

Impact of Early Diagnosis in Lung Cancer

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Lung Cancer – the leading cause of cancer death

Lung cancer, regarded as the leading cause of cancer death worldwide¹, is expected to have affected ~240,000 people in US in 2023².

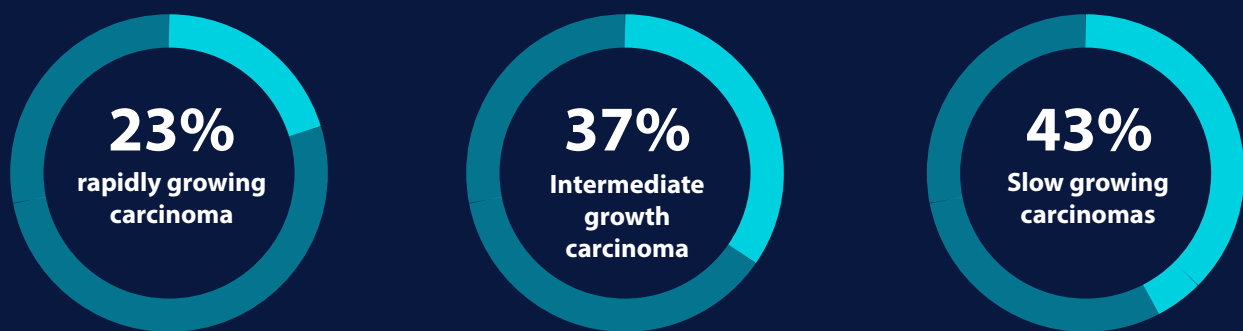
Although the incidence and mortality of lung cancer in US has been declining annually at 2% (2010-2019) and 4.1% (2011-2020) respectively³, it still claims ~125,000 lives every year².

Shorter Tumor Doubling Time correlates with lower 5-yr survival rate

Tumor volume doubling time (VDT), the number of days it takes for the nodule to double in volume, is a clinically relevant metric in lung cancer screening. Lung cancer is estimated to take an average of 166 days to double in volume. At 222 days, adenocarcinoma had a slower VDT than squamous cell (115 days), large cell (67.5 days) and small cell (86 days) carcinomas.⁴

The 5-year survival rate for rapidly growing carcinomas (VDT<110 days) was 23%, for intermediate growth carcinomas (VDT between 110 – 252 days) was 37%, and for slow growing carcinomas (VDT>252 days) was 43%.⁴

5-year Survival Rate



As the cancer grows, it progresses in its stage by metastasizing to the lymph nodes, neighboring tissues as well as other organs, making treatment more challenging.

Unfortunately, three quarters of patients with lung cancer are diagnosed at stage III or IV, by which stage the cancer would have spread to lymph nodes or other organs and becomes incurable.⁵

Early detection of lung cancer offers several clinical and economic benefits

Clinical

- a) 5 yr survival rates are much higher for earlier stages than later stages. For Non-small Cell Lung Cancer, the 5 year survival rate for Stage 1A is 92% v/s 10% for Stage IV⁶
- b) Early detection permits surgical resection, the best strategy for patients with strong clinical suspicion of Stage I and II lung cancer⁷
- c) Treatment options could require fewer hospital visits⁸, which in turn could help reduce the risk for nosocomial infections
- d) Higher likelihood of success for immune-related anti-tumor and targeted therapies⁷

5 Year Survival Rate for Non-small Cell Lung Cancer

92% vs **10%**
Stage 1A Stage IV

Private, Medicare and Medicaid Pulmonary Surgery Average Reimbursement

\$41,500
per Procedure

Economic

- a) Radical surgical resection followed by observation remains the best treatment strategy for early-stage NSCLC⁹; Pulmonary surgeries generate an average reimbursement of \$51k for Private, \$29k for Medicare, and \$23k for Medicaid (\$41.5K/ procedure weighted average)¹⁰
- b) The cost of treating lung cancer was much higher for patients with Stage IV lung cancer (\$21,000/month) compared with patients with Stage I lung cancer (\$7,000/month)⁸
- c) Treatment options for later stage diagnosis require more frequent hospital visits and associated with lower survival⁸, which could be associated with higher indirect costs such as travel and transportation of patient, lost wages, rehabilitation expenses, palliative care etc.
- d) Higher early diagnosis rates, coupled with better survival rates, could lend an aura of "Center of care excellence" to the care facility, further driving patient volume and revenue.

Average Monthly Cost of Treating Lung Cancer

\$7,000
Stage I

\$21,000
Stage IV

Various challenges exist with diagnosing lung cancer in early stages

The challenges can be broadly categorized into the following:

1. Patient dependent factors

- a) Absence of symptoms in early stages¹¹
- b) Symptoms ignored or deemed not important⁵
- c) Medical nihilism⁵
- d) Stigma around smoking¹²
- e) Fear that radiation exposure from screening could lead to cancer¹²



2. Hospital protocol dependent factors

- a) Absence of an Incidental Lung Nodule program, or poor guidelines on managing incidental nodule findings
- b) Coordination of screening and follow-up to ensure patients with suspicious lesions receive timely care¹²
- c) Limited familiarity with Lung Cancer Screening (LCS) guidelines¹²

3. Lesion dependent factors

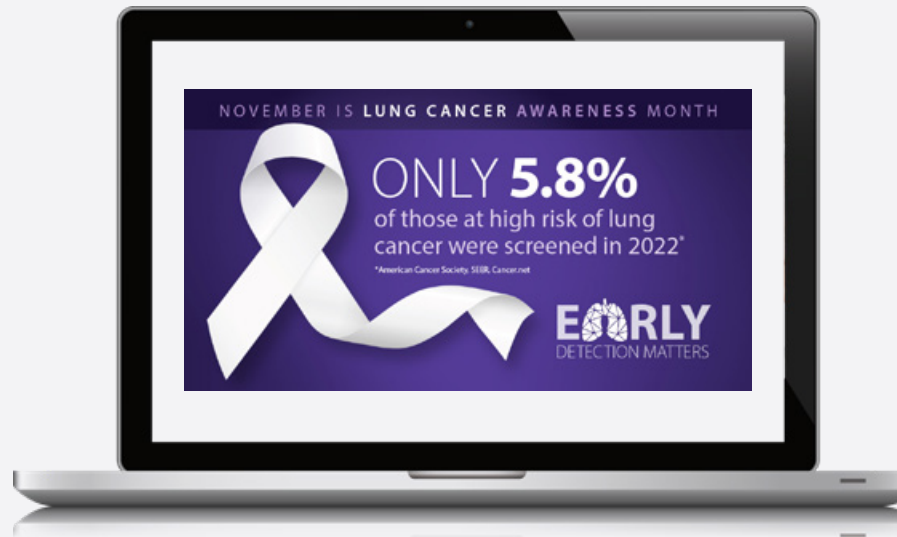
- a) Small size of lesion¹³ and/or challenging location making accurate biopsy challenging
- b) Poor visibility of lesion during biopsy, especially with Ground-glass opacity (GGO) findings¹³



Addressing the challenges to early detection

1. Patient awareness and education

A lack of knowledge regarding lung cancer screening may negatively impact the health of high-risk patients. Studies have shown that educating patients using knowledge measurement tools, online videos on lung cancer screening, social media etc., significantly increased the mean knowledge scores of study participants.¹⁴

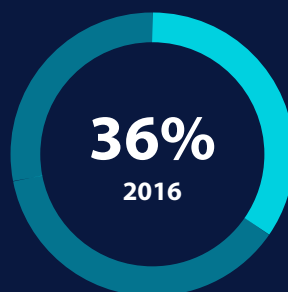
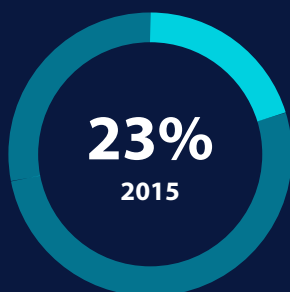


2. Comprehensive and integrated Lung Biopsy programs that incorporate Incidental Lung Nodule Programs and Lung Cancer Screening programs

Although an increasing number of centers have developed incidental lung nodule management and screening programs, challenges in workload and workflow management, referral pathways, expertise, and systematic tracking remain barriers.¹⁶

A single center chart review from Blount Memorial Hospital in Tennessee showed that, after initiating a multi-disciplinary comprehensive and coordinated lung nodule program in 2016, the number of patients with lung nodules referred to the program increased over 2 years. The proportion of Stage I-II cancer diagnoses increased from 23% prior to program implementation to 36% in Year 1 and 38% in Year 2.¹⁶

Stage I-II Cancer Diagnoses





3. Leveraging advanced robotic and imaging technologies to help biopsy challenging lesions

Robotic assisted bronchoscopic technologies have, in pre-clinical studies, demonstrated high navigational success and diagnostic yields^{17,18,19}. One pre-clinical study has shown that robotic assistance allowed access to twice as many bronchial divisions than that of standard flexible bronchoscopy of equal outer diameter²⁰.

However, only the Galaxy system has demonstrated a similarly high diagnostic yield in clinical trials, without the need for advanced imaging technologies.²¹ One of the reasons for this could be attributed to correcting for CT to body divergence.

While other platforms require expensive dedicated CT imaging systems to correct for CT to body divergence, Galaxy's proprietary technology allows it to integrate with a variety of C-arms to recreate a tomographic image to correct for CT to body divergence. This capability, along with other features such as augmented fluoroscopy, a graphical overlay indicating the location of less visible GGOs, and Strikepoint technology, a measure of distance of the biopsy tool from the center of the lesion, offers confidence to the user in biopsying lesions in challenging locations as well as those with challenging visibility and size.

Conclusion

A combination of patient education, multi-disciplinary integrated lung nodule programs and the use of advanced imaging-integrated robotic-assisted biopsy technologies can help identify, diagnose and treat lung cancer at an earlier stage and improve clinical outcomes for patients while relieving some of the economic burden associated with lung cancer.

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