Use of Machine Learning to Predict Non-Diagnostic Home Sleep Apnea Tests

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SUMMARY

Researchers led by Robert Stretch from the Division of Pulmonary, Critical Care & Sleep Medicine at UCLA have developed an algorithm that can predict whether a patient will have a non-diagnostic home sleep apnea test based upon data from the electronic health record and a brief questionnaire.

BACKGROUND

Obstructive sleep apnea (OSA) affects between 4-37% of the adult population depending on the diagnostic criteria applied and population studied. Diagnostic testing for OSA typically starts with an “unattended” home sleep apnea test (HSAT) using a portable device. Since this test has a 17% false-negative rate, it is recommended that all patients who have a non-diagnostic initial HSAT should undergo an “attended” in-laboratory polysomnogram (PSG). A non-diagnostic HSAT is one in which the recording is technically inadequate (i.e. due to signal loss) or appears normal (i.e. respiratory event index < 5/hr). In clinical practice the rate of non-diagnostic HSATs varies between 15-30% of all studies. The ability to predict a non-diagnostic HSAT result prior to the test being ordered allows clinicians to pre-emptively order a PSG instead, thereby minimizing harms in the form of delayed diagnoses, missed diagnoses, additional financial burden to the patient and healthcare system, and inefficient use of limited resources.

INNOVATION

Researchers led by Robert Stretch from the Division of Pulmonary, Critical Care & Sleep Medicine at UCLA have developed an algorithm that predicts whether a patient will have a non-diagnostic home sleep apnea test. The algorithm was developed using machine learning techniques and uses data from the electronic health record (automatically sourced) and patient responses to a brief questionnaire to make predictions with a high degree of precision and accuracy. Assuming all patients with a non-diagnostic HSAT subsequently undergo PSG (as per American Academy of Sleep Medicine guidelines), implementing this model to guide testing would result in the following:

For every 1000 patients currently undergoing HSAT as their initial test for OSA...

- The number of patients needing to undergo both HSAT and PSG before obtaining a diagnosis would decrease by 139 (45.9%). These patients would instead be diagnosed on the first test.
- The absolute diagnostic yield of initial sleep studies would increase by 13.9% (83.6% up from 69.7%).
- The absolute diagnostic yield of HSATs would increase by 10.5% (80.2% up from 69.7%).
- 172 fewer HSATs (17.2% decrease) and only 33 additional PSGs (10.9% increase) would be performed. This represents a net cost saving based on published literature regarding the relative cost of HSAT and PSG.

The algorithm’s classification threshold can also be adjusted to meet the specific needs of an institution. For example, one such alternative threshold results in a 24.4% reduction in the number of patients needing both HSAT and PSG while only increasing total PSGs performed by 2.6%.

APPLICATIONS

- Predicting non-diagnostic HSAT results
- Integration into sleep study triage processes in hospitals and clinics
- Use by insurers to optimize sleep study prior authorization

ADVANTAGES

- Unique approach that improves the economic and diagnostic efficiency of HSATs while minimizing the harms associated with non-diagnostic studies
- Optimizes the allocation of limited sleep resources (HSAT devices, PSG beds) required for the diagnosis of OSA
- Patient-centered approach to testing that reduces average time-to-diagnosis and improves patient satisfaction

STATE OF DEVELOPMENT

Initial derivation and validation in a split cohort of 613 patients.

RELATED MATERIALS


PATENT STATUS

Patent Pending