Leveraging AI for Opportunistic Screening: Identifying Coronary Artery Calcification on Non-ECG Gated Lung Cancer Screening Chest CT

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Disclosures

Nanox AI provided software free of charge for the purposes of conducting this study.

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Background

- Atherosclerotic cardiovascular disease (ASCVD) is prevalent in the general population and remains one of the leading causes of morbidity and mortality in the United States
- Coronary artery calcium (CAC) is a highly specific feature of coronary atherosclerosis which has been shown to predict mortality
- With advances in computed tomography, CAC scoring has become a widely available way to assess ASCVD risk for major cardiovascular events, particularly for those who are asymptomatic
- CAC scoring has shown to be cost effective as its detection allows for treatment through primary prevention strategies

Purpose

- Asymptomatic adults with intermediate to high ASCVD risk are typically screened for CAC with dedicated ECG-gated chest CT examinations
- CAC can be detected incidentally on non-ECG gated chest CT studies performed for other reasons including trauma, dyspnea, and lung cancer screening
- Evaluation of the presence of CAC and its severity on all non-contrast chest CTs is recommended by the Society of Cardiovascular Computed Tomography and Society of Thoracic Radiology based on their 2016 guidelines
- Using commercially available artificial intelligence (AI) solutions, we can identify patients with moderate or severe coronary artery calcification with high specificity
- Early detection of CAC can be clinically impactful for patients without known coronary artery disease (CAD) who would otherwise not be screened

Current State of Risk Assessment on Non-Dedicated Exams

Presence of coronary calcification may not be reported

When reported, there is no standard assessment

- Binary reporting of presence or absence
- Subjective “eyeball” estimation of mild-moderate-severe

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Examinations Across Atlantic Health System

Approximately 10,000 outpatient non-contrast chest CTs were performed within our health system in 2023

Of these, 3200 were low-dose chest CTs performed for lung cancer screening

Utilizing Nanox AI, we can identify and report on the presence and severity of CAC more consistently on these non-targeted studies

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Nanox AI Cardiac Solution

Analyzes non-contrast, non-ECG gated chest CTs

Automatically measures calcified plaque

- Quantifies by Agatston score
- Agatston risk stratification based on total calcium score
  - Zero
  - Minimal (1-10)
  - Mild (11-100)
  - Moderate (101-400)
  - Severe (>400)

Outputs key images for verification

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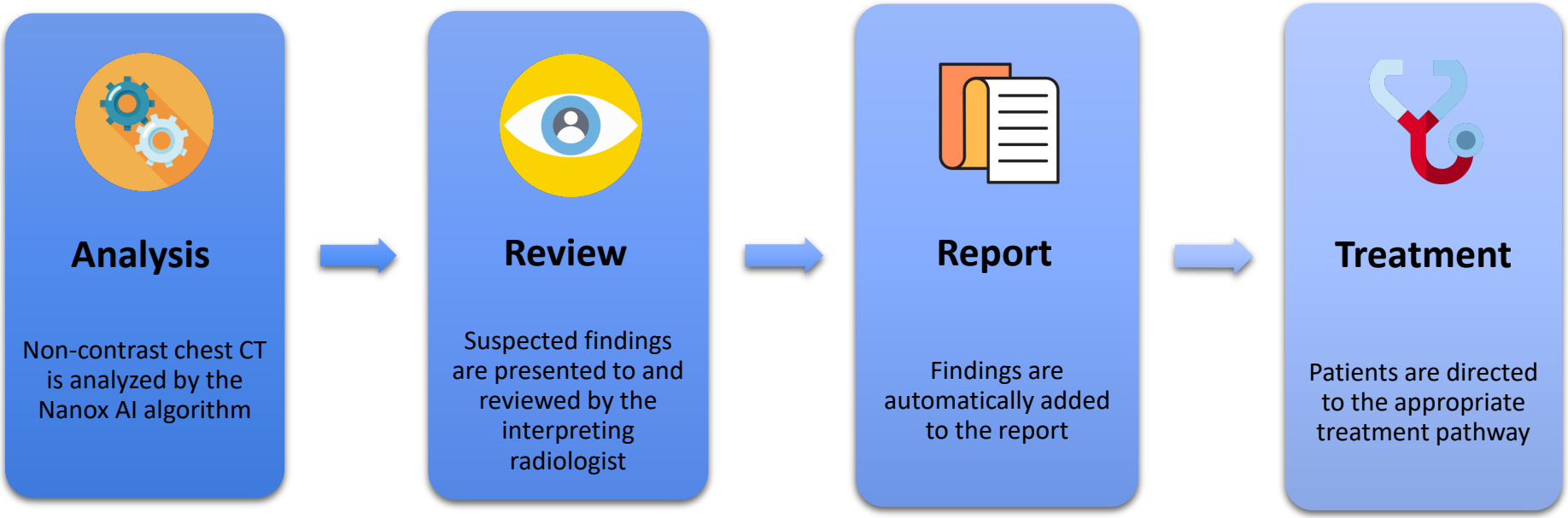
Nanox AI Workflow



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Nanox AI Examination Criteria

Inclusion Criteria

- Modality: CT
- Gender: All
- Orientation: Axial
- Age: 30 years old and older
- Slice thickness 0.1 mm – 3.1 mm (inclusive)
- Slice interval 0.1 mm – 3.1 mm (inclusive)
- Non-contrast studies only
- Any CT that includes the heart

Exclusion Criteria

- Any CT not including the entire heart
- ECG-gated CTs
- Number of slices: <20
- Series: CT Attenuation Correction, PET

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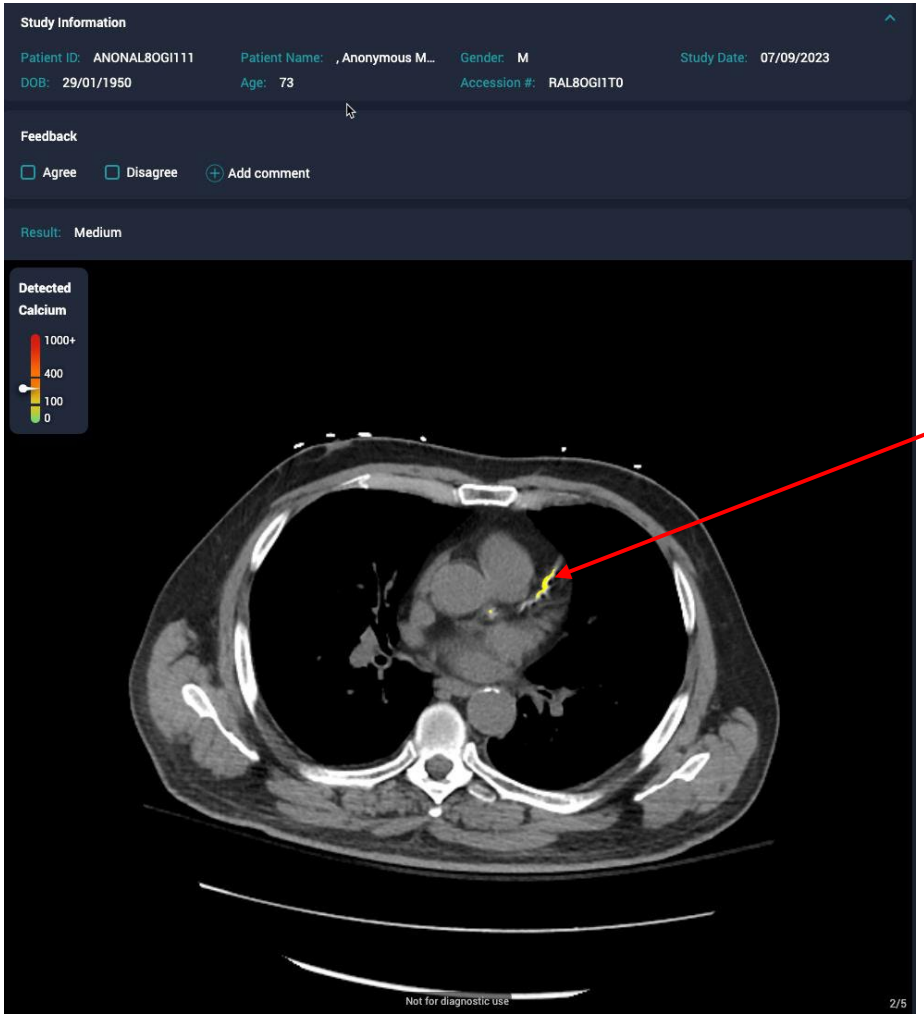
Nanox AI Sample Image



Index bar indicates CAC quantification

Segmentation of coronary artery indicated in yellow

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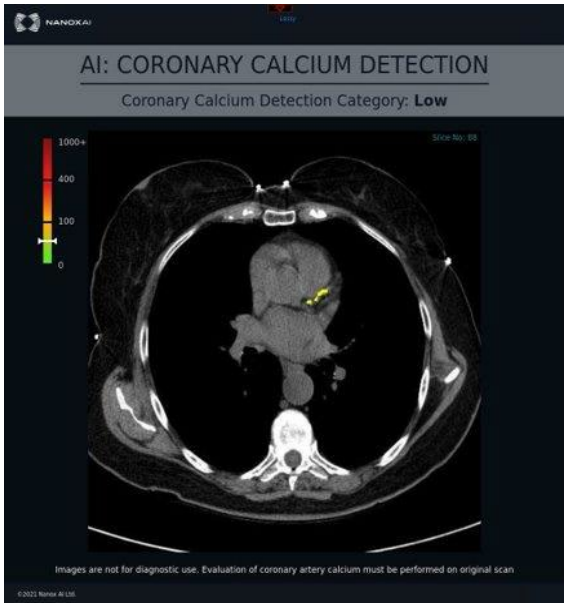
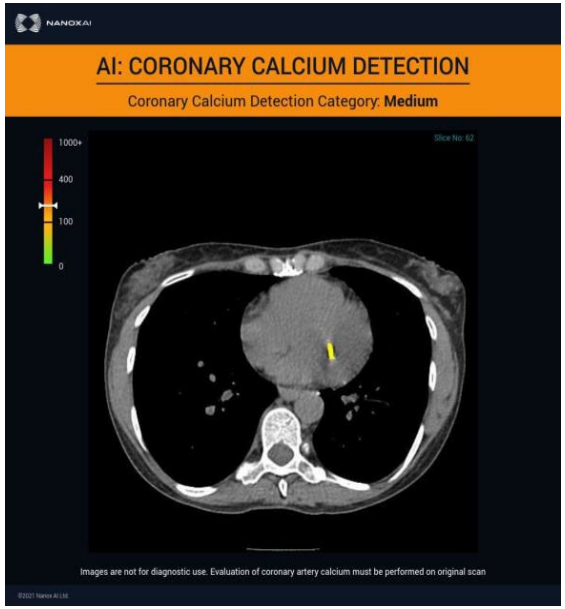
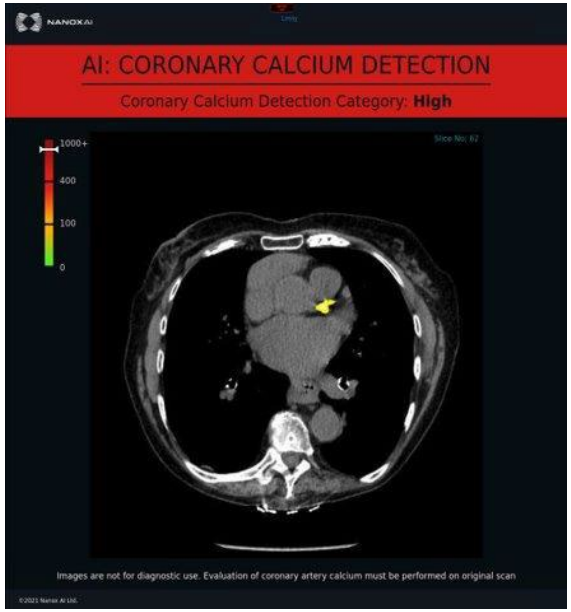
Objective Coronary Calcium Scoring







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Two Phase Pilot at Atlantic Health System

- Phase 1
  - Validation
    - Does the AI work with our population and technology?
    - How user friendly is it?
    - Do our results match published data?

- Phase 2
  - Experimental Phase
    - Is it reproducible if we apply it to a subset of our population?
    - What can we learn?
      - What is the incidence of undocumented disease?
      - Can we derive any demographic relationships?
      - How do we leverage our findings to improve the health of our patients?

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Phase 1: Validation

- 497 adult non-contrast, non-ECG gated chest CTs were retrospectively submitted to Nanox AI for analysis
- Of these, 382 (77%) studies were successfully analyzed by the AI algorithm
- In 41.6% of cases (159/382), moderate to severe disease was discovered
  - 30.1% with CAC Score > 400 (Severe)
  - 11.5% with CAC Score of 100-400 (Moderate)

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Phase 2: Experimental

- 492 lung cancer screening studies were submitted for analysis by Nanox AI
- 87.6% (431/492) were successfully analyzed
- 39.7% (171/431) of patients were found to have moderate to severe disease
  - 23.4% (101) with CAC Score > 400 (Severe)
  - 16.2% (70) with CAC Score of 100-400 (Moderate)

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Study Population Demographics

- Mean patient age = 67 (SD = 5.8)
- Age range = 52 – 78

Gender	Frequency	Percentage
Male	120	70
Female	51	30
Total	171	100

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Chart Review

- AI detected moderate to severe CAC burden in 39.7% (171) patients undergoing lung cancer screening with low-dose chest CT
- Upon chart review, 31.0% (53) of these patients did not have a known diagnosis of coronary artery disease at the time of imaging
- Known/existing coronary artery disease was defined as a documented diagnosis of CAD, documented statin therapy, and/or a history of coronary artery stenting

At the time of imaging, did the patient have known/existing CAD?	Frequency	Percentage
Yes	118	69
No	53	31
Total	171	100

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Lung-RADS Score vs Known/Existing CAD at Imaging

	Known/Existing CAD at Imaging?		
Lung RADS	No	Yes	Total
3	3 30%	7 70%	10 100%
3S	2 67%	1 33%	3 100%
4A	1 17%	5 83%	6 100%
4B	2 100%	0 0%	2 100%
4X	1 100%	0 0%	1 100%
Total	9 41%	13 59%	22 100%

Correlation Between Lung-RADS Score and Moderate-Severe CAC

Lung RADS	Frequency	Percentage
1	31	18.1
1S	4	2.3
2	97	56.7
2S	17	9.9
3	10	5.8
3S	3	1.8
4A	6	3.5
4B	2	1.2
4X	1	0.6
Total	171	100

A Lung-RADS score of 3 or higher is considered significant

13% (22/171) of patients with moderate to severe CAC also had significant Lung-RADS findings

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Correlation Between Lung-RADS Score and Moderate-Severe CAC

	AI Result of Disease		
Lung RADS	Moderate	Severe	Total
Less than 3	61 41%	88 59%	149 100%
Greater than or equal to 3	9 41%	13 59%	22 100%
Total	70 41%	101 59%	171 100%

No significant relationship was seen between Lung-RADS Score and the presence of moderate to severe CAC

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Relationship Between Gender and AI Results

	AI Result of Disease		
Gender	Moderate	Severe	Total
Female	26 51%	25 49%	51 100%
Male	44 37%	76 63%	120 100%
Total	70 41%	101 59%	171 100%

Male patients undergoing lung cancer screening were found to have a higher incidence of severe CAC burden compared to female patients

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Conclusion

- Using a commercially available AI solution, we were able to successfully identify the presence of CAD in a significant number of patients within our health system who did not previously have a known or existing CAD
- Moderate to severe CAC burden was detected by AI in 41.6% and 39.7% of cases following each phase of the study
- 31.0% of patients undergoing lung cancer screening with low-dose chest CT were found to have moderate to severe CAC and did not have a known or existing diagnosis of CAD at the time of imaging
- No significant relationship was demonstrated between moderate to severe CAC burden and significant Lung-RADS findings
- Utilizing AI to detect incidental CAC in patients undergoing non-dedicated CT exams can lead to early detection of clinically significant CAD
    - This can lead to early intervention with primary prevention strategies which would ultimately improve long-term outcomes and decrease healthcare costs

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