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Effectiveness of Cloud-based Computer Aided Quality Control System in Korean National Lung Cancer Screening

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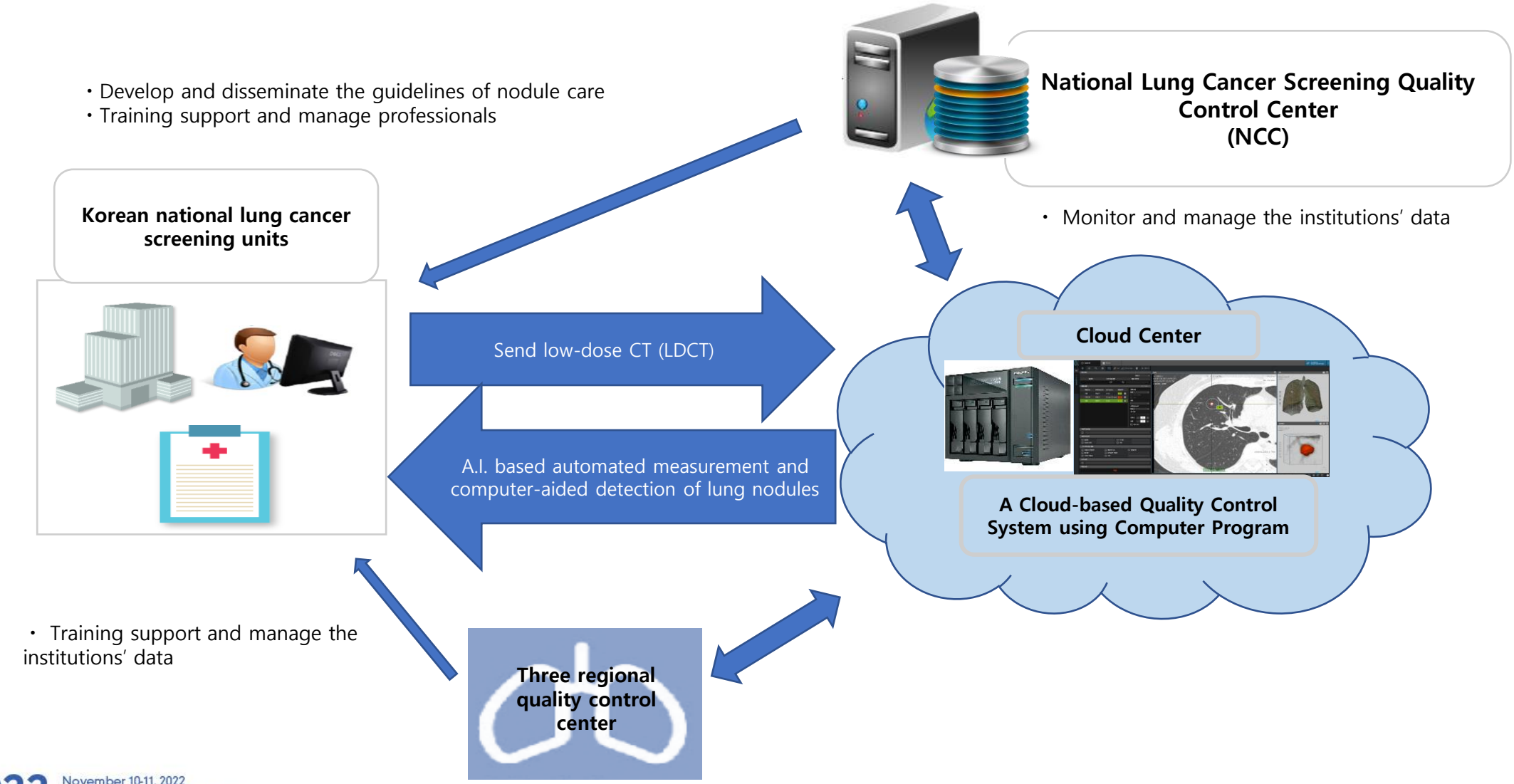
Background

- In 2019, Korean national lung cancer screening program (KNLCS), targeting high-risk smoking population aged 54 to 74 with at least 30 pack-years of smoking history, using low-dose CT (LDCT) was implemented.
- A cloud-based quality control system (CQCS) using computer-aided detection program (CAD) was used to assist radiologists in LDCT lung nodules detection, measurement and categorization.
- In 2021, Artificial Intelligence (AI)-based CAD was launched as a developed version of CQCS.
- This study evaluated effectiveness of CQCS on positive rate and inter-observer variability in KNLCS.

< Cloud-based Quality Control System using Computer Program in KNLCS >



Methods

- Subjects
  - 577 radiologists performed lung cancer screenings in KNLCS nationwide
  - 61 radiologists used CQCS voluntarily
  - 516 radiologists did not use CQCS

- Statistical analysis
  - Compared the quality index between screening units using and not using CQCS in 2019-2021
  - Compared the quality index between screening units before and after using CQCS in 2019-2021

- Primary outcome
  - The quality index: evaluated by positive rates, suspicious rates, and their variability across screening units
  - **Positive rate**: a rate of classified lung nodules requiring either diagnostic procedures or additional follow-up LDCTs and a total number of screenings performed, based on Lung-RADS category 3 or 4
  - **Suspicious rate**: a rate of classified lung nodules requiring additional follow-up LDCTs and a total number of screenings performed, based on Lung-RADS category 4
  - **Variability** in positive rates and suspicious rates is evaluated by **coefficient of quartile variation** (CQV, $\hat{\theta}_{CQV}$.) CQV is defined as a ratio of the difference between the interquartile range and the sum of the 1st and 3rd quartiles and measures the dispersion of a distribution. A higher CQV represents a higher degree of variability.

$$\hat{\theta}_{CQV} = \frac{\hat{\theta}_3 - \hat{\theta}_1}{\hat{\theta}_3 + \hat{\theta}_1}$$

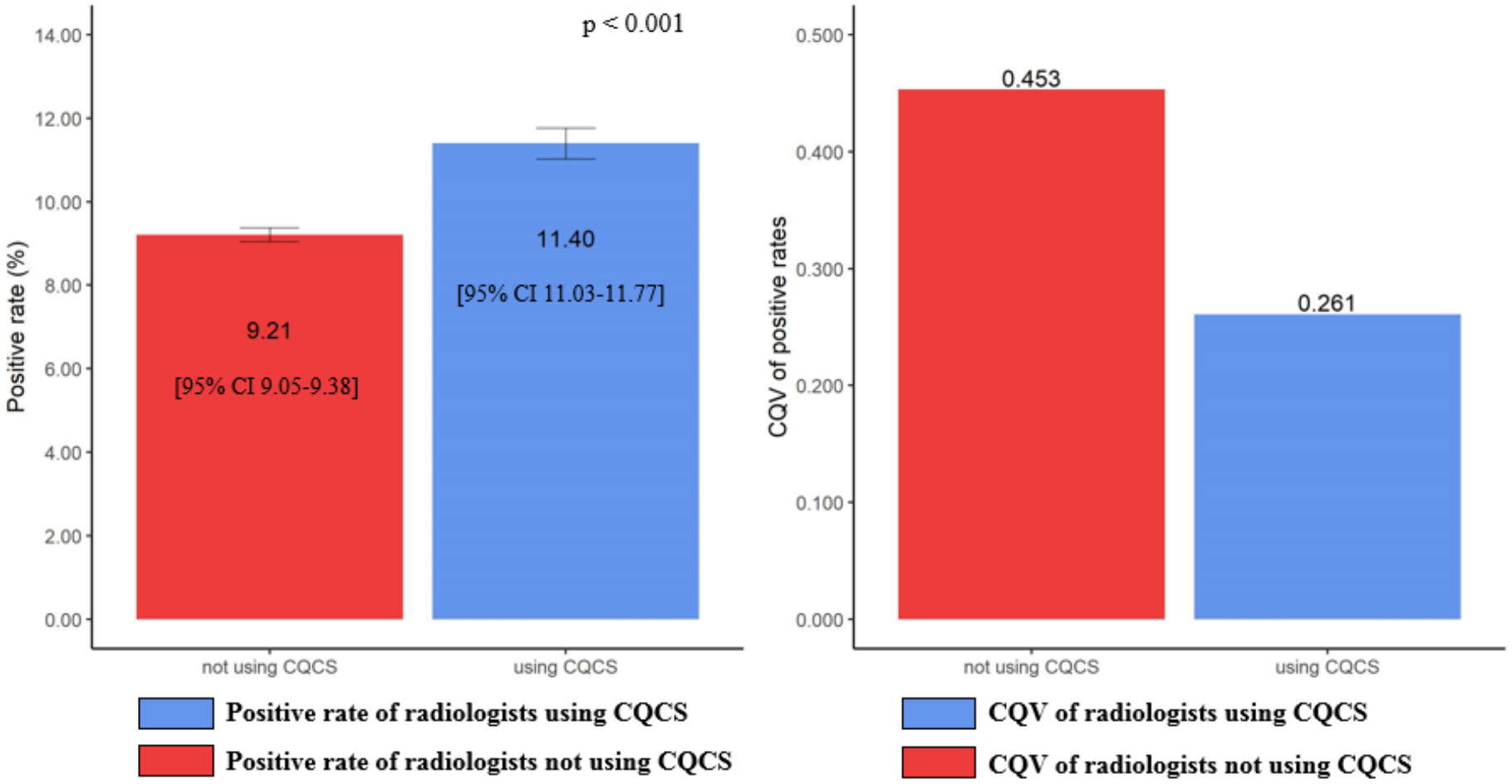
Results

- In CQCS, positive rates were higher by 2.19% (11.40% vs. 9.21%; p<.001) and variability of the positive rates was lower by 0.192 (CQV, 0.261 vs. 0.453).

- When positive rates were compared before and after using CQCS, positive rates increased by 4.90% (11.41% vs. 6.51%; p<.001) and CQV decreased from 0.448 to 0.330 after utilization of CQCS among 29 radiologists.

- After adopting AI-based CAD program in CQCS, positive rates increased by 1.75% (11.71% vs. 9.96%; p=.044) and CQV increased from 0.233 to 0.272 for 35 radiologists.

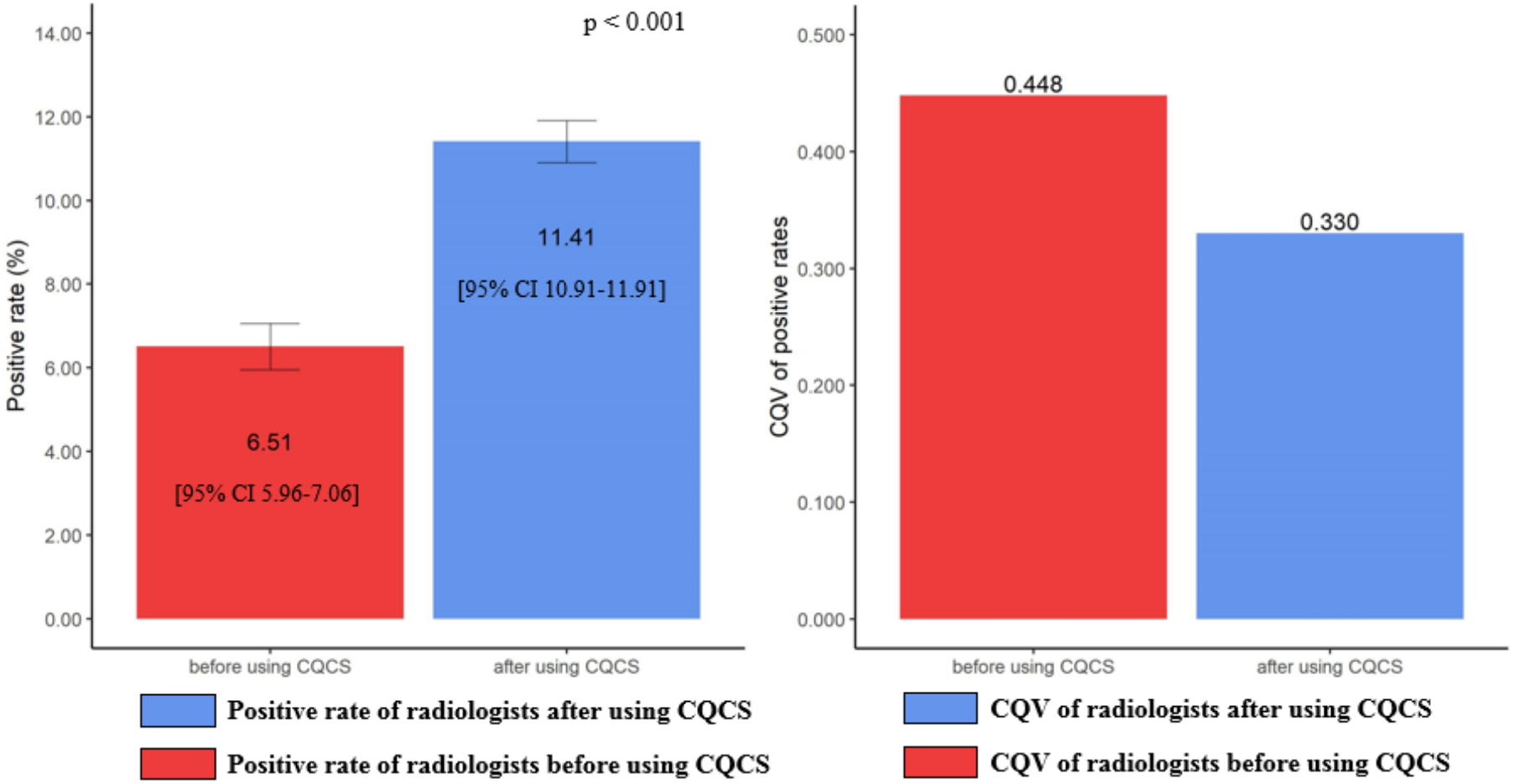
Figure 1. Comparison of positive rates and variability between screening units using and not using CQCS



(A) Positive rates of radiologists using and not using CQCS

(B) Inter-radiologist variabilities using and not using CQCS

Figure 2. Comparison of positive rates and variability between screening units before and after using CQCS



(C) Positive rates of radiologists before and after using CQCS

(D) Inter-radiologist variabilities before and after using CQCS

Conclusion

- The CQCS showed effectiveness in assisting in lung nodule detection and lowering variability of screening results across radiologists and screening units.

- Further studies on quality control strategies for newly implemented AI-based CAD are required.