

In-Hospital Sleep Program: Challenges and Success Stories

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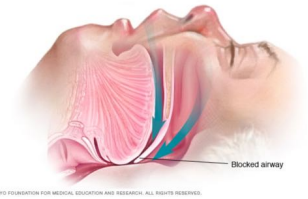
October 18, 2019



Disclosures

- I have no disclosures

Outline



- Why consider sleep testing among inpatients?
- Inpatient populations at high risk for OSA
- Benefits of PAP initiation in inpatients
- Testing options for OSA in inpatients

Why consider sleep testing for inpatients?

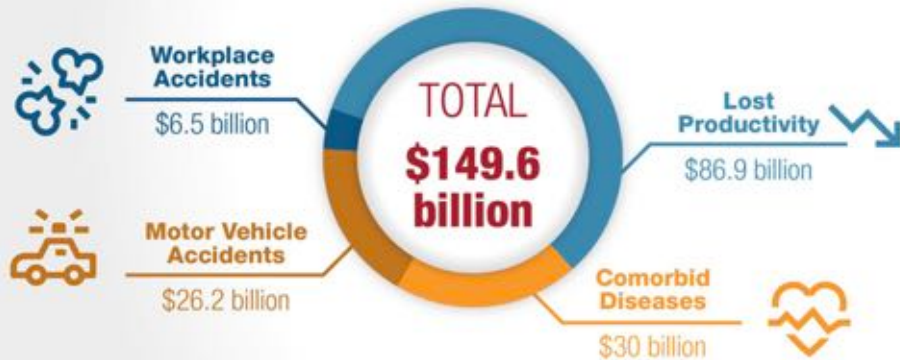
- OSA is underdiagnosed overall and probably especially prevalent in the multi-morbid inpatient population
- OSA in hospitalized patients has been associated with adverse outcomes
- OSA patients use more physician services and are admitted to hospitals at higher rates compared with individuals without OSA



Goring K & Collop N. *J Clin Sleep Med* 2008 ;4(2):105-110.
 Sharma et al. *Am J Med.* 2017; 130:1184.
 Tarasiuk A, *Curr Opin Pulm Med.* 2013;19(6):639-44.

Undiagnosed Sleep Apnea: *A Hidden Health Crisis*

In the U.S. the estimated economic cost of undiagnosed obstructive sleep apnea was nearly \$150 billion in 2015.

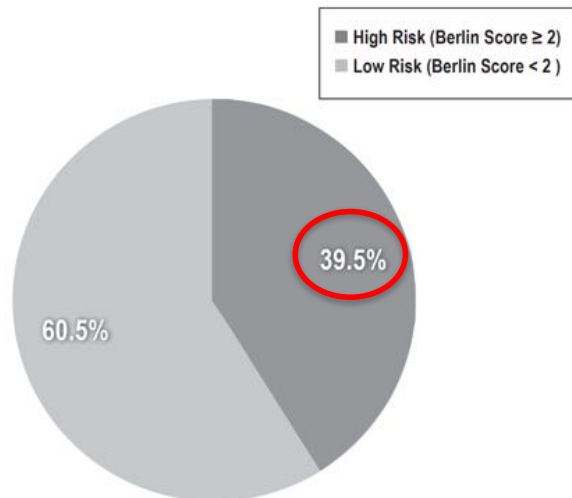


Source: American Academy of Sleep Medicine, 2018 | www.sleepeducation.org



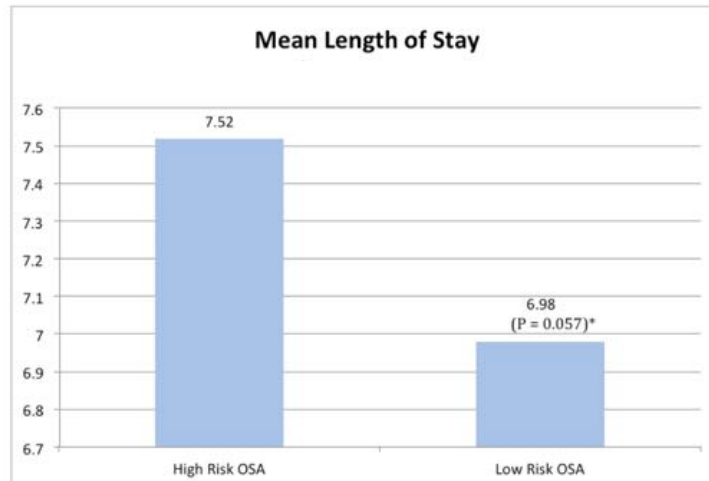
OSA is highly prevalent in hospitalized patients

Figure 2—Percentage of hospitalized patients screened at high risk for obstructive sleep apnea (total n = 424).



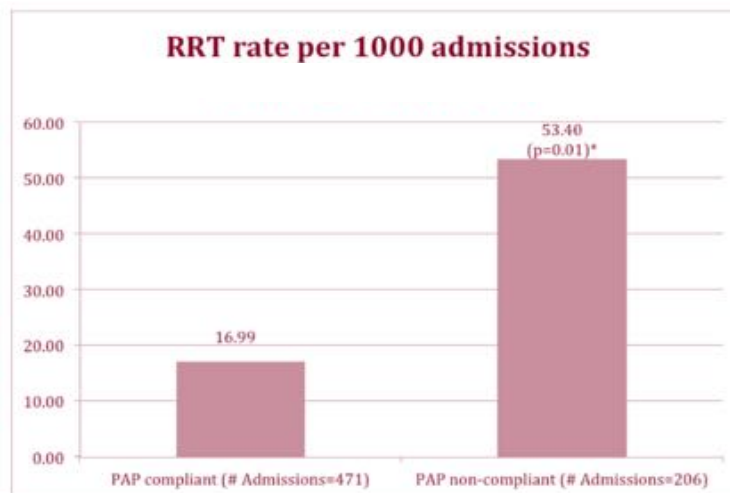
Shear et al. *JCSM*. 2014; 10(10): 1061.

Pts at high risk for OSA have longer length of stay



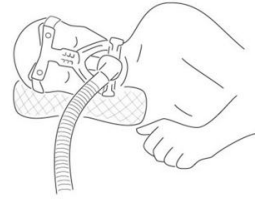
Sharma S et al. 2016. *PLoS One*; 11(5):e0153790.

PAP noncompliance is associated with higher rapid response rates



Sharma S et al. 2016. *PLoS One*; 11(5):e0153790.

OSA nonadherence is associated with higher 30-day hospital readmission rate



- Retrospective study of VA pts
- 30-day all-cause readmission rates higher in those nonadherent with CPAP, aOR=3.5
- 30-day cardiovascular-cause readmission rate also significantly higher in the nonadherent group, aOR=2.31

Truong KK et al. [J Clin Sleep Med](#). 2018 Feb 15;14(2):183-189.

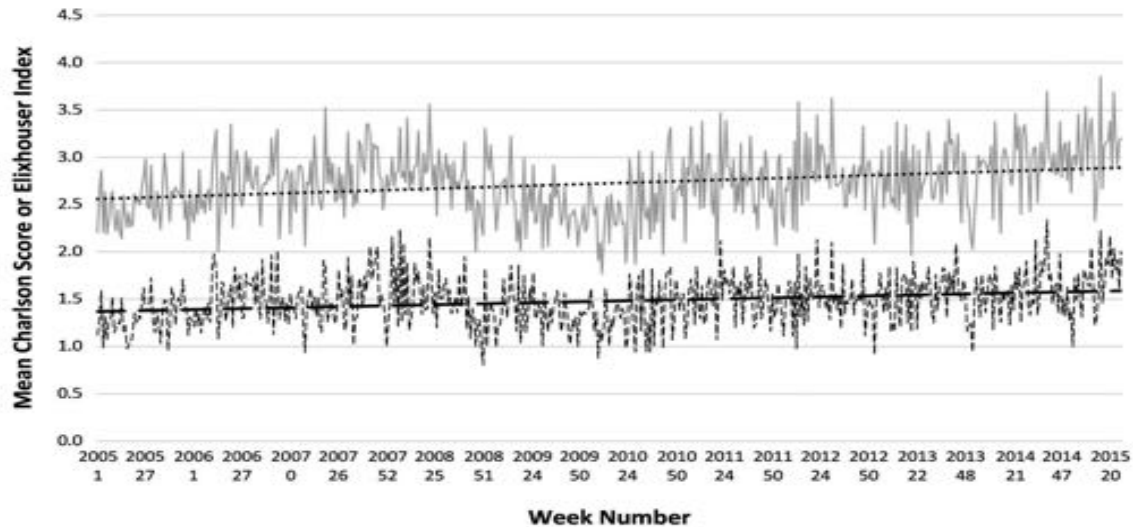
To (inpatient) test or not to test?

Pros

- Expedite Dx & Tx
- Convenience – a captive audience
- Access to hospital resources for complex patients (eg. Hoyer lifts, nursing)

Cons

Patients undergoing laboratory PSG are increasingly medically complex



Colaco B. *J Clin Sleep Med.* 2018;14(4):631–639.

To (inpatient) test or not to test?

Pros

- Early recognition, expedited Tx
- Convenience – a captive audience
- Access to hospital resources for complex patients (eg. Hoyer lifts, nursing)
- Opportunity for inpatient education
- Reduce loss to follow-up

Cons

- “Another test, doc?!?”
- Disturbed sleep is common (potential for inconclusive results)
- Many pts to require repeat testing after clinical condition stabilizes
- Not reimbursable (but potential for capturing future outpt charges)

Whom should we test?

Screening for OSA



- Standard screening questionnaires (eg. Berlin, STOP-Bang) have not been validated in inpatients
- Consider screening populations with high OSA prevalence:
 - Post-stroke
 - Cardiac patients (heart failure, afib)
 - Perioperative

Post-Stroke Patients



- OSA an independent risk factor for ischemic and hemorrhagic stroke
- High prevalence of OSA after CVA/TIA
 - AHI > 5 in 72%; AHI > 20 in 38%
- Obstructive > central sleep apnea
- Presence of OSA predicts poor functional outcome, longer hospitalization/rehab stay, higher mortality and increases risk for recurrent stroke

Yaggi HK. *NEJM* 2005; 10;353(19):2034.
Johnson et al. *J Clin Sleep Med* 2010; 6(2): 131.

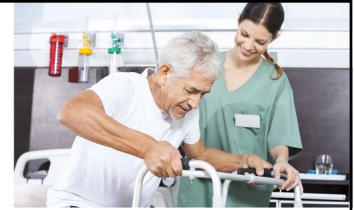
Management of OSA after Stroke



- All patients with TIA and stroke should be assessed for possible sleep apnea*
- Mixed evidence re: whether PAP improves stroke severity scores, but starting earlier may be better
- Acute stroke patients tend to have more trouble using CPAP if they have dementia, delirium, aphasia, or severe motor impairment

• American Heart Association and American Stroke Association recommendations
Bravata et al., *Sleep*. 2011; 34(9):1271.
McEvoy et al. *NEJM*. 2016;375(10):919.

CPAP may improve functional outcomes after stroke rehab



- Active vs. sham CPAP x 18 months post-stroke
- Average usage 3.7 hrs/night (50% adherent by CMS)
- Change in Functional Independence Measure (disability) *avored CPAP* but not statistically significant

·Change in Functional Independence Measure (FIM) during study.

On-treatment FIM change	Active CPAP (n = 13)	Sham CPAP (n = 17)	p value
Total	32 (21–40)	26 (20–32)	0.11
Cognitive	6 (3–6)	2 (2–5)	0.06
Motor	29 (18–32)	23 (20–26)	0.17

Khot et al. *JCSM* 2016; 12(7): 1019.

Sleep Apnea & Heart Failure



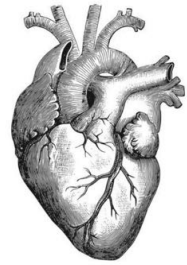
- HF the most common cause of hospital admissions and readmissions in the US
- ~75% of pts admitted for acute decompensated heart failure have SDB (central and obstructive)
- Pts diagnosed with OSA during an admission for CHF had higher rates of readmission and mortality at 14 mos (hazard ratio 2.9)

Padeletti et al. *Sleep Med.* 2009; 10(3):353.
Ohmura et al. *Am J Cardiol.* 2014; 113(4): 697.

NEW RESEARCH

JCSM
Journal of Clinical
Sleep Medicine

pii: jc-00265-13
http://dx.doi.org/10.5664/jcsm.4096

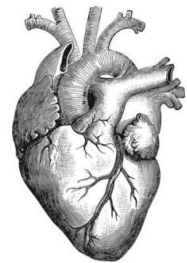


Diagnosis and Treatment of Sleep Disordered Breathing in Hospitalized Cardiac Patients: A Reduction in 30-Day Hospital Readmission Rates

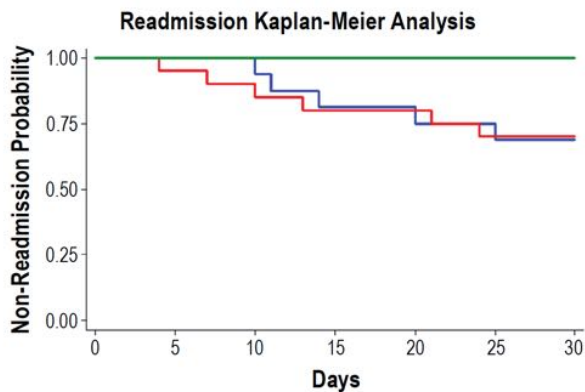
Shilpa R. Kautz, M.D.¹; Brendan T. Keenan, M.S.¹; Lee Goldberg, M.D.²; Richard J. Schwab, M.D.¹
¹Center for Sleep and Circadian Neurobiology, University of Pennsylvania, Philadelphia, PA;
²Department of Cardiology, University of Pennsylvania, Philadelphia, PA

- >100 cardiac inpatients admitted with heart failure, arrhythmias, MI and reporting OSA Sx
- Inpatient sleep testing → 80% had sleep apnea

Sleep Apnea Dx/Tx may reduce heart failure readmissions



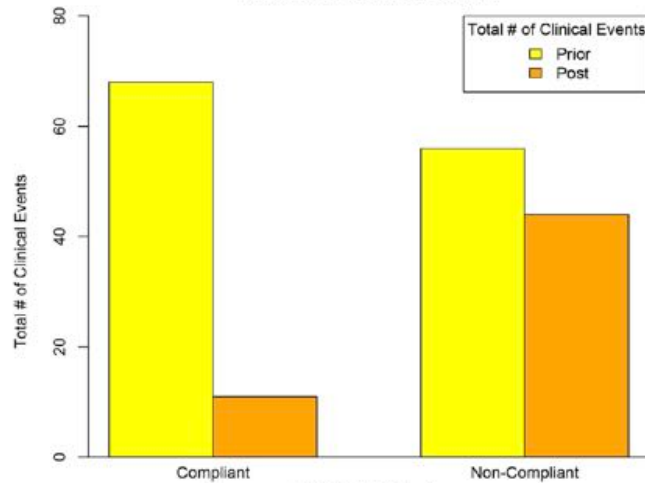
— Non-Users — Partial Users — Full Users



- None of the patients with regular PAP usage had ED visits or readmissions within 30 days of discharge
- Readmission rates 30% in pts with non-use/partial-use (p = 0.025)

Kautz SR et al. 2014. *J Clin Sleep Med*; 10(10):1051.

Heart failure readmissions are lower at 6-months in PAP-adherent pts



- 70 patients diagnosed with SDB after discharge, 53% compliant with PAP
- Compliant pts had a significant reduction in readmissions over 6 months ($p < 0.0001$)

Sharma S et al. 2016. *Am J Cardiol*; 117(6):940.

OSA & Afib



- Most studies show a strong association between afib and OSA, independent of shared risk factors
- Growing data suggest OSA is a risk factor for recurrent afib after cardioversion or ablation
- Treatment of OSA may reduce the risk of recurrent afib

Mehra R. *Chest*. 2018 Nov;154(5):1008-1010
 Ng et al. *Am J Cardiol* 2011; 108(1):47.
 Fein et al. *J Am Coll Cardiol* 2013;62(4):300.

OSA & Surgery



- OSA pts are often undiagnosed at time of surgery
- Many studies show worse perioperative outcomes in pts with OSA
 - pulmonary complications, oxygen desaturation events, difficult intubation, cardiac complications, ICU transfer
- Professional society guidelines recommend incorporating an OSA screening tool in the preoperative assessment of patients preparing for any surgery

Chung F et al. *Anesth Analg.* 2016 Aug;123(2):452-73.

Some studies show CPAP use for OSA pts is associated with ↓ post-op pulmonary complications +/- LOS

Recent meta-analysis failed to show a difference in post-op adverse events, but possibly underpowered

TABLE 1 | Effect of CPAP on Postoperative Outcomes in Surgical Patients With OSA

Author	Study Type	No.	Result
Rennotte et al, 1995 ²⁰	Case series report	16	No-CPAP vs CPAP; 2 vs 14 First patient died; second patient: serious postop Cx 14 patients nasal CPAP Rx, no Cx
Gupta et al, 2001 ⁴³	Retrospective case-control study	101	No-CPAP vs CPAP group: 68 vs 33 Any Cx: 44% vs 27% (P = .1) Serious Cx: 31% vs 9% (P = .02) Total ICU stay: 32.3% vs 3% (P = .001) Unplanned ICU stay: 27.9% vs 3% (P = .003) Hospital stay: 7 ± 3 vs 6 ± 2 days (P = .03)
Jensen et al, 2008 ⁵³	Prospective cohort study	284	No-CPAP/BIPAP vs CPAP/BIPAP: 140 vs 144 Pneumonia: 2.1% vs 0.7% (NS) Hospital stay: 2.2 vs 2.7 days (P = .244)
Liao et al, 2009 ⁵²	Retrospective matched-cohort study	480	OSA vs non-OSA: 240 vs 240 Postop Cx: 44% vs 28% (P < .05) SpO ₂ < 90%: 17% vs 8% No-CPAP vs CPAP: 90 vs 150 Postop Cx: 46.6% vs 40.6% (P = .36)
Liao et al, 2013 ⁵⁴	RCT	177	No-APAP vs APAP: 90 vs 87 Postoperative Cx: 48.3% vs 48.3% (P = .939) Preoperative AHI vs postoperative AHI (NS) APAP: 30.1 to 3.0 (P < .001) No-APAP: 30.4 to 31.9 (P = .302) Hospital stay: 4.3 ± 5.5 vs 3.5 ± 6.2 days (P = .36)
O'Gorman et al, 2013 ⁵⁵	RCT	138	No-APAP vs APAP Any Cx: 20.9% vs 23.3% (P = 1.0) No significant difference between LOS (P = .65)
Mutter et al, 2014 ⁵⁰	Matched-cohort study	20,488	Respiratory Cx Overall: 2.08, 95% CI, 1.35-2.19, P = .0008 Diagnosed OSA vs undiagnosed OSA OR, 0.68; 95% CI, 0.27-1.71; P = .41 Cardiovascular Cx Undiagnosed OSA vs matched cohort control OR, 2.20; 95% CI, 1.16-4.17; P = .02 Diagnosed OSA vs matched cohort control OR, 0.75; 95% CI, 0.43-1.28; P = .29 Diagnosed OSA vs undiagnosed OSA OR, 0.34; 95% CI, 0.15-0.77; P = .009
Abdelsattar et al, 2015 ⁵¹	Prospective cohort study	2646	Untreated OSA vs treated OSA: 1,465 vs 1,181 Cardiopulmonary Cx 6.7% vs 4.0%; aOR, 1.8; P = .001 Unplanned reintubations aOR, 2.5; P = .003 Myocardial infarction aOR, 2.6; P = .031
Proczo et al, 2014 ⁴⁶	Retrospective cohort	693	Diagnosed OSA and Rx with CPAP vs STOP-Bang ≥ 3 99 vs 182 Hypertension 11.1% vs 11.5% (P = .9142) Death: 0% vs 1% (P = .5142) Hospital stay: 3.2 vs 4.1 days (P < .0001) Pneumonia: 2% vs 9.3% (P < .04) Reintubation: 0% vs 3.8% (P = .1442) ICU admission: 0% vs 1% (P = .5142)

Nagappa M et al.. *Anesth Analg* 2015, 120 (5):101

Options for OSA Testing in Inpatients

Testing for OSA in inpatients

- Portable/“home”/ambulatory sleep apnea testing
- Overnight oximetry
- Full diagnostic polysomnography
- Titration studies not practically feasible

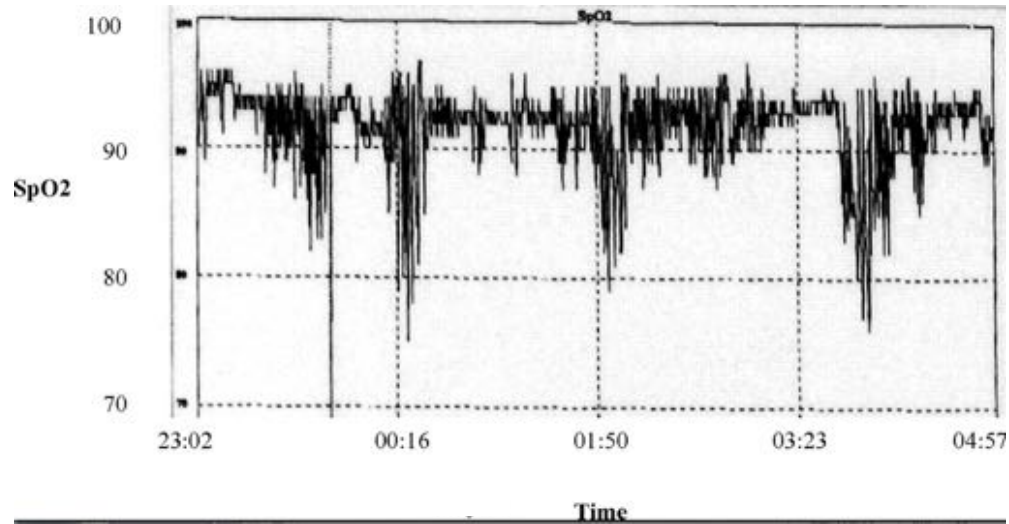
Portable sleep testing equipment



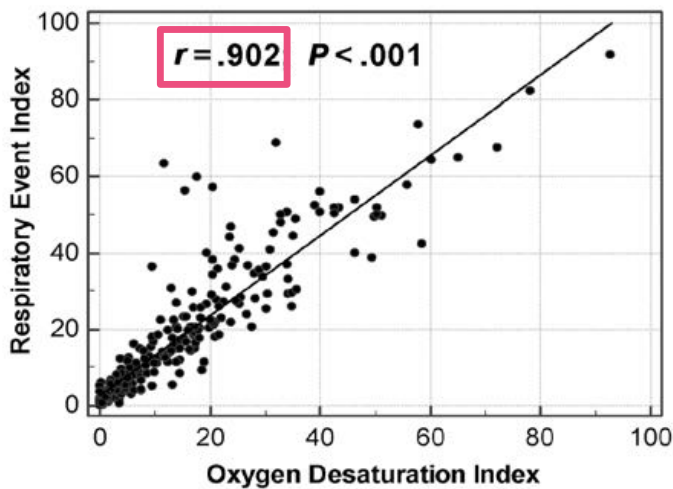
Many inpatients are not traditional candidates for portable monitoring

- Severe cardiorespiratory disease
- Potential respiratory muscle weakness (eg. neuromuscular disease)
- Awake hypoventilation or suspected sleep-related hypoventilation
- Chronic opioid use

Sawtooth pattern on pulse oximetry in OSA



Oximetry may accurately identify post-stroke patients with OSA



ODI \geq 5 events/h rules in the presence of SDB (specificity 91.7%, PPV 96.3%)

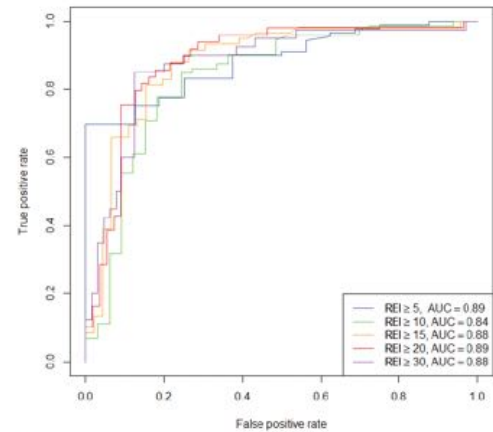
ODI $<$ 5 events/h rules out moderate to severe SDB (sensitivity 100%, NPV 100%)

Lin SH J Clin Sleep Med. 2018;14(12):2065–2073.

High-resolution pulse oximetry as a testing option

- Prospective trial of 125 pts admitted with CHF
- Underwent simultaneous portable monitoring and high-resolution pulse oximetry → good agreement
- HRPO a simple and perhaps cost-effective screening tool for OSA

Figure 1—ROC curves for diagnosing SDB using ODI measured by HRPO (true diagnosis of SDB is defined by 5 REI thresholds [≥ 5 , ≥ 10 , ≥ 15 , ≥ 20 , ≥ 30 events/h]).



Sharma et al. *J Clin Sleep Med*. 2017; 13(10):1185.
Yaddanapudi SS, *J Stroke Cerebrovasc Dis*. 2018 Nov;27(11):2986-2992.

Practical Considerations for Inpatient Sleep Testing

- Development of institutional protocols & procedures
 - Patient selection
 - Who can order the studies
 - Equipment type
 - Study location
- Training of specialized RTs
- Handling inevitable interruptions



Practical Considerations for Inpatient Sleep Testing, cont.

- Study interpretation / timing
- DME communication
- Transition to outpatient sleep clinic
- Get the word out



Building your case for Inpatient Sleep Testing

- Consider hospital perspectives & incentives
- Potential to reduce financial penalties for early readmissions

CMS includes the following six condition/procedure-specific 30-day risk-standardized unplanned readmission measures in the program:

- Acute Myocardial Infarction (AMI)
- Chronic Obstructive Pulmonary Disease (COPD)
- Heart Failure (HF)
- Pneumonia
- Coronary Artery Bypass Graft (CABG) Surgery
- Elective Primary Total Hip Arthroplasty and/or Total Knee Arthroplasty (THA/TKA)

- Illustrate “big picture” plan inclusive of outpatient follow-up

Hospitalization: an educational opportunity for CPAP use?



Summary

- OSA is common and likely under-diagnosed among hospitalized patients
- Consider inpatient testing in high-risk populations
 - Post-stroke
 - Cardiac patients
 - Peri-operative
- Nocturnal oximetry or portable monitoring likely the most practical testing options for most institutions

Thank you!



Questions?

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