Improved Efficiency with LungFlag vs. Opportunistic Selection in a Theoretical East Asian Lung Cancer Screening Program

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Background

Asia has the highest incidence of lung cancer and lung cancer mortality in the world and is estimated to have the largest increase in lung cancer incidence of all regions by 2040 (more than Europe and NA combined). The incidence of lung cancer among non-smokers in Asia (particularly East Asia) is substantially higher than in Europe and NA, and based on this difference, it would be intriguing to include never smokers in population-based screening algorithms currently under exploration[1-3].

Methods

We compared the number of lung cancer cases and distribution of early vs. late stage for individuals selected by two methods for screening (a) a previously-published[4] machine-learning (ML) algorithm developed and validated with US-based datasets that uses EHR and laboratory data and (b) opportunistic selection. We used a 5-year simulation over 1,000,000 eligible adults (ages 50 and above) to measure performance.

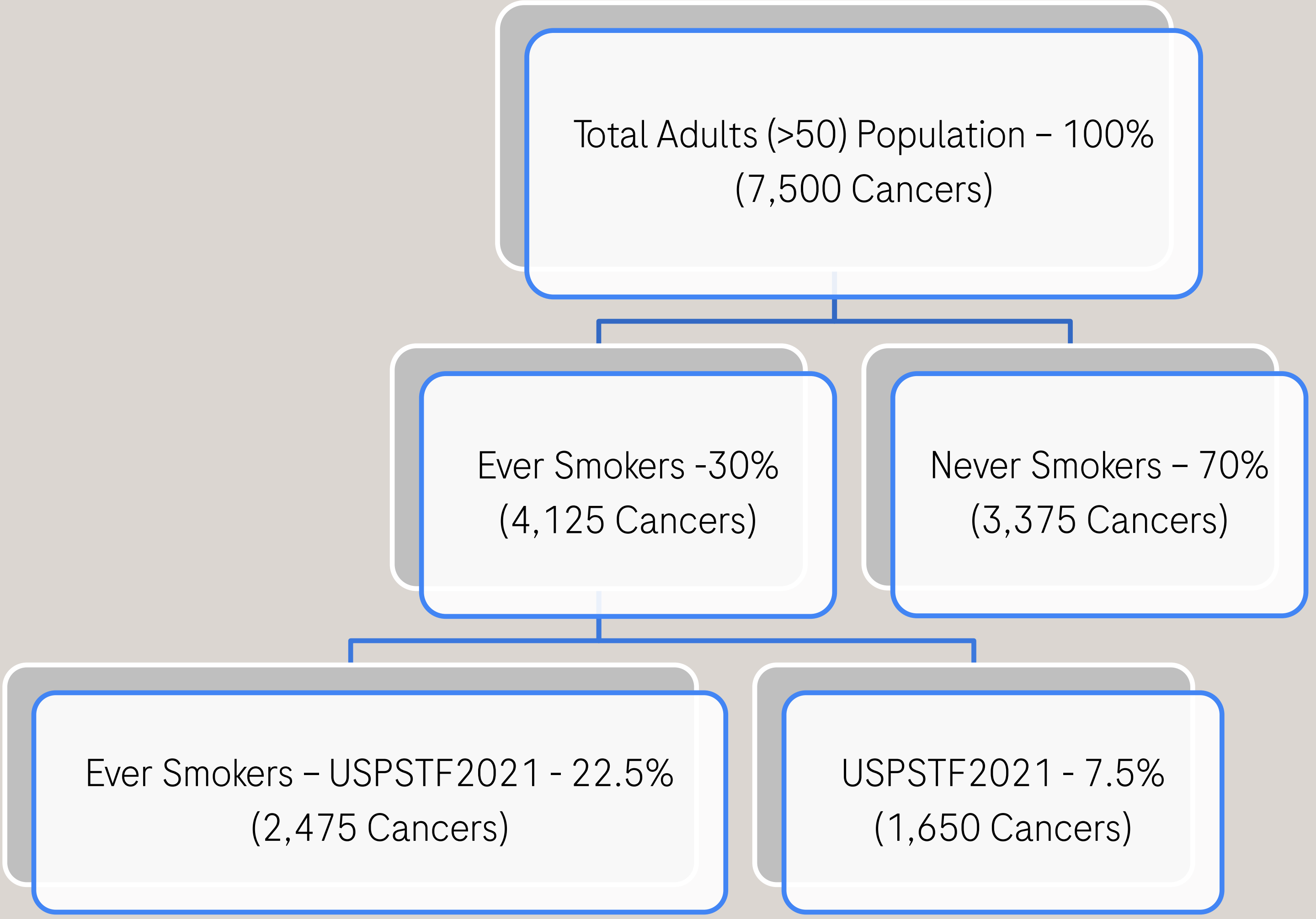
We considered three groups based on smoking status: high-risk smokers (7.5% of the population) meeting USPSTF2021 criteria, ever smokers not meeting USPSTF2021 criteria (22.5%) and never smokers (remaining 70%). Individuals with no smoking information were classified as never smokers. In each group there are two arms, LungFlag, including individuals with the top 10% of scores from the model and Opportunistic Screening, that randomly selects 10% individuals from that group (total 100K Low-dose computed tomography [LDCT] across each group for each selection method).

The population and incidence assumptions were that 30% of the total population were ever smokers harboring about 55% of total lung cancers, where the subgroup of higher-risk smokers (defined with minimum 20 pack-years, current or former smoker < 15 years) is about 25% of the ever smokers responsible for 40% of lung cancers. Risk score was calculated for the entire population.

References

1. Junjie Huang et al., Cancer Incidence and Mortality in Asian Countries: A Trend Analysis. Cancer Control. 2022 Jan-Dec; 29: 10732748221095955.
2. Vivian W. Y. Lee et al., Burden of smoking in Asia-Pacific countries. Tob Induc Dis. 2021; 19: 28.
3. Fei Zhou et al., Lung cancer in never smokers—the East Asian experience. TLCR , Vol 7, No 4 (August 28, 2018)
4. Gould MK, Huang BZ, Tammemagi MC, et al. 2021. Machine Learning for Early Lung Cancer Identification Using Routine Clinical and Laboratory Data. AJRCCM 204(4).

Compare the effect of selecting 10% from each subgroup by
LungFlag AI Model
vs
Random Opportunistic Selection



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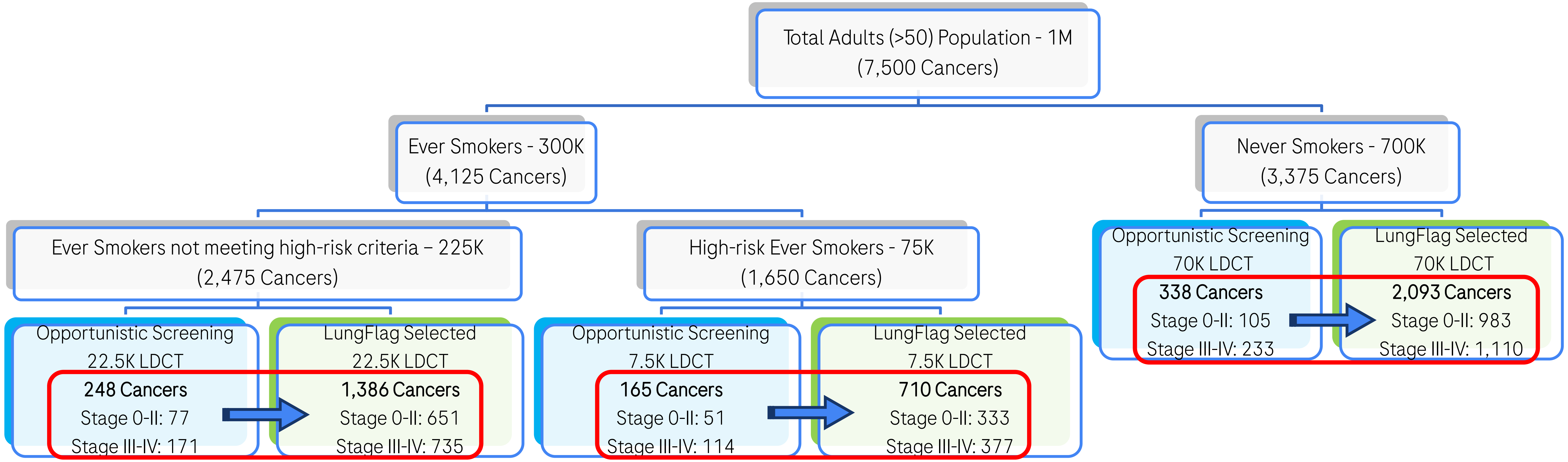
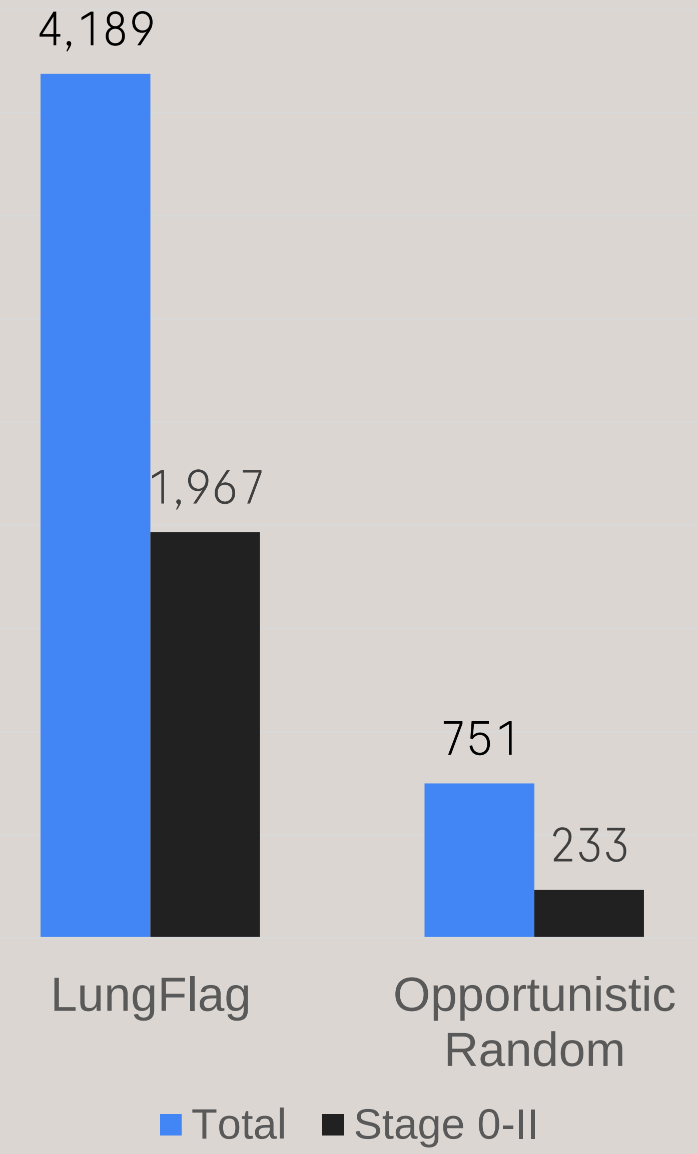
Results

Data were analyzed using sensitivity analysis per arm (random vs model) for early (0-II) and late (III-IV) cancer stages, and results are presented by estimated number of detected cases based on similar screening resources for different sub-populations labeled by their smoking habits. As detailed in the figure below. LungFlag model flagged 4,189 lung cancers (1,967 of those in stages 0-II, or 47%) , Random selection picked 751 lung cancers (233 in early stages, or 31%) , **x5.5 more cases** and **more than 50% increase in early-stage proportion**.



Number of Cases and Stages by Selection Method



Conclusions

The model demonstrated a highly increased odds ratio compared to opportunistic selection in ever smokers (x5) and never smokers (x6) subpopulations, suggesting a single model can be used as a pre-screening tool to identify elevated risk populations. Furthermore, the model showed increased performance in detection of earlier-stage cancers (>50% improvement).

AI LungFlag model has increased (x5) Odds Ratio and selects 50% more early-stage cancer than opportunistic random