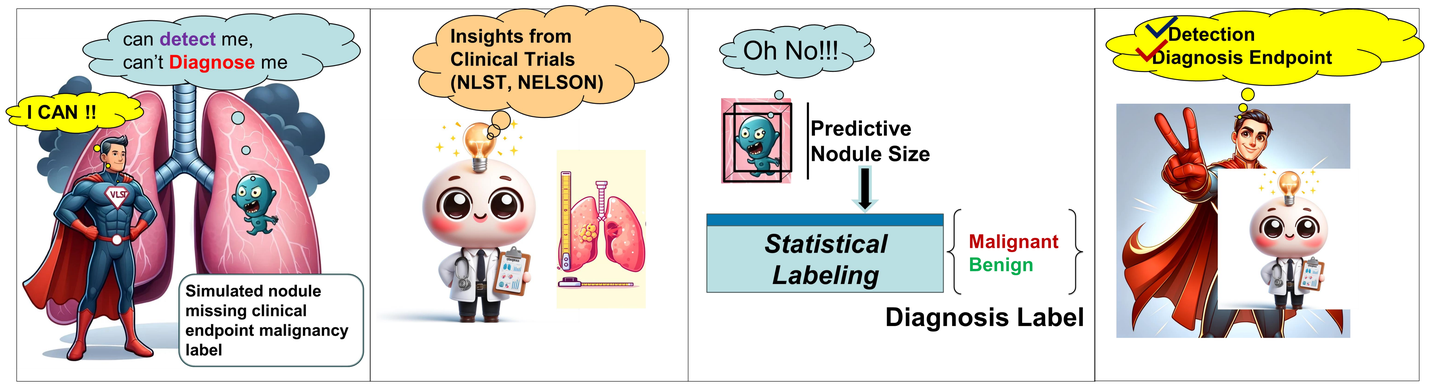
From Pixels to Prognosis: Advancing Virtual Imaging Trials Toward Clinical Endpoints

Duke researchers use statistical labeling in virtual lung cancer CT screening, transforming nodule detection into actionable cancer diagnosis.



***Beyond Detection:* Bridging the Gap Between Nodule Detection and Lung Cancer Diagnosis in Virtual Imaging Trials (VITs).**

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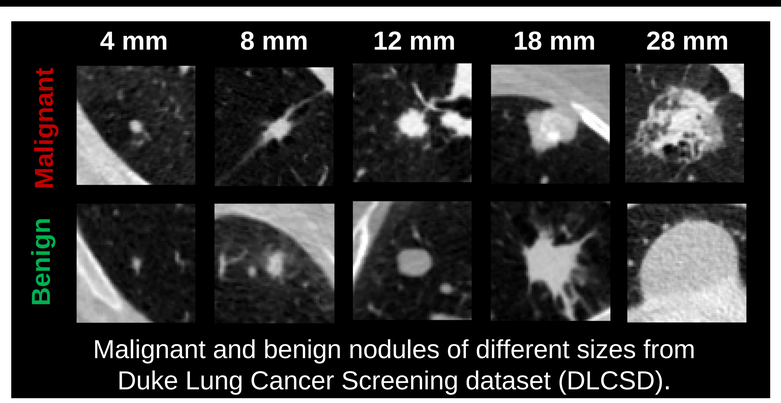
Introduction

One of the **significant drawbacks** of **VITs** is the lack of **clinical endpoints**, such as diagnosis outcomes.

Virtual Lung Screening Trial (**VLST**), prioritizes early nodule **detection** in lung cancer diagnosis. Yet, the critical diagnostic **goal remains:** discerning if nodules are **benign** or **malignant.**

Clinical trails showed **size matter**, however **larger dimensions alone do not confirm malignancy**.

Nodule size distribution of the **screen-detected (CT) lung cancer or no-cancer** in the **National Lungs screening trial** (**NLST**).



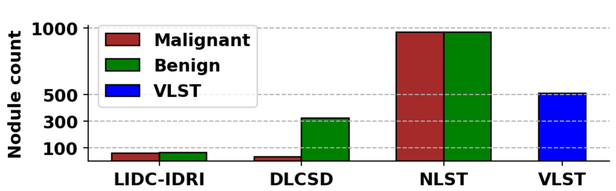
Malignant and benign nodules of different sizes from Duke Lung Cancer Screening dataset (DLCSD).

Purpose: To investigate image-based **statistical modeling** in **VLST** to classify lung nodules, bridging detection and simulated diagnosis with clinical insights.

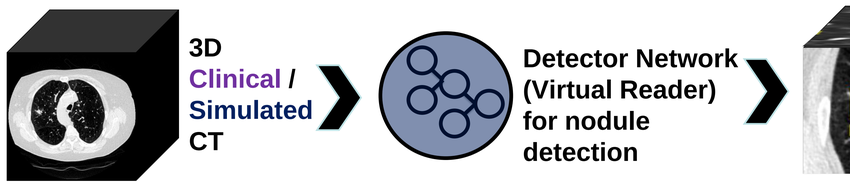
Dataset

This respiratory study applied the proposed method to multiple clinical datasets (**DLCSD, NLST, LIDC-IDRI**), each containing lesions with real diagnosis labels of **benign/malignant**, varying numbers of lesions with different characteristics

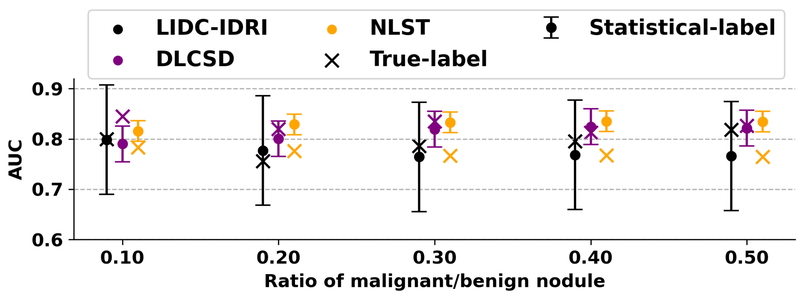
Subsequently, the proposed method was applied to **512** simulated lung nodules from **VLST**, to acquire diagnosis labels.



Methods

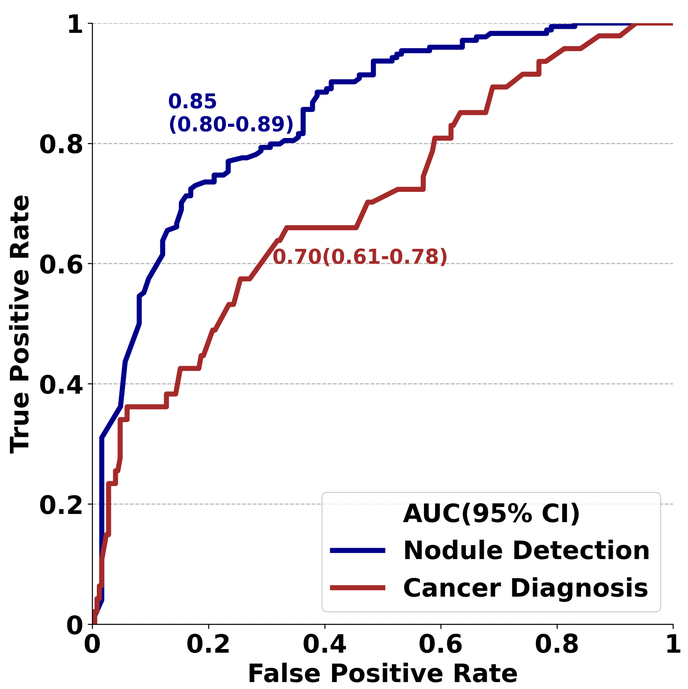


Results



Our statistical labeling method shown consistency while evaluating performance on different clinical datasets with **varying positive-to-negative** case rations while comparing to the **true-label** (maker "**x**"). Vertical error bar revealing standard deviations from 50 random runs, closer markers to the true-label **AUC** indicating higher label accuracy.

Predicted statistical **malignant** and **benign** labels of simulated nodules of different sizes from **VLST**.



Patient-level nodule detection (**blue** ROC) and cancer diagnosis (**brown** ROC) performance of virtual reader of **VLST**. Cancer diagnosis performance utilizing proposed statistical labeling aligns with reported clinical datasets.

Conclusion

Results indicate that **nodule detection** outperformed **cancer diagnosis**, consistent with findings from real lung cancer diagnosis studies.

Our current approach is limited to utilizing a single predictive **imaging-based feature (nodule size),** with plans to incorporate additional features such as sphericity, margin, lobulation, speculation, and texture in future iterations.

Furthermore, future work will explore **evidence-driven fusion of demographic** information to enhance patient-level outcomes.

In conclusion, our innovative statistical labeling technique offers a pioneering approach for **probabilistic labeling of simulated lung nodules**. This advancement has the potential to significantly enhance the accuracy of virtual screening trials, paving the way for more precise real-world diagnostic protocols and optimized interventions for nodules in virtual scenarios.

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Amazing VITs

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VIT-COVID VLST

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