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Obstructive Sleep Apnea Phenotypes and the Personalized Impact of PAP Therapy on Healthcare Resource Use

Melike Deger[1], R Benjamin Dexter[2], Caleb Woodford[2], Naomi Alpert[3], Will McConnell[3], Kate V Cole[3]

[1]Resmed Science Center, Munich Germany, [2]Resmed Science Center, Halifax NS Canada, [3]Resmed Science Center, San Diego CA United States

INTRODUCTION

- Phenotyping enhances our understanding of disease heterogeneity and helps predict differential responses to therapies.
- Obstructive sleep apnea (OSA), affecting nearly 1 billion people worldwide, is well suited for such stratified analysis.

We identified phenotypes among newly diagnosed OSA patients based on comorbid conditions and examined their healthcare resource utilization outcomes following positive airway pressure therapy initiation.

METHODS

Data Source: US administrative insurance claims (Phase 1), linked with objective positive airway pressure (PAP) therapy device usage (Phase 2).

Phase 1:

Cohort: patients newly diagnosed with OSA between January 2015-May 2022 (n=1,797,769)

Analysis: K-modes cluster analysis to identify patient phenotypes based on groupings of ICD-9/10 codes (Phecodes) with at least 10% prevalence

Phase 2:

Cohort: subset of patients with PAP therapy usage data available for 2 years from setup (n=373,008)

Analysis: Within each phenotype, the number of ER visits and hospitalizations in the in the 1st and 2nd year of PAP use were compared for those with an average of ≥4 hours/night to <4 hours/night. Inverse probability of treatment weighting (IPTW) was applied to balance groups on baseline covariates.

RESULTS

Phase 1: Seven OSA phenotypes were identified from nearly 1.8 million patients.

Comorbidity burden	**Low**	**Moderate**	**Moderate**	**Moderate**	**High**	**High**	**High**
Primary characteristic	Obesity	Malaise and fatigue	Hyperlipidemia	Nose and sinus conditions	Nicotine dependence	Anxiety and inflammatory conditions	Cardiometabolic conditions
	N=440,571 (24.5%)	N=249,783 (13.9%)	N=506,395 (28.2%)	N=223,876 (12.5%)	N = 152,430 (8.5%)	N = 131,802 (7.3%)	N = 92,912 (5.2%)
Characteristic							
Female, %	42.7	48.8	37.7	47.8	57.7	74.7	54.6
Age, mean (years)	45.4	48.0	54.6	47.4	52.8	52.1	59.9
Number of Conditions, mean (Phecodes)	6.3	9.1	9.6	9.5	16.2	18.3	21.3
Obesity, %	65.1	18.6	68.4	31.8	77.4	79.8	81.6
Select Phecodes, %							
Hypertension	18.4	26.6	89.0	32.1	81.0	74.7	94.0
Hyperlipidemia	12.6	25.0	84.0	28.9	69.7	66.9	88.1
Atherosclerosis	2.2	3.8	14.3	4.6	19.3	10.5	67.8
Rhinitis and Nasal Congestion	8.2	12.7	13.6	74.7	23.6	30.0	30.0
GERD	15.3	19.2	20.4	24.1	68.7	41.1	61.7
Diabetes Mellitus	9.3	9.4	33.2	10.4	30.1	32.2	77.3
Malaise and Fatigue	15.2	74.2	23.6	27.2	37.5	46.6	65.5
Affective Disorders	19.1	24.1	15.8	18.8	58.9	68.5	31.2
Osteoarthritis	8.8	12.9	14.7	10.4	28.6	60.2	58.8
Nicotine Dependence	13.3	16.0	18.2	15.5	71.2	31.3	42.2

Phase 2: PAP therapy was consistently associated with reductions in ER visits and hospitalizations

- **High comorbidity burden phenotypes**: Greatest benefit observed, with substantial reductions in ER visits and hospitalizations.
- **Low & Moderate comorbidity burden phenotypes**: Patients with an average usage over 4 hours experienced modest reductions in ER visits; hospitalization changes were minimal.
- **Low burden with obesity & Moderate burden with hyperlipidemia**: Average PAP use less than 4 hours was associated with increased ER visits.

Comorbidity burden	**Low**	**Moderate**	**Moderate**	**Moderate**	**High**	**High**	**High**
Primary characteristic	Obesity	Malaise and fatigue	Hyperlipidemia	Nose and sinus conditions	Nicotine dependence	Anxiety and inflammatory conditions	Cardiometabolic conditions
% change in per patient outcomes (Yr 2 vs. baseline)	N=94,856 (25.4%)	N=48,693 (13.0%)	N=114,671 (30.7%)	N=43,621 (11.7%)	N=30,260 (8.1%)	N=23,575 (6.3%)	N=17,332 (4.6%)
Hospitalizations							
≥4 hours/night	+4.5%	+13.2%	-20.6%	-18.5%	-42.6%	-35.1%	-49.8%
<4 hours/night	+48.0%	+29.6%	+3.2%	+8.3%	-29.5%	-20.3%	-30.8%
ER Visits							
≥4 hours/night	-6.9%	-17.6%	-16.9%	-24.3%	-39.9%	-32.5%	-36.6%
<4 hours/night	+19.2%	-2.6%	+7.8%	-5.0%	-26.6%	-23.1%	-26.0%

Relative increases in hospitalizations for low/moderate comorbidity burden may represent small absolute changes

CONCLUSION

OSA phenotypes differ in their response to PAP therapy. Generally, greater benefit is seen with greater PAP usage over 2 years. These findings can guide clinical decision-making by highlighting phenotype-specific HCRU benefits.

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