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# Early Impact of Lung Cancer Screening in US population in the SEER Registries

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## Background

Lung cancer is the second most common cancer in both men and women, comprising 13% of all new cancers. It is by far the leading cause of cancer death among men and women. Each year, more people die of lung cancer than of colon, breast, and prostate cancers combined. Increasing age is a risk factor for the development of lung cancer with most cases diagnosed in individuals who are 65 or older.(1,2) There is an increasing effort to improve early detection of lung cancer, since this is a curable cancer if diagnosis and treatment are performed in a timely manner.(3)

The National Lung Cancer Screening Trial (NLST) demonstrated improved overall survival (OS) and lung cancer specific survival (LCSS), likely due to finding early-stage Non-Small Cell Lung Cancer (NSCLC). (4,5)

## Objectives

Our study investigates the impact of the NLST publication in 2011 on the lung cancer outcomes in the general US Population by assessing the incidence rates, ratio of early/late stage, and lung cancer mortality in the years immediately prior to and following this publication.

## Methods

Rate sessions from the SEER18 database were accessed during the years 2008-2015. We analyzed overall lung cancer incidence and mortality rates. The ratio of early/late stage was obtained by dividing the number of stage I and II cases by the number of stage III and IV diagnosed by year. We investigate changes in level and trend using interrupted time series in STATA12, considering 2011 as the intervention. In addition, we performed a T-test for averages ratios comparing the years 2007-2010 to the years 2012-2015 for the entire lung cancer population and for subgroups by median family income, ethnicity, sex, age and SEER Registry.

## Results

Although the overall lung cancer rates remained stable during the study period, a significant increase in the ratio of early/late stage was observed following the release of NLST for the overall lung cancer population (p=0.006) and for the screening age group (p= 0.014). The effects of ratio of early/late stage as noted in the overall group persisted for all patient subgroups, except for patients associated with a median income <$40,000, for those who were white, and for the following regions: Detroit Metro, Iowa, Greater and Rural Georgia and Louisiana where no association was found between the release of the NLST and changes in the ratios of early detection. Even more, in some cases there was a decrease in late stage detection. There was no impact on lung cancer mortality in the general lung cancer population or in any patient subgroups.

## Results

Figure 1. Overall Lung Cancer rate and mortality rates at 25 months and 36 months *100.000 inhabitants SEER-18 registries, 2007 to 2015, United States.

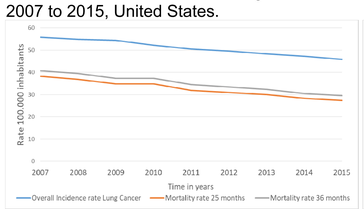



Figure 2. Early, Late stage lung Cancer rate *100.000 inhabitants and ratio Early/late stage SEER-18 registries, 2007 to 2015, United States.

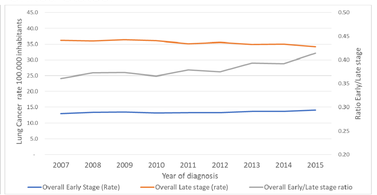



Figure 3. Lung Cancer rate *100.000 inhabitants and ratio Early/late stage SEER-18 registries, (A) male and (B) female, 2007 to 2015, United States.

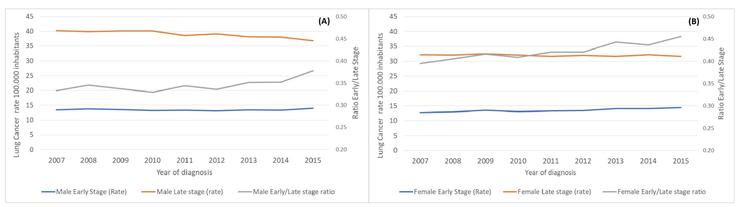



Figure 4. Lung Cancer rate *100.000 inhabitants and ratio Early/late stage SEER-18 registries, by age groups, (A) 55-74 years old, (B) 75+ years old, 2007 to 2015, United States.

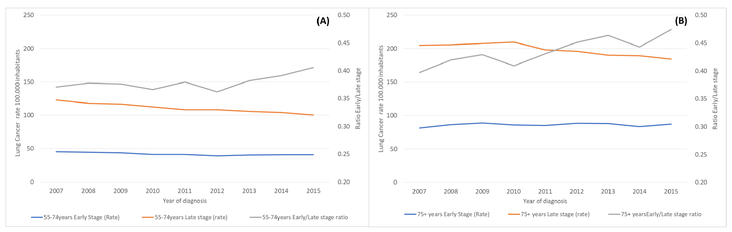
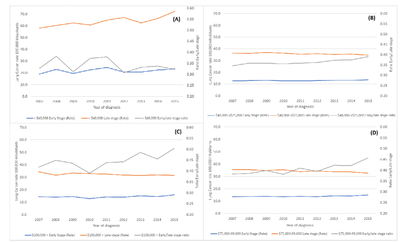



Table 1. Means ratio of early/late stage of Non-Small Cell Lung Cancer (NSCLC) for 2007-2010 and 2012-2015, SEER-18 registries.

| Variables | 2007-2010 | 2012-2015 | p-value I* | p-value II** |
|---|---|---|---|---|
| Overall | 0.37 | 0.39 | **0.026** | **0.006** |
| Male | 0.34 | 0.35 | **0.101** | **0.011** |
| Female | 0.41 | 0.44 | **0.009** | **0.003** |
| Non-Hispanic white | 0.39 | 0.36 | 0.307 | 0.498 |
| Non-Hispanic black | 0.28 | 0.31 | **0.011** | **0.036** |
| Hispanic | 0.38 | 0.41 | **0.044** | **0.014** |
| Asian | 0.31 | 0.34 | **0.021** | 0.393 |
| 55-74 | 0.37 | 0.39 | 0.227 | **0.014** |
| 75+ | 0.41 | 0.46 | **0.004** | 0.798 |
| Low Income | 0.35 | 0.33 | 0.250 | 0.365 |
| Median Income | 0.35 | 0.38 | **0.024** | **0.033** |
| Median-high Income | 0.39 | 0.43 | **0.029** | **0.002** |
| High Income | 0.39 | 0.42 | **0.033** | **0.009** |
| Very High Income | 0.42 | 0.47 | **0.043** | **0.046** |
| San Francisco | 0.34 | 0.41 | **0.004** | **0.313** |
| Connecticut | 0.44 | 0.50 | **0.018** | **0.015** |
| Detroit Metro | 0.37 | 0.37 | 0.933 | 0.289 |
| Hawaii | 0.33 | 0.35 | 0.379 | **0.020** |
| Iowa | 0.37 | 0.36 | 0.888 | 0.215 |
| New Mexico | 0.34 | 0.38 | **0.082** | 0.540 |
| Seattle | 0.38 | 0.44 | **0.004** | **0.039** |
| Utah | 0.31 | 0.35 | **0.019** | 0.217 |
| Atlanta Metro | 0.35 | 0.38 | 0.389 | 0.487 |
| San Jose | 0.36 | 0.40 | 0.108 | 0.354 |
| Los Angeles | 0.33 | 0.37 | **0.014** | 0.446 |
| Alaska | 0.24 | 0.32 | 0.291 | 0.254 |
| Georgia- Rural | 0.38 | 0.32 | 0.227 | 0.284 |
| California-Others | 0.36 | 0.40 | **0.053** | 0.455 |
| Kentucky | 0.38 | 0.39 | 0.310 | 0.359 |
| Louisiana | 0.35 | 0.35 | 0.872 | 0.738 |
| New Jersey | 0.40 | 0.44 | **0.019** | **0.020** |
| Greater Georgia | 0.37 | 0.36 | 0.393 | 0.488 |

p-value I* reflects a T-test between the two periods, p-value < 0.05 are in bold
p-value II** reflects the interrupted time series p-value for the level estimate in the final models.

Figure 5. Lung Cancer rate *100.000 inhabitants and ratio Early/late stage SEER data base, by income, (A)< $40,000, (B) $40,000-<$75,000, (C) $75,000-99,000 and (D) $100,000 + , 2007 to 2015, United States.




The significance levels varied between T-Test (p-value I) and Interrupted time series analysis (p-value II), being relevant to the age groups, and some geographic locations.

## Conclusions

Since the publication of the NLST in 2011, there has been no impact on lung cancer mortality or overall incidence of lung cancer in the general US population. However, there is a favorable increase in the proportion of early stage lung cancers, depending upon median family income, race and location. Our approach has limitations due the length of time after trial release and recommendation by the US Preventive Services Task Force (USPSTF) in 2015. We may see a further shift in the coming years because the US Preventive Services Task Force (USPSTF) recommended screening and CMS approved lung cancer CT-screening, both in 2015. We will develop further analysis and models to expand the understanding of the impact of lung cancer screening in the upcoming years.

## References

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