V I R G I N I A  C O M M O N W E A L T H  U N I V E R S I T Y

# Comparative Outcomes of Hypoglossal Nerve Stimulation versus CPAP Therapy in Obstructive Sleep Apnea: A TriNetX Cohort Study

***Aaron Tucker, BA[1,2]**; Iman Adibi, BS[1]; Amala Nayak, BS[1] Alyssa Calder, MD[2]; Arman Saeedi, MD[2]; Ryan Nord, MD[2]

[1]Virginia Commonwealth University School of Medicine, Richmond, VA; [2]Department of Otolaryngology - Head and Neck Surgery, Virginia Commonwealth University, Richmond, VA; * **Presenter**

## Objective

- Obstructive sleep apnea (OSA) is linked to cardiovascular disease, renal dysfunction, pulmonary complications, neurocognitive impairment, and higher healthcare utilization.
- Continuous positive airway pressure (CPAP) is first-line therapy, but long-term adherence is poor (often <50%).
- Hypoglossal nerve stimulation (HNS) is a surgical alternative that activates upper airway dilator muscles in synchrony with respiration.
- Comparative data between HNS and CPAP are limited, especially for systemic outcomes.
- **Study Aim:** To compare cardiovascular, renal, pulmonary, neuropsychiatric, and healthcare utilization outcomes in OSA patients treated with HNS versus CPAP, with secondary analysis comparing HNS to uvulopalatopharyngoplasty (UPPP).

**Objectives**

- Determine whether HNS reduces cardiovascular, renal, and pulmonary complications compared with CPAP.
- Compare healthcare utilization (ED visits, hospitalizations) between HNS and CPAP patients.
- Explore selection bias by comparing outcomes between HNS and UPPP patients.

## Methods

- **Design:** Retrospective cohort study using TriNetX Research Network (>150M de-identified EHRs across 100+ U.S. health systems).
- **Cohorts:** HNS (n=2,292) vs CPAP (n=2,292).
  HNS (n=1,245) vs UPPP (n= 1,245) (secondary analysis).
- **Inclusion:** Adults with OSA diagnosis, 2 years follow-up.
- **Matching:** 1:1 propensity score matching (PSM) on demographics, BMI, smoking, comorbidities (HTN, diabetes, CAD, CKD, sinusitis). Balance confirmed with standardized mean difference (SMD <0.1).
- **Outcomes (30 days–2 years post-initiation):** Stroke, MI, atrial fibrillation/flutter, heart failure, PE, pneumonia, COPD exacerbation, AKI, daytime sleepiness, ED visits, hospitalizations.
- **Analysis:** Odds ratios (OR) with 95% CI, using logistic regression within TriNetX.

Aaron Tucker, B.A.
VCU Department of Otolaryngology – Head & Neck Surgery
1200 East Broad Street, West Hospital, Richmond, VA, 23298

## Figures/Tables

Figure 1: Flow diagram outlining inclusion, exclusion, and 1:1 propensity score matching of OSA patients receiving HNS versus CPAP therapy based on demographics, comorbidities, and outpatient visit frequency.

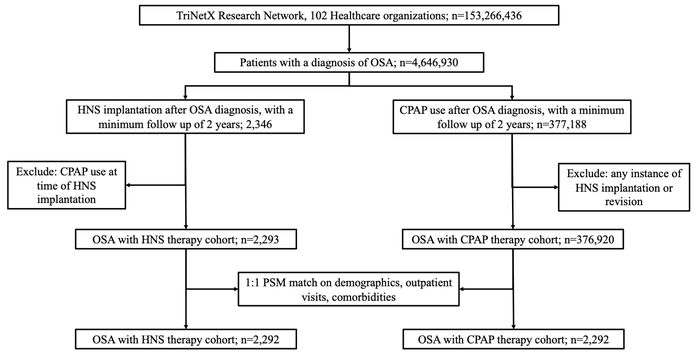
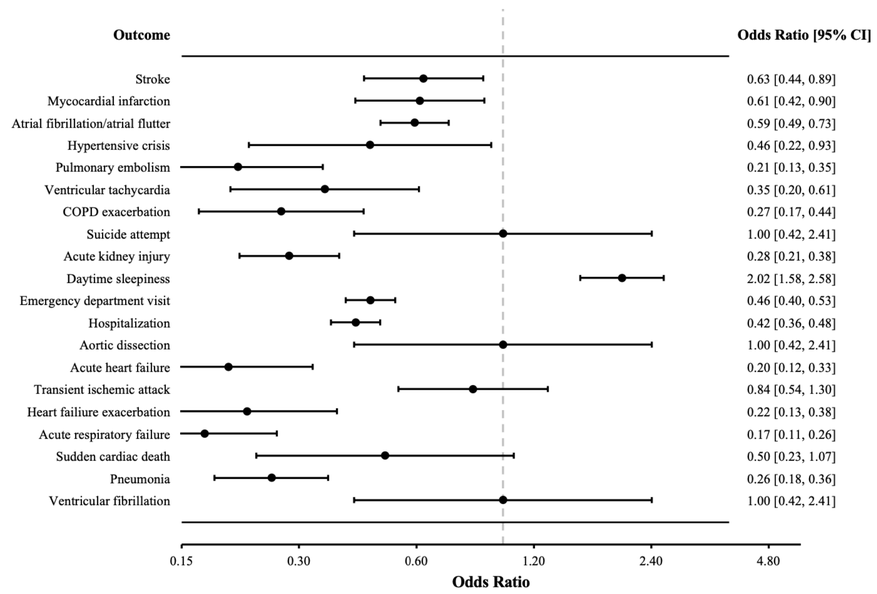



Figure 2: Two-year odds ratios of adverse outcomes in OSA patients treated with HNS versus CPAP. Values below 1.0 indicate reduced risk with HNS therapy (n = 2,292).




## Results

**Cohort characteristics:** After matching, both groups had similar demographics and comorbidities (n=2,292 per arm). Mean age ≈ 62 years, 65% male.

**Cardiovascular outcomes (HNS vs CPAP):**
Stroke (2.3% vs 3.6%, OR 0.63, p=0.0085)
MI (1.9% vs 3.1%, OR 0.61, p=0.0108)
Atrial fibrillation/flutter (7.4% vs 11.8%, OR 0.59, p<0.0001)
Hypertensive crisis (0.5% vs 1.0%, OR 0.46, p=0.0274)

**Pulmonary outcomes:**
COPD exacerbation (0.9% vs 3.3%, OR 0.27, p<0.0001)
Acute respiratory failure (1.1% vs 6.2%, OR 0.17, p<0.0001)

**Renal outcomes:**
AKI (2.6% vs 8.7%, OR 0.28, p<0.0001)

**Healthcare utilization:**
ED visits (15.0% vs 27.9%, OR 0.46, p<0.0001)
Hospitalizations (15.2% vs 30.0%, OR 0.42, p<0.0001)

**Adverse finding:**
Daytime sleepiness was more common in HNS (8.6% vs 4.5%, OR 2.02, p<0.0001).

**HNS vs UPPP (matched, n=1245 each):** Comparable outcomes overall, though HNS had lower ED visits (10.9% vs 15.3%, OR 0.68, p=0.001) and lower AKI (1.0% vs 2.0%, OR 0.52, p=0.0498).

## Conclusion

HNS was associated with **lower cardiovascular, respiratory, renal, and healthcare utilization outcomes** compared to CPAP over 2 years.
**Exception:** Daytime sleepiness was more frequently documented in HNS patients.
**Differences may reflect better adherence with HNS**, but also possible selection bias (healthier, higher SES surgical cohort).
Secondary analysis showed **HNS and UPPP had similar systemic outcomes**, though HNS patients had fewer ED visits and AKI events.
**Future directions:** Prospective trials including adherence data, sleep severity metrics, and cost-effectiveness analyses are needed.

## References

1. Hillman DR. Treatment options for obstructive sleep apnea: general and perioperative. *Int Anesthesiol Clin*. 2022;60(2):74-82. doi:10.1097/AIA.0000000000000354
2. CPAP for Prevention of Cardiovascular Events in Obstructive Sleep Apnea | New England Journal of Medicine. Accessed May 11, 2025. https://www.nejm.org/doi/full/10.1056/NEJMoa1606599?utm_source=openevidence
3. Mashaqi S, Patel SI, Combs D, et al. The Hypoglossal Nerve Stimulation as a Novel Therapy for Treating Obstructive Sleep Apnea-A Literature Review. *Int J Environ Res Public Health*. 2021;18(4):1642. doi:10.3390/ijerph18041642
4. The outcomes of hypoglossal nerve stimulation in the management of OSA: A systematic review and meta-analysis | World Journal of Otorhinolaryngology- Head and Neck Surgery. Accessed May 11, 2025. https://mednexus.org/doi/full/10.1016/j.wjorl.2018.04.006
5. Stuck BA, Ravesloot MJL, Eschenhagen T, de Vet HCW, Sommer JU. Uvulopalatopharyngoplasty with or without tonsillectomy in the treatment of adult obstructive sleep apnea – A systematic review. *Sleep Med*. 2018;50:152-165. doi:10.1016/j.sleep.2018.05.004
6. Shah J, Russell JO, Waters T, Kominsky AH, Trask D. Uvulopalatopharyngoplasty vs CN XII stimulation for treatment of obstructive sleep apnea: A single institution experience. *Am J Otolaryngol*. 2018;39(3):266-270. doi:10.1016/j.amjoto.2018.03.003