Lung Cancer Screening: The Missouri Story

Examining Lung Cancer Screening and Diagnosis Trends in Missouri's Commercially Insured Population to Identify Opportunities for Action and Intervention

Table of Contents

Project Objectives

1. Assess Missouri trends in lung cancer screening, including factors impacting access.
2. Identify gaps and opportunities to increase awareness, knowledge, and motivation for action.
3. Inform policies and programs to improve rates of lung cancer screening, early diagnosis, and health outcomes for Missouri residents diagnosed with lung cancer.

Look for a companion report discussing biomarker testing for targeted cancer treatment to be published to by the Midwest Health Initiative (MHI) in future months.

Key Findings

1. According to the CDC, **Missouri had the 7th-highest state rate of new lung and bronchus cancer diagnoses** in 2019**,** and the **9th-highest rate of lung and bronchus cancer deaths.**

2. The **five-year survival rate (FYSR) of lung cancer is 56%** for diagnoses that occur **early**, but around **5% for lung cancer diagnoses** that occur once the cancer is advanced.

3. **12.8% of adults 50 to 80 years old were eligible for annual low-dose CT (LDCT) lung cancer screening from 2018 to 2021,** based on criteria set forth by the United States Preventive Services Task Force (USPSTF).

4. Missouri's 2021 lung cancer screening rate among USPSTF-eligible individuals was **6.6%**, which **doubled since 2018.**

5. Of the Missouri metropolitan statistical areas (MSAs), **St. Joseph had the highest screening rate among USPSTF-eligible individuals in 2021**, with 11.5%, and **Cape Girardeau had the lowest**, with 3.4%.

6. Annual LDCT **lung cancer screenings** for individuals recommended to be screened by the USPSTF **are covered without cost sharing** by plan sponsors and regional health plans, as required by the Affordable Care Act.

7. **2.5% of individuals within the USPSTF-eligible population were diagnosed with lung cancer from 2018 to 2021.** The rate of diagnosis among the general population was 0.14%.

8. Breast cancer and colorectal cancer screening are recommended at lower frequencies than lung cancer screening, but were both utilized among eligible individuals at similar or higher rates in 2021.

9. A higher level of social deprivation, as defined by Robert Graham Center's Social Deprivation Index, was **weakly correlated with lower rates of lung cancer screening** across Missouri counties.

I. Lung Cancer: The Missouri Story

In the United States, lung cancer is the leading cause of cancer death in both men and women, and accounts for approximately 21% of overall cancer deaths.[1] The five-year survival rate (FYSR) of lung cancer is 56% for diagnoses that occur early (i.e. when tumor is still localized). However, the FYSR drops to around 5% for lung cancer once the tumor has spread to other areas. These numbers demonstrate how crucial it is to diagnose lung cancer as early as possible, in order to increase the likelihood of survival. Despite this, only 16% of lung cancer cases are diagnosed at an early stage.[2]

Figure 1. United States and Missouri Lung Cancer Statistics		
	Smoking Rate	**New Cases per 100,000**
US	14%	57
MO	18%	70

Source: American Lung Association, State of Lung Cancer 2022

According to the CDC, Missouri had the seventh-highest state rate of new lung and bronchus cancer diagnoses in 2019, and the ninth-highest rate of lung and bronchus cancer deaths.[3] This is not surprising, given that the American Lung Association's 2022 *State of Lung Cancer* reports Missouri's smoking rate as 18%, which is higher than the national smoking rate of 14%. Not only is lung cancer more prevalent in Missouri than the U.S. average, but Missouri's FYSR for lung cancer from 2012 to 2018 was also lower than the national average, at 23% and 25%, respectively.[4]

Who Should Be Screened for Lung Cancer?

A large contributing factor to the prevalence of late-stage diagnosis is the poor rate of lung cancer screening. Lung cancer can be detected early through low-dose computed tomography (LDCT) scans. In 2013, the United States Preventive Services Task Force (USPSTF) began recommending annual LDCT screening for lung cancer for high-risk individuals, defined until 2021 as those aged 55 to 80 years old with a 30 pack-year smoking history, who have quit smoking less than 15 years ago. This excludes individuals with health problems that significantly limit life expectancy or who are unable or unwilling to undergo curative lung surgery.[5] In 2019 and 2020, only around 6.5% of these high-risk Americans received lung cancer screenings.[6] **In March 2021, the USPSTF expanded its definition of high-risk individuals to include individuals 50 to 80 years old with a 20 pack-year smoking history.[7]**

Why More is Not Always Better

Though early detection of lung cancer is of paramount importance for survivability, the decision to partake in screening is more complex than it may initially seem. There are potential risks associated with lung cancer screening, such as false positive and negative test results, low doses of radiation exposure, and overdiagnosis.[8] Additionally, lung cancer screening is not appropriate for patients who are unwilling or unable, due to other health conditions, to undergo treatment if lung cancer is found. Early detection won't change the outcome for patients who will not be treated, but may still cause emotional or physical harm.

"We shouldn't assume that increasing the screening rate will benefit everyone; unless you have a system in place to inform patients of risk, appropriately handle abnormal results, and triage patients for follow-up, you can actually do more harm than good," says Dr. Edward Ellerbeck, Professor of Population Health and Internal Medicine, University of Kansas Medical Center. *"It's estimated that over 50% of patients who undergo lung cancer screening experience some sort of abnormality on their scan, which can cause anxiety and lead to repeat testing and biopsies."*

Patients referred for LDCT lung cancer screening at the University of Kansas Cancer Center are enrolled in a comprehensive care program that provides smoking cessation counseling and helps inform and coordinate their care to minimize unintended screening consequences.[9] However, not all screening sites have programs like these, and it is important to note the potential emotional harm to patients that are screened inappropriately or without knowledge of the associated risks. It is vital that patients and physicians accommodate these factors when pursuing screening. Project Connect, a collaborative effort by the University of Texas MD Anderson Cancer Center and the North American Quitline Consortium, provides a thoughtful discussion guide for patients to go through with their doctor to decide if screening is right for them, which can be found here or in the Lung Cancer Resources section on the Midwest Health Initiative (MHI) website.[10]

Other Risk Factors

Approximately 10% of lung cancer incidences occur in individuals who have never smoked. Additional risk factors for lung cancer include environmental exposure to tobacco smoke and other substances, such as radon, asbestos, arsenic, nickel, and chromium.[11] Behind smoking, radon exposure is the next-highest cause of lung cancer in the U.S.[12]

Improved Treatment Outcomes

Though lung cancer remains the leading cause of cancer death, declining mortality in the past decade is likely due in part to advancements in immunotherapy and targeted treatments informed by tumor biomarker testing.[13] Biomarker testing, also called molecular testing, is a new and rapidly evolving field that enables medical professionals to study tumor cells and characterize their genetic mutations, protein expression, and tissue environment. In lung cancer, it is primarily utilized for late-stage non-small cell lung cancer (NSCLC) to identify potential treatments that can target the specific molecular pathways of those cancer cells. Clinical stage, biomarkers, tumor histology, and several other factors all contribute to the treatment decision.[14] A future MHI report will provide additional insights into tumor biomarkers for targeted therapy and coverage for lung cancer biomarker testing.

II. Missouri Commercial Claims Analysis

MHI Data Set and Subpopulation Definitions

The MHI data set includes commercial medical and pharmacy claims representing care received by about two million people in Missouri and the bordering metropolitan areas from 115 counties in Missouri, nine counties in Illinois, and six counties in Kansas. Because this database is entirely commercial claims, findings may differ from those of data sets including Medicare and Medicaid data.

In order to determine the number of individuals within its population that were eligible to receive lung cancer screening, MHI identified a subpopulation within its data set using characteristics available within claims data analysis to come as close as possible to USPSTF eligibility requirements. This group consisted of individuals aged 50 to 80 years old who were coded in medical claims with a history of tobacco. MHI was unable to match the criteria exactly, because smoking pack-year history is not available in medical claims data. For more information on this methodology and its limitations, see Appendix I.

Figure 2. Subpopulations Identified in Analysis

USPSTF-Eligible* Criteria

Age: 50-80
Exposure: Tobacco Use (Smoking or other)

*Modified criteria for claims analysis, See Appendix I for more information.

Potentially At-Risk Criteria

Age: 18-80
Exposure (at least one):
Tobacco (Use, Environmental, Occupational), Radon, Asbestos, Silica, Uranium, Arsenic, Nickel, Chromium, or Air Pollution

Lung Cancer Screening: The Missouri Story

Additionally, MHI investigated trends in lung cancer diagnosis within a second subpopulation, consisting of individuals categorized as having a potentially higher risk for lung cancer than the general population. This "potentially at-risk" group included individuals aged 18 to 80 years old coded for exposures to any of a variety of substances associated with an increased risk of lung cancer (Figure 2). This group includes those within USPSTF-eligible population, as well as other individuals with potentially elevated risk for lung cancer, such as those with exposures other than tobacco use, or those outside of the 50 to 80 years age range. For a full list of codes utilized for each subpopulation, see Appendix I.

Coverage for Lung Cancer Screening

To assess the current state of LDCT lung cancer screening coverage among commercially insured Missourians, MHI obtained summary plan documents from eight employer plan sponsors (seven private, and one public), as well as publicly available clinical guidelines and policies from five major health plans in Missouri. Because ore and coal miners have been found to exhibit an elevated risk for lung cancer due to occupational exposures, the plan designs of four mining companies were selected for analysis.[15] Additional private plans were those from one national retailer, one transportation company, and one university.

III. Key Findings from MHI Data

Screening Coverage

MHI found that **all eight employers provided coverage without cost-sharing for LDCT annual screening for lung cancer** for individuals aged 50 to 80 years old with a 20 pack-year smoking history who currently smoke or quit less than 15 years ago. Employer summary plan documents do not generally list all preventive services that are covered, as is the case with lung cancer screening, but rather cite their congruence with the requirement set by the Affordable Care Act (ACA) for all "non-grandfathered" health plans to cover all A and B grade preventive services recommended by the USPSTF.[16] This ensures compliance as the guidelines are updated. Six of the eight plans used language simply stating that coverage was provided for services with an A or B rating from the USPSTF. One plan stated that coverage was provided as required by the ACA guidelines for preventive care. One plan redirected to a U.S. Centers for Medicare & Medicaid Services webpage that listed required services. **All health plan clinical policies specified LDCT lung cancer screening as medically necessary** for USPSTF-eligible individuals.

Lung Cancer Screening for USPSTF-Eligible

MHI found that on average, from 2018 to 2021, **12.8% of commercially insured Missouri adults 50 to 80 years old were found to be eligible for screening under USPSTF criteria**, as defined in Figure 2. MHI found that **in 2021, 6.6% of USPSTF-eligible individuals received LDCT lung cancer screening.** Despite this rate remaining low, it **consistently increased** over the years observed, more than doubling from 2018 to 2021.
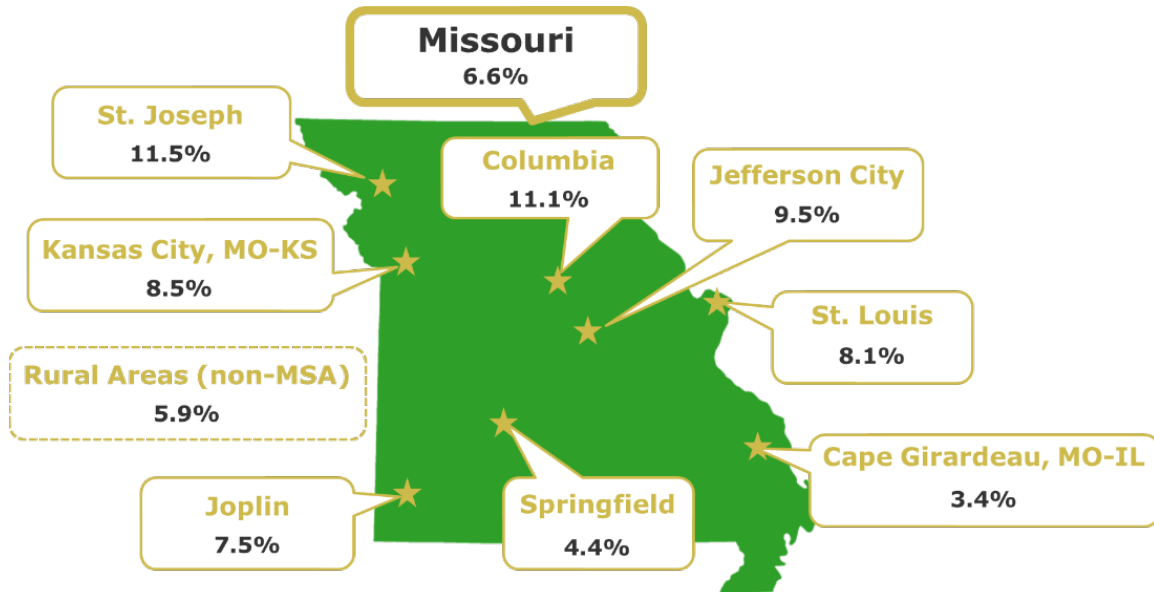
Figure 3. Lung Cancer Screening Rate Among USPSTF-Eligible Subpopulation, 2018 - 2021

2018: 2.9%
2019: 3.9%
2020: 4.5%
2021: 6.6%
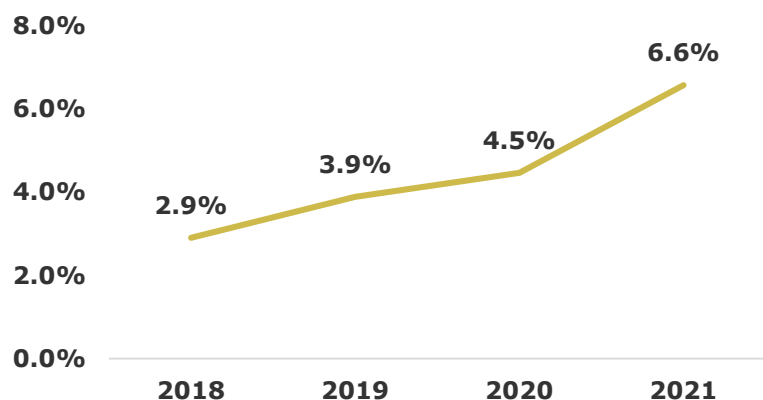
Regional Variation in Screening

Taking a closer look at individual Missouri Metropolitan Statistical Areas (MSAs), MHI found that **in 2021, Cape Girardeau had the lowest screening rate of USPSTF-eligible individuals, with 3.4%. St. Joseph had the highest rate, with 11.5%.**

Figure 4. Lung Cancer Screening Rate Among USPSTF-Eligible Subpopulation by Missouri MSA, 2021

Missouri
6.6%

St. Joseph
11.5%

Columbia
11.1%

Jefferson City
9.5%

Kansas City, MO-KS
8.5%

St. Louis
8.1%

Rural Areas (non-MSA)
5.9%

Cape Girardeau, MO-IL
3.4%

Joplin
7.5%

Springfield
4.4%

Looking at screening relative to diagnosis among USPSTF-eligible individuals across the MSAs, **MHI found that in Cape Girardeau in 2021, the lung cancer diagnosis rate was similar to the screening rate, at 3.6% and 3.4%, respectively.** This differed from the other seven metropolitan areas and rural areas (those not included in any MSAs), which all had approximately two to five times as many screenings as diagnoses within the USPSTF-eligible subpopulation.

Figure 5. Screening and Diagnosis of Lung Cancer Among USPSTF-Eligible Subpopulation by Missouri MSA, 2021

Bar chart showing Screening and Diagnosis rates by location: Cape Girardeau, Columbia, Jefferson City, Joplin, Kansas City, Rural Areas, Springfield, St. Joseph, St. Louis. Y-axis from 0% to 15%.

Legend: ■ Screening ■ Diagnosis
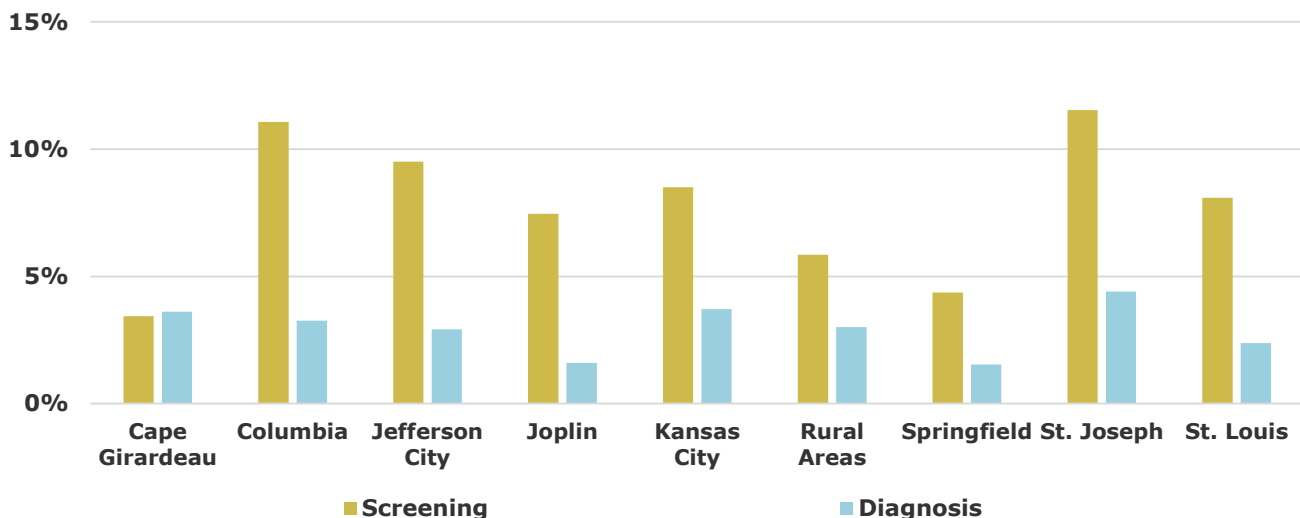
Utilization Comparison of Preventive Screenings

Given that the ACA dictates lung cancer screening as a covered benefit without cost-sharing, the price of screening should not be a barrier to screening for covered individuals. MHI compared the utilization of LDCT screening for lung cancer among eligible people in 2021 with two other screenings that are mandated to be covered without cost-sharing: mammography for breast cancer screening and colonoscopy for colorectal cancer screening.

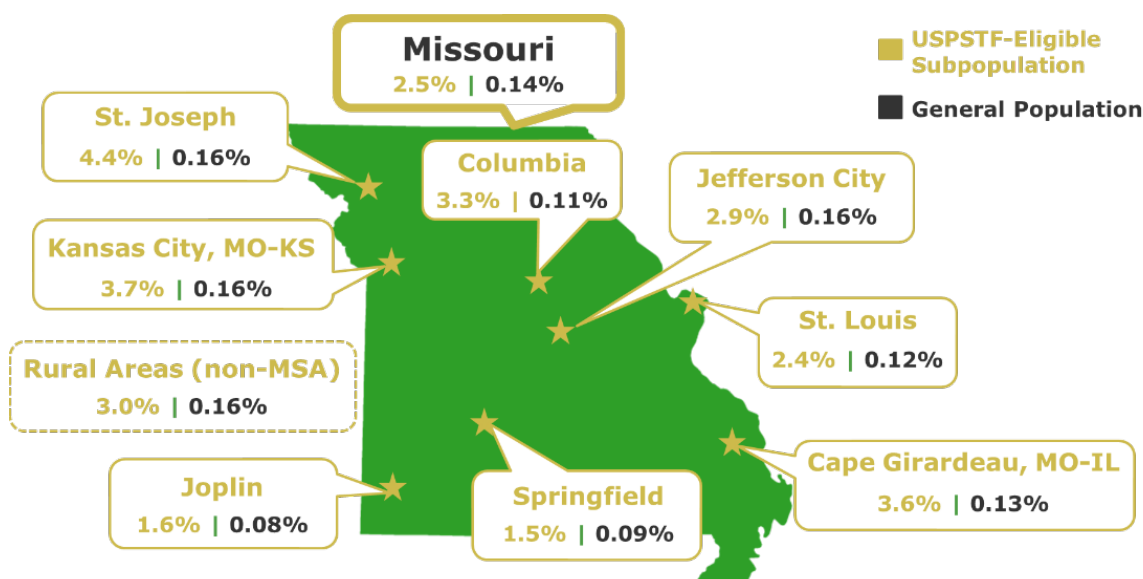**Figure 6. Utilization of Preventive Screenings Among Eligible Individuals, 2021**
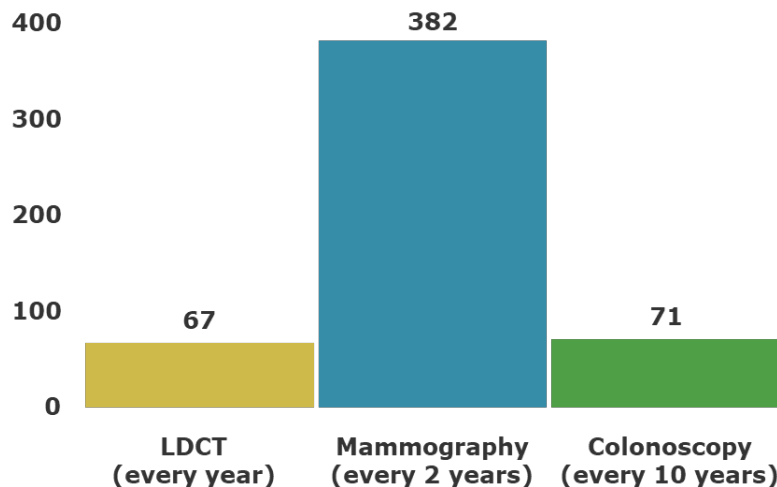
For USPSTF criteria for eligibility, see Appendix II. Breast cancer and colorectal cancer screening are recommended at lower frequencies than lung cancer screening, but were both utilized among eligible individuals at similar or higher rates in 2021. When comparing utilization of these screenings, it is important to remember that not only is lung cancer screening a newer recommendation, but colorectal and breast cancer screenings are recommended for much broader groups of individuals, making public health messaging easier to achieve and identifying potential screening candidates less complicated. These high levels of utilization spark hope for preventive screening rates for lung cancer in the future.

Lung Cancer Diagnosis Among USPSTF-Eligible Subpopulation

To compare regional differences in lung cancer prevalence, MHI examined the rates of lung cancer diagnosis across the Missouri MSAs in the USPSTF-eligible subpopulation and the general population. MHI found that **2.5% of Missouri individuals within the USPSTF-eligible subpopulation were diagnosed with lung cancer in 2021. Lung cancer was at least 16 times more prevalent in the USPSTF-eligible group than the general population** in all of the Missouri MSAs. St. Joseph had the highest rates of lung cancer diagnosis in USPSTF-eligible individuals, followed by Kansas City. However, St. Joseph also had the highest rate of screening among USPSTF-eligible individuals, which could increase the diagnosis rate. St. Joseph, Kansas City, Jefferson City, and rural areas had the highest rates of diagnosis among the general population at 0.16%.

Figure 7. Lung Cancer Diagnosis Rate by Missouri MSA, 2021

Missouri
2.5% | 0.14%

■ **USPSTF-Eligible Subpopulation**

■ **General Population**

St. Joseph
4.4% | 0.16%

Columbia
3.3% | 0.11%

Jefferson City
2.9% | 0.16%

Kansas City, MO-KS
3.7% | 0.16%

St. Louis
2.4% | 0.12%

Rural Areas (non-MSA)
3.0% | 0.16%

Joplin
1.6% | 0.08%

Springfield
1.5% | 0.09%

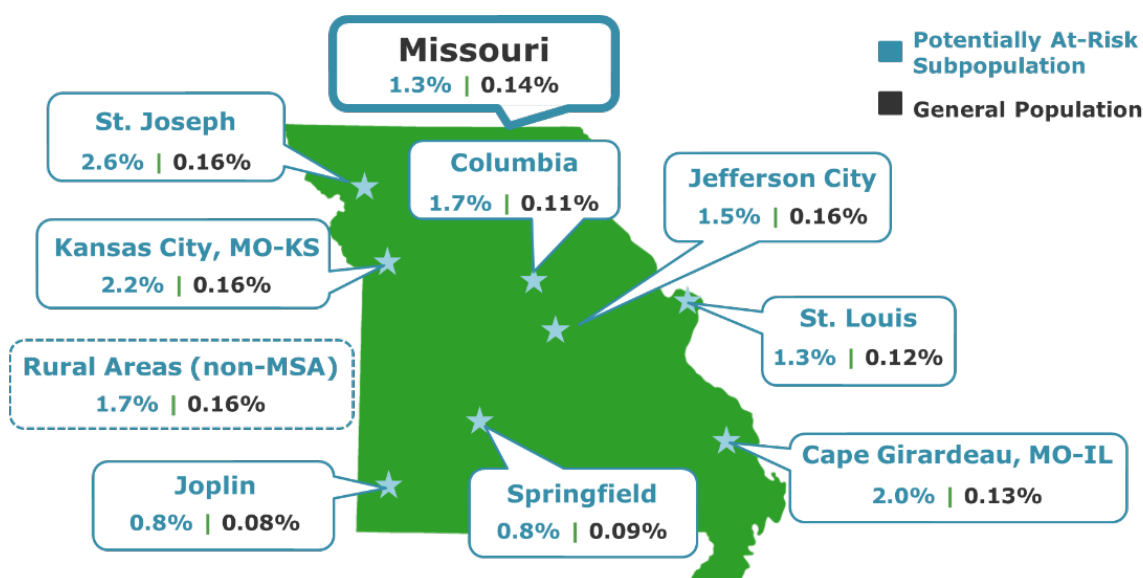**Cape Girardeau, MO-IL**
3.6% | 0.13%

Environmental Risk Factors & Smoking

Because there are individuals who may have an elevated risk for developing lung cancer from other carcinogenic exposures like radon, MHI also examined lung cancer screening and diagnosis trends in a second group, "potentially at-risk", as defined in Figure 2. From 2018 to 2021, on average, 9.1% of adults aged 18 to 80 years old were categorized as potentially at-risk, which was approximately two times as many people as were categorized under USPSTF-eligible criteria.

Comparing the rates of lung cancer diagnosis, MHI found that **lung cancer was at least eight times more prevalent in the potentially at-risk subpopulation than the general population** in all of the Missouri MSAs.

Figure 8. Lung Cancer Diagnosis Rate of Potentially At-Risk Subpopulation by Missouri MSA, 2021

Missouri
1.3% | 0.14%

■ **Potentially At-Risk Subpopulation**

■ **General Population**

St. Joseph
2.6% | 0.16%

Columbia
1.7% | 0.11%

Jefferson City
1.5% | 0.16%

Kansas City, MO-KS
2.2% | 0.16%

St. Louis
1.3% | 0.12%

Rural Areas (non-MSA)
1.7% | 0.16%

Joplin
0.8% | 0.08%

Springfield
0.8% | 0.09%

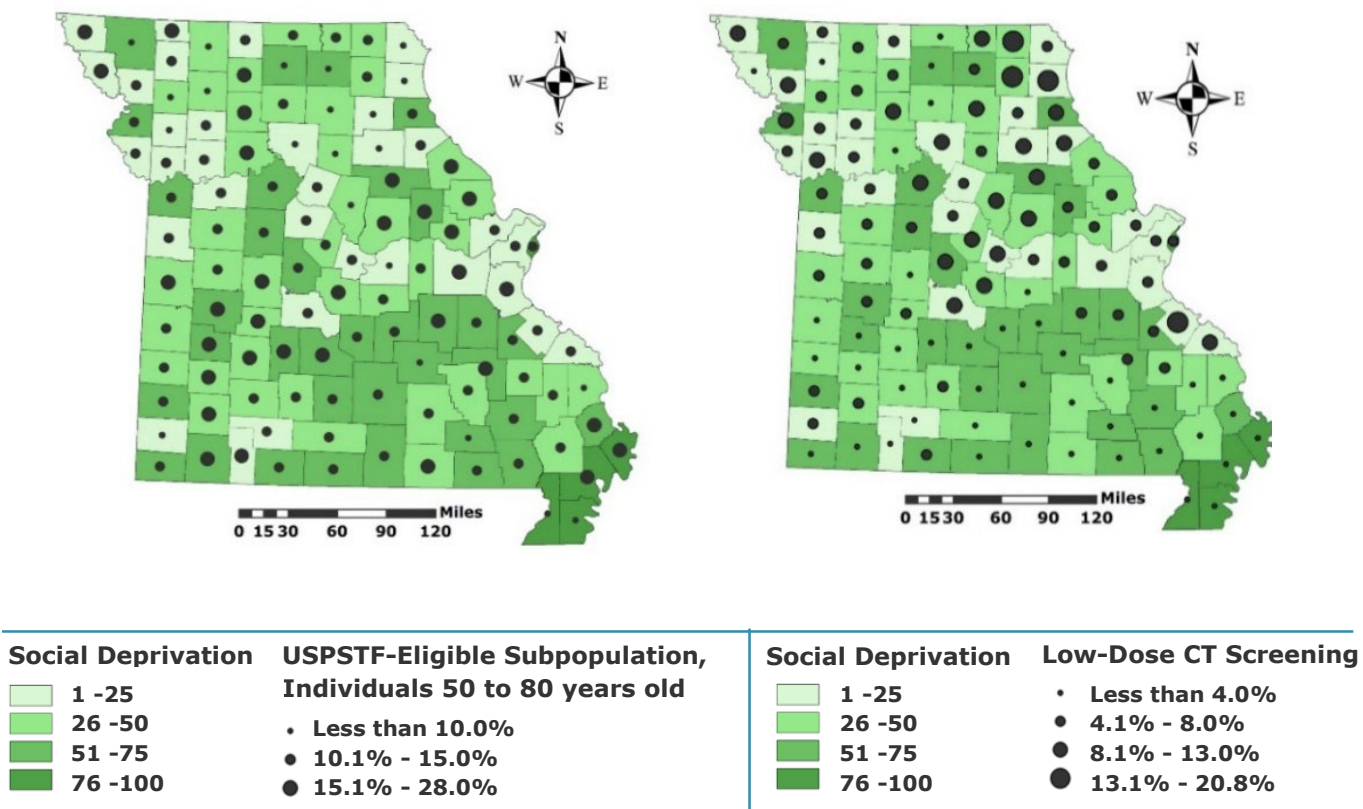**Cape Girardeau, MO-IL**
2.0% | 0.13%

Social Determinants of Health

In order to assess the relationship between social deprivation and lung cancer risk, screening, and diagnosis, MHI utilized the Robert Graham Center's Social Deprivation Index (SDI), which incorporates relevant social factors such as income, education, and employment.

Figure 9 illustrates the relationship between SDI and rates of lung cancer screening eligibility and utilization by Missouri county in 2021. There was no significant correlation between social deprivation and lung cancer screening eligibility rates by county. However, **higher levels of social deprivation were weakly correlated with lower lung cancer screening rates** [r_s = -0.24, p = 0.011].

Figure 9. SDOH and Lung Cancer Screening & Eligibility by Missouri County, 2021

Social Deprivation	USPSTF-Eligible Subpopulation, Individuals 50 to 80 years old	Social Deprivation	Low-Dose CT Screening
1 - 25		1 - 25	• Less than 4.0%
26 - 50	• Less than 10.0%	26 - 50	● 4.1% - 8.0%
51 - 75	● 10.1% - 15.0%	51 - 75	● 8.1% - 13.0%
76 - 100	● 15.1% - 28.0%	76 - 100	● 13.1% - 20.8%

Source: US Census Bureau 2020; Robert Graham Center – SDI Data 2015; Map by MHI 2022

Similarly, MHI found no significant correlation between social deprivation and lung cancer diagnosis rates across Missouri counties in 2021. It is possible that if further analyses were conducted to examine specific variables within the SDI, such as income or education, new or stronger correlations could be found. A full summary of correlations calculated can be found in Appendix III.

Summary of Key Findings
Table 1. Eligibility, Screening, and Diagnosis, 2021

Geographic Region	USPSTF Eligibility Rate*	Screening Rate Among USPSTF-Eligible Subpopulation	Diagnosis Rate Among USPSTF-Eligible Subpopulation	Diagnosis Rate Among General Population
Missouri	**12.4%**	**6.6%**	**2.5%**	**0.14%**
Cape Girardeau MSA	8.5%	3.4%	3.6%	0.13%
Columbia MSA	9.0%	11.1%	3.3%	0.11%
Jefferson City MSA	10.8%	9.5%	2.9%	0.16%
Joplin MSA	10.5%	7.5%	1.6%	0.08%
Kansas City MSA	9.1%	8.5%	3.7%	0.16%
Rural Areas (Non-MSA)	11.4%	5.9%	3.0%	0.16%
Springfield MSA	13.1%	4.4%	1.5%	0.09%
St. Joseph MSA	10.7%	11.5%	4.4%	0.16%
St. Louis MSA	10.3%	8.1%	2.4%	0.12%

Percentage of commercially insured aged 50 to 80 years old eligible under USPSTF lung cancer screening criteria

IV. Improving Lung Cancer Health Outcomes

Clinical Insights

In order to gain a more informed overview of lung cancer in Missouri, MHI connected with three clinicians from St. Louis and Kansas City medical centers with backgrounds in pulmonary oncology and preventive health. The clinicians shared important clinical and practical considerations from their experience, which contributed to a better understanding of why Missouri's lung cancer screening rate may be low (Figure 10), as well as possible actions to improve health outcomes for people with lung cancer.

Figure 10. Potential Reasons for Missouri's Low Screening Rate

1. Low awareness of screening guidelines and the importance of early detection
2. Low awareness of mandatory insurance coverage without patient cost-sharing
3. Patient fear of lung cancer diagnosis
4. Patient failure to accurately report smoking history
5. Patient disinterest in treatment if lung cancer is detected
6. Physicians may be unaware of recent change in USPSTF guidelines
7. Physician hesitancy due to potential screening harm or knowledge of patient clinical status not compatible with treatment

Opportunities for Action

Though Missouri's lung cancer screening rate for eligible individuals has increased in recent years, there is still ample room for improvement. It is crucial to recognize that not all individuals who meet the age and pack-year requirements of the USPSTF guidelines are recommended to receive annual lung cancer screening. Patients who have life-limiting comorbidities or are otherwise unwilling or unable to undergo treatment would not be appropriate candidates.

Despite these contraindications to screening, Missouri lung cancer screening rates are too low. Increased screening would enable earlier lung cancer detection, thereby improving health outcomes and quality of life for patients and their families. Pairing the insights gained through clinician interviews with the key findings from this project, MHI identified the following opportunities for action in Missouri to improve health outcomes (survivability) for patients diagnosed with lung cancer:

1. Ensure Physician Awareness of Recent Update to USPSTF Guidelines

USPSTF guidelines began recommending LDCT lung cancer screening in 2013, and the latest update to these guidelines came during the COVID-19 pandemic, when the health care industry's attention to preventive care was limited. This update lowered eligible age and pack-year criteria. There is an important opportunity to heighten physician awareness through dissemination of educational materials and resources.

2. Equip Providers with Tools to Navigate the Difficult Conversations

Some eligible patients may not want to acknowledge their tobacco use or pursue lung cancer screening for a variety of reasons, some of which may be related to the stigma associated with smoking, disinterest in giving up tobacco, or an unwillingness to undergo lung cancer treatment.

"Historically, lung cancer has been stigmatized as only occurring in people with a history of smoking, which is considered a 'bad habit,'" says Dr. Jun Zhang, Associate Professor, Medical Oncology, University of Kansas Medical Center. *"This stigma may lead to patients withholding information from their primary care physician regarding their smoking history, preventing their physician from recommending screening."*

Public health communication specialists have developed thoughtful tools, such as Project Connect's [discussion guide](#), to aid clinicians in initiating and navigating these sensitive conversations with patients around tobacco use and lung cancer diagnosis and treatment. These resources help enable physicians to guide patients in making informed decisions on continued tobacco use and lung cancer screening.

3. Ensure Easy Access to Screening Across Missouri, Especially for Patients with Greater Social Needs

Many factors likely contribute to the observed weak correlation between Missouri counties with greater social needs and lower levels of lung cancer screening. Policy makers, public health officials, and other health care decision makers could take steps to make it easier to access lung cancer screening by organizing and disseminating information on quality screening sites, instructions for scheduling, operating hours, and suitable public transportation options.

4. Public Health Messaging to Missouri Smokers Emphasizing the Importance of Early Lung Cancer Detection

Targeted messaging educating smokers and their loved ones on the importance of the early detection of lung cancer and the eligibility criteria for screening could greatly improve screening rates among those eligible, enabling earlier detection of lung cancer.

"When lung cancer is detected early, we are often able to remove the tumor with surgery, but advanced lung cancer is treated through more rigorous therapy that is usually aimed at prolonging survival rather than curing the disease completely," says Dr. Ramaswamy Govindan, Professor of Medicine, Division of Oncology, and Director, Section of Medical Oncology, Washington University School of Medicine. *"Patients with a long history of smoking often have other cardiovascular or pulmonary comorbidities that are not favorable for these treatments."*

Though smoking cessation is the ideal choice for health outcomes, it is important that tobacco users who don't desire to quit understand the importance of getting screened annually, if eligible, to increase their chance of survival.

5. Inform Employees of Lung Cancer Screening and Coverage

While coverage is not a barrier to lung cancer screening among insured individuals, employees may not be aware that this service is covered without cost-sharing for those who are USPSTF-eligible. Employers providing educational materials to employees to clarify their benefits could aid in employees' understanding of this coverage, as well as raise their awareness of the importance of lung cancer screening. Including additional materials with screening site locations and operating hours as described in #3 could aid this effort.

Prevention

Though this report mainly focuses on improving early detection of lung cancer through screening high-risk individuals, it must be said that prevention is still the best policy.

It is important that Missouri tobacco users fully understand the implications of smoking on their health (which span much wider than lung cancer) and are made aware of tobacco cessation resources that are available to aid them if they desire to quit or decrease tobacco use. Educational campaigns and tobacco cessation resources, including those emphasizing harm reduction, are necessary to address lung cancer.

Though it is typically associated with smoking, other exposures, such as asbestos and radon, can elevate the risk of lung cancer, especially when combined with tobacco. Ensuring that homes, workplaces, and public places are free from these harmful carcinogens is another important step in decreasing the prevalence of lung cancer. See the Lung Cancer Resources page on MHI's website for more information on radon, the second-leading cause of lung cancer, its associated risks, and testing kit availability.

Missouri Lung Cancer Initiatives

United towards the common goal of improving lung cancer health outcomes for Missourians, several active initiatives are focused on reducing tobacco use and increasing lung cancer screening rates in the state. Connecting key partners and the public around the latest research and evidence-based intervention strategies, the Department of Health and Senior Services' Missouri Comprehensive Cancer Control Program (MCCCP) and the Missouri Cancer Consortium (MCC) began implementing a Screening Improvement Program (SIP) in the fall of 2020 with the goal of improving cancer screening rates for Missouri state employees. Working with various other MCC partners, the SIP launched a multimedia screening educational campaign for all Missouri residents and coordinated educational webinars for state employees, initially focusing on breast and colorectal cancer screening, and adding in lung and other additional cancer screenings as the project continued.[17]

The Department of Health and Senior Services' Tobacco Prevention and Control Program, an important SIP contributor, offers free resources and coaching in tobacco cessation for Missourians aged 13 or older through Missouri Tobacco Quit Services, including a toll-free Quitline that is open 24/7.[18]

V. Conclusion

This report serves to provide policy leaders and decision makers with insights on lung cancer among Missouri's population that can be used to inform data-driven decisions and initiatives to improve health, health care quality, and health care value in our region. Though the lung cancer screening rate of USPSTF-eligible individuals in Missouri has doubled in recent years, there is still room for improvement in screening, as well as in the prevalence of lung cancer in Missouri.

A holistic approach to lung cancer emphasizing prevention, screening for USPSTF-eligible individuals, and appropriate follow-up care for those who are screened is key to improving health outcomes. In order to protect patient safety and wellbeing, it is crucial that messaging and strategies focusing on increasing screening rates only promote screening for appropriate candidates eligible under USPSTF criteria, which require that the patient is able and willing to undergo lung cancer treatment if they are diagnosed. Pairing screening messaging with tobacco cessation educational materials and resources would allow for optimal improvement in Missouri's lung cancer landscape. State entities, legislators, employers, health care providers, and the community all have key roles to play in addressing this prevalent issue in our state in order to improve the health and quality of life of Missourians.

For supplementary data and information, see the [Appendices](#).

For lung cancer and tobacco cessation educational resources and tools, see the [Lung Cancer Resources](#) on the Midwest Health Initiative website.

About the Midwest Health Initiative

The Midwest Health Initiative (MHI) brings together those who provide, pay for, and use health care to share knowledge and develop solutions for the problems that vex our region's health care system. As a Missouri nonprofit health improvement collaborative, MHI is dedicated to generating data insights that support multi-stakeholder collaboration for higher quality, more affordable health care. A belief in power of information and collaboration to transform health care is the common thread that binds MHI's multi-stakeholder leaders and partners.

The MHI Data Set

In addition to its common table, MHI stewards the region's largest commercial claims data set, which includes medical and pharmacy claims, as well as enrollment and provider files, representing care received by more than two million people across Missouri and the metropolitan areas along its borders.

MHI's unique data asset can help our community learn about the health of its residents and the care provided. It also assists physicians, hospitals, and other health care providers in better understanding the care received by their patients.

Acknowledgements

This work is made possible through the support of MHI's Friends and its Champions for Health Care Value. MHI is grateful for their generous support of its mission and work.

- AbbVie
- Anthem Blue Cross and Blue Shield of Missouri
- Bayer
- BJC HealthCare
- Blue Cross and Blue Shield of Kansas City
- The Boeing Company
- Cigna
- Genentech
- Graybar Electric Company, Inc.
- Missouri Consolidated Health Care Plan
- Novo Nordisk Inc.
- St. Louis Area Business Health Coalition
- UnitedHealthcare

MHI is grateful to the following partners for their contributions to this report and dedication to improving lung cancer screening and treatment outcomes in the state of Missouri.

Missouri Department of Health and Senior Services: *Missouri Comprehensive Cancer Control Program* and *Tobacco Prevention and Control Program*

Edward Ellerbeck, MD, MPH, Professor of Population Health and Internal Medicine, *University of Kansas Medical Center*

Ramaswamy Govindan, MD, *Professor of Medicine, Division of Oncology, and Director, Section of Medical Oncology, Washington University School of Medicine*

Jun Zhang, MD, PhD, Associate Professor, Medical Oncology, *University of Kansas Medical Center*

This project was funded by an independent policy grant from **Merck Sharp & Dohme LLC.**

Appendix 1. Data Limitations and Subpopulation Definitions

The USPSTF recommends annual LDCT screening for lung cancer for high-risk individuals, defined as those aged **50 to 80 years old with a 20 pack-year smoking history** who currently smoke or have quit smoking less than 15 years ago. This excludes individuals with health problems that significantly limit life expectancy or who are unable or unwilling to undergo curative lung surgery.[7]

In order to determine the number of individuals within its population that were eligible to receive lung cancer screening, MHI identified a subpopulation within its data set using characteristics available within claims data analysis to come as close as possible to USPSTF eligibility requirements. In this report, this group is referred to as the **USPSTF-eligible subpopulation** and was comprised of individuals aged **50 to 80 years old** coded with Z codes for **tobacco use**. For Z codes used to determine this population, see Table A1.

This methodology included some individuals that would not meet USPSTF eligibility criteria for lung cancer screening, due to the following limitations:

1. Z Codes for smoking do not specify the pack-year history.
2. Some Z codes indicating tobacco use do not specify the form of tobacco.
3. Individuals who quit smoking more than 15 years ago or are unable or unwilling to undergo curative surgery cannot be identified in claims data.

This could potentially decrease this study's rate of screening among USPSTF-eligible individuals, because those who were included in this subpopulation, but did not fully meet the USPSTF criteria may be less likely to be screened.

However, this methodology also leaves some individuals out who would be considered USPSTF-eligible due to the underutilization of coding in medical claims data for tobacco use.

In order to investigate the prevalence of lung cancer among a broader group of individuals coded with exposures associated with an increased risk of lung cancer, MHI defined a second **potentially at-risk** subpopulation. This group included individuals aged **18 to 80 years old** coded for any of the following exposures: tobacco smoking, environmental tobacco, occupational tobacco, radon, asbestos, silica, uranium, arsenic, nickel, chromium, or air pollution. For Z codes used to identify these exposures, see Table A1.

Table A1. Z Codes Utilized to Determine Subpopulations

Z Code	Description	USPSTF Eligible Criteria (one or more)	Potentially At-Risk Criteria (one or more)
Z87.891	History of tobacco dependence	✔	✔
Z72.0	Tobacco Use	✔	✔
F17.210	Nicotine dependence, cigarettes, uncomplicated	✔	✔
F17.211	Nicotine dependence, cigarettes, in remission	✔	✔
F17.213	Nicotine dependence, cigarettes, withdrawal	✔	✔
F17.218	Nicotine dependence, cigarettes, other nicotine-induced disorders	✔	✔
F17.219	Nicotine dependence, cigarettes, unspecified nicotine-induced disorders	✔	✔
Z571	Occupational exposure to radiation		✔
Z5731	Occupational exposure to environmental tobacco smoke		✔
Z5739	Occupational exposure to other air contaminants		✔
Z575	Occupational exposure to toxic agents in other industries		✔
Z77123	Contact with and (suspected) exposure to radon and other naturally occurring radiation		✔

Z77090	Contact with and (suspected) exposure to asbestos		✔
Z77010	Contact with and (suspected) exposure to arsenic		✔
Z77012	Contact with and (suspected) exposure to uranium		✔
Z572	Occupational exposure to dust		✔
Z77028	Contact with and (suspected) exposure to other hazardous aromatic compounds		✔
Z77110	Contact with and (suspected) exposure to air pollution		✔
Z77018	Contact with and (suspected) exposure to chromium or nickel		✔
Z7722	Contact with and (suspected) exposure to environmental tobacco smoke (acute) (chronic)		✔
P9681	Exposure to tobacco smoke in the perinatal period		✔

Appendix 2. Preventive Screening Eligibility

Eligibility for breast and colorectal cancer screenings were determined using USPSTF criteria shown in Table A2.

Table A2. USPSTF Recommendation Criteria for Cancer Screening

Screening (Modality)	Population	Frequency	Grade
Breast Cancer Screening (Mammography)[19]	Women aged 50 to 74	Biennial	B
Colorectal Cancer Screening (Colonoscopy)[20]	Adults aged 50 to 75	Every 10 years	A

Appendix 3. Social Determinants of Health

Robert Graham Center Social Deprivation Index[21]

To assess the relationship between social deprivation and lung cancer risk, screening, and diagnosis, MHI utilized the Robert Graham Center's Social Deprivation Index (SDI), which is a composite measure of social deprivation levels based on these seven demographic characteristics measured by the American Community Survey:

1. Percentage of population below the federal poverty level
2. Percentage of population with less than 12 years of education
3. Percentage of families that are single-parent households with dependents
4. Percentage of households living in rented housing units
5. Percentage of families living in crowded housing units
6. Percentage of households with no vehicle
7. Percentage of population aged 16 to 64 years old that is unemployed

For this project, SDI data was utilized at the county level (Figure 9 and Figure A1) and zip code level (Figure A2 and Figure A3).
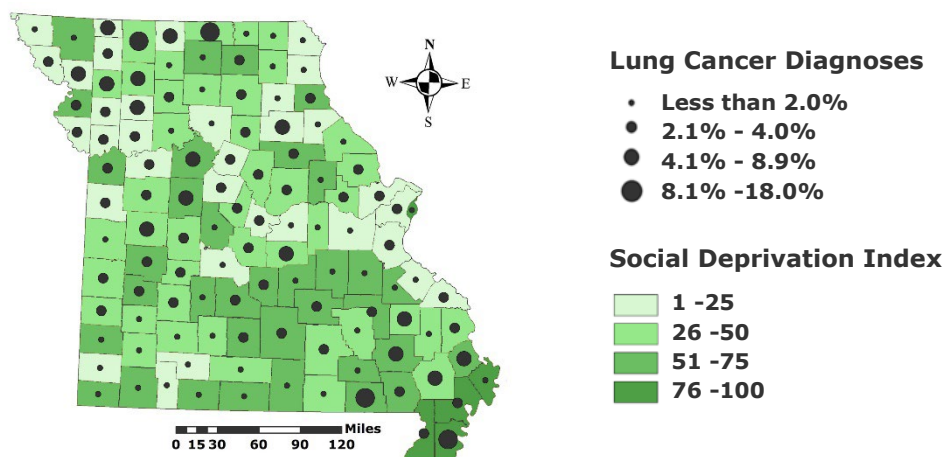
Social Deprivation Index Correlations and Graphs

Table A3. SDOH Spearman's Rho Correlations by Missouri County, 2021

Dependent variable	r_s	p value
Screening Eligibility Rate	-0.0238	0.8005
Screening Rate	-0.236	0.011*
Diagnosis Rate	0.0187	0.8424

*statistically significant correlation

Figure A1. Social Deprivation Index and Lung Cancer Diagnoses Rates by Missouri County, 2021
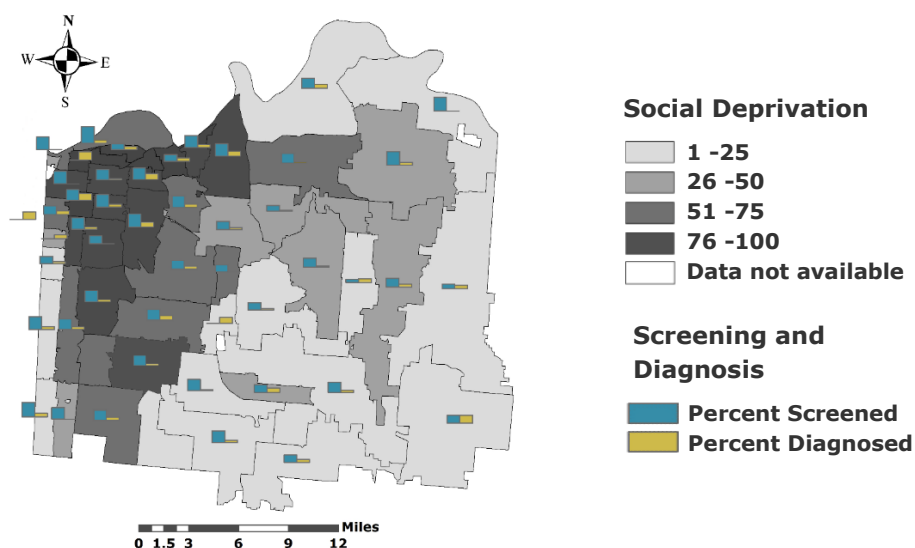

Source: US Census Bureau 2020; Robert Graham Center– SDI Data 2015; Map by MHI 2022

Table A4. SDOH Spearman's Rho Correlations by Zip Code, Jackson County, 2021

Dependent variable	r_s	p value
Screening Eligibility Rate	-0.1491	0.2915
Screening Rate	0.0040	0.9794
Diagnosis Rate	-0.1504	0.348

statistically significant correlation

Figure A2. Social Deprivation Index, Lung Cancer Screening and Diagnoses Rates by Zip Code, Jackson County, 2021

Source: US Census Bureau 2020; Robert Graham Center – SDI Data 2015; Map by MHI 2022

Table A5. SDOH Spearman's Rho Correlations by Zip Code, St. Louis City, 2021

| Dependent variable	r_s	p value
Screening Eligibility Rate	-0.1745	0.4855
Screening Rate	-0.4470	0.06294
Diagnosis Rate	-0.8010	0.003043*

statistically significant correlation

Table A6. SDOH Spearman's Rho Correlations by Zip Code, St. Louis County, 2021

Dependent variable	r_s	p value
Screening Eligibility Rate	-0.0180	0.9083
Screening Rate	0.0928	0.5641
Diagnosis Rate	0.0059	0.9723

statistically significant correlation

Figure A3. SDI and Lung Cancer Screening & Eligibility by Zip Code, St. Louis City and St. Louis County, 2021
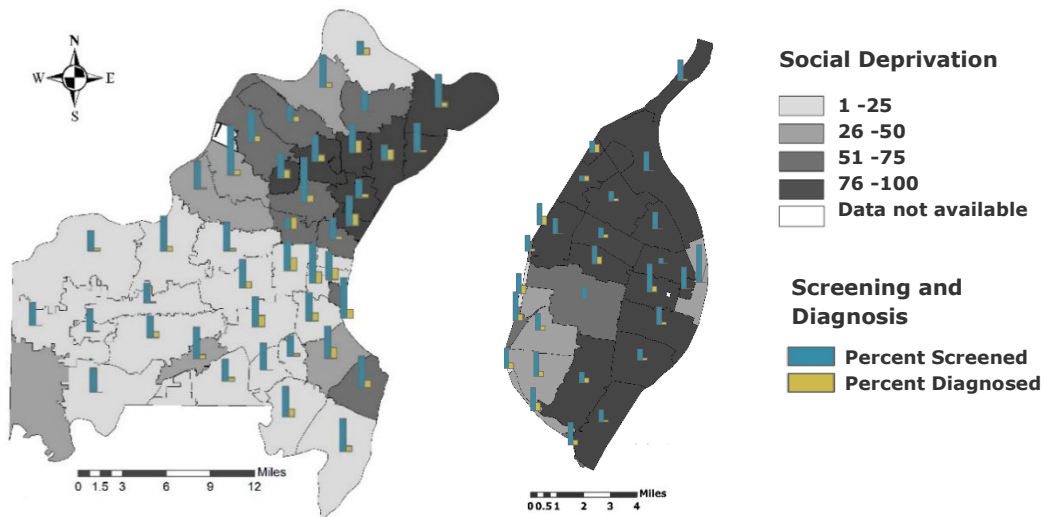
Source: US Census Bureau 2020; Robert Graham Center – SDI Data 2015; Map by MHI 2022

References

1. Lung Cancer Statistics. LUNGevity. https://www.lungevity.org/for-supporters-advocates/lung-cancer-awareness/lung-cancer-statistics#1. Published 2022. Accessed November 9, 2022.

2. Lung Cancer Fact Sheet. American Lung Association. https://www.lung.org/lung-health-diseases/lung-disease-lookup/lung-cancer/resource-library/lung-cancer-fact-sheet#:~:text=The%20five%2Dyear%20survival%20rate. Published November 17, 2022. Accessed November 9, 2022.

3. United States Cancer Statistics: Data Visualizations. Centers for Disease Control and Prevention. https://gis.cdc.gov/Cancer/USCS/#/AtAGlance/. Published November 2022. Accessed December 9, 2022.

4. State of Lung Cancer: Missouri. American Lung Association. https://www.lung.org/research/state-of-lung-cancer/states/missouri. Published November 2022. Accessed December 9, 2022.

5. Moyer VA. Screening for lung cancer: U.S. Preventive Services Task Force Recommendation Statement. *Annals of Internal Medicine.* 2014;160(5):330-338. doi:10.7326/m13-2771

6. Fedewa SA, Bandi P, Smith RA, Silvestri GA, Jemal A. Lung Cancer Screening Rates During the COVID-19 Pandemic. *Chest.* Published online July 2021. doi:10.1016/j.chest.2021.07.030

7. USPSTF Recommends Lung Cancer Screening with Low-dose CT. AAFP. https://www.aafp.org/news/health-of-the-public/20210325uspstflungcancer.html. Published March 25, 2021. Accessed November 9, 2022.

8. PDQ® Screening and Prevention Editorial Board. PDQ Lung Cancer Screening. Bethesda, MD: National Cancer Institute. Updated July 30, 2021. https://www.cancer.gov/types/lung/patient/lung-screening-pdq. Accessed January 15, 2023. [PMID: 26389428]

9. Lung Cancer. University of Kansas Medical Center. https://www.kumc.edu/school-of-medicine/academics/departments/internal-medicine/divisions/medical-oncology/research/lung-cancer.html. Published 2023. Accessed January 27, 2023.

10. MD Anderson Cancer Center, North American Quitline Consortium. Talking with Your Doctor About Lung Cancer Screening. Project CONNECT. https://lungscreen.health/#discussPage. Accessed January 15, 2023.

11. Lung Cancer Risk Factors. Johns Hopkins Medicine. https://www.hopkinsmedicine.org/health/conditions-and-diseases/lung-cancer/lung-cancer-risk-factors. Published August 8, 2021. Accessed November 5, 2022.

12. Radon. American Lung Association. https://www.lung.org/clean-air/at-home/indoor-air-pollutants/radon. Published November 17, 2022. Accessed February 1, 2023.

13. Howlader N, Forjaz G, Mooradian MJ, et al. The effect of advances in lung-cancer treatment on population mortality. *New England Journal of Medicine.* 2020;383(7):640-649. doi:10.1056/nejmoa1916623

14. What to Know About Biomarker Testing for Lung Cancer: An Expert Q&A. Cancer.Net. https://www.cancer.net/blog/2022-06/what-know-about-biomarker-testing-lung-cancer-expert-qa. Published June 9, 2022. Accessed November 9, 2022.

15. Taeger D, Pesch B, Kendzia B, et al. Lung cancer among coal miners, ore miners and quarrymen: smoking-adjusted risk estimates from the synergy pooled analysis of case–control studies. *Scandinavian Journal of Work, Environment & Health.* 2015;41(5):467-477. doi:10.5271/sjweh.3513

16. Preventive services covered by private health plans under the Affordable Care Act. KFF. https://www.kff.org/womens-health-policy/fact-sheet/preventive-services-covered-by-private-health-plans/. Published October 26, 2022. Accessed January 15, 2023.

17. Phillips MA, Chavez S, Grotefendt M, et al. Implementing educational and systems-level changes to improve cancer screening rates among state employees in Missouri. *Preventing Chronic Disease*. 2022;19. doi:10.5888/pcd19.220155

18. Smoking and Tobacco. Missouri Department of Health and Senior Services. https://health.mo.gov/living/wellness/tobacco/smokingandtobacco/#:~:text=Missouri%20Tobacco%20Quit%20Services%20is,day%2C%20seven%20days%20a%20week. Accessed January 15, 2023.

19. Breast Cancer: Screening. U.S. Preventive Services Task Force. https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/breast-cancer-screening. Published January 11, 2016. Accessed January 15, 2023.

20. Colorectal Cancer: Screening. US Preventive Services Task Force. https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/colorectal-cancer-screening#tab1. Published May 18, 2021. Accessed January 15, 2023.

21. Social deprivation index (SDI). Robert Graham Center - Policy Studies in Family Medicine & Primary Care. https://www.graham-center.org/rgc/maps-data-tools/sdi/social-deprivation-index.html. Published November 5, 2018. Accessed January 15, 2023.