# ARTIFICIAL INTELLIGENCE IN THE DIAGNOSIS AND TREATMENT OF SLEEP APNEA. FIRST APPLICATIONS

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## ABSTRACT

**During the past several years the application of digital health and artificial intelligence in sleep medicine has been developing at an extremely rapid pace. The diagnosis and treatment of patients with obstructive sleep apnea can be improved by artificial intelligence, facilitating the clinical work of sleep medicine specialists. Technologies based on artificial intelligence are becoming an integral part of the clinical practice of specialists in sleep medicine and ENT specialists. Artificial intelligence in medicine serves to make the right diagnosis, which is the key to proper treatment. From the literature review of scientific articles on artificial intelligence, the authors conclude that its application in sleep medicine can bring many benefits for rapid diagnosis and treatment. Artificial intelligence supports the treatment of obstructive sleep apnea and, even though it demands the right amount of data, which is a hurdle, it will prevent the development of a variety of problems, including severe morning headaches, daytime drowsiness, neurocognitive disorders, cardiovascular and metabolic disorders.**

**Keywords:** *artificial intelligence, obstructive sleep apnea, CPAP, digital health*

## INTRODUCTION

During the past several years, the application of digital health and artificial intelligence (AI) in sleep medicine has been developing at an extremely rapid pace. The diagnosis and treatment of patients with obstructive sleep apnea (OSA) can be improved by AI, facilitating the clinical work of sleep medicine specialists. Technologies based on AI are becoming an integral part of the clinical practice of specialists in sleep medicine and ENT specialists (1).

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## AIM

The objective of the present study is to investigate the first applications of AI in the diagnosis and treatment of OSA.

## MATERIALS AND METHODS

In the period between January 2021 and March 2022, in the available database (PubMed, BioMedCentral, ScienceDirect, Scopus, Web of Science), a systematic analysis of scientific publications examining the first applications of AI in the diagnosis and treatment of OSA.

## RESULTS AND DISCUSSION

According to research, polysomnography in OSA stands as the current diagnostic gold standard. Polysomnography is a non-invasive procedure to diagnose sleep disorders. This is, however, a labor-intensive method that requires specialists to utilize it. It could come at high cost, and could have challenges

such as availability. Recognition and understanding of obstructive sleep apnea in the primary care setting is another challenge that could be faced. This procedure records oxygen levels in the blood, brain waves, hearth rate, breathing, eye and leg movements. It does monitor sleep stages and cycles to identify if or when sleep patterns are disrupted and why there are 4–6 sleep cycles in one night where each lasts 90 minutes. Artificial intelligence systems present a chance for new diagnostic ways that would be able to overcome the impediments of polysomnography and will ultimately benefit patients in terms of the diagnostic process (2).

Some of the hurdles that AI is facing in the diagnostic treatment of OSA are classified in terms of data/biases, technology/accountability, perception, human factors and management. A few of the first studies exploring AI application in the diagnosis of OSA are focused on a generalized relapse neural network. This neural network shows a capability towards a precise rule in OSA from clinical statistics, with a precision and awareness (3).

Taking into consideration that OSA is analyzed based on clinical features, a different system was established. Four different categories are determined: snoring status, age, sex, and body mass index (BMI). This way OSA can be determined significantly more easily in an office setup without the use of polysomnography or oximetry. Other studies show advanced systems where pulse oximetry's physiological data are included as well as electrocardiogram features. These systems are turning out to be a beneficial screening tool with a high negative predictive value (3).

In order to see how AI functions in this setting, we need to ensure a large database access, which is necessary to develop AI tools, as well as the long-term storage of this information. All this creates an additional barrier for its implementation. Most AI systems developed by researchers do not use such large database which does not precisely mirror the general case (4).

Positive pressure ventilator can be described as noninvasive positive airway pressure ventilation (NIPPV), which includes normal continuous positive airway pressure (CPAP) and smart CPAP (Auto CPAP) ventilation and bi-level positive airway pressure (BiPAP) ventilation. Keeping the upper airway open is extremely important for patients with OSA to prevent upper airway collapse during sleep, as well as to help improve the patients' sleep quality. It is very often observed in patients who have varying severity of OSA—from moderate to severe (5).

The first choice for patients with OSA accompanied by systemic diseases, pronounced daytime sleepiness, hypoxemia and hypercapnia, sleep fragmentation is treatment with CPAP.

Thanks to the face mask, which is part of the device and is in contact with the orofacial complex of the patient, continuous ventilation of air with positive pressure is carried out. The mask has a humidifier, which is an integral part of the ventilator. The main application is to moisten and warm the inhaled air. It creates comfort and the device is better tolerated by patients. Patients suffering from OSA resulting from recurrent airway obstruction have symptoms of severe sleep fragmentation and intermittent hypoxemia and hypercapnia.

A smart positive pressure ventilator is a utility in which AI is an integral part of the device, so it is extremely precise and convenient for the patient. The data transmission mechanism allows the CPAP ventilator to be connected to the local medical terminal. CPAP data is collected, sent, and transmitted in real time for a fixed period (5).

***Design of Real-Time Database.*** The CPAP program automatically generates a database for a new patient and performs operations to add or delete a record. Smart breathing monitoring is set up by two-way communication of doctor-patient information that is transmitted within the cloud platform, where the doctor can obtain the information.

## CONCLUSION

Artificial intelligence in medicine serves to make the right diagnosis, which is the key to proper treatment. From the literature review of scientific articles on AI, the authors conclude that the application of AI in sleep medicine can bring many benefits for rapid diagnosis and treatment. Artificial intelligence supports the treatment of OSA and, even though it demands the right amount of data, which is a hurdle, it will prevent the development of a variety of problems, including severe morning headaches,

daytime drowsiness, neurocognitive disorders, cardiovascular and metabolic disorders.

## REFERENCES


1. Davenport T, Kalakota R. The potential for artificial intelligence in healthcare. Future Healthc J. 2019;6(2):94-8. doi: 10.7861/futurehosp.6-2-94.
2. Peng Y, Zhang Y, Wang L. Artificial intelligence in biomedical engineering and informatics: an introduction and review. Artif Intell Med. 2010;48(2-3):71-3. doi: 10.1016/j.artmed.2009.07.007.
3. Brennan HL, Kirby SD. Barriers of artificial intelligence implementation in the diagnosis of obstructive sleep apnea. J Otolaryngol Head Neck Surg. 2022;51(1):16. doi: 10.1186/s40463-022-00566-w.
4. Nuance AI-Powered Virtual Assistants for Healthcare Available from: https://www.nuance.com/healthcare/ambient-clinical-intelligence/virtual-assistants.html
5. Chen Z, Zhao Z, Zhang Z. Obstructive Sleep Apnea Syndrome Treated Using a Positive Pressure Ventilator Based on Artificial Intelligence Processor. J Healthc Eng. 2021;2021:5683433. doi: 10.1155/2021/5683433.