USING TECHNOLOGY TO IMPROVE OUTCOMES IN SLEEP DISORDERED BREATHING

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Saturday, January 19, 2019 – 10:40 a.m. – 11:10 a.m.

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Conflict of Interest Statement

I do not have any relationships with any entities producing, marketing, re-selling, or distributing health care goods or services consumed by, or used on, patients.

Due to the nature of the talk, commercial products are discussed; no endorsement is made.

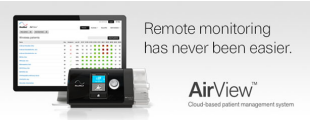
Learning Objectives

- Review outcomes-related data with respect to use of technologies to enhance the treatment of sleep disordered breathing
- Review delivery models combining telemonitoring and telemedicine
- A look towards the future of consumer facing devices

The Landscape

- Sleep medicine is a poster child for dramatic change in models of care delivery and technology
- In recent years, home sleep testing has replaced a portion of laboratory sleep studies for the diagnosis of obstructive sleep apnea
- Consumer wearables and trackers, mobile applications, and health interfaces abound
- Remote device monitoring has advanced and is widely available on newer and a broader range of devices

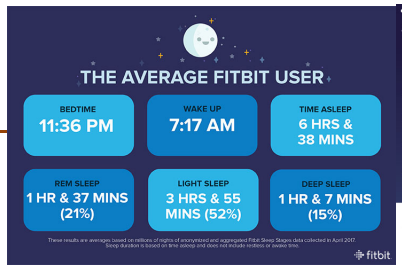
Opportunities

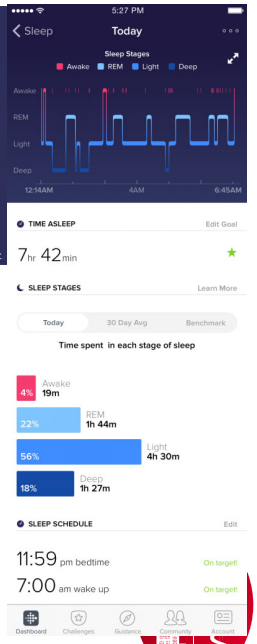


- New Treatments
  - Devices more adaptive than in the past
  - NIPPV for complicated or advanced respiratory disorders exist – patients with higher risk profile
  - Use of such devices often requires more proactive, nimble management
    - Patients highly reliant on devices
    - More rapid disease state change

- New superhighways of patient-derived data
  - Patient assessments and HST data can be remotely and securely scored and routed
  - Advent of usage data on cloud-based portals augments ability to manage patients remotely
    - Preset triggers to detect who might be struggling
    - Not just for CPAP/ BL; ST, IVAPS, AVAPS, Trilogy, Astral available
  - Websites & mobile applications to increased patient-facing information, tracking, and engagement
- New models of sleep center proximity, access
  - Remote in-home testing
  - Increasing use of telehealth platforms, remote provider access, etc
  - Value based alternative payment models

Approach





- Remote Data collection/ telemonitoring
- Telehealth/ Telemedicine: principles & data
- Diagnostics and tracking: Consumer health vs medical tool?

"New Fitbit Features Deliver Data Previously Only Available Through a Sleep Lab", https://blog.fitbit.com/sleep-stages-and-sleep-insights-announcement/ accessed 1/2/2019

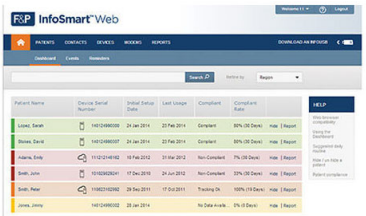
Remote PAP Monitoring: "The Cloud"

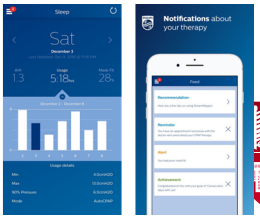
Industry-Sponsored Portals

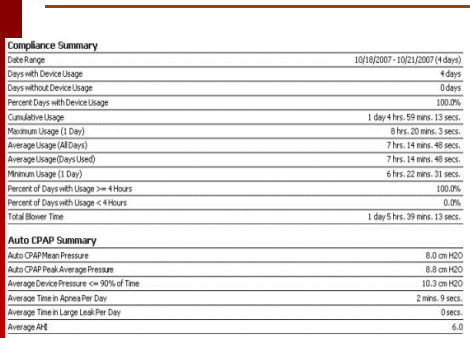
- Latest devices have wireless access to remote device data
- Most of the data available from a traditional "download" in clinic:
  - Hours of usage
  - Device-calculated proxies of AHI, leak, ventilation measures, patient-triggered breaths
  - In some scenarios, breath-to-breath data, leak, and event scoring
- Caution: different manufacturers detect and report differently
  - *Stay tuned for sessions at 1:40 and 2:20 today!*
- Patients can have access to some/ most of this data via smartphone apps or websites
- Also potential for alerts to patient or clinician if problems detected
- *Independent* outcomes data demonstrating consistent benefits of using patient-facing informatics on adherence to therapy largely absent until recently; also assessed by industry

Industry-Sponsored Portals

- Resmed: AirView (web-based; for provider); MyAir (patient; web-based and/or mobile)
- Phillips Respironics: EncoreEverywhere (web-based; for provider; transitioning to CareOrchestrator); DreamMapper (patient; web-based and/or mobile)
- Fisher and Paykel: Infosmart Web (web-based)





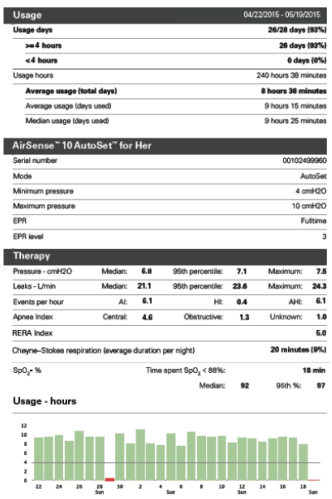


Compliance Summary

Date Range	10/18/2007 - 10/21/2007 (4 days)
Days with Device Usage	4 days
Days without Device Usage	0 days
Percent Days with Device Usage	100.0%
Cumulative Usage	1 day 4 hrs. 59 mins. 13 secs.
Maximum Usage (1 Day)	8 hrs. 20 mins. 3 secs.
Average Usage (All Days)	7 hrs. 14 mins. 48 secs.
Average Usage (Days Used)	7 hrs. 14 mins. 48 secs.
Minimum Usage (1 Day)	6 hrs. 22 mins. 31 secs.
Percent of Days with Usage >= 4 Hours	100.0%
Percent of Days with Usage < 4 Hours	0.0%
Total Blower Time	1 day 5 hrs. 39 mins. 13 secs.

Auto CPAP Summary

Auto CPAP Mean Pressure	8.0 cm H2O
Auto CPAP Peak Average Pressure	8.8 cm H2O
Average Device Pressure <= 90% of Time	10.3 cm H2O
Average Time in Apnea Per Day	2 mins. 9 secs.
Average Time in Large Leak Per Day	0 secs.
Average AHI	6.0



Usage 04/22/2015 - 05/19/2015

Usage days	**26/28 days (93%)**
>=4 hours	**26 days (93%)**
<4 hours	**0 days (0%)**
Usage hours	240 hours 38 minutes
Average usage (total days)	**8 hours 36 minutes**
Average usage (days used)	9 hours 15 minutes
Median usage (days used)	9 hours 25 minutes

AirSense™ 10 AutoSet™ for Her

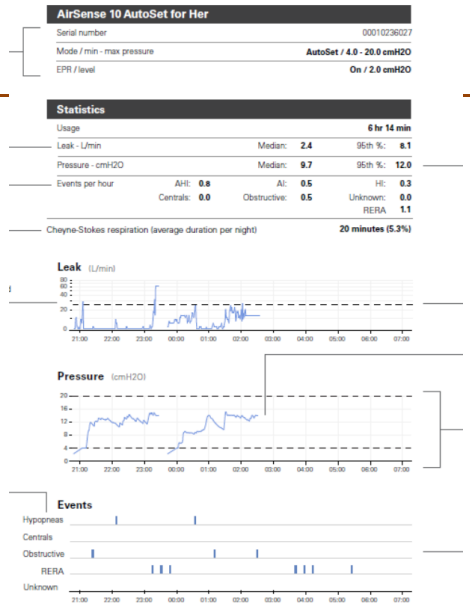
Serial number	00102409960
Mode	AutoSet
Minimum pressure	4 cmH2O
Maximum pressure	10 cmH2O
EPR	Fulltime
EPR level	3

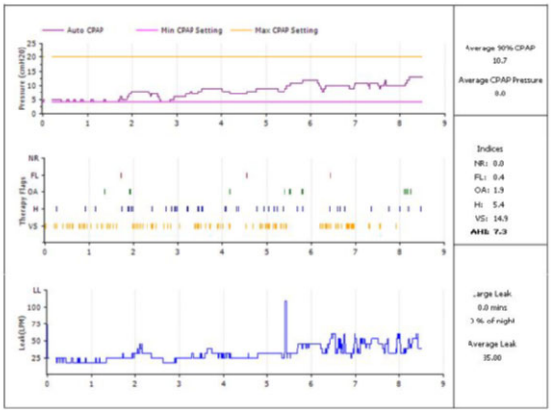
Therapy

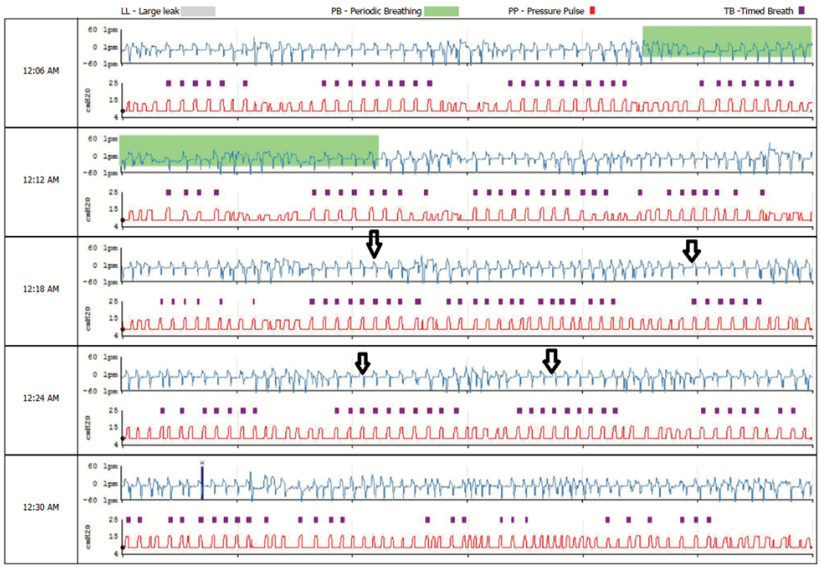
Pressure - cmH2O	Median:	6.8	95th percentile:	7.1	Maximum:	7.5
Leaks - L/min	Median:	21.1	95th percentile:	23.6	Maximum:	24.3
Events per hour	AI:	6.1	HI:	0.4	AHI:	6.1
Apnea Index	Central:	4.6	Obstructive:	1.3	Unknown:	1.0
RERA Index						5.0
Cheyne–Stokes respiration (average duration per night)						**20 minutes (9%)**
SpO_2 - %			Time spent SpO_2 < 88%:			18 min
			Median:	92	95th %:	97

Usage - hours

https://airview.resmed.com/resources/welcome-page/pdf/1018991_airview-report-guide_usa_eng.pdf



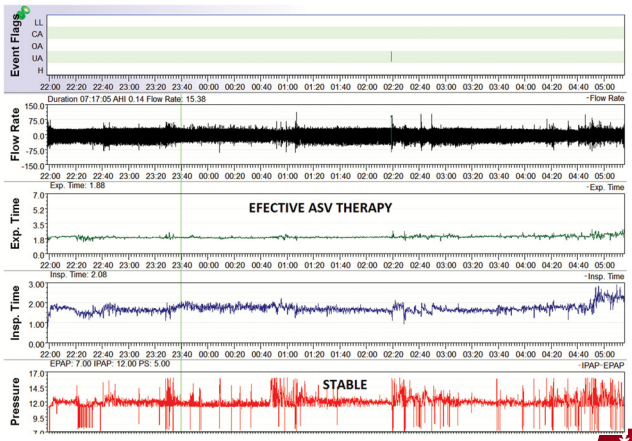




Estimation of adaptive ventilation success and failure using polysomnogram and outpatient therapy biomarkers. Sleep. 2018;41(9).

Sleepyhead

- https://sleepyhead.jedimark.net
- freeware enables review of data on SD cards
- flow, pressure, leak, inspiratory and expiratory times, and mean and median of respiratory rate, tidal volume, and minute ventilation



Thomas RJ et al. Urgent need to improve PAP management: the devil is in two (fixable) details. J Clin Sleep Med . 2017;13(5):657–664.

Early studies of remote PAP monitoring: depends what happens with the data…

Table 1 Remote monitoring of Positive Airway Pressure Therapy in OSA: published studies

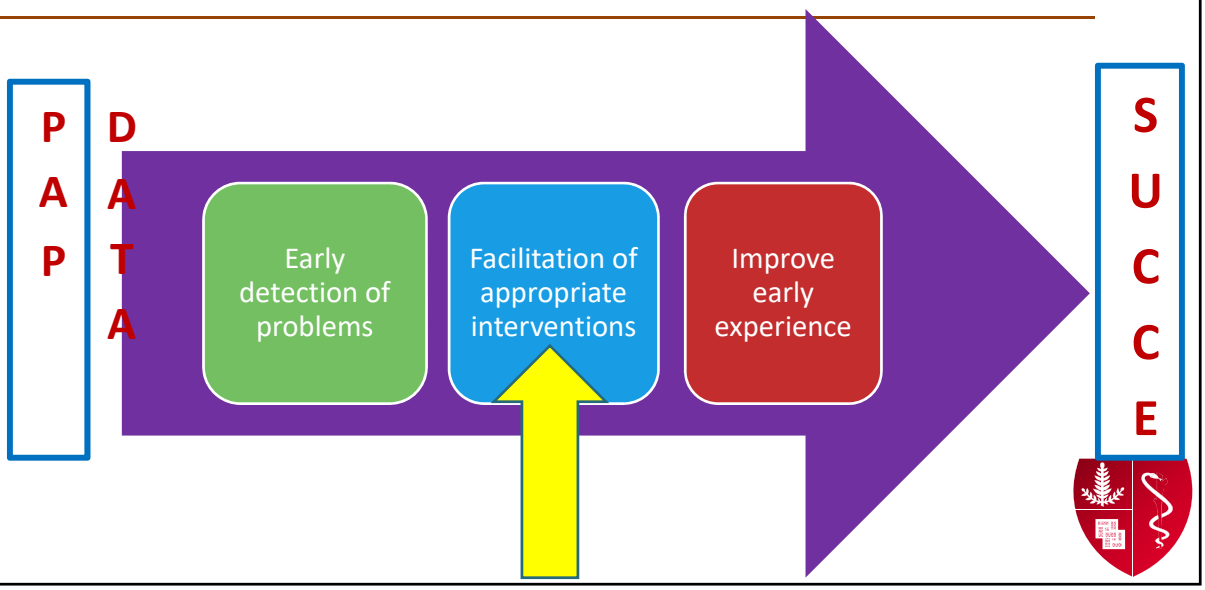
Author [reference]	Study design/ number of patients	Age (years)	Apnoea–hypopnoea index (number/hour)	Impact of TM on CPAP adherence	Functional outcomes	Patient's perception of TM	Labour/ cost-effectiveness
Stepnowsky CJ[18]	Pilot RCT/45	59 ± 14.3	39 ± 16.8	4.1 ± 1.8 (TM) vs 2.8 ± 2.2 (UC) hours, $P < 0.07$	No between groups differences for ESS, QOL (FOSQ)	No concern about being wirelessly monitored; wireless transmition data	NA
Fox N[24]							
Anttalainen U[24]							
Turino C[35]							
Munafo D[21]	RCT/140	52.3 ± 10.6 (TM); 50.0 ± 11.7 (UC)	34.3 ± 24.5 (TM); 27.4 ± 18.0 (UC)	No difference in 3 months CPAP adherence	NA	privacy aspects Program acceptance was high and similar in the two groups	Labour time for coaching was reduced in the TM arm

CPAP, continuous positive airway pressure; ESS, Epworth Sleepiness Scale; NA, not applicable; QOL (FOSQ), quality of life (Functional Outcomes of Sleep Questionnaire); RCT, randomized controlled trial; TM, telemonitoring; UC: usual care

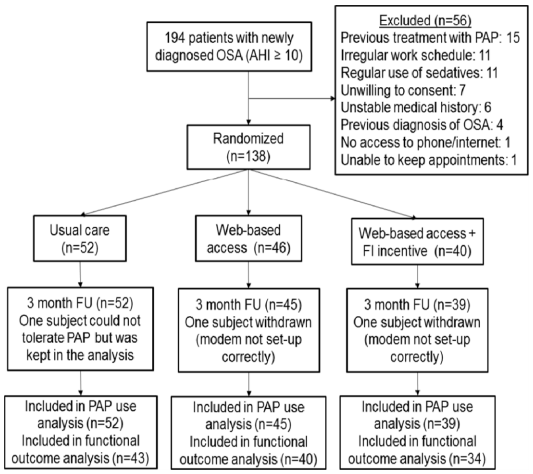
The impact of telemonitoring on CPAP adherence is dependent on pre-existing 'usual care' in the control arm as well as what type of intervention is employed based on telemonitored data

Pepin et al. Does remote monitoring change OSA management and CPAP adherence? Respirology. 2017 Nov;22(8):1508-1517. doi: 10.1111/resp.13183.

Remote PAP monitoring: What happens next?



Empowering PAP adherence through *patient-facing* telemonitoring data (website access to CPAP usage data)



Kuna et al. Web-Based Access to Positive Airway Pressure Usage with or without an Initial Financial Incentive Improves Treatment Use in Patients with Obstructive Sleep Apnea. Sleep. 2015;38(8):1229-1236.

Improved adherence when given access to website-based PAP usage data

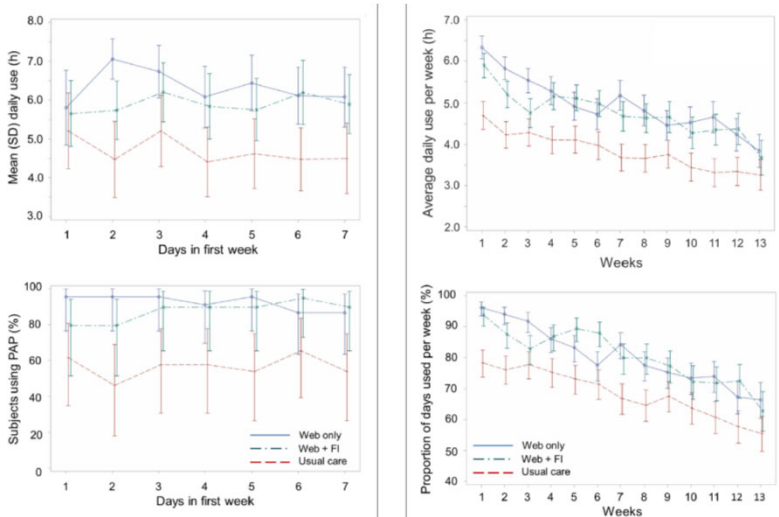
Table 2—Positive airway pressure device data in first week and 3-mo treatment period.

	Usual Care (n = 52)	Web Access (n = 45)		Web Access with FI (n = 39)	
Variable	**Mean ± SD**	**Mean ± SD**	**P**	**Mean ± SD**	**P**
First week results					
Average days used	5.5 ± 2.6	6.7 ± 0.8	0.001	6.6 ± 1.3	0.005
Average daily h of use	4.7 ± 3.3	6.3 ± 2.5	< 0.0001	5.9 ± 2.5	< 0.0001
Average daily h of use on days used	6.0 ± 2.4	6.6 ± 2.2	0.002	6.3 ± 2.0	0.128
Average AHI_{Flow} (events/h)	3.6 ± 3.8	4.7 ± 4.8	0.001	3.8 ± 3.7	0.523
Average air leak (LPM)	36.8 ± 22.7	34.6 ± 11.3	0.104	34.3 ± 13.6	0.072
3-mo results					
Average days used	4.7 ± 2.96	5.6 ± 2.3	< 0.0001	5.6 ± 2.3	< 0.0001
Average daily h of use	3.8 ± 3.3	5.0 ± 3.2	< 0.0001	4.8 ± 3.0	< 0.0001
Average daily h of use on days used	5.6 ± 2.4	6.2 ± 2.3	< 0.0001	5.9 ± 2.0	< 0.0001
Average AHI_{FLOW} (events/h)	3.2 ± 3.7	3.4 ± 4.3	0.015	2.9 ± 3.3	0.007
Average air leak (LPM)	39.0 ± 26.1	33.1 ± 13.0	< 0.001	35.3 ± 19.8	< 0.001

P values compare estimated means from each intervention group (Web access and Web access with financial incentive) to usual care via a generalized linear model. AHI, apnea-hypopnea index; FI, financial incentive; LPM, liters per minute; SD, standard deviation.

Kuna et al. Web-Based Access to Positive Airway Pressure Usage with or without an Initial Financial Incentive Improves Treatment Use in Patients with Obstructive Sleep Apnea Sleep. 2015;38(8):1229-1236.

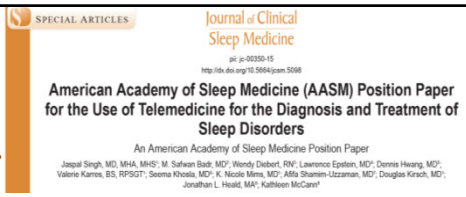
Improved adherence when given access to website-based PAP usage data



Kuna et al. Web-Based Access to Positive Airway Pressure Usage with or without an Initial Financial Incentive Improves Treatment Use in Patients with Obstructive Sleep Apnea Sleep. 2015;38(8):1229-1236.

Pairing Telemonitoring and Telemedicine

Telemedicine


SPECIAL ARTICLES

Journal of Clinical Sleep Medicine

pii: jc-00350-15

http://dx.doi.org/10.5664/jcsm.5098

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

Joseph Singh, MD, MHA, MHS[1]; M. Safwan Badr, MD[2]; Wendy Diebert, RN[3]; Lawrence Epstein, MD[4]; Dennis Hwang, MD[5]; Valerie Karnes, BS, RPSGT[1]; Seema Khosla, MD[6]; K. Nicole Mims, MD[7]; Atifa Shamim-Uzzaman, MD[7]; Douglas Kirsch, MD[1]; Jonathan L. Heald, MA[8]; Kathleen McCann[8]

- "Delivery of health care services at a distance", using information and communication technology.
  - **Telehealth**: Electronic exchange of medical information to improve a patient's health status. Broader concept than telemedicine.
  - **Telemedicine**: A legal patient/clinician encounter using electronic communication.
- Major rationales for introduction: decreased costs, improved efficiency; increased access in health care delivery; potential for improved outcomes
- Sleep-specific rationales:
  - Increased opportunities to increase adherence rates in sleep disorder treatment management;
  - OSA – HST; PAP data downloads and feedback
  - Evaluation of home environment - assessing sleep dysfunction such as equipment problems, aspects of poor sleep hygiene, lighting, etc.

J Clin Sleep Med 2015;11(10):1187–1198

Sample Telemedicine Workflow for OSA Patients

Consultation can be Traditional or via Telemedicine

- Symptoms
- Findings
- Consistent decision-making in accordance with clinical practice guidelines

→

Diagnostic Testing at Home or In-lab

- HSAT
- PSG/Split night
- Use of Auto-PAP

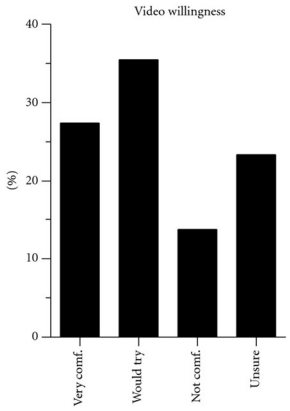
→

Follow-up can be Traditional or via Telemedicine

- Result review
- Device downloads
- Management

Singh, J, et al. Sleep Telemedicine Implementation Guide. Darien, IL: AASM; 2017; https://aasm.org/download-the-sleep-telemedicine-implementation-guide-a-free-resource-from-aasm/

Majority of Sleep Patients Willing to Try Telemedicine



Kelly JM et al. Sleep telemedicine: a survey study of patient preferences. ISRN Neurol. 2012;2012:135329.

Acceptance using Telemedicine Platforms for OSA Management

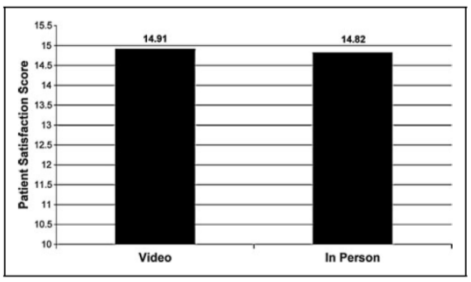


Fig. 1. Patient satisfaction score comparison.

Single center;
Initial appt in person or via TM

Table 1. Descriptive Statistics—Patient Satisfaction

	IN PERSON	VIDEOCONFERENCE
Number of patients (n=90)	56	34
Sex		
Male (%)	25 (44.64%)	14 (42.42%)
Female (%)	31 (55.36%)	19 (57.58%)
Not reported		1
Age		
Mean (standard deviation)	53.70 (15.15)	49.21 (13.62)
Median	56	47.5
Minimum	23	24
Maximum	85	79
Ethnicity		
White (%)	49 (100%)	24 (92.30%)
Asian (%)	0 (0%)	1 (3.85%)
Hispanic (%)	0 (0%)	1 (3.85%)
Not reported	7	8

Parikh R et al. Sleep telemedicine: patient satisfaction and treatment adherence. Telemed J E Health. 2011 Oct;17(8):609-14.

Equivalent PAP Adherence Using Telemedicine Platforms

Table 4. Mann–Whitney Test—Treatment Adherence (Percentage of Nights Use ≥4 h)

	IN PERSON (N=111)	VIDEOCONFERENCE (N=61)
Percentage of nights with use ≥4 h	0.71	0.65
Standard deviation	0.33	0.33
Minimum	0.00	0.00
Maximum	1.00	1.00
Mann–Whitney test		
p-Value	0.198	

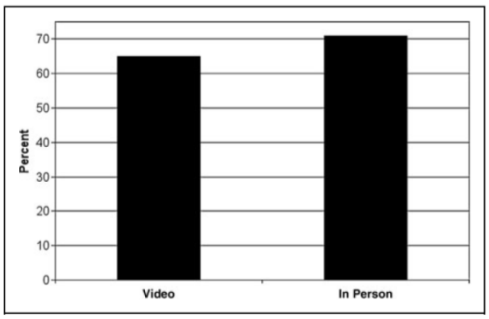
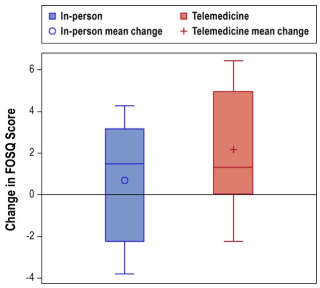


Fig. 2. Percentage of nights continuous positive airway pressure (CPAP) was used ≥4 h.

Parikh R et al. Sleep telemedicine: patient satisfaction and treatment adherence. Telemed J E Health. 2011 Oct;17(8):609-14.

Feasibility and Acceptance

- Prospective, parallel-group randomized pilot study
- Assessed feasibility of telemedicine for OSA evaluation and management vs. traditional, in-person care
- 60 Veterans at 3 affiliated VA locations
- Video vs in-person visit; HST; APAP; phone follow up at 1w; phone (w download) vs. in- person at 1m, and 3m
- PAP adherence NS between groups
- ESS improvement NS between groups
- TM highly accepted in this population



Fields BG et al. Remote Ambulatory Management of Veterans with Obstructive Sleep Apnea. Sleep. 2016 Mar 1;39(3):501-9.

Access

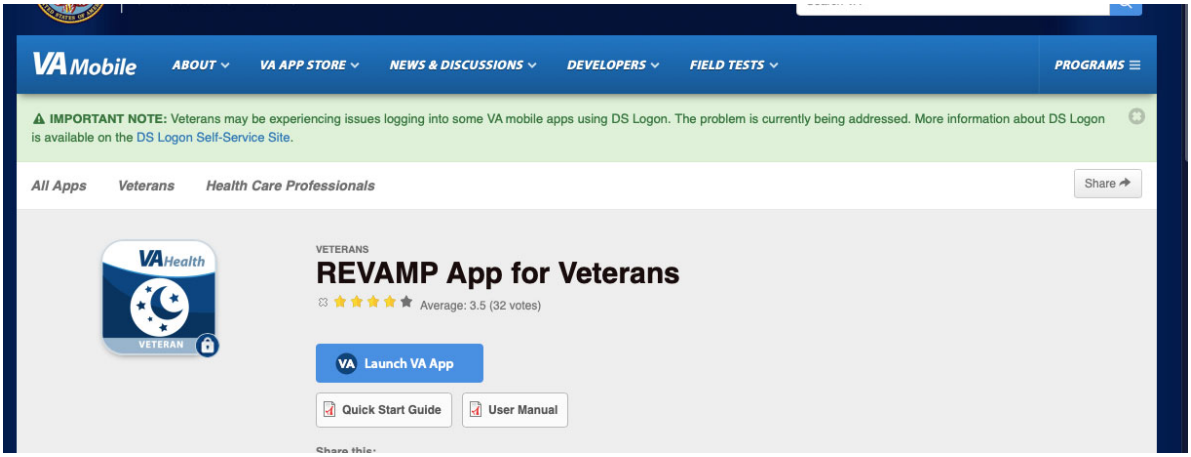
- Single-hospital VA study found telemedicine resulted in an average travel savings of 145 miles and 142 minutes per visit;
- Patients to take less time off from work, associated with high levels of patient satisfaction

Watson NF. Expanding Patient Access to Quality Sleep Health Care through Telemedicine. J Clin Sleep Med. 2016 Feb;12(2):155-6. Russo JE, McCool RR, Davies L, VA telemedicine: an analysis of cost and time savings. Telemed J E Health. 2015. Markwick L, McConnochie K, Wood N, authors. Expanding telemedicine to include primary care for the urban adult. J Health Care Poor Underserved. 2015;26:771–6

REVAMP Trial

- VA-sponsored trial, n=350 participants
- Randomized, open label
- Access to interactive website Veterans complete intake and follow-up questionnaires
- Unattended home sleep test (HST) without in-person instructions.
- Sleep specialists review the findings with the patient during an initial phone clinic.
- REVAMP auto-populates templated progress notes that are exported to EMR
- Veterans diagnosed with OSA are treated with APAP
- Telemonitoring data available to both Veterans and practitioners, thereby promoting patient self-management and productive patient-practitioner interactions.
- End point is non-inferior care; also measures of access; wait times.

clinicaltrials.gov; ClinicalTrials.gov Identifier: NCT03007745



Home sleep testing; Built-in alerts for sleep tests; Sleep health questionnaires
Submit requests for PAP supplies; Sleep tracking graphs; Send and receive secure messages with your sleep care team

Telemonitoring and Telemedicine in OSA: Patient-Facing App

- Retrospective study funded by Resmed
- Patients initiated PAP therapy between 2009-2014
- Managed either using telemedicine (AirView™; "proactive care" group) or telemedicine + patient engagement app (AirView™ + myAir™; "patient engagement")
- Proactive care: homecare provider telephoned patients if compliance during the first 2 weeks of PAP therapy fell below the required level (<4 h/day).
  - 2 weeks - 6 months: patients were telephoned again if continued periods of no or low usage were identified from telemonitoring data.
  - 6 months+: patients were notified via telephone call or letter if telemonitoring data showed that PAP device usage dropped significantly or did not reach the required threshold (average of 4 h/night).
  - When contacted, patients were provided with detailed information on use of their PAP therapy device and management of side effects (eg, upper airway dryness, pressure, etc).

Woehrle H, Arzt M, Graml A, Fietze I, Young P, Teschler H, Ficker JH. Effect of a patient engagement tool on positive airway pressure adherence: analysis of a German healthcare provider database. Sleep Med. 2018 Jan;41:20-26.

Data at 180 days of therapy

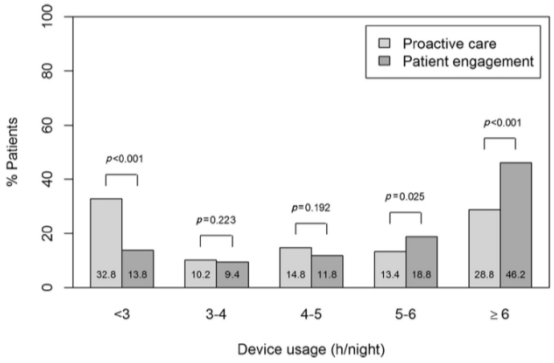


Table 4
Sleep apnea parameters.

	Proactive care ($n = 500$)	Patient engagement ($n = 500$)	Difference	p
Apnea-hypopnea index, /hour				
Mean ± SD	3.1 ± 3.6	2.8 ± 3.3	−0.3 ± 4.9	0.181
Median (IQR)	1.9 (0.9, 3.5)	1.7 (0.9, 3.2)		
Apnea index, /hour				
Mean ± SD	2.1 ± 2.9	1.9 ± 2.7	−0.2 ± 3.9	0.161
Median (IQR)	1.1 (0.6, 2.4)	1.1 (0.4, 2.1)		
Hypopnea index, /hour				
Mean ± SD	0.9 ± 1.2	0.8 ± 1.2	−0.1 ± 1.8	0.460
Median (IQR)	0.5 (0.2, 1.0)	0.4 (0.2, 1.0)		
Leak, L/minute				
Mean ± SD	4.1 ± 5.3	2.7 ± 4.0	−1.4 ± 6.7	<0.001
Median (IQR)	2.3 (0.6, 5.7)	1.3 (0.3, 3.5)		

Woehrle H, Arzt M, Graml A, Fietze I, Young P, Teschler H, Ficker JH. Effect of a patient engagement tool on positive airway pressure adherence: analysis of a German healthcare provider database. Sleep Med. 2018 Jan;41:20-26.

Addition of Engagement Tool to Telemonitored, Proactive Care Led to Higher Device Usage

Positive airway pressure therapy device usage.

	Proactive care ($n = 500$)	Patient engagement ($n = 500$)	Difference	p
Proportion of nights with usage >4 h, %				
Mean ± SD	63 ± 32	77 ± 25	14 ± 41	<0.001
Median (IQR)	73 (35, 91)	87 (64, 97)		
Average usage on nights used, hours/night				
Mean ± SD	5.5 ± 1.7	6.2 ± 1.4	0.7 ± 2.2	<0.001
Median (IQR)	5.8 (4.5, 6.7)	6.5 (5.4, 7.2)		
Average usage over first 180 days, hours/night				
Mean ± SD	4.2 ± 2.4	5.4 ± 1.9	1.2 ± 3.1	<0.001
Median (IQR)	4.6 (2.2, 6.2)	5.8 (4.2, 6.8)		
Proportion of nights used, %				
Mean ± SD	79 ± 24	88 ± 17	9 ± 30	<0.001
Median (IQR)	90 (68, 98)	96 (84, 99)		
Number of nights with usage >0				
Mean ± SD	127 ± 55	151 ± 35	25 ± 66	<0.001
Median (IQR)	152 (94, 172)	166 (139, 176)		
Days without observation, *n*				
Mean ± SD	29 ± 35	20 ± 28	−9 ± 45	<0.001
Median (IQR)	15 (4, 43)	8 (2, 28)		

IQR, interquartile range (25th and 75th percentile values); SD, standard deviation.

Woehrle H, Arzt M, Graml A, Fietze I, Young P, Teschler H, Ficker JH. Effect of a patient engagement tool on positive airway pressure adherence: analysis of a German healthcare provider database. Sleep Med. 2018 Jan;41:20-26.

Telemonitoring and Telemedicine in OSA

- N= 1455, mean age 49 ± 12.5 years, RCT
  - 956 underwent HST
  - 556 prescribed CPAP
- 2 telemedicine interventions were tested:
  - Web-based OSA education (Tel-Ed)
  - PAP telemonitoring with automated patient feedback (Tel-TM)
- 4-arm randomized trial
  - Usual care
  - Tel-Ed
  - Tel-TM
  - Tel-Ed + Tel-TM

ORIGINAL ARTICLE

Effect of Telemedicine Education and Telemonitoring on Continuous Positive Airway Pressure Adherence
The Tele-OSA Randomized Trial

Dennis Hwang[1], Jeremiah W. Chang[1], Adam V. Benjafield[2], Maureen E. Crocker[2], Colleen Kelly[3], Kendra A. Becker[1], Joseph B. Kim[1], Rosa R. Woodrum[1], Joanne Liang[1], and Stephen F. Derose[1,4]

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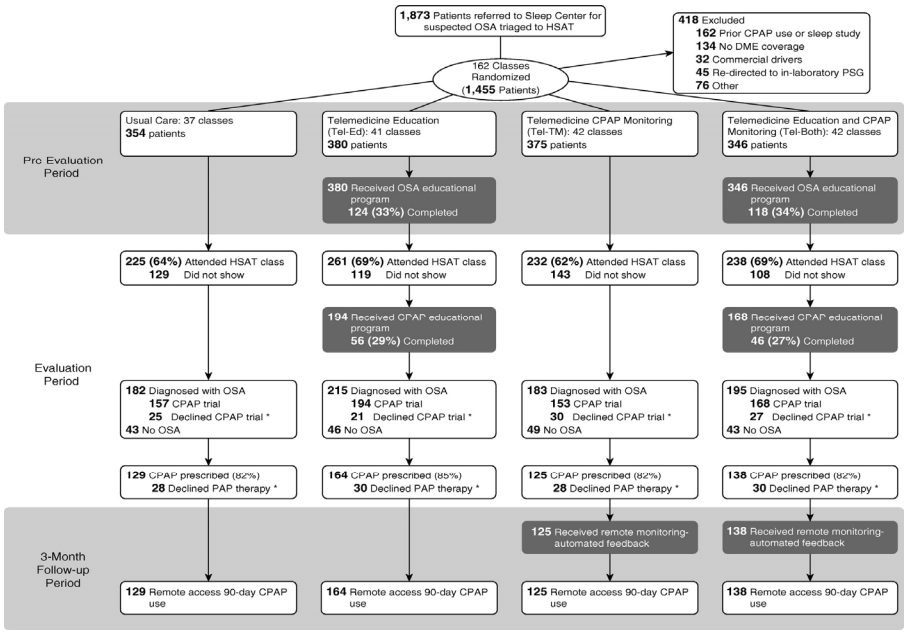
ORCID IDs: 0000-0002-4070-1640 (D.H.); 0000-0002-5150-7229 (M.E.C.).

Hwang D, Chang JW, Benjafield AV, Crocker ME, Kelly C, Becker KA, Kim JB, Woodrum RR, Liang J, Derose SF. Effect of Telemedicine Education and Telemonitoring on Continuous Positive Airway Pressure Adherence. The Tele-OSA Randomized Trial. Am J Respir Crit Care Med. 2018 Jan 1;197(1):117-126.



Hwang D, Chang JW, Benjafield AV, Crocker ME, Kelly C, Becker KA, Kim JB, Woodrum RR, Liang J, Derose SF. Effect of Telemedicine Education and Telemonitoring on Continuous Positive Airway Pressure Adherence. The Tele-OSA Randomized Trial. Am J Respir Crit Care Med. 2018 Jan 1;197(1):117-126.

Table 3. CPAP Use and Subjective Outcomes 90 Days after CPAP Dispensation

	Usual Care	Tel-Ed	Tel-TM	Tel-Both	Tel-Ed Effect (95% CI), *P* Value	Tel-TM Effect (95% CI), *P* Value	Tel-Both Effect (95% CI), *P* Value
	n = 129	*n* = 163	*n* = 125	*n* = 138			
Days used, %	64.8 ± 34.2	68.6 ± 31.3	76.6 ± 28.3	78.3 ± 28.3	2.8 (−2.3 to 7.9), 0.28	10.6 (5.5 to 15.7), <0.0001	13.4 (6.1 to 20.8), 0.0004
Average usage on all days, h	3.8 ± 2.5	4.0 ± 2.4	4.4 ± 2.2	4.8 ± 2.3	0.3 (−0.1 to 0.7), 0.10	0.8 (0.4 to 1.15), 0.0002	1.1 (0.5 to 1.7), 0.0002
Average usage on days used, h	5.2 ± 1.8	5.2 ± 1.8	5.3 ± 1.7	5.8 ± 1.6	0.2 (−0.1 to 0.5), 0.13	0.4 (0.1 to 0.7), 0.006	0.6 (0.2 to 1.0), 0.003
Medicare adherence, *n* (%)	69 (53.5)	100 (61.0)	82 (65.6)	101 (73.2)	1.4* (1.0 to 2.0), 0.07	1.7* (1.2 to 2.4), 0.003	2.4* (1.4 to 3.9), 0.001
	n = 83	*n* = 113	*n* = 90	*n* = 93			
Change in ESS score†	−3.7 ± 4.7	−2.8 ± 6.4	−3.7 ± 5.2	−3.0 ± 3.7	0.8 (−0.2 to 1.9), 0.13	−0.14 (−1.2 to 0.9), 0.80	0.7 (−0.9 to 2.3), 0.38
Change in FOSQ-10 score†	−14.2 ± 10.3	−9.9 ± 12.9	−10.9 ± 11.2	−11.3 ± 12.8	1.9 (−0.8 to 4.5), 0.16	0.6 (−2.0 to 3.3), 0.64	2.5 (−1.3 to 6.4), 0.20

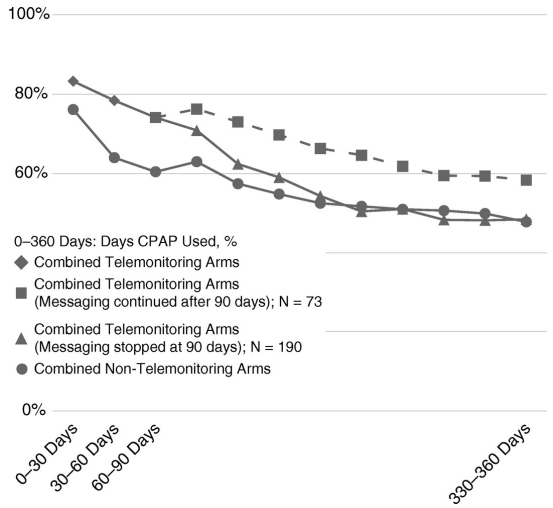
Hwang D, Chang JW, Benjafield AV, Crocker ME, Kelly C, Becker KA, Kim JB, Woodrum RR, Liang J, Derose SF. Effect of Telemedicine Education and Telemonitoring on Continuous Positive Airway Pressure Adherence. The Tele-OSA Randomized Trial. Am J Respir Crit Care Med. 2018 Jan 1;197(1):117-126.

Results

- Usage significantly higher in the Tel-TM and Tel-both groups versus usual care (P = 0.0002 for both) but not for Tel-Ed (P = 0.10)
- Telemedicine-based education did not improve CPAP adherence but did increase clinic attendance for OSA evaluation.
- CPAP telemonitoring with automated feedback messaging improved 90-day adherence in patients with OSA.
- *The improvement was observed without requiring additional provider intervention.*

Hwang D, Chang JW, Benjafield AV, Crocker ME, Kelly C, Becker KA, Kim JB, Woodrum RR, Liang J, Derose SF. Effect of Telemedicine Education and Telemonitoring on Continuous Positive Airway Pressure Adherence. The Tele-OSA Randomized Trial. Am J Respir Crit Care Med. 2018 Jan 1;197(1):117-126.

Chronic Disease Management



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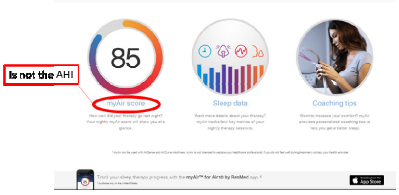
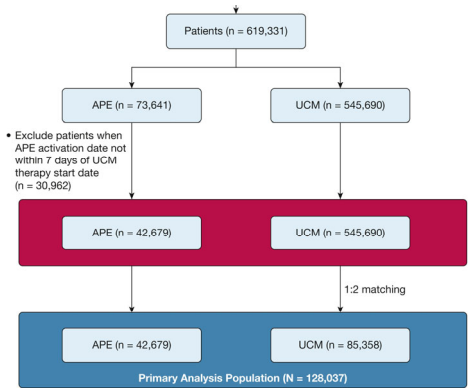
Patient-facing interventions alone?

Resmed Active Patient Engagement

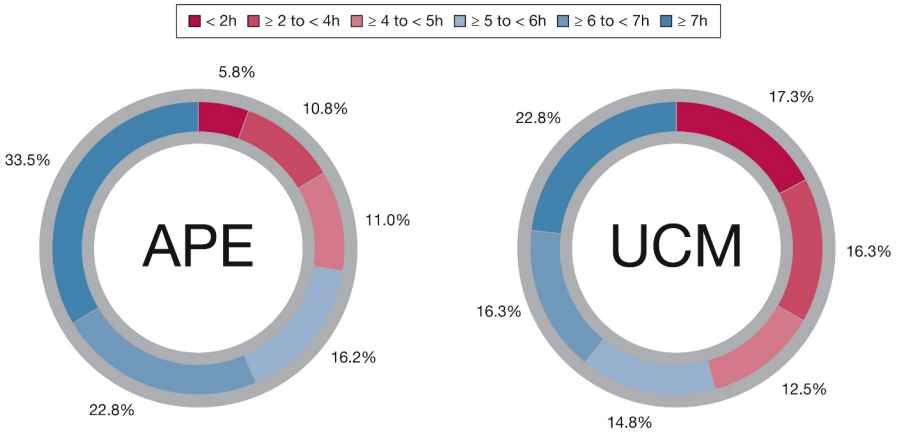
- Retrospective; 128,037 pts analyzed
- APE = MyAir
- MyAir score, usage based praise, badges, etc
- Tips on making PAP more comfortable
- Personalized coaching and reinforcement sent via email
- Increase self management reward success, resolve basic issues
- Primary outcome: % compliance in first 90 days





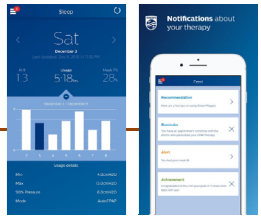
Malhotra A et al. Patient Engagement Using New Technolo
Improve Adherence to Positive Airway Pressure Therapy: A
Retrospective Analysis. Chest. 2018 Apr;153(4):843-850.

Adherence: APE 87.3% vs UC 70.4%



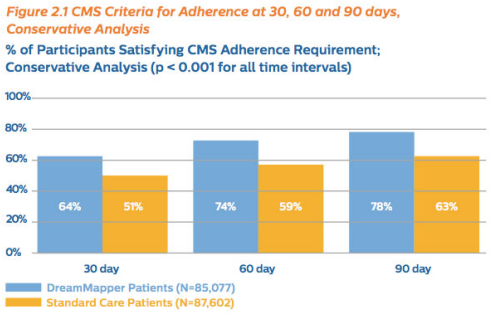
Malhotra A et al. Patient Engagement Using New Technology to Improve Adherence to Positive Airway Pressure Therapy: A Retrospective Analysis. Chest. 2018 Apr;153(4):843-850.

DreamMapper



N ~ 173,000 pts

- PAP with DreamMapper vs not
- 90-day compliance 78% (vs 63%)
- Average usage 1.1 hours longer



Hardy et al. A Mobile Application and website to engage sleep apnea patients in PAP therapy and improve adherence to treatment. Phillips Respironics White Paper, 2016.

Consumer health space and diagnostics?

Is the future of medicine a smartphone?

THE WALL STREET JOURNAL

The Saturday Essay

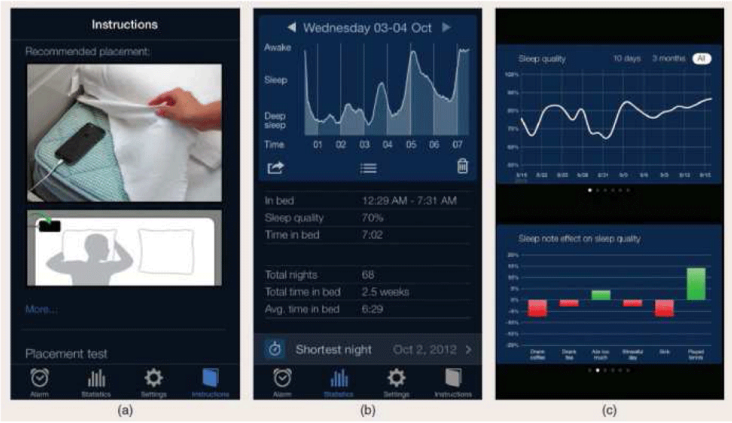
The Future of Medicine Is in Your Smartphone: New tools are tilting health-care control from doctors to patients By Eric J. Topol Jan. 9, 2015

Advancement of Consumer-Facing Tools

- Use of smartphone to detect OSA for almost 15 years
- Ever-growing number of consumer devices in the sleep space
- Smartphones: fast processing, ability to monitor ambient light and noise, accelerometery, low cost oximetry probes (HR and O2 sat) – requires beat to beat processing

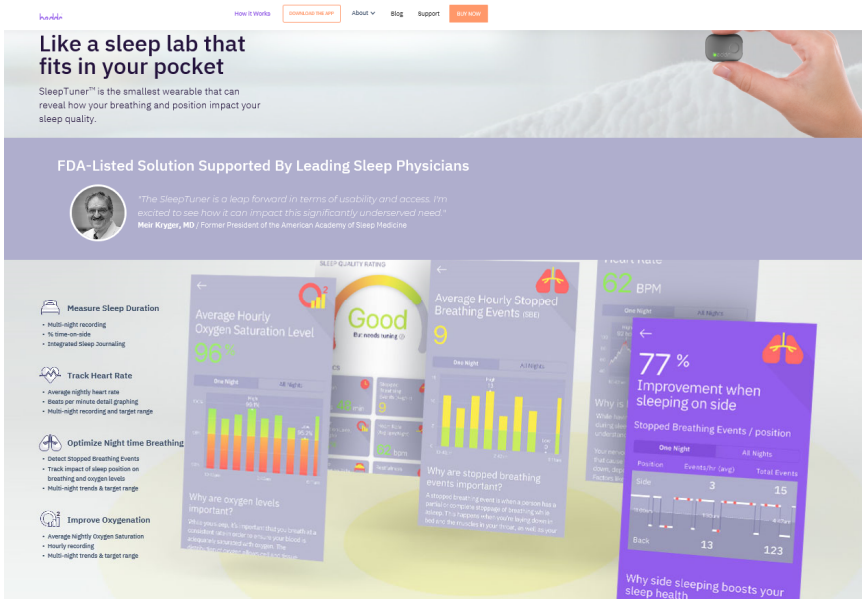
Ishida R, Yonezawa Y, Maki H, et al.: A wearable, mobile phone-based respiration monitoring system for sleep apnea syndrome detection. Biomed Sci Instrum. 2005; 41: 289–93.

Ex: Smartphone applications to track sleep without external sensors



Penzel T, Schöbel C and Fietze I. New technology to assess sleep apnea: wearables, smartphones, and accessories [version 1]. F1000Research 2018, 7:413.

F1000Research



Day or night, in the gym or while you sleep, the wearable watch style **BodiMetrics™ O_2 Vibe™** Sleep & Fitness Monitor helps you keep track of oxygen (SpO_2) levels, pulse rate and motion, during sleep and counts steps during exercise. If the **O_2 Vibe**'s built-in sensor detects a drop in oxygen levels while you sleep, an adjustable vibration function stimulates you to change positions. You can record up to 10 hours during sleep and 5 hours during activity, and download the data to your Android or iOS device.

Small, lightweight but packed with features

- Built-in sensor to track and analyze oxygen levels and sleep quality
- Vibrates when it detects a drop of oxygen saturation in the blood
- Two modes: sleep mode monitors SpO_2 levels, heart rate and motion during sleep; fitness mode monitors SpO_2 levels, heart rate and counts steps during light exercise.
- Customizable settings, alerts and vibration level.
- Pairs with device via available free app and Bluetooth
- Includes one soft thumb ring sensor and USB charging cable
- Rechargeable via USB and included cable
- So light you'll hardly notice it – just 1.6 oz.

The **BodiMetrics O_2 Vibe** fits on your wrist and has a thumb sensor to track heart rate and motion, and detect drops in oxygen levels. In sleep mode, the monitor vibrates when your oxygen level drops to stimulate you to change position, which can be helpful for people who snore. The quiet, adjustable vibration setting gently wakes you when your SpO_2 falls below the threshold you set, without disturbing your partner.

In the morning, you can see when and how often your blood oxygen levels dropped. With our **FREE mobile app**, you can preserve data and trends, see full color graphs and reports on your nightly oxygen levels, heart rate, and motion, including averages, lowest levels, duration, and overall score. You can share these with your health care provider via a secure cloud service.

*See the link below to download the complete **Quick Start Guide***

JCSM
Journal of Clinical Sleep Medicine

SPECIAL ARTICLES

Clinical Use of a Home Sleep Apnea Test: An Updated American Academy of Sleep Medicine Position Statement

Ilene M. Rosen, MD, MS[1]; Douglas B. Kirsch, MD[2]; Kelly A. Carden, MD[3]; Raman K. Malhotra, MD[4]; Kannan Ramar, MD[5]; R. Nisha Aurora, MD[6]; David A. Kristo, MD[7]; Jennifer L. Martin, PhD[8,9]; Eric J. Olson, MD[5]; Carol L. Rosen, MD[10]; James A. Rowley, MD[11]; Anita V. Shelgikar, MD, MHPE[12]; American Academy of Sleep Medicine Board of Directors

[1]Division of Sleep Medicine, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania; [2]Carolinas Healthcare Medical Group Sleep Services, Charlotte, North Carolina; [3]Saint Thomas Medical Partners - Sleep Specialists, Nashville, Tennessee; [4]Washington University Sleep Center, St. Louis, Missouri; [5]Division of Pulmonary and Critical Care Medicine, Center for Sleep Medicine, Mayo Clinic, Rochester, Minnesota; [6]Johns Hopkins University, School of Medicine, Baltimore, Maryland; [7]University of Pittsburgh, Pittsburgh, Pennsylvania; [8]Veteran Affairs Greater Los Angeles Healthcare System, North Hills, California; [9]David Geffen School of Medicine at the University of California, Los Angeles, California; [10]Department of Pediatrics, Case Western Reserve University, University Hospitals - Cleveland Medical Center, Cleveland, Ohio; [11]Wayne State University, Detroit, Michigan; [12]University of Michigan Sleep Disorders Center, University of Michigan, Ann Arbor, Michigan

The diagnosis and effective treatment of obstructive sleep apnea (OSA) in adults is an urgent health priority. It is the position of the American Academy of Sleep Medicine (AASM) that only a medical provider can diagnose medical conditions such as OSA and primary snoring. Throughout this statement, the term "medical provider" refers to a licensed physician and any other health care professional who is licensed to practice medicine in accordance with state licensing laws and regulations. A home sleep apnea test (HSAT) is an alternative to polysomnography for the diagnosis of OSA in uncomplicated adults presenting with signs and symptoms that indicate an increased risk of moderate to severe OSA. It is also the position of the AASM that: the need for, and appropriateness of, an HSAT must be based on the patient's medical history and a face-to-face examination by a medical provider, either in person or via telemedicine; an HSAT is a medical assessment that must be ordered by a medical provider to diagnose OSA or evaluate treatment efficacy; an HSAT should not be used for general screening of asymptomatic populations; diagnosis, assessment of treatment efficacy, and treatment decisions must not be based solely on automatically scored HSAT data, which could lead to sub-optimal care that jeopardizes patient health and safety; and the raw data from the HSAT device must be reviewed and interpreted by a physician who is either board-certified in sleep medicine or overseen by a board-certified sleep medicine physician.

Keywords: home sleep apnea test, HSAT, obstructive sleep apnea, OSA
Citation: Rosen IM, Kirsch DB, Carden KA, Malhotra RK, Ramar K, Aurora RN, Kristo DA, Martin JL, Olson EJ, Rosen CL, Rowley JA, Shelgikar AV; American Academy of Sleep Medicine Board of Directors. Clinical use of a home sleep apnea test: an updated American Academy of Sleep Medicine position statement. *J Clin Sleep Med.* 2018;14(12):2075–2077.

Maintains:

- Only a license practitioner can diagnose a medical condition
- HSTs should not be used for screening the asymptomatic
- Diagnosis should not be made solely on automatically scored HST; raw data must be reviewed by BC sleep MD

Rosen IM, Kirsch DB, Carden KA, Malhotra RK, Ramar K, Aurora RN, Kristo DA, Martin JL, Olson EJ, Rosen CL, Rowley JA, Shelgikar AV; American Academy of Sleep Medicine Board of Directors. Clinical use of a home sleep apnea test: an updated American Academy of Sleep Medicine position statement. J Clin Sleep Med. 2018;14(12):2075–2077.

Integrating new tools into a Patient-Centered Approach

Pepin et al. Does remote monitoring change OSA management and CPAP adherence? Respirology. 2017 Nov;22(8):1508-1517. doi: 10.1111/resp.13183.

Summary

"It is ironic that the least complex and most healthy individuals get the maximum oversight – CPAP compliance is vigorously tracked in OSA patients, with a pathologically obsessive fixation on four hours of use per night regardless of severity, comorbid illnesses, or native sleep times, and the device "taken away" if adequate use is not demonstrable. Biological and clinical efficacies are nearly irrelevant. Patients in respiratory failure can obtain a bilevel ventilator with no polysomnographic data or long-term tracking requirements... In this day and age, our management should be data driven – clinical and device, of the highest quality and resolution, and dynamically tracked (over time). Blind assumptions of device efficacy raise the likelihood of harm. Once we try to manipulate respiratory drive and rhythm, adaptive and maladaptive outcomes are possible and readily recognizable, if the raw data are reviewed and analyzed."

Thomas R., Positive pressure therapy induced harm - non-linear, adaptive and maladaptive responsesSleep Medicine 16 (2015) 1582–1583

Thank you!