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# DISPARITIES IN ACCESS TO CHEMOTHERAPY AMONG KENTUCKY STAGE IV NON-SMALL CELL LUNG CANCER PATIENTS

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# DISPARITIES IN ACCESS TO CHEMOTHERAPY AMONG KENTUCKY STAGE IV NON-SMALL CELL LUNG CANCER PATIENTS

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CAPSTONE THESIS

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A paper submitted in partial fulfillment of the
requirements for the degree of Master of Public Health
in the College of Public Health at the University of Kentucky

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**ABSTRACT**

**OBJECTIVE:** This population-based retrospective cohort study examines the association of sociodemographic disparities with the receipt of chemotherapy among patients with metastatic non-small cell lung cancer in the Commonwealth of Kentucky in the precision oncology and immunotherapy era.

**METHODS:** Kentucky Cancer Registry data from 2010 through 2017 was analyzed using univariate, bivariate, unadjusted, and adjusted multivariate regressions to assess disparities in our population (N = 9490).

**RESULTS:** We found no significant difference in receipt of chemotherapy between sexes (OR 0.99, P=0.90) nor races (OR 1.12, P=0.22). Patients diagnosed in an Appalachia county were significantly less likely to receive chemotherapy (OR 0.71, P<0.01) compared to non-Appalachia. Patients who received chemotherapy were significantly younger compared to those who did not (63.1 vs 69.8 years, respectively, P<0.01). Patients who were married or lived with a domestic partner were significantly more likely to receive chemotherapy (OR 1.71, P<0.01) than those who lived alone. Patients with Medicare (OR 0.73), Medicaid (OR 0.54), and no insurance (OR 0.49) were significantly less likely to receive chemotherapy compared to privately insured. Patients who ever used tobacco products were significantly less likely to receive chemotherapy (OR 0.82, P<0.01).

**CONCLUSIONS:** Higher proportions of patients have received chemotherapy over time. Receipt of life-prolonging chemotherapy is associated with patients' age, Appalachian status, marital/living status, insurance type, and tobacco use.

**KEYWORDS:** Appalachia, Chemotherapy, Kentucky, KCR, Non-small Cell

DISPARITIES IN ACCESS TO CHEMOTHERAPY AMONG
KENTUCKY STAGE IV NON-SMALL CELL LUNG CANCER PATIENTS

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2. Kentucky Cancer Registry

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## INTRODUCTION

Lung cancer is the third most common cancer in the United States (US) and is the leading cause of cancer mortality accounting for approximately 25% of all cancer-related deaths. It is estimated that in 2021 there were 131,880 deaths from lung cancer alone. [1] Similar to other malignancies, early-stage lung cancer is often curable, however up to 56% of lung cancer patients are diagnosed with metastatic disease. The overall five-year survival rate for lung cancer is 21.7% but is only 6.3% for metastatic disease. [2] Lung cancer is most common in the southeastern portion of the US with Kentucky at the epicenter. In 2018, Kentucky had the highest rate of lung cancer incidence and mortality with 82.8 per 100,000 people and 53.5 per 100,000 people, respectively. [3] Lung cancer consists of two subtypes: small cell carcinoma and non-small cell lung cancer (NSCLC), with NSCLC accounting for 85% of all lung cancers. [1] Over the past decade the treatment paradigm for NSCLC has rapidly evolved, leading to significant improvements in overall survival, progression free survival, and quality of life.

Historically, treatment for advanced NSCLC has consisted of induction platinum-doublet systemic chemotherapy followed by single-agent chemotherapy maintenance regimens including agents such as cisplatin, carboplatin, pemetrexed, and gemcitabine. [4] Over the last decade, precision oncology and the treatment of NSCLC has been revolutionized through advancements in biomolecular testing, targeted therapies, and immune checkpoint inhibitors such as pembrolizumab (Keytruda) and atezolizumab (Tecentriq). [5-14] Subsequently, lung cancer mortality has shown significant improvements. According to recent data from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) database, the lung cancer mortality rate in 2008 was 49.6 per 100,000 people but decreased to 33.4 per 100,000 people in 2019. [3] These advances in the management of NSCLC have greatly improved the quality of care, setting new standards. [4] However, this

rapid transformation in treatment has unknown implications on socioeconomic disparities in lung cancer that this study aims to address.

Previous studies have examined disparities in access to treatment for all cancer types including NSCLC. [15, 16] However there remain limitations and a lack of focus on certain populations in these studies. Kentucky, particularly eastern Kentucky, not only has a high incidence of lung cancer, but also has risk factors associated with lung cancer itself: reduced access to medical care, high rates of poverty, and low educational attainment. [17, 18] In this population-based retrospective cohort study, we assess sociodemographic disparities in the management of metastatic NSCLC in the Commonwealth of Kentucky in the precision oncology and immunotherapy era.

**LITERATURE REVIEW**

Prior studies have been conducted looking at disparities in access to treatment for all cancer types including NSCLC. [15, 16] Variables studied included access to oncologists, age, race, ethnicity, sex, insurance, urban vs rural status, comorbidities, education, socioeconomical status, and social support. [19] Ganti et al. used SEER and MarketScan data reporting that upwards of 12% of all patients do not have appropriate access to see a cancer specialist. [20] King et al. looked at adult cancer survivors for factors that impacted delay of treatment in minorities, using National Health Interview Survey data from 2000-2011. They reported that Hispanics most commonly delayed treatment due to organizational barriers and blacks delayed treatment due to transportation barriers. Additionally, they reported that age, insurance, and comorbidities were all significant factors that contributed to disparities. [21]

Multiple studies have assessed access to chemotherapy over time and most suggest that access to chemotherapies for NSCLC patients has increased over the past few decades. Earle et al. looked at Stage IV NSCLC patients from 1991-

1993, reporting that only 22% of patients received chemotherapy. Patients that were younger, had fewer comorbidities, were not African-American/black, had higher socioeconomical status (SES), and were treated at academic hospitals were more likely to get treatment. [22] Lang et al. reported a similar finding of 28% patients receiving chemotherapy using SEER data. Lang also reported that males were more likely to get treatment than females (OR 1.14, 95% CI 1.06-1.22). [23] Similarly, Patel et al. used European Cancer Registry data for all stages of lung cancer from 1994-2003 and observed an increase in receipt of chemotherapy over time (15% to 30%). [24] Sacher et al. in Ontario, Canada analyzed stage IV NSCLC patients, from 2005-2009, reporting 24% of patients received first line chemotherapy. [25] More recently, Simeone et al. looked at stage IV NSCLC patients in the Flatiron database from 2013-2017. They reported that overall, 73.3% of patients received any kind of chemotherapy with platinum-doublet and immunotherapies being the most common first line and second line treatments, respectively. [26] Fortunately there has been an increase in the proportion of patients receiving chemotherapy over time. However, among stage IV NSCLC patients, whom all are indicated for chemotherapy based on clinical practice guidelines, there remains a significant proportion of patients that do not receive chemotherapy. The extent of disparities in the precision oncology and immunotherapy era is not yet clear.

Recent studies have investigated known disparities among specific populations for receiving targeted inhibitors, systemic chemotherapy, and some immunotherapies. Chou et al. looked at advanced stage (stage IIIB/IV) NSCLC patient SEER data assessing disparities in oral tyrosine kinase inhibitors (geftinib, erlotinib, crizotinib, ceritinib, and afatinib) focusing on low-income subsidy (LIS) for Medicare part D patients (aged 65 and older). They used LIS as a surrogate for poverty and theorized that patients receiving more financial support through a LIS, would be more likely to start treatment. They were able to demonstrate that

patients receiving the full LIS were more likely to receive treatment compared to those receiving only partial LIS or no LIS (HR 0.77, 95% CI 0.62-0.97 and HR 0.87, 95% CI 0.79-0.95, $p<0.01$ respectively). This shows the financial barrier of out-of-pocket costs associated with oral chemotherapy, especially among those impoverished. [27] Duma et al. conducted a unique study assessing the sociodemographic variables that affect patient refusal of chemotherapy for stage IV NSCLC identified by the National Cancer Database (NCDB). Overall, 10.3% of patients refused recommended chemotherapy, which increased over time. They also found that chemotherapy refusal was associated with low income, lack of insurance (OR 2.24), Medicaid (OR 2.17), and Medicare (OR 1.17). [28]

Maguire et al. analyzed California Cancer Registry data for stage IV NSCLC patients 20 years of age or older. Their initial analysis identified disparities in receiving any type of systemic therapy. They reported that Asians were more likely to receive chemotherapy compared to any other race (OR 1.12) and patients who had Medicaid insurance or were uninsured were less likely to receive systemic therapy (OR 0.78 and OR 0.68, respectively). Their secondary analysis focused on the use of bevacizumab, a vascular endothelium growth factor inhibitor. Among this subpopulation, blacks (OR 0.71), Hispanics (OR 0.72), patients with Medicaid insurance (OR 0.57), and lower SES (OR 0.75) were less likely to receive bevacizumab. [29] Kehl et al. conducted a similar study using SEER-Medicare data of stage IV lung cancer for patients 65 and older. They stratified their analysis looking at receipt of any systemic therapy and immunotherapy specifically. For receipt of any systemic therapy, they reported that blacks were less likely to receive treatment compared to non-Hispanic whites (OR 0.82) and those among the highest poverty rates compared to lowest poverty rates (OR 0.80). However, once stratified to receipt of immunotherapy, they found no significant differences in race, insurance, education, nor poverty. [30] O'Connor et al. conducted a cohort study using Flatiron Health Database looking at race disparities among advanced

melanoma, renal cell carcinoma, and NSCLC with receipt of anti-PD-1 agents. They reported no significant differences in race and this study did include a large proportion of NSCLC patients compared to melanoma and renal cell carcinoma. [31] Verma et al. assessed racial and insurance disparities in the use of immunotherapy in stage IV NSCLC. They found that black patients (OR 0.86), the uninsured (OR 0.84), and Medicaid patients (OR 0.83) were less likely to get treatment. They also found higher likelihood of treatment among those with higher education (OR 1.14). [32]

Although there are some conflicting findings from these studies, there remains common trends throughout. These include evidence that non-white race, older age, low income or SES, lower education, and being uninsured are risk factors for not receiving recommended therapies for the treatment of metastatic NSCLC. Most of these studies examined large datasets from national databases, such as SEER or the NCDB, which provides them power for finding significant differences however masks their accurate assessment of certain subpopulations. Particularly when looking at Appalachia Kentucky where minorities, especially Asians, are a very small proportion of the population.

*Appalachia and Rurality Disparities in NSCLC*

Extensive research is being devoted to understanding the health disparities in Appalachian regions regarding various areas including NSCLC. Ray et al. conducted a study to evaluate rural versus urban disparities in NSCLC treatment among the Delta Regional Authority area. This area is comprised of 8 different states including western Kentucky. They found that institution-level disparities were most prominent regardless of home rurality status. They showed that patients treated at urban institutions were more likely to receive stage-preferred treatment (OR 1.68, 95% CI 1.44-1.96). Additionally, they analyzed hazard of death and reported that treatment at urban institutions was less hazardous than rural

institutions (HR 0.80). [33] This study combined with the findings of Pham et al. could potentially exemplify worse disparities for rural Appalachia health. Pham et al. used Kentucky Cancer Registry data to assess the effect of "migration" from hospitals after diagnosis of NSCLC. They found that 73% of patients stay at their initial hospital for treatment. However, migration to a different hospital was associated with non-metastatic staging, younger age, longer overall survival (OS) among all stages of disease, and private insurance. Their analysis connects the relationship between NSCLC survival benefit and insurance status. [34] Johnson et al. analyzed the relationship between survival disparities in NSCLC and rurality using the Georgia Cancer Registry. They found that rural residents had increased odds of unstaged disease (OR 1.63), decreased odds of receiving radiation therapy (OR 0.89), and chemotherapy (OR 0.92). They further analyzed census tracts and found those with lower educational levels were associated with decreased odds of receiving chemotherapy as well (OR 0.74). Of note, rural residents did not have poorer survival after adjusting for treatment and even presented a lower risk of death for early-stage disease (HR 0.90). This supports the idea that poor survival is not inherent in rural or Appalachian patients themselves but rather, their access to adequate treatment is to blame. [35]

## METHODS

### *Data Source*

This retrospective, population-level cohort study examined data collected from patients aged 18 years and older diagnosed with stage IV NSCLC, as their primary and first cancer, from 2010 through 2017, identified by the Kentucky Cancer Registry (KCR). All patient cases were residents of Kentucky at the time of diagnosis, as identified by the KCR. Any case with residence in a different state was excluded. The KCR, established in 1991, is a population-base cancer incidence registry. It is part of the National Cancer Institute's SEER and the Centers for Disease Control and Prevention's National Program of Cancer Registries (NPCR). The KCR is also an active participant in the North American Association of Central

Cancer Registries (NAACCR) holding numerous Gold Certifications from the NAACCR, meeting the highest standards for complete, accurate, and timely data. [36, 37] The KCR provided data for stage IV NSCLC patients with the following variables: sex, race, age at diagnosis, tobacco use, marital status at diagnosis, insurance, county at diagnosis, Appalachian county at diagnosis, treatment modality, vital status, survival status, and survival interval. In 2018, the American Joint Committee on Cancer (AJCC) released the 8$^{th}$ edition of their AJCC Cancer Staging Manual. Due to the changes in the 2018 AJCC staging criteria for lung cancer, it was not possible to compare patients diagnosed with stage IV NSCLC in 2018 to patients diagnosed with stage IV NSCLC in previous years. Thus, the data for this study were limited to the eight year period 2010-2017. [38] KCR uses the Facility Oncology Registry Data (FORD) Standards for defining and recording patient information in their registry. According to the FORD standards chemotherapy is defined as: cancer therapy that achieves its antitumor effect through the use of antineoplastic drugs that inhibit the reproduction of cancer cells by interfering with DNA synthesis and mitosis. [39]

*Exclusions and Modifications*

Patients with non-binary sex or missing race were excluded from the study. The few patients that had missing data were excluded, creating a complete data set to run our analyses. Kentucky has a unique population with very few minority groups other than blacks. Therefore, race was dichotomized as black/non-black. Marital status was condensed to three categories: “Single/lives alone,” “Married/Domestic Partner,” and “Other/unknown.” Patients who were divorced, separated, or widowed were considered single/lives alone. This decision was made due to patients’ social support system being comprised of the people the patients interact with and live with, regardless of legal marital status, but rather living status. Marital/living status does not fully encompass social support however, it most closely represents the patients’ social support system, as a

surrogate marker, than marital status alone. Insurance was characterized as private, Medicare, Medicaid, and no insurance. Tobacco use (all types; cigarette, cigar, pipe, chewing tobacco) was condensed to 'ever users' and 'never users' for analysis. Lastly, the basis of the study is to assess receipt of chemotherapy. Therefore, treatment modality was categorized as patients who received chemotherapy and those who did not receive chemotherapy.

*Statistical Analysis*

The primary focus of this study looked at the association between Appalachian residence diagnosed with NSCLC and receipt of chemotherapy, a discrete variable. First, a Kaplan-Meier survival graph was constructed to visualize the differences in stage IV NSCLC survival between patients who did and did not receive chemotherapy. Descriptive, univariate statistics for all demographics were calculated. Bivariate analyses were conducted using a chi-square test to compare differences in categorical variables and student's t-tests were utilized to compare differences in continuous variables. The association of receiving chemotherapy and being an Appalachian resident at diagnosis, while controlling for age, sex, race, marital/living status, insurance type, and tobacco use was assessed using multivariate logistic regression. First, using all independent variables, a saturated unadjusted logistic regression model was performed. Only variables that were significantly ($p<0.05$) associated with the receipt of chemotherapy were retained in the final logistic regression. All statistics were calculated using the Statistical Analysis System (SAS) version 9.4. This study was approved by the institutional review board at the University of Kentucky.

## RESULTS

*Baseline Characteristics*

From 2010 through 2017, there were 9,524 Kentucky residents diagnosed with stage IV NSCLC and reported to the Kentucky Cancer Registry. Two patients were excluded based on non-binary sex, one patient had missing race, and 31 patients were excluded due to missing smoking data, leaving 9,490 (N) patients to be analyzed. The average age was 66.6 years, 56.8% were males, 93.5% were white/other, 50.6% were married or lived with a domestic partner, 61.4% had Medicare insurance, 85.7% had ever used tobacco, 33.9% were Appalachian county residents, and 47.4% received chemotherapy (Table 1).

*Bivariate and Multivariate Analyses*

From 2010 through 2017, people with stage IV NSCLC in Kentucky who received chemotherapy were significantly younger on average compared to those who did not receive chemotherapy (63.1 years vs 69.8 years, respectively, P<0.01) (Table 2). There was no difference in the receipt of chemotherapy by sex (OR 0.99, 95% CI 0.92 – 1.08, P = 0.90) (Table 3). In our unadjusted model, those who received chemotherapy were more likely to be of black race compared to white/other race (OR 1.21, 95% CI 1.03 – 1.42, P = 0.02). However, this became non-significant once adjusting for other variables (OR 1.12, 95% CI 0.94 – 1.34, P = 0.22) (Table 4). Those who received chemotherapy were more likely to be married or living with a domestic partner compared to those who were single or living alone (OR 1.71, 95% CI 1.56 – 1.87, P <0.01). Those who received chemotherapy were more likely to have private health insurance compared to Medicare (OR 0.73), Medicaid (OR 0.54), and those who were uninsured (OR 0.49). Those who received chemotherapy were more likely to have never used tobacco compared to ever users (OR 0.66, 95% CI 0.54 – 0.80, P <0.01). Those who received chemotherapy were more likely to be residents of a non-Appalachian county

compared to those residents of an Appalachian county (OR 0.71, 95% CI 0.65 – 0.78, P < 0.01) (Table 4).

## DISCUSSION

The advancements in the treatment of NSCLC over the past decade have led to significant survival benefit. [5-14] Our investigation of 9,524 Kentucky patients with stage IV NSCLC demonstrates a significant survival difference between those who received chemotherapy and those who did not (Figure 1). Consistent with our primary hypothesis, we found significant disparities in receipt of chemotherapy by Appalachian status, age, marital/living status, insurance, and tobacco use. We found no differences in receipt of chemotherapy among sexes or races.

### *Appalachia*

Appalachian disparities in public health and access to health care have been and continue to be evident in Kentucky. We found that patients who were residents of an Appalachian county from 2010 through 2017 were less likely to receive chemotherapy for the treatment of their metastatic NSCLC, compared to those residents of non-Appalachian counties. Appalachian regions of Kentucky, on average, are poorer, have lower educational attainment, smoke more, and subsequently have less access to care. [17, 18, 40] Based on the results of Pham et al. and Ray et al., transportation also appears to be a factor contributing to this disparity. [33, 34] Some patients must receive treatments as often as once a week with additional labs and monitoring. If there are no cancer treatment centers near the patient, they must travel long distances accruing additional costs. These socioeconomic characteristics of Appalachian residents present significant barriers to access to care. Programs like the University of Kentucky Markey Cancer Center (MCC) affiliate hospital network work to help patients in Appalachia, as well as non-Appalachian of the state, gain access to high-quality cancer services in

their communities. [41] Programs like MCC are essential to helping reduce the disparities for NSCLC patients in Appalachia regions of Kentucky.

*Age*

We found that patients who received chemotherapy were significantly younger than those who did not. Historically, chemotherapy agents were non-specific and toxic drugs that had large and somewhat daunting adverse effect profiles. These drugs were poorly tolerated by most patients that received them for treatment, young and old. [42] This caused oncologists to become cautious about the use of these medications in their older patients. Fortunately, newer drug alternatives with more favorable adverse effect profiles have come to market that patients tolerate better. However, perceptions of traditional chemotherapy and prior treatment practices remain in effect, causing fewer elderly patients to receive treatment than perhaps should. [43] Oncology is a unique field because disease management has become very patient specific, down to genetic testing. Therefore, standard practice is to have open, honest conversations about test results, treatment options, and weigh benefits versus risks with patients. Due to the chemotherapy perception and potential fear of adverse effects, many oncologists and patients may decline treatment despite advancements over the years. This is a reminder of how pharmacists can provide valuable chemotherapy counseling that can improve patient care and public health. This will continue to be important in this new era of NSCLC treatments and as treatment advances further.

*Race*

In our unadjusted model it appeared that blacks were more likely to receive chemotherapy compared to whites. However, this association was not significant after adjustment for other factors. Prior studies have presented conflicting results for disparities among races. King et al. found that Hispanics and

blacks were more likely to delay treatment. [21] Earle et al. found that non-black race was associated with higher likelihood of receiving treatment. [22] Kehl et al. found that receipt of any systemic therapy was less likely in blacks compared to non-Hispanic whites. However, after stratifying by treatment subtype (i.e. immunotherapy vs chemotherapy), they found no difference. [30] Additional studies have assessed chemotherapy receipt disparities among races both in NSCLC and other cancer types, with similar findings. [31, 32] Although there seems to be varying results on disparities between races, it seems apparent that through the past decade, disparities among newer treatment modalities have dwindled compared to historic trends. One important note for our study is the unique population of Kentucky residents. Kentucky is comprised of very few minority groups which is different than many other states.

*Marital/Living Status*

We found that those who were married or living with a domestic partner were significantly more likely to receive chemotherapy compared to those who were single or lived alone. Social support among cancer patients is a well described phenomenon that is intertwined and impacts patients' mental wellbeing, feeling of identity, feeling of security, and physical health. A cancer diagnosis and treatment changes patients' and their families' lives significantly. It has far reaching impacts on patients' daily activities, relationships, work, and psychological stress. [44] Patients' social support includes financial, physical, emotional, spiritual, and transportation, all of which are factors affecting healthcare. Patients with larger support systems around them are more likely to be able to pay for necessary medical services, have reliable income if they lose their job or must stop working, have reliable transportation to treatment centers, and have physical support if they experience adverse events or feel ill from chemotherapy. Marital/living status alone does not fully encompass patients' social support system however using this as a surrogate marker proves some

useful insight into the concept of social support surrounding cancer patients. Additionally, our findings are consistent with previous research and highlights the continued importance of social support for NSCLC patients.

*Insurance Type*

Consistent with previous studies, compared with privately insured, stage IV NSCLC patients with Medicaid, Medicare, or no insurance were less likely to receive chemotherapy. [27-29, 32] In our unadjusted model Medicaid patients were the most likely to receive chemotherapy of the group. However, after adjusting for age among other factors, Medicare patients were the most likely to receive chemotherapy which is consistent with previous literature. This suggests that age may possible be a confounder for insurance type. However, further research is needed to fully understand this relationship. Patients with Medicare, who were more likely to receive chemotherapy than the other two groups, are known to have healthcare barriers compared to those privately insured. Medicare patients may have less hospital services coverage, potential formulary restrictions, and higher drug costs. All of which are crucial with new and expensive chemotherapy or immunotherapies. Medicare patients, who were most likely to receive chemotherapy, face these barriers, let alone those with Medicaid or no insurance who potentially face more barriers.

*Tobacco Use*

Tobacco use (specifically tobacco smoking), although a well-known risk factor for developing lung cancer, has not been well explained as a risk factor for receipt of chemotherapy. We found that patients who received chemotherapy were more likely to have never used tobacco compared to those who had ever used. It is known that individuals that smoke are consistently found to be poorer, have lower educational attainment, and have more comorbidities than those who have never used tobacco. [45-49] Additionally, patients who smoke are known to

have biological changes in their respiratory tract affecting lung function. Thus, we theorize that patients who smoke may have more advanced disease, poorer lung function, poorer overall health, and less healthcare insurance leading them to be less likely to tolerate chemotherapy and receive it less often. However, further research is warranted to fully understand this phenomenon.

*Limitations*

The main limitation to this study is that the exact type or subtype of chemotherapy was not recorded in the KCR data set. There may likely be differences between more traditional chemotherapies and newer targeted therapies that this study could not assess. Treatments for stage IV NSCLC can range from months to years with varying agents used. Therefore, this information is hard to collect without matching insurance claims data. However, this study was conducted on a population level consisting of all patients diagnosed with stage IV NSCLC in Kentucky from 2010 through 2017. This large sample size allows for generalizability to various other states' populations that may be similar.

**CONCLUSIONS**

Consistent with our primary hypothesis, this study found that residents of Appalachian Kentucky diagnosed with stage IV NSCLC are significantly less likely to receive chemotherapy compared to non-Appalachian residents. Additionally, this study found that being single or living alone, tobacco use, and insurance type were also associated with a decreased likelihood of receiving chemotherapy. Consistent with other studies, access to chemotherapy for stage IV NSCLC appears to be associated with new therapies becoming available. These newer therapies appear to be more equally utilized among different groups of people, reducing the historical disparities among sex and race. These results highlight the impact that hospital affiliate networks and adequate patient counseling can have in reducing

these disparities. These results also aid future research looking to further understand these disparities, as treatment for NSCLC advances.

## TABLES AND FIGURES

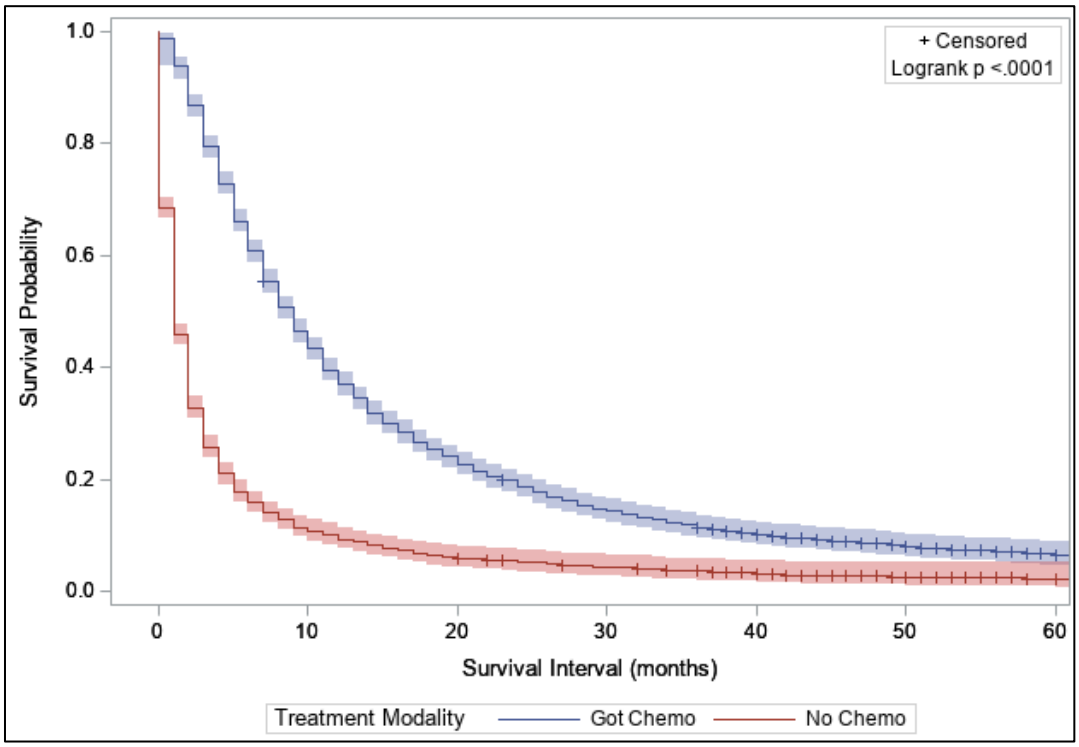


**Figure 1.** Kentucky Stage IV NSCLC Survival Curve by Receipt of Chemotherapy, 2010-2017

**Table 1.** Characteristics of Kentucky Stage IV NSCLC Patients, 2010-2017 (Univariate analysis)

| **Variable** | **(N = 9490)** |
|---|---|
| *Appalachia (n,%)* | |
| Non-Appalachia | 6273 (66.10) |
| Appalachia | 3217 (33.90) |
| *Age at Diagnosis* | |
| Mean | 66.63 (11.09) |
| *Sex (n,%)* | |
| Male | 5392 (56.82) |
| Female | 4098 (43.18) |
| *Race (n,%)* | |
| White/other | 8869 (93.46) |
| Black | 621 (6.54) |
| *Marital/Living Status (n,%)* | |
| Single/Lives Alone | 4450 (46.89) |
| Married/Domestic Partner | 4802 (50.64) |
| Other/Unknown | 238 (2.51) |
| *Insurance (n,%)* | |
| Private | 2106 (22.19) |
| Medicare | 5825 (61.38) |
| Medicaid | 1142 (12.03) |
| Uninsured | 346 (3.65) |
| Unknown | 71 (0.75) |
| *Tobacco Use (n,%)* | |
| Never user | 547 (5.76) |
| Ever user | 8136 (85.73) |
| Unknown | 807 (8.50) |
| *Treatment Modality (n,%)* | |
| No Chemotherapy | 4988 (52.56) |
| Chemotherapy | 4502 (47.44) |

**Table 2.** Characteristics of Kentucky Stage IV NSCLC by received or did not receive chemotherapy, 2010-2017 (Bivariate Analyses)

| Variable | No Chemo (n = 4988) | Got Chemo (n = 4502) | P |
|---|---|---|---|
| *Appalachia (n,%)* | | | |
| Non-Appalachia | 3144 (50.12) | 3129 (49.88) | **<0.01** |
| Appalachia | 1844 (57.32) | 1373 (42.68) | |
| *Age at Diagnosis* | | | |
| Mean (std.) | 69.8 (11.00) | 63.1 (10.12) | **<0.01** |
| *Sex (n,%)* | | | |
| Male | 2831 (52.50) | 2561 (47.50) | 0.90 |
| Female | 2157 (52.64) | 1941 (47.36) | |
| *Race (n,%)* | | | |
| White/other | 4689 (52.87) | 4180 (47.13) | **0.02** |
| Black | 299 (48.15) | 322 (51.85) | |
| *Marital/Living Status (n,%)* | | | |
| Single/Lives Alone | 2656 (59.69) | 1794 (40.31) | **< 0.01** |
| Married/Domestic Partner | 2180 (45.40) | 2622 (54.60) | |
| Other/Unknown | 152 (63.87) | 86 (36.13) | |
| *Insurance (n,%)* | | | |
| Private | 691 (32.81) | 1415 (67.19) | **<0.01** |
| Medicare | 3535 (60.69) | 2290 (39.31) | |
| Medicaid | 548 (47.99) | 594 (52.01) | |
| Uninsured | 163 (47.11) | 183 (52.89) | |
| Unknown | 51 (71.83) | 20 (28.17) | |
| *Tobacco Use (n,%)* | | | |
| Never user | 264 (48.26) | 283 (51.74) | **<0.01** |
| Ever user | 4328 (53.20) | 3808 (46.80) | |
| Unknown | 396 (49.07) | 411 (50.93) | |

**Table 3.** Characteristics of Stage IV NSCLC Patients Associated with Receiving Chemotherapy, 2010-2017 (Unadjusted Logistic Regression Model)

| **Variable** | **OR** | **95% CI** | **P** |
|---|---|---|---|
| *Appalachia* | | | |
| Non-Appalachia | - | - | - |
| Appalachia | 0.75 | 0.69 – 0.82 | **<0.01** |
| *Sex* | | | |
| Male | - | - | - |
| Female | 0.99 | 0.92 – 1.08 | 0.90 |
| *Race* | | | |
| White/other | - | - | - |
| Black | 1.21 | 1.03 – 1.42 | **0.02** |
| *Marital/Living Status* | | | |
| Single/Lives Alone | - | - | - |
| Married/Domestic Partner | 1.78 | 1.64 – 1.93 | **<0.01** |
| Other/Unknown | 0.84 | 0.64 – 1.10 | **<0.01** |
| *Insurance* | | | |
| Private | - | - | - |
| Medicare | 0.32 | 0.29 – 0.35 | **<0.01** |
| Medicaid | 0.53 | 0.46 – 0.61 | **0.02** |
| Uninsured | 0.55 | 0.44 – 0.69 | **0.04** |
| Unknown | 0.19 | 0.11 – 0.32 | **<0.01** |
| *Tobacco Use* | | | |
| Never user | - | - | - |
| Ever user | 0.82 | 0.69 – 0.98 | **<0.01** |
| Unknown | 0.97 | 0.78 – 1.20 | 0.42 |

**Table 4.** Characteristics of Stage IV NSCLC Patients Associated with Receiving Chemotherapy, KCR 2010-2017 (Final Adjusted Logistic Regression Model)

| **Variable** | **OR** | **95% CI** | **P** |
|---|---|---|---|
| *Appalachia* | | | |
| Non-Appalachia | - | - | - |
| Appalachia | 0.71 | 0.65 – 0.78 | **<0.01** |
| *Race* | | | |
| White/Other | - | - | - |
| Black | 1.12 | 0.94 – 1.34 | 0.22 |
| *Marital/Living Status* | | | |
| Single/Lives Alone | - | - | - |
| Married/Domestic | 1.71 | 1.56 – 1.87 | **<0.01** |
| Partner | | | |
| Other/Unknown | 0.72 | 0.54 – 0.95 | <0.01 |
| *Insurance* | | | |
| Private | - | - | - |
| Medicare | 0.73 | 0.64 – 0.82 | **<0.01** |
| Medicaid | 0.54 | 0.46 – 0.63 | **<0.01** |
| Uninsured | 0.49 | 0.39 – 0.62 | **<0.01** |
| Unknown | 0.26 | 0.15 – 0.45 | <0.01 |
| *Tobacco Use* | | | |
| Never user | - | - | - |
| Ever user | 0.66 | 0.54 – 0.80 | **<0.01** |
| Unknown | 0.74 | 0.59 – 0.95 | 0.35 |

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