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Artificial Intelligence Applications in Thoracic Medicine

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Abstract

Artificial intelligence (AI) has rapidly transformed thoracic medicine, offering innovative solutions across diagnostic imaging, functional assessment, prognostication, and clinical documentation. This review synthesizes current AI researches and applications in key domains of pulmonary and critical care medicine.

In chest radiography (CXR), deep learning algorithms have demonstrated remarkable proficiency in detecting pulmonary pathologies including pneumonia, tuberculosis, lung nodules, pneumothorax, effusion and etc.... Convolutional neural networks trained on large-scale datasets achieve diagnostic accuracy comparable to experienced radiologists, with area under the receiver operating characteristic curve exceeding 0.95 for several conditions. AI-assisted CXR interpretation enhances screening efficiency, reduces diagnostic delays, and supports first-line medical staffs.

Chest CT analysis has benefited substantially from AI-driven segmentation and classification techniques. Automated detection and characterization of pulmonary nodules, interstitial lung disease patterns, and emphysematous changes enable early diagnosis and longitudinal monitoring. Small airway dysfunction and mucus plugs are also fields with significant potentials.

In pulmonary function test, text to speech models can help generate voice introductions and commands, to help relieve technicians' work burden. In critical care, AI-based risk prediction models incorporating physiological parameters, laboratory values, and demographics, can help predict major organ dysfunction risks. Sleep medicine has emerging AI applications in automated polysomnography scoring, sleep stage classification, and detection of sleep-disordered breathing events. AI assisted sleep data analysis can provide further advanced insight for obstructive sleep apneas, including hypoxic burden and endotypes evaluation.

What more, large language models also had great potential for generate structured medical records, summaries, reducing documentation burden and enhancing staff working quality in clinical practice.

Despite promising results, challenges including algorithmic bias, interpretability, external validation, and data reliability remain. Future efforts should prioritize multicenter validation, and integration into clinical workflows, to realize the AI application in thoracic medicine.