metadata variables and the second dataset contained 54 EMR based metadata variables. Three random forest models were trained to detect OSA diagnostic thresholds (AHI> 5, AHI>15, and AHI>30) over three different screening models: STOP-Bang, P-Bang (blood-pressure, BMI, age, neck-size, gender), and Common Clinical Data Set (CCDS)-OSA (all metadata variables simulating EMR CCDS standard).
Results: CCDS-OSA ROC-AUC exceeded STOP-Bang and P-Bang for both sleep study collections, resulting in AHI>15 ROC-AUC values of 0.73 and 0.71 (CCDS-OSA) compared to AHI>15 ROC-AUC values of 0.68 and 0.69 (STOP-Bang). Additionally, we analyzed the Gini feature importance ranking of the trained CCDS-OSA model to evaluate which variables showed highest predictive value of OSA. The ranking revealed the top 5 features were the five physiologic based STOP-Bang parameters, followed by EMR based physiologic measurements such as HDL, triglycerides, systolic BP, and disease conditions such as diabetes, hypertension, and depression.
Conclusion: This study shows that while STOP-Bang contains data critical to OSA screening, a variety of other EMR-based parameters can improve performance of OSA detection. AI-based EMR screening can provide a critical tool for more systematic and accurate screening of undiagnosed sleep apnea. Nationwide standards facilitating patient EMR data interoperable health information exchange, particularly the United States Core Data for Interoperability (USCDI CCDS), holds promise to foster broad clinical and research opportunities. Resulting data sharing will allow application of AI screening tools at the population health scale with ubiquitous, existing EMR data to improve population sleep health.
Support (if any):

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ADVANCED GESTATIONAL AGE IS A PREDICTOR OF NON-COMPLETION OF SLEEP APNEA TESTING IN PREGNANCY

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Introduction: Sleep apnea is emerging as an important and underdiagnosed comorbidity in pregnancy. Screening, diagnosis, and initiation of therapy are all time-sensitive processes during the dynamic progression of gestation. Completion of referral and testing for sleep apnea during pregnancy requires a significant commitment of time and effort on the part of the pregnant patient. We evaluated for predictors of non-completion of sleep apnea testing within our obstetric-sleep referral pipeline, in an effort to inform and optimize future referrals.
Methods: We performed a retrospective chart-review of 405 pregnant patient referrals for sleep apnea evaluation at the University of Wisconsin-Madison/UnityPoint sleep apnea pregnancy clinic. We used logistic regression analysis to determine predictors of lack of completion of sleep apnea testing.
Results: The vast majority of referrals (>95%) were triaged directly to home sleep apnea testing with the Alice PDX portable device, rather than a sleep clinic visit. The overall rate of referral non-completion was 59%. Predictors of non-completion of sleep apnea evaluation in our pregnant population included higher gestational age (GA) at referral (1–12 wks GA: 30%, 13–26 wks GA: 31%, and 27–40 wks GA: 57% non-completers, p=0.006) and multiparity with 1 or more living children (65% non-completers if any living children, compared to 45% non-completers if no living children, p=0.002). Age, race, and transportation were not predictors of failure to complete sleep apnea testing.
Conclusion: We have identified several predictors of pregnant patients' failure to complete sleep apnea evaluation with objective home sleep apnea testing after referral from obstetrics. Not surprisingly, higher gestational age emerged as a strong negative predictor of referral completion, with >50% of patients referred in the third trimester not completing sleep apnea testing. Early screening and referral for sleep apnea evaluation in pregnancy should be prioritized, given the time-sensitive nature of diagnosis and therapy initiation, and demonstrated reduced completion of referrals in advanced pregnancy.
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INVESTIGATING THE UTILITY OF ROUTINE CARBON DIOXIDE MEASUREMENTS DURING POLYSOMNOGRAPHY IN THE EVALUATION OF OBESE ADULT PATIENTS

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Introduction: With the increasing prevalence of obesity, the diagnosis of obstructive sleep apnea (OSA) and obesity hypoventilation syndrome (OHS) have also increased. Adding routine transcutaneous carbon dioxide (TcCO2) or end-tidal carbon dioxide sensors (EtCO2) may add beneficial information to the polysomnogram (PSG) and expand the diagnostic and treatment capabilities in this population. Our study looks at the use of this parameter in obese adults on whom CO2monitoring has been used.
Methods: We performed a retrospective chart review of obese adult patients (body mass index [BMI] >30) undergoing a PSG. We documented the EtCO2 values at baseline (supine awake) and during sleep. Correlations between the EtCO2 readings and BMI were reviewed. We excluded patients that had poor EtCO2 waveforms and patients with known preexisting hypoventilation syndromes, such a COPD.
Results: Fifty patients were identified between January and November 2020 at the Memorial Hermann Sleep Center. 54% were female and 46% were male with an average age of 55.3 years (range 26–73) and an average BMI for the cohort of 40.1 (SD +/-9.5). The average AHI on the diagnostic study (CMS criteria) was 30.9 events/hour (SD +/-43) and the average oxygen desaturation nadir was 79%. Sixteen patients (32%) met diagnostic criteria for OHS based on the baseline awake EtCO2 which would have otherwise been missed without CO2 monitoring. When comparing the mean values of the ETCO2 between Group 1 whose BMI was less than 40 kg/m2 (39.9 mmHg) to Group 2 whose BMI was greater than 40 kg/m2 (45.9 mm Hg), the difference was statistically significant with a p-value is 0.001.
Conclusion: OHS is reported to have greater mortality when compared to OSA. CO2 monitoring is currently only routinely required in pediatric PSGs. Our review suggests a higher diagnostic yield of OHS in adults with the use of CO2 monitoring especially when morbidly obese. Given the alarming trend towards obesity in the US, this advocates for the routine use of CO2 monitoring in adult obese patients. Although more research is needed, we may draw a conclusion that there is meaningful data to support the use of routine ETCO2 monitoring in this adult patient population.
Support (if any):

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CLINICAL VALIDATION OF A.I. ANALYSIS OF PHOTOPLETHYSMOGRAM (PPG) BASED SLEEP-WAKE STAGING, TOTAL SLEEP TIME, AND RESPIRATORY RATE

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Introduction: The Photoplesthymogram (PPG) raw waveform is the basis for both the pulse rate and oximetry during polysomnography (PSG) and Home Sleep Apnea Tests (HSAT). The PPG has also recently become ubiquitous as a basis of continuous measurement for the most widely adopted consumer sleep technologies, particularly smart watches. In this study, we clinically validate AI performance for interoperable, PPG-based epoch-by-epoch Sleep-Wake staging (PPG-SW), Total Sleep Time (PPG-TST), and Respiratory Rate (PPG-RR), when compared to 1) PSG-based panel scoring by technologists (RPSGTs) and 2) PSG-based AI scoring (EEG-SW, EEG-TST, Effort Belt-RR).
Methods: We applied stratified random sampling with proportionate allocation to a database of N>10,000 retrospective PSGs. We controlled for: 1) Obstructive sleep apnea severity, 2) Sleepiness, 3) Medical diagnoses including sleep, psychiatric, neurologic, neurodevelopmental, cardiac, pulmonary, metabolic disorders, 4) Medications including benzodiazepines, antidepressants, stimulants, opiates, sedative-hypnotics, 5) Demographics including sex, age, BMI, weight, and height, to establish representative adult (N=100) PSG studies from which PPG samples were obtained. Double blinded scoring was prospectively collected for each PSG by 3 experienced RPSGTs randomized from a pool of 6 scorers. RR was established by mode when two scorers agreed on RR value and median otherwise.
Results: AI EEG-SW demonstrated 96%/94%/95% Sensitivity/Specificity/Accuracy compared to 2/3 majority PSG staging, and AI PPG-SW demonstrated 90%/89%/90% Sensitivity/Specificity/Accuracy compared to the same PSG panel. AI EEG-TST achieved a Pearson Correlation Coefficient (R-value) of 0.968 and AI PPG-TST achieved 0.873 R-value compared to 2/3 majority PSG-TST. When compared to the RR panel consensus in N=282 one-minute RR scoring epochs of PSG, AI Effort Belt-RR performance was <= 2 breaths-per-minute (brpm) in 93.6% of epochs with an average difference of 0.992 brpm, and AI PPG-RR performance was <= 2 brpm in 92.2% of epochs with an average difference of 0.996 brpm.
Conclusion: The study shows interoperable AI analysis performs robustly in evaluating PPG-based epoch-by-epoch sleep-wake stages, total sleep time, and respiratory rate, demonstrating state-of-art accuracy when compared to a prospective, double-blinded PSG scoring panel. This work has implications for consumer sleep technology, HSAT accuracy, inpatient sleep monitoring, and may support the growth of HSATs by increasing total sleep time accuracy and reliability.
Support (if any):

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COMPARISON OF PAP INTERFACE PRESSURE ON THE NASAL BRIDGE: SOFT CLOTH VS. TRADITIONAL MASKS

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Introduction: Pressure between a CPAP mask and the skin is a significant contributor to irritation and pressure ulcers, an area of localized soft tissue ischemic necrosis caused by prolonged pressure over bony prominences that exceeds supra capillary pressure (70 mmHg). We hypothesized that cloth masks (CM) would exert a lower nasal bridge pressure than traditional mask (TM) products constructed of silicone and plastic.
Methods: We evaluated the pressure exerted by seven types of nasal masks in three trials onto the nasal bridge of two healthy adult volunteers, one female, one male, while they received 10 cm H_2O of CPAP. Five commercially available CMs (SleepWeaver® 3D, SleepWeaver® Advance Pediatric, SleepWeaver® Élan, and SleepWeaver® Prevent, Circadiance®, LLC) were tested as were three TMs constructed primarily of silicone and plastic (DreamWisp™, Philips Respironics, Inc.; Mirage™, ResMed; Zest™, Fisher & Paykel Healthcare). Pressure was detected using a texsens®-g low pressure sensor force measuring device. Pressure data from each 30 second trial were summarized as the median value after confirming that pressure did not vary by time (one-way ANOVA, p = 0.7393). Median values were then compared across trials, subjects, and masks using one-way ANOVAs and student's t-tests.
Results: After confirming that pressure did not vary by trial (one-way ANOVA, p=0.4585) or subject (t-test, p=0.0938), pressure data were summarized by mask. On average, CMs exerted 37.0 (17.7) mmHg of nasal bridge pressure, although there was significant variation across masks (one-way ANOVA, p < 0.0001). Conversely, TMs averaged 112 (38.5) mmHg of nasal bridge pressure without significant variation across masks (one-way ANOVA, p=0.1291). CMs averaged 75.26 mmHg less pressure than TMs (p < 0.0001), a difference of 67 percent.
Conclusion: The data supports the hypothesis that pressure from CMs on the bridge of the nose are significantly lower than a sample of TMs with similar shape and style, and the null hypothesis was rejected. Furthermore, the average CM was below the threshold for capillary closing, in contrast to the average TM. Therefore, for CPAP users with predicted or existing skin sensitivity, comfort and/or compliance concerns, CM should be considered as a first choice in mask selection.
Support (if any):

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BAROREFLEX SENSITIVITY DURING HANDGRIP IN OBSTRUCTIVE SLEEP APNEA WITH AND WITHOUT CPAP

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Introduction: Obstructive sleep apnea (OSA) disrupts multiple aspect of autonomic regulation; it is unclear whether intervention with continuous positive airway pressure (CPAP) can correct such disruptions. One key index of autonomic regulation is baroreflex sensitivity (BRS), an index that indicates heart rate (HR) changes to blood pressure (BP) alterations, and which is a significant measure for evaluating long-term cardiovascular changes induced by OSA. BRS can be assessed from BP and HR changes during an autonomic challenge task such as handgrip (HG). In a cross-sectional study, we assessed BRS during HG in untreated OSA (OSA_un) and CPAP treated OSA (CPAP), together with healthy control (CON) participants to determine if CPAP can recover BRS.
Methods: We collected ECG and continuous beat-by-beat BP from 95 people: 32 newly-diagnosed OSA_un (51.5±13.9years; AHI 21.0±15.3events/hour; 20male); 31 CPAP (49.4±14.0years; 22.4±14.1events/hour in initial diagnosis; 23male); and 32 CON (44.1±13.8years; 10male). We acquired data over 7 mins, during which people performed three 30s HGs (60 s baseline, 90 s recovery, 80% maximum strength). We calculated BRS over the 7 min period using sequence analysis in AcqKnowledge 5.0 BRS, followed by group comparisons using ANOVA. We also analyzed BP, HR and their variabilities: BPV and HRV (sympathetic-vagal).
Results: Mean arterial BP increases during HG were similar in all groups, although baseline mean arterial BP was higher in OSA_unc and CPAP, relative to CON (p < 0.05; OSA_un:mean±std, 90±11mmHg;