

From Eligibility to Uptake: Dynamics of Participation in Lung Cancer Screening

Hesam Mahmoudi

Dismal participation in initial (baseline) low-dose CT screenings and suboptimal adherence to subsequent follow-up exams undermines the life-saving potential of lung cancer screening. Despite lung cancer's status as the leading cause of cancer mortality in the United States—accounting for nearly 130,000 deaths each year—real-world data show that fewer than one in five eligible individuals undergo recommended screening. Moreover, even among those who do participate initially, only around half return for their annual follow-up scans. These low rates of uptake and adherence mean that many high-risk individuals are not benefiting from early detection opportunities, thereby contributing to continued high mortality and missed chances for more effective treatment. Consequently, identifying the behavioral, social, and structural factors driving this participation gap is an urgent public health priority.

Low uptake and adherence in US lung cancer screening can be traced to a combination of limited awareness, stigma and fear, complex eligibility and logistical barriers, provider and system-level knowledge gaps, and broader social determinants of health. Effective strategies to improve screening rates typically involve increasing provider education, developing patient-centered and culturally tailored communication, implementing systematic reminder and referral programs, ensuring coverage and reducing out-of-pocket costs, and making LDCT screening more accessible through coordinated healthcare networks.

For this modeling project, we will develop a system dynamics model that captures the progression of lung cancer as it is driven by the accumulation of smoking history. Screening eligibility in the model will be determined by both smoking history and age, while participation in regular screening can substantially improve treatment effectiveness through earlier detection. However, factors such as fear, stigma, and a high rate of false-positive results shift the perceived balance of benefits and costs, potentially deterring individuals from participating—or continuing—in screening.

By the end of this exercise, the model should be able to depict how individual smoking history accumulates and eventually triggers LDCT eligibility. It also should be able to show how uptake and adherence evolve over time in response to both clinical (e.g., stage at detection) and psychosocial factors (e.g., fear, screening stigma).

Commented [HR1]: Good problem definition; you can spell out the details of the desired model a bit further at the end: Two parts stand out: 1) capturing disease progression (perhaps with age cohorts?) 2) capturing perceived costs and benefits (based on test sensitivity and specificity, and the curve of survival conditional on detection/treatment vs. not).

Commented [HR2]: You may want to provide more details on how these factors should be translated into perceived costs and benefits, as they have somewhat different mechanisms and thus complicated for many to build into an operational model. Do you for example recommend people explicitly modeling false positives (with stock of incorrectly suspected) or just have a risk of false-positive informing the (emotional) costs of screening? Do you want to combine that with fear and stigma? How would people calculate benefits realistically?

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