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Metrics of the routine use of a deep learning algorithm for diagnostic support of chest radiographs embedded in the workflow of a high-volume verticalized health service

Almeida, MFA; Barbosa, PNVP; Oliveira-Filho, EN; Machado, FP

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INTRODUCTION

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- Along with recent developments in deep learning techniques, computer-aided diagnosis has been growing rapidly in the medical imaging field.
- The diagnostic performance of radiologist marginally improved with the use of artificial intelligence (AI) solutions for chest X-ray interpretation, but it has been shown in recent studies that detection of thoracic abnormalities by radiology residents and non-radiologist doctors improved with the use of AI assistance.

Huang EJ et al. Development and Validation of a Deep Learning-Based Automated Detection Algorithm for Major Thoracic Diseases on Chest Radiographs. JAMA Netw open. 2019.

Eng J et al. Interpretation of Emergency Department Radiographs: A Comparison of Emergency Medicine Physicians with Radiologists, Residents with Faculty, and Film with Digital Display. AJR 175, 2000.

OBJECTIVE

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In this work, we evaluate the metrics of using a deep learning algorithm (DLA) for diagnostic support of chest radiographs (CR) embedded in the workflow of a high-volume verticalized health service.

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METHODS

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- This study was approved by the Institutional Research Ethics Committee.
- In this retrospective cohort study, we investigated consecutive patients who underwent chest radiograph in a verticalized health service in Brazil, between August 14, 2020, and April 11, 2022.
- All chest radiographs were automatically analyzed by a commercially available DLA (Insight CXR, Lunit, Seoul, South Korea).

METHODS

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- Using extraction and transformation tools (queries in SQL databases and computational scripts), we continuously monitor Lunit reports through data analysis in Power BI®.
- For observation of metrics, analysis of three abnormalities was performed: nodule, pleural effusion, and pneumothorax.
- We used the same cutoffs of the probability score defined in the algorithm validation study: 16% as the high sensitivity cutoff (probability score ≥ 16%) and 46% as the high specificity cutoff (probability score ≥ 46%).

RESULTS

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- Among 115,379 patients, 292,281 chest radiographs were performed during the study period.
- Our service performs an average of 17,566 chest X-rays per month, 592 exams/day.
- About 9% are ordered with high priority, usually in emergency rooms or intensive care units. Medium priority corresponds to 16.7% of chest X-ray requests and most exams correspond to low priority requests (74%).

RESULTS

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Number of patients	115,379	
Number of chest x-rays with Lunit report	292,281	
	Probability score ≥ 16%	**Probability score ≥ 46%**
Chest X-ray with at least one thoracic abnormality	235,746 (80.6%)	207,413 (71%)
Nodule	25,908 (8.9%)	5,404 (1.8%)
Pleural effusion	15,758 (5.4%)	9,881 (3.4%)
Pneumothorax	6,218 (2.1%)	2,567 (0.9%)

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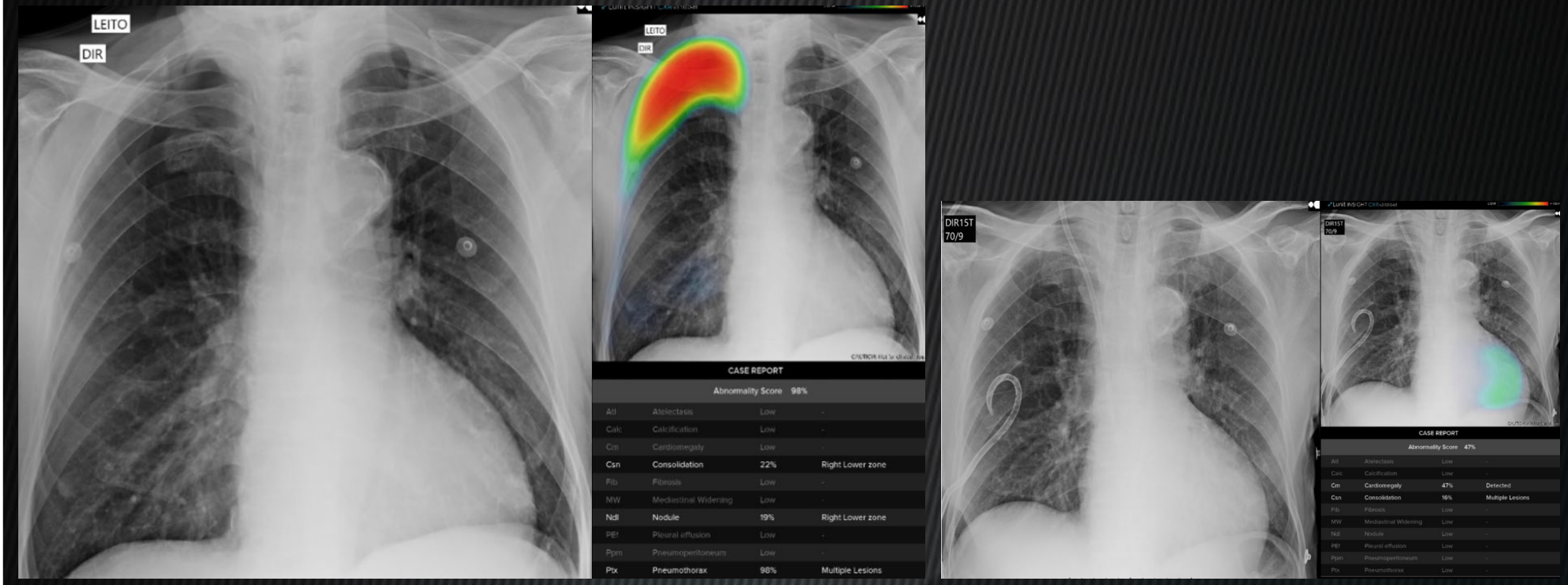

PNEUMOTHORAX

84-year-old male patient with complaints of chest pain and dyspnea. The software identified a pneumothorax on chest X-ray, with a degree of certainty of 98%. The patient underwent chest drainage, with complete lung expansion in the control X-ray.

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RESULTS

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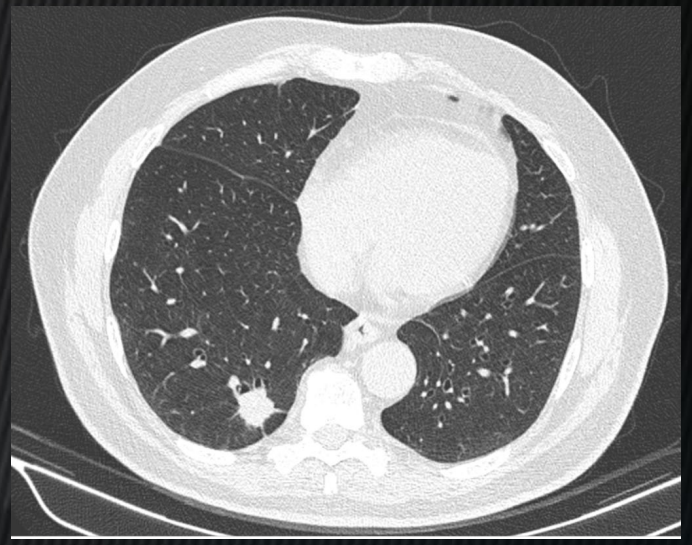

NODULE

73-years-old male patient, ex-smoker for ten years (40 packs/year), admitted to the ER complaining of cough, performed a chest X-ray. The AI software showed a pulmonary nodule at the right lower lobe, with a score of 55%. Chest CT confirmed a solid lesion of 17 mm referred for percutaneous biopsy and the histological diagnosis was primary lung adenocarcinoma.

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DISCUSSION

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- The use of AI for X-ray interpretation aims to prevent thoracic anomalies from going unnoticed.
- DLA provided satisfactory performance for the detection of referable thoracic abnormalities in previous studies.
- In high-volume healthcare services, where there is no availability of radiologists to report all chest radiographs, DLA assists in the workflow of the medical teams, increasing the confidence in the interpretation of chest radiographs without the support of the radiologist, especially for high-priority exams.

Potchen EJ et al. Measuring performance in chest radiography. Radiology. 2000.

Munera F, Infante JC. Deep learning for chest radiography in the emergency department. Radiology. 2019;293(3):581–2.

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Thank you!

maria.arruda@preventsenior.com.br