Combining automated malignancy risk estimation with lung nodule detection may reduce physician effort and increase diagnostic accuracy

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Rationale: Lung nodules are a frequent finding on chest computed tomography (CT) that can lead to early lung cancer diagnosis. The detection, diagnosis and management of these nodules requires substantial physician time and healthcare cost. Diagnostic uncertainty for many of these, particularly smaller indeterminate nodules, often leads to delayed cancer diagnosis and unnecessary follow-up procedures for patients.

Current study: The present study analyzes the potential benefit of combining two commercially-available* tools: lung nodule detection (SEARCH Lung CT) and a computer aided diagnostic to assist physicians' assessment of cancer risk (RevealAI™-Lung). While each of these have individual performance metrics summarized here, the aim of this study was to analyze performance when combined in a small test dataset, providing initial evidence for an end-to-end solution.

** See the vendors' websites for current market clearance information*

Methods: A balanced random sample of CT scans from the U.S. NLST study were selected for analysis (15 patients with benign nodules and 17 that included a malignant nodule). These scans were first analyzed using the nodule detection functionality of contextflow SEARCH Lung CT that produced image coordinates of nodules that are ≥ 3mm (includes calcified nodules). These coordinates and the CT series were then used as input to RevealAI-Lung to assess malignancy risk (the mSI score). For each patient, an index nodule identified within NLST was confirmed and assigned a LungRADS score. Diagnostic performance and comparisons to Lung-RADS are reported as mean (median).

** Detection results are updated from the abstract for the latest SEARCH Lung CT version (1.4.1)*

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Prior research: The use of SEARCH Lung CT has demonstrated a significant, 31% reduction in reading time through automated retrieval of 19 lung-specific patterns including lung nodules[1]. RevealAI-Lung's clinical results demonstrate a significant increase in diagnostic sensitivity and specificity across populations (both screening and routine chest CT)[2].

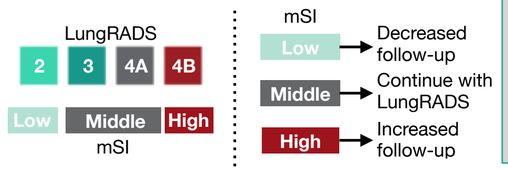
Current results: Using a sensitivity threshold of 94%, contextflow's analysis found 5.75 (4) nodules per patient*. Of the manually selected index nodules, all 32 were detected by contextflow's analysis (with one excluded due to computed size > 3cm). Using a malignancy risk threshold of under 1%, mSI labeled 59% of the detected benign nodules as low-risk (reduction $p < 0.001$). Of the confirmed malignant nodules, one 6.5mm nodule would be included in this low-risk group. While a small sample size, if mSI were used in conjunction with LungRADS, four of the 17 patients with malignant nodules could be shifted to earlier diagnosis, and three of 15 patients with benign nodules could be shifted to lower-risk compared to Lung-RADS.

Potential integrated workflow:

SEARCH Lung CT for detection and quantification

RevealAI-Lung to assess nodule malignancy risk

Model clinical decision-making:



- Works in conjunction with guidelines
- Straight-forward implementation into both radiology workflow and clinical decisions
- Significant impact on physician time and clinical follow-up

Conclusions: If adopted into clinical practice, combining automated detection with accelerated review of low-risk nodules could save a significant amount of physician time. Furthermore, the increased diagnostic accuracy from use of CADx may lead to early diagnosis for cancer patients and reduced follow-up procedures for benign nodules.

Discussion: Guidelines such as Lung-RADS™ and the Fleischner Society pulmonary nodule recommendations provide valuable guidance to physicians for recommending appropriate follow-up, and can be supplemented by clinical risk asessment tools such as the Brock or Mayo calculators. Adding automated tools that capitalize on enhanced image feature analysis and search of confirmed patient diagnoses can supplement these tools to benefit both patients and clinicians.

References:

[1]Röhrich et al, Impact of a content-based image retrieval system on the interpretation of chest CTs of patients with diffuse parenchymal lung disease. 2022, Eur Radiol.

[2]Adams et al, Clinical impact and generalizability of a computer-assisted diagnostic tool to risk-stratify lung nodules with computed tomography, 2022, submitted.

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