ETHICS OF ARTIFICIAL INTELLIGENCE IN RESPIRATORY MEDICINE: A NARRATIVE REVIEW

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Rezumat
Inteligența artificială (IA) a devenit un instrument essential în medicina respiratorie, cu aplicații tot mai diverse în diagnostic, stratificarea riscului și suportul decizional. Utilizând algoritmi de învățare automată (machine learning) și învățare profundă (deep learning), IA poate analiza volume mari de date – de la imagistică medicală până la dosare electronice de sănătate – pentru a sprijini clinicianul în luarea deciziilor. În boli precum BPOC, boala pulmonară interstițială (ILD), cancerul pulmonar și apneea obstructivă în somn (SASO), IA a demonstrat o acuratețe comparabilă cu a experților umani. De exemplu, modelele ML pot prezice exacerbările în BPOC sau severitatea SASO folosind parametri clinici, iar rețelele neuronale convoluționale (CNN) au îmbunătățit identificarea nodulilor pulmonari și clasificarea bolii pulmonare interstitiale. Cu toate acestea, majoritatea sistemelor nu sunt încă validate prospectiv sau aprobate de reglementatori. Integrarea IA ridică și probleme etice importante privind echitatea, transparența, autonomia pacientului, confidențialitatea datelor și responsabilitatea decizională. Pentru o implementare sigură și eficientă, dezvoltarea IA trebuie să fie centrată pe pacient, echitabilă și reglementată corespunzător.
Cuvinte cheie: *inteligență artificială, învățare automată, boli respiratorii, sindrom de apnee in somn obstructiva, etică medicală.*

Abstract
Artificial Intelligence (AI) has become a transformative tool in the armamentum of respiratory medicine, offering applications in diagnostics, risk stratification, and clinical decision support. Leveraging machine learning (ML) and deep learning (DL), AI systems analyse large datasets — from imaging to electronic health records — to assist clinicians in managing respiratory conditions. In diseases such as COPD, interstitial lung disease (ILD), lung cancer, and obstructive sleep apnea (OSA), AI has achieved diagnostic accuracy comparable to human experts. ML models predict COPD exacerbations and OSA severity, while convolutional neural networks (CNNs) enhance lung nodule detection and ILD classification. Despite promising

results, most systems lack prospective validation and regulatory approval. The use of AI also raises critical ethical issues, including bias and fairness, algorithmic transparency, patient autonomy, data privacy, and liability in decision-making. To ensure trustworthy integration of AI into respiratory care, future development must be patient-centered, ethically grounded, and supported by robust regulatory frameworks.

Keywords: *artificial intelligence, machine learning, respiratory medicine, obstructive sleep apnea, medical ethics.*

Introduction

Artificial Intelligence (AI) has evolved from a theoretical concept to a transformative force in modern healthcare. Since its conceptualization by Alan Turing in the 1950s and the development of early learning algorithms in the 1960s, AI has seen major advances, particularly with the emergence of machine learning (ML) and deep learning (DL) in the last two decades. In respiratory medicine, AI is increasingly used for diagnostics, risk stratification, and decision support, raising both opportunities and ethical concerns.

Types of AI in Respiratory Medicine

AI in respiratory care includes rule-based systems, machine learning algorithms, deep learning neural networks, and natural language processing (NLP). These tools analyze large datasets — ranging from imaging studies to sleep studies and electronic health records — to aid clinicians in diagnosing and managing respiratory diseases.

Machine learning models are particularly prominent in the diagnosis of obstructive lung diseases, while deep learning is applied in radiology, such as CT image interpretation. NLP is used to mine clinical notes for phenotype classification and outcome prediction.

AI Applications in Respiratory Diseases

1. Chronic Obstructive Pulmonary Disease (COPD): AI models can predict exacerbations using wearable sensors and analyze spirometry curves for automated interpretation[1].
2. Interstitial Lung Disease (ILD): Deep learning has been used for high-resolution CT scan analysis to classify ILD subtypes with expert-level accuracy[2].
3. Lung Cancer: AI assists in nodule detection and malignancy prediction on radiographs and CT scans [3].

4. Obstructive Sleep Apnea (OSA): AI plays a growing role in OSA screening, diagnosis, and treatment optimization. Algorithms can automate the scoring of polysomnography data and predict OSA severity from demographic and clinical parameters[4].

Material and Methods

A narrative literature review was conducted using PubMed and Scopus databases from January 2015 to June 2024. The search included terms such as "artificial intelligence", "machine learning", "deep learning", "respiratory medicine", "obstructive sleep apnea" and "ethics." Peer-reviewed English-language studies were selected. Only studies with clear methodology and clinical relevance were included. Emphasis was placed on ethical analysis frameworks, regulatory aspects, and clinical applications.

Results

Numerous AI systems demonstrated diagnostic accuracy comparable to or exceeding that of human experts in various areas of respiratory medicine:

- Topalovic et al.[1] developed an expert system for spirometry interpretation that showed over 90% agreement with certified pulmonologists. The system improved the consistency and accuracy of lung function test interpretation.
- Walsh et al.[2] applied deep learning models to classify idiopathic interstitial pneumonias using HRCT scans. The AI system matched expert radiologists in accuracy, enabling consistent and rapid diagnosis of complex ILD subtypes.
- Ardila et al.[3] used a 3D convolutional neural network on low-dose chest CT to predict lung cancer malignancy. Their AI model demonstrated performance comparable to six radiologists, with a sensitivity of 94.4% and reduced false positives.
- Kheirandish-Gozal and Gozal[4] employed ML techniques to predict OSA severity using clinical variables such as BMI, age, and neck circumference. The models achieved an AUC over 0.85 for predicting moderate-to-severe OSA.
- Borkowski et al.[5] reviewed AI applications in OSA, reporting that ML-based algorithms could automatically analyze polysomnography and outperform traditional rule-based systems in terms of diagnostic efficiency and reproducibility.
- These results confirm that AI is a powerful tool across multiple diagnostic domains in respiratory medicine, although further validation and standardization are necessary.

Discussions

The integration of AI into respiratory medicine raises key ethical questions:

- Bias and Fairness: AI models trained on unrepresentative data risk perpetuating health disparities. For example, underrepresented populations may receive suboptimal predictions for OSA severity[6].
- Transparency: The "black box" nature of some AI algorithms, particularly deep learning models, challenges clinicians' ability to interpret decisions, raising concerns about accountability[7].
- Autonomy and Consent: Patients may be unaware of AI's involvement in their diagnosis or management, leading to concerns about informed consent.
- Data Privacy: Respiratory data (e.g., sleep recordings, imaging) are sensitive. Ensuring confidentiality and compliance with GDPR and HIPAA standards is crucial.
- Responsibility and Liability: In AI-assisted decision-making, the delineation of

responsibility between physician and algorithm is not clearly established[8].

Conclusion

AI has the potential to revolutionize respiratory medicine, especially in conditions like OSA, COPD, and ILD. Its integration promises efficiency and diagnostic precision but must be approached cautiously to uphold ethical standards. Transparent, unbiased, and patient-centered AI development, alongside strong regulatory frameworks, is essential to ensure safety and trust.

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