicole Mims, MD\(^7\); Afifa Shamim-Uzzaman, MD\(^7\); Douglas Kirsch, MD\(^7\); Jonathan L. Heald, MA\(^8\); Kathleen McCann\(^9\)

\(^1\)Carolina HealthCare System, Charlotte, NC; \(^2\)Wayne State University, Detroit, MI; \(^3\)The Virtual Engine, LLC, St. Louis, MO; \(^4\)Welltrinec, Darien, IL; \(^5\)Kaiser Permanente, Fontana, CA; \(^6\)North Dakota Center for Sleep, Fargo, ND; \(^7\)University of Michigan, Ann Arbor, MI; \(^8\)American Academy of Sleep Medicine, Darien, IL
THE VA EXPERIENCE IN MILWAUKEE

• Sleep Medicine started in 2008
• Retrospective study 2008 – 2012
• Sleep consult to PAP Rx interval
  • ↓ ≥60 days to ≤7 days
• ↑ Consults & Sleep studies
• ↑ Data download / follow up

SO WHAT COULD THE FUTURE DELIVERY OF HEALTHCARE FOR SLEEP PATIENTS LOOK LIKE?
OPTISOM - PROJECT Z

Helps to identify, educate, and manage employees’ sleep health

The Three Step Approach

Clinical Screening
Individual Plan
Treatment and Ongoing Engagement

http://www.optisom.com/project-z/
OPTISOM BUSINESS TEAM

DAVID FRENCH – CEO
TAY NGUYEN - CTO
THOMAS LEE
CHIEF SLEEP ADVOCATE
WHAT SLEEP ISSUES ARE INCLUDED

- Jet Lag
- Shift Work
- Restless Legs
- Chronic Stress
- Hypnotic Dependence
- Sleep Deprivation
- Transient Insomnia

- Chronic Insomnia
- Obstructive Sleep Apnea
- Conditioned Arousal
- Sleep Hygiene – Lifestyle
- Sleep Hygiene – Environment
- Delayed Sleep Phase Syndrome
- Advanced Sleep Phase Syndrome
- And more!
WHAT DO THEY PROMISE?

- Better Productivity
- Better Health
- Better Safety
- Cost savings
- Happy workers
- Return on investment (ROI) 1 : 3 $
HOW DO THEY DO IT?

Sleep Health Screener

ProjectZ Therapy Modules
CONTINUATION

ProjectZ Challenge Cards

101: Create a Bedtime Routine
- Consistency is Your Friend
- Read "How to Develop a Sleep Routine" to better understand why and how to develop a sleep routine.
- Read More

ProjectZ Dashboard
EDUCATION

- SleepMatters
- The Johns Hopkins
- 10 minute lectures – mini module
- basic sleep physiology
- common sleep disorders
POSTGRADUATE DIPLOMA - 10/2017

• The Physiological Basis of Sleep
• Introduction to Sleep Medicine and Methodological Approaches
• Circadian Rhythm Disruption and Sleep
• Insomnias
• Sleep Disordered Breathing and Sleep-related Movement Disorders
• Hypersomnias and Parasomnias
• Sleep in Specialist Populations
• Sleep and Society
SLEEP HEALTH

• A Mobile App Study and Wellness tool

• American Sleep Apnea Association and the University of California, San Diego

• Powered by Apple’s Research Kit and IBM Watson Health Cloud.
THE WISCONSIN SLEEP COHORT (WSC)

• Ongoing longitudinal study of the causes, consequences and natural history of sleep disorders in adults—particularly sleep apnea—now in its 26th year

• 40-minute cognitive test battery
• Echocardiography and vascular imaging
• Ambulatory blood pressure
• Blood samples
• Gait and balance testing
• General and mental health questionnaires
• Physical activity questionnaires
• Neuroimaging
DATABASES

• SHOW is a novel program for monitoring population health

• It gathers information about health of state residents living in both urban and rural areas

• It offers new opportunities for epidemiologic and translational health research
SHOW DATA - SLEEP

Average Hours of Sleep

High Chance of Dozing Off
• International Sleep Genetic Epidemiology Consortium (ISGEC)
• National Sleep Research Resource (NSRR)
• The Sleep Heart Health Study (SHHS)
• Childhood Adenotonsillectomy Trial (CHAT)
• Heart Biomarker Evaluation in Apnea Treatment (HeartBEAT)

• Cleveland Family Study (CFS)
• Study of Osteoporotic Fractures (SOF)
• MrOS Sleep Study
• Cleveland Children's Sleep and Health Study (CCSHS)
• Hispanic Community Health Study / Study of Latinos (HCHS/SOL)
NSRR

- Offers free web access to large collections of de-identified physiological signals and clinical data elements collected in well-characterized research cohorts and clinical trials.
Datasets

Read documentation, download files, and view charts and statistics.

- Sleep Heart Health Study
- Childhood Adenotonsillar...
- Heart Biomarker Evaluati...
- Cleveland Family Study
- Study of Osteoporotic Fra...
- MrOS Sleep Study
- Cleveland Children’s Slee...
- Hispanic Community Hea...
- Honolulu-Asia Aging Stud...
# Community Tools

<table>
<thead>
<tr>
<th>Name</th>
<th>URL</th>
<th>User</th>
</tr>
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<tbody>
<tr>
<td>Data Chromatix</td>
<td><a href="https://github.com/saramariani/Data-Chromatix">https://github.com/saramariani/Data-Chromatix</a></td>
<td>Sara Mariani</td>
</tr>
<tr>
<td>Heart Rate Variability Toolkit</td>
<td><a href="http://physionet.org/tutorials/hrv-toolkit/">http://physionet.org/tutorials/hrv-toolkit/</a></td>
<td>mrueschman</td>
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<td>Multiscale entropy-based EEG artifact detector</td>
<td><a href="https://github.com/saramariani/MSE-based-EEG-artifact-detector">https://github.com/saramariani/MSE-based-EEG-artifact-detector</a></td>
<td>Sara Mariani</td>
</tr>
<tr>
<td>Multiscale Poincare Plots</td>
<td><a href="https://github.com/saramariani/Multiscale-Poincare-Plots">https://github.com/saramariani/Multiscale-Poincare-Plots</a></td>
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<tr>
<td>SpectralTrainFig</td>
<td><a href="https://github.com/nsrr/SpectralTrainFig">https://github.com/nsrr/SpectralTrainFig</a></td>
<td>Sara Mariani</td>
</tr>
<tr>
<td>XML Annotation Extractor (R)</td>
<td><a href="https://gist.github.com/mrueschman/6ef53b972a76a00748b8">https://gist.github.com/mrueschman/6ef53b972a76a00748b8</a></td>
<td>mrueschman</td>
</tr>
</tbody>
</table>

## Software Images

- **EDF Editor and Translator** (Java)
- **Block EDF Loader** (Matlab)
- **EDF Viewer** (Matlab)
- **Signal Raster View** (Matlab)
- **SpectralTrainFig** (Matlab)
- **Spout** (Ruby)
- **NSRR Cross Dataset Quer...** (Web)
Summary
we are almost there
• Various apps and technology are available for the benefit of patients and healthcare workers alike.
• Technology evolves constantly, facilitating learning, research, collaboration and patient care.
• New solutions to old problems come with new questions to new problems.