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Title: Explainable Transfer Learning Ensemble - AI Model for Pneumothorax Detection

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ABSTRACT

Lung ultrasound is crucial for rapid, bedside pneumothorax diagnosis, but its effectiveness is often limited by human variability and a lack of interpretable artificial intelligence models. To address these challenges, this study introduces a robust, explainable soft-voting ensemble AI model trained on a diverse dataset of 1,856 ultrasound clips from critically ill patients, tailored cadaver models, and healthy volunteers.

When benchmarked against an expert panel of 11 experienced clinicians, the AI model achieved 100% sensitivity and 100% specificity, significantly outperforming the human experts who exhibited higher rates of false positives, particularly when interpreting M-mode imaging. The AI's decision-making process is made transparent through Grad-CAM++ heatmaps, which were validated by clinicians to ensure anatomical accuracy. Ultimately, this explainable AI tool functions as a highly reliable "second reader," capable of standardizing bedside diagnoses and substantially improving patient safety.