nox MEDICAL

Seeing What Was Missed

How DeepResp™ Supported the Identification of Obstructive Sleep Apnea in a Woman with an Inconclusive/False Negative Initial Diagnosis

LBL-0670 REV01

Executive summary

Obstructive sleep apnea (OSA) remains profoundly underdiagnosed in women, despite its strong association with cardiovascular, metabolic, and neurocognitive disease. Women frequently present with atypical symptoms — fatigue, insomnia, mood disturbance, and headaches — rather than classic snoring and witnessed apneas. As a result, traditional home sleep testing and scoring methods that focus on desaturation-related events and do not score sleep stages / awakenings may produce inconclusive or false-negative results.

This case study highlights how DeepResp™ 2.1 AI (SaMD), leveraging RIP-based technology by Nox Medical, supported the identification of clinically significant OSA in a female patient whose traditional home sleep apnea test (HSAT) without AI was interpreted as negative. AI-enabled scoring analysis changed the diagnostic outcome, clarified the patient's symptoms, and altered her clinical trajectory.

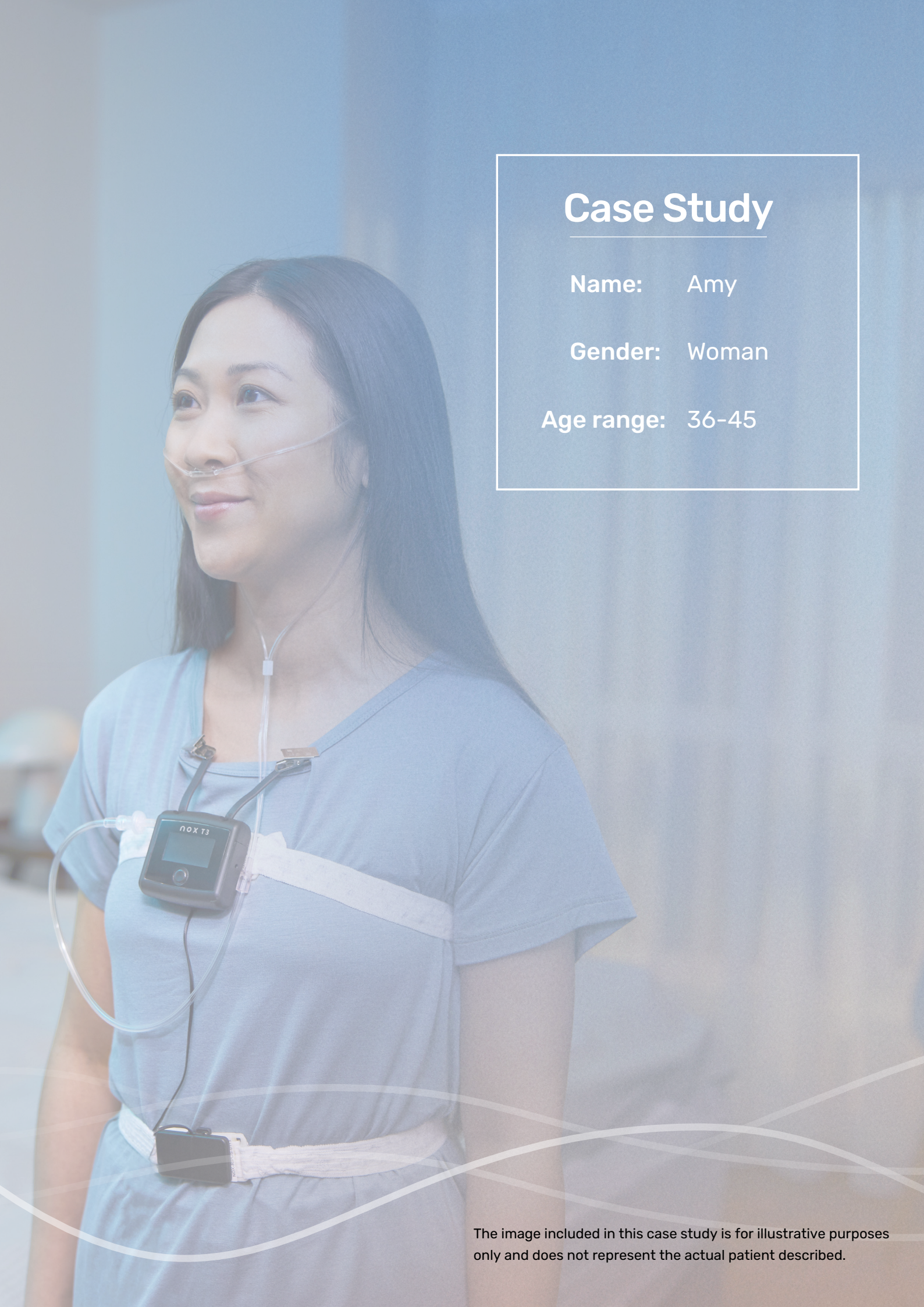
Key takeaways

Not all HSAT devices are appropriate for diagnosing obstructive sleep apnea in women. Many fail to detect the subtle respiratory and effort-related changes that characterize OSA in women. Nox RIP technology captures these signals through measurement of thoracoabdominal movement and breathing patterns. Adding AI-driven analysis and scoring of arousals and sleep stages helps resolve diagnostic ambiguity in women. This reduces missed or delayed OSA diagnoses — an issue with broad population-level implications.

Background: A systemic diagnostic gap

Nearly 1 in 5 women have OSA, yet up to 90% remain undiagnosed[1,2]. Women often lack classic symptoms, even with moderate to severe disease. As many as 40% of women with moderate to severe OSA do not present with typical symptoms[3,4]. Other physiologic contributors include hormonal changes (perimenopause, menopause), loss of progesterone-mediated airway protection, REM-predominant OSA and flow-limitation-dominant patterns, and increased arousals rather than frank apneas.

> *"There is this perception of what sleep apnea should look like; that is something we are trying to change. This is critical because untreated sleep apnea has so many links to chronic medical conditions, such as heart disease, heart failure, stroke, hypertension, diabetes, and obesity."* — *Heidi Doss Riney, MD, Chief Medical Officer, Nox Health.*



Case Study

Name: Amy

Gender: Woman

Age range: 36-45

The image included in this case study is for illustrative purposes only and does not represent the actual patient described.

Case study: “Amy”, woman, age 36-45

“Amy”, a 36-45-year-old woman with moderate obesity (BMI 35 to 39.9) living in the northeastern United States, was struggling with insomnia and morning headaches that had been going on for more than a year*. While she reported some possible mild snoring, she did not report experiencing apneas, gasping, choking or awakenings. She also claimed that she did not experience excessive sleepiness or cognitive complaints, such as brain fog, or mood symptoms.

As part of her background, Amy indicated that she continued to use caffeine but no longer smoked (but did ten years ago) or used alcohol. Her family history was positive for sleep apnea, diabetes, obesity, high blood pressure and hypertension, and her own medical history included previous iron deficiency and anemia. Her lifestyle included a typical bedtime of 10 to 11 pm until 7 am with one prolonged awakening in the night, estimating total sleep time at six hours. She works regular daytime hours with no varied shift work or differences between workdays and weekends.

After seeking help with her initial insomnia complaint in 2024, and testing negative for OSA with an AHI/REI below 5, Amy’s symptoms did not resolve. When tested for OSA again in 2025, thanks to the inclusion of Nox DeepResp AI technology as part of making the diagnosis, Amy’s underestimation was revealed. Her second test showed an AHI above 20, which placed her in the “moderate” OSA class.

Patient profile:	
Characteristic	**Details**
Gender	Female
BMI (Category)	36-45
Comorbidities	Iron deficiency/anemia; prior insomnia diagnosis
Family History	sleep apnea, diabetes, obesity, high blood pressure and hypertension
Smoking / Alcohol	No
Medications	Birth control pills

Symptom profile	
Symptom	Present
Insomnia	☑
Chronic fatigue / non-restorative sleep	☐
Morning headaches	☑
Cognitive complaints (“brain fog”)	☐
Mood disturbance	☐
Snoring	☑ (mild)
Witnessed apneas	☐
Symptom duration: At least a year, likely longer	
Prior diagnoses or explanations: Negative for apnea in original OSA HST	

Presenting symptoms and clinical intake

Chief complaint: Insomnia and morning headaches

Prior diagnostic journey	
Previous sleep testing:	☑ Yes ☐ No
Prior result:	☐ Normal ☐ Borderline ☑ Inconclusive
Time from symptom onset to diagnosis:	Original onset of symptoms: 2+ years. negative diagnosis in first sleep test; at least another year passed before referral to a second HST, which produced a moderate (AHI above 20) result.
Access barriers:	None known or reported

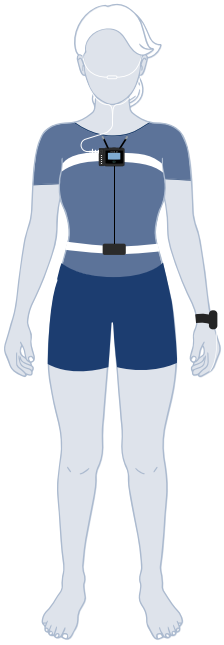
*Patient details have been de-identified and modified to protect privacy. Case information is based on internal data on file.
The patient participated in the SleepCharge® program, which is managed by Nox Health, the parent company of Nox Medical.

Diagnostic evaluation/discussion

Sleep study overview

Amy's first sleep study provided negative results, leaving Amy with continued symptoms.

The patient's home sleep test was conducted using the Nox T3s sleep recorder, primarily used to aid in the diagnosis of sleep-disordered breathing. Amy wore the Nox T3s device and dual (thoracoabdominal) RIP belts, a nose cannula, and a pulse oximeter fingertip sensor to collect key data points. These include breathing effort (Nox RIP belts), airflow (both belts and nose cannula), and oxygen levels (fingertip sensor). Body position and movement was also measured. Together these signals help create a clear picture of how breathing changes through the night.



Sleep study setup

Both the original sleep study and subsequent test were set up as follows:

Study type: Home sleep apnea test (HSAT) with Nox T3 device, Nox RIP belts, nose cannula, pulse oximeter

Setup: Device attached to chest with dual RIP belts; nasal cannula and wireless oximeter placed.

Data acquisition: The Nox T3s recorder captures and stores physiological signals

Recording duration: Set to record for at least four hours to be considered valid

Sleep study results and analysis

Traditional (non-AI) results

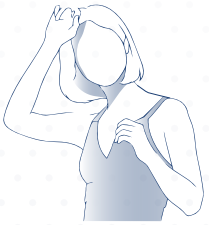
Result: Inconclusive

AHI / metric: Below 5

Key limitation: Subtle respiratory events and effort-related disturbances not captured or detected without DeepResp AI scoring DeepResp results

AI-assisted diagnosis*: Obstructive Sleep Apnea

Severity classification: Moderate (AHI > 20)



Symptoms: insomnia, mild snoring, headaches

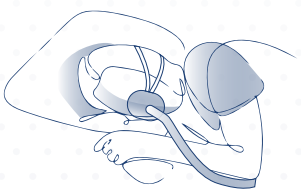
→ **REI<5**

Initial HSAT Results

1+ year: Symptoms persist

→ **AHI>20**

HSAT with DeepResp Results



Treatment referral: CBTi and PAP therapy

*Disclaimer: All diagnostic conclusions were made by a qualified medical professional following review of DeepResp™ outputs.

Side-by-side comparison:
Traditional vs. DeepResp

Metric	Traditional Analysis	DeepResp™ AI
Diagnostic outcome	Inconclusive	OSA identified
Severity		Moderate
Respiratory pattern detection	Limited	Enhanced
Clinical confidence	Low	High

> *"Women frequently have respiratory instability that does not meet classic scoring thresholds. RIP-based AI allows us to see what we were missing and apply the technology to address a population-level problem affecting millions of women."*
>
> *— Heidi Doss Riney, MD, Nox Health*

Clinical interpretation and impact

Home Sleep Apnea Testing (HSAT) using the Nox T3 leverages respiratory inductance plethysmography (RIP) to capture high-fidelity airflow and effort signals. Compared with alternative consumer-oriented or indirect technologies (e.g., peripheral arterial tonometry [PAT][5-7]), RIP-based HSAT provides a more direct, physiologic assessment of respiratory events and remains a superior diagnostic approach for obstructive sleep apnea (OSA) detection outside the lab[8].

Manual HSAT scoring, however, relies on conventional event definitions and manual or semi-automated review processes that may under-detect OSA in patients with atypical or subtle respiratory patterns — particularly women. In Amy's case, this led to a false negative diagnosis.

Including AI-assisted analysis with DeepResp identified sleep stages, arousals, and respiratory events that were not fully captured through traditional HSAT scoring, leading to a clinically meaningful change in diagnosis and management. Amy's case illustrates not a limitation of RIP-based HSAT technology, but rather the opportunity to further unlock its diagnostic potential through advanced analytics, especially relevant for populations that are historically underrepresented and missed, such as women, younger and non-obese patients. As a result of supporting AI technology, a missed or delayed diagnosis can be avoided and confident clinical decision-making enabled.

DeepResp by Nox Medical:

- DeepResp™ enhances HSAT by applying FDA-cleared CE AI models to high-quality RIP data.
- Analyzes respiratory effort, timing, and variability from RIP signals
- Performs AI-assisted sleep staging and arousal detection without EEG
- Improves detection of subtle respiratory events and flow-limited breathing
- Produces AHI values that more closely align with PSG outcomes
- Validated on 5,800+ studies
- Not a black box solution - allows clinical review and edit

By augmenting—not replacing—traditional HSAT scoring, DeepResp unlocks deeper clinical insight from already superior physiological data, helping clinicians diagnose OSA with greater accuracy and confidence.

Impact

Following clinician-confirmed diagnosis, Amy received patient education that included information on the medical risks of untreated OSA and the pathophysiology of OSA. She received advice on what to avoid if experiencing excessive daytime sleepiness as well as recommendations for sleep hygiene. Because she also experienced co-occurring insomnia, she was additionally given information about CBT-I as the established first-line treatment for chronic insomnia and received a referral to the Clinical Care Coordinator for more information about both digital CBT-I and PAP.

> *"Incomplete diagnoses affect treatment access, effectiveness, and outcomes. Women are disproportionately affected by this due to the likelihood for misdiagnosis. The increased risk for cardiovascular and metabolic health, mental health and cognitive effects, hormonal and reproductive health, daytime function and safety – and long-term overall health is real. Proper and timely diagnosis helps ensure appropriate and timely care."*
>
> *— Heidi Doss Riney, MD, Nox Health*

Conclusion

DeepResp™ AI supports clinicians in improving diagnostic confidence of sleep apnea in women when traditional methods fall short. This case reinforces the need to rethink diagnostic standards and incorporate validated AI-enabled tools for historically underrepresented populations in sleep medicine as key to advancing equitable sleep care.

References

1. Franklin KA, Lindberg E. Obstructive sleep apnea is a common disorder in the population. J Thorac Dis. 2015;7(8):1311–1322.
2. Society for Women's Health Research. Women & Sleep Apnea. Society for Women's Health Research; 2017. https://swhr.org/wp-content/uploads/2017/11/SWHR_Women-Sleep-Apnea.pdf. Accessed February 14, 2026. Society for Women's Health Research. Women & Sleep Apnea.
3. Wimms A et al. Obstructive sleep apnea in women: specific issues and interventions. Biomed Res Int. 2016.
4. Wimms AJ et al. Mild obstructive sleep apnoea in females: MERGE trial post hoc analysis. ERJ Open Research. 2024.
5. Iftikhar IH, Finch CE, Shah AS, Augunstein CA, Ioachimescu OC. A meta-analysis of diagnostic test performance of peripheral arterial tonometry studies. J Clin Sleep Med. 18(4):1093-1102. Doi:10.5664/ jcsm.9808
6. Ichikawa M, Akiyama T, Tsujimoto Y, Anan K, Yamakawa T, Terauchi Y. Diagnostic accuracy of home sleep apnea testing using peripheral arterial tonometry for sleep apnea: A systematic review and meta-analysis. J Sleep Res. 2022;31(6):e13682. Doi:10.1111/ jsr.13682
7. Riha RL, Celmina M, Cooper B, et al. Technical Standards for using Type III devices (limited channel studies) in the diagnosis of sleep disordered breathing in adults and children. Eur Respir J 2022; in press (https://doi.org/10.1183/13993003.00422-2022).
8. Finnsson E, Erlingsson E, Hlynsson HD, Valsdóttir V, Sigmarsdottir TB, Arnardóttir E, Sands SA, Jónsson SÆ, Islind AS, Ágústsson JS. Detecting arousals and sleep from respiratory inductance plethysmography. Sleep Breath. 2025 Apr 11;29(2):155. doi: 10.1007/s11325-025-03325-z. PMID: 40214714; PMCID: PMC11991959.