Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

Signature:

_____ _____

Brittany N. White Date

Medicaid Expansion and Overall Survival Among Patients with Esophageal Cancer in the National Cancer Database

By

Brittany N. White

Master of Public Health

Epidemiology

_____

Theresa Wicklin Gillespie, PhD, MA, BSN
Committee Chair

_____

Michael Goodman, MD, MPH
Committee Member

Medicaid Expansion and Overall Survival Among Patients with Esophageal Cancer in the National Cancer Database

By

Brittany N. White

Master of Public Health

B.S, Spelman College, 2018

Thesis Committee Chair: Theresa Wicklin Gillespie, PhD, MA, BSN

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of Master of Public Health in Epidemiology 2022

ABSTRACT

Medicaid Expansion and Overall Survival Among Patients with Esophageal Cancer in the National Cancer Database

By: Brittany N. White

Importance: Medicaid expansion under the Patient protection and Affordable Care Act may be associated with improved access to earlier esophageal cancer treatment, but its impact on esophageal cancer survival is uncertain.

Objective: To determine whether there is an association between Medicaid expansion and improved survival rates among esophageal cancer patients.

Design, Setting, Participants: A retrospective study of adults (40-64 years) included in the National Cancer Database with newly diagnosed esophageal cancer from January 1, 2004, to December 31, 2018.

Exposure: Living in a Medicaid expansion state by December 31, 2018, vs a Medicaid non-expansion state.

Main Outcomes and Measures: The primary outcome was overall survival (OS) defined as years from diagnosis to death or last contact. We measured this outcome by constructing three Cox Proportional Hazard Models.

Results: The dataset included 12,760 patients, 8,216 in the Medicaid expansion group and 4,544 in the Medicaid non-expansion group. Approximately half of all participants (48% in the expansion group and 50% in the non-expansion group) were between 50- 59 years old and 82-83% of patients were male. We ran three Cox models: first adjusted for race, age and sex, then further adjusted for cancer stage, education and income levels based on 2008-2012 data, and finally replacing 2008-2012 education and income variables with corresponding variables for 2012-2016. The multivariable models demonstrated no appreciable difference in survival between expansion and non-expansion states with HR (95% CI) estimates of 0.98 (0.93, 1.03) in the first model 0.98 (0.93, 1.04) in the second model and 0.99 (0.93, 1.04) in the third model. Patients diagnosed with Stage 4 disease had a 76% higher mortality rate relative to patients who had early-stage cancer. Those living in zip codes with the highest proportion of person who did not finish high school had a 13% to 16% higher rates of death following diagnosis

Conclusion and Relevance: Esophageal cancer remains an important contributor to cancer-related mortality worldwide. Among adults with newly diagnosed esophageal cancer, Medicaid expansion was not associated with improved overall survival.

Medicaid Expansion and Overall Survival Among Patients with Esophageal Cancer in the National Cancer Database

By

Brittany N. White

Master of Public Health

B.S, Spelman College, 2018

Thesis Committee Chair: Theresa Wicklin Gillespie, PhD, MA, BSN

A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of Master of Public Health in Epidemiology 2022

TABLE OF CONTENTS

Introduction

Esophageal cancer is one of the least studied and deadliest cancers worldwide because of its extremely aggressive nature and poor survival rate. While esophageal cancer's incidence represents only 1% of all cancers diagnosed in the Unities States, esophageal cancer is the sixth leading cause of cancer-related deaths and the eighth-most common cancer worldwide, with a 5-year survival rate of less than 25%.[1] For 2021, the United States estimates 19,260 new esophageal cancer diagnoses (15,310 in men and 3,950 in women). So far, in 2021, about 15,530 deaths have occurred, with 12,410 deaths in men and 3,120 deaths in women.[2]

This literature review will explore previous studies of esophageal cancer, disparities reported within esophageal cancer, and the potential benefits of Medicaid expansion to set the foundation of this thesis research.

Esophageal Cancer Epidemiology

Esophageal cancer is a disease in which malignant cells form in the tissues of the esophagus, the hollow, muscular tube that moves food and liquid from the throat to the stomach. Esophageal cancer starts on the inside lining of the esophagus and spreads outward through the other layers as it grows.

Esophageal cancer typically occurs in one of two forms, simple "squamous" cell carcinomas arising from the epithelial lining of the esophagus and adenocarcinomas affecting the columnar glandular cells. Squamous cell carcinoma is often in the upper and middle parts of the esophagus and is the most common histological type of esophageal cancer worldwide.[3] The incidence of simple cell carcinoma increases with age and peaks around 70 years old. In addition, squamous cell esophageal cancer incidence is three times higher in blacks than whites, whereas adenocarcinomas are more common in white men.

Cancers of the esophagus are relatively uncommon in the United States. Esophageal cancer age-adjusted incidence of blacks is about twice that of whites, where the incidence in blacks is 8.63 per 100,000 compared to 4.39 per 100,000 in whites.[4]

Survival

The five-year survival from esophageal cancer remains poor for all groups of people, but significantly poorer in blacks than whites. The overall five-year relative survival rate for all SEER esophageal cancer stages combined (localized, regional, and distant) in people with esophageal cancer in 2021 is 20%. Treatment for esophageal cancer has slowly improved from the 1960s and 1970s, where the overall 5-year survival rate was 5%.[5]

Whereas the overall outlook for patients diagnosed with esophageal cancer has improved in the past 40 years, most patients continue to present with advanced disease for which survival remains poor.[6] Five-year survival rate of people with localized cancer is 47%; regional disease (spread to surrounding tissues or organs and regional lymph nodes) is 25%; with distant disease having a survival rate of only 5%.[7] Overall, more than 30% of patients have metastatic disease at the time of presentation.[8]

Risk factors

Several factors can increase one's risk of esophageal cancer. Some risk factors are more often associated with adenocarcinoma while others are commonly associated with squamous cell carcinoma of the esophagus.

The chance of getting esophageal cancer increases with age; less than 15% of cases are in people younger than 55 years of age. In addition, esophageal cancer is more common among men than among women. The lifetime risk of esophageal cancer in the United States is about 1 in 125 in men and about 1 in 417 in women.[9]

Tobacco in any form (cigarettes, cigars, pipes, and chewing tobacco) and alcohol are major risk factors for esophageal cancer. Both greater quantity and longer duration of tobacco use translates to higher cancer risk. Tobacco and alcohol use are primary causes of squamous cell carcinoma, making the risk factor association even more substantial. Risk associated with tobacco use decreases after tobacco cessation. Smoking combined with drinking alcohol raises the risk of squamous cell esophageal cancer much more than using either alone.[10] [11]

Gastroesophageal reflux disease (GERD) is an important risk factor for esophageal cancer. GERD takes place in the stomach. The digestion process produces acid and enzymes to facilitate the digestion of food; when acid produced from digestion escapes the stomach and enters the lower esophagus, GERD occurs. Moreover, GERD is a risk factor that can contribute to adenocarcinoma of the esophagus. This risk is higher in those who frequently experience more GERD symptoms. GERD can also cause Barret's esophagus, another common risk factor for esophageal cancer. Patients with Barrett's esophagus have a 50 to 100 times increase in their risk of developing cancer compared to the general population.[12] Thus, people with Barrett's esophagus are much more likely to develop cancer of the esophagus. These people require close medical follow-up in order to find cancer early. Still, although they have a higher risk, most people with Barrett's esophagus do not go on to develop cancer of the esophagus. In their population-based cohort study, Hvid-Jensen et al., reported an annual risk of esophageal adenocarcinoma of 0.12% among patients with Barrett's esophagus.[13]

The increasing prevalence of obesity in the Western world is thought to add to the rising incidence of esophageal adenocarcinoma. On the other hand, adipose tissue itself influences tumor development. [14] [15] [16] [17] Adipocytes and inflammatory cells secrete adipokines and cytokines, which are known to promote tumor development. The abundant availability of lipids

from adipocytes in the tumor microenvironment supports tumor progression and uncontrolled growth. Obese and overweight people have a higher chance of getting adenocarcinoma of the esophagus. This associated risk is because individuals who are obese are also more likely to have gastroesophageal reflux. These persons at risk typically have a lower socioeconomic status where they consume high salt diets. According to a study on cancer incidence, researchers concluded that esophageal cancer is related to poverty. Individuals who consume high vegetables and beans have a decreased risk of esophageal cancer than those at increased risk who indulge in a high salt diet.[18] Diet is a significant risk factor for cancer. Specific substances of a diet may increase esophageal cancer risk, like diets high in processed meat and pickled vegetables. In addition, diets that consist of drinking very hot liquids of 149 degrees may increase one's risk for squamous cell type esophageal cancer. On the other hand, diets high in fruits, and vegetables lower risk due to their high content of vitamins and minerals.[19]

The risk factors for esophageal cancer vary and even mimic risk factors for other cancers and diseases. Age, sex, smoking/tobacco use, alcohol, GERD, Barrett's Esophagus, weight, and diet are important risk factors that contribute to esophageal cancer. Having a risk factor or even many does not mean one will get esophageal cancer, and some who get the disease might not have any known risk factors. In a study by Rustgi et al., 80% to 90% of cases of esophageal adenocarcinoma are diagnosed in patients without known Barrett's Esophagus.[20] This statistic validates that esophageal cancer can occur without known risk factors, but it is difficult to find statistics on how often this happens.

Clinical Presentations and Screening

No screening tests are recommended for esophageal cancer. Thus, most people with esophageal cancer are diagnosed because they have symptoms. It is rare for people without symptoms to be diagnosed with this cancer. The cancer is usually found by accident when it does

happen because of tests done for other medical problems. Unfortunately, most esophageal cancers do not cause symptoms or cause subtle symptoms until they have advanced and are harder to treat.[21]

The most common symptoms of esophageal cancer are:

- Trouble swallowing
- Chest pain
- Weight loss
- Hoarseness
- Chronic cough
- Vomiting
- Bone pain (if cancer has spread to the bone)
- Bleeding into the esophagus. This blood then passes through the digestive tract, which may turn the stool black. Over time, this blood loss can lead to anemia (low red blood cell levels), which can make a person feel tired.

Relatively low incidence of esophageal cancer, absence of onset symptoms, and rarity of a hereditary form of the disease make population-based screening untenable except in certain high-risk areas of the world, like China and the eastern coast of Africa from Ethiopia to South Africa. .[22] [23] Nevertheless, early screening might be favorable for patients with Barrett's esophagus. Patients with Barrett's esophagus might be candidates for regular endoscopic surveillance due to the incidence of low-grade dysplasia, high-grade dysplasia, and cancer is approximately 4%, 1%, and 0.5% per year among those with Barrett's esophagus.[24] It is debated if regular endoscopic surveillance guidelines from the American College of Gastroenterology is beneficial for patients to detect Barrett's among patients with chronic reflux disease because at least 40% of patients

with Barrett's esophagus do not have chronic reflux disease.[25] Proponents of screening for Barrett's esophagus point to the clear associations between reflux, Barrett's esophagus, and esophageal adenocarcinoma and suggest the rising esophageal incidence of adenocarcinoma justifies screening.[26] However, some experts have recommended that endoscopy be performed every three to five years in patients who have Barrett's esophagus in the absence of epithelial dysplasia and more frequently if they are found to have low-grade dysplasia.[27] Some experts recommend consistent screening in Barrett's Esophagus patients due to its' ability to reduce the rate of misdiagnoses of lesions and the occurrence of esophageal cancer.[28]

Treatment

Esophageal cancer treatment options are vast and have risks and benefits to each of them. There are several different surgery options for treating esophageal cancer: The first is surgery to remove very small tumors if the cancer is small and confined to one area in the peripheral layers of the esophagus and has not spread. The second surgery option is surgery to remove a portion of the esophagus(esophagectomy). During an esophagectomy, the surgeon removes a portion of the esophagus that contains cancer and the upper part of one's stomach, usually done by pulling the stomach up to meet the remaining esophagus. The final surgery option is surgery to remove part of the esophagus and the upper portion of one's stomach (esophagogastrectomy). This surgical option requires the surgeon to remove parts of the esophagus, nearby lymph nodes, and a larger part of the stomach. The remainder of the stomach is pulled up and reattached to the esophagus, and if necessary, part of the colon is used to help join the two.[29] Esophageal cancer surgery carries serious risks and complications like infection, bleeding at the esophagus, and stomach reattachment site.

Chemotherapy is drug treatment used to kill cancer cells and is typically used before or after surgery in individuals with esophageal cancer. In advanced cancer that has spread beyond the esophagus, chemotherapy may be used alone to help relieve symptoms. However, use of chemotherapy in metastatic disease is generally used for palliation.[30]

Radiation therapy uses high-energy beams externally from a machine to kill cancer cells. Radiation treatment can also be placed inside one's body near the cancer cells. Radiation and chemotherapy are most often combined in patients with esophageal cancer. It is also very common to use radiation as treatment in advanced esophageal cancer.[31]

Targeted drug treatment primarily focuses on identifying and targeting the abnormal signals from cancer cells without affecting normal cells within the body. By blocking or turning off these signals, targeted drug treatments are combined with chemotherapy and cause cancer cells to die or stop proliferation in patients who do not respond to other treatments.[32]

Cost

The cost of treatment for esophageal cancer can be very expensive. In a study by Tramontano et al., researchers looked at the cost of esophageal cancer by stage and treatment modality from 2000-2013 within a cohort of 8,061 esophageal cancer patients. Esophageal cancer treatment varies based on histology, stage, and treatment, and thus costs vary as well.

Researchers allocated patient's costs into four separate phases of care-staging(surgery), initial, continuing, and terminal defined in terms of months, where "month" refers to a unit of 30 days, regardless of where it falls on the calendar. The mean (95% CI) monthly cost estimates for esophageal cancer overall were $8953($8385-$9485) for staging phase, $7731($7492-$7970) for initial phase, $2984($2814-$3154) for continuing phase, and $18,150($17,211-$19,089) for terminal phase.

Researchers further distinguished cost within each phase of care by splitting each phase into four different stages defined by the American Joint Committee on Cancer (AJCC) Cancer Staging Manual. The different stages range from stages I-IV; stage I-clinical, stage II-pathological, stage III-post-therapy, and stage IV- restaging. The highest staging costs were in stages III, $9,249($8,025-$10,474) and II $9,171($7,642-$10,699). The highest initial phase cost was in stage IV, $9,263 ($8,758-49,768), the lowest continuing phase cost was in stage I, $2,338 ($2,160-$2,517), and the highest terminal phase costs were in stages II $20,533($17,772-$23,293) and III $20,599($18,268-$22,929).[33] This paper shows the overall economic burden of esophageal cancer and its' significant economic impact amongst all stages.

Medicaid Expansion Overview

Medicaid, one of the nation's largest sources of health coverage, provided care to seventy-seven million individuals as of January 2017.[34] The Affordable Care Act (ACA) allowed states on January 1st, 2014, to expand Medicaid eligibility to nonelderly adults with incomes up to 138 percent of the federal poverty level.[35] Although the expansion was initially intended to be enacted nationwide, in 2012, the US Supreme Court ruled that states could opt out of it. As of January 2022, thirty-nine states and the District of Columbia had opted to expand Medicaid eligibility.[36] Following the expansion, Medicaid enrollment grew by 14.5 million people by 2016.

Benefits

In a systematic review of the peer-reviewed scientific literature, researchers found evidence that the Medicaid expansion following the ACA was associated with increases in care access, quality, and Medicaid spending. Importantly, they found very little evidence that Medicaid expansion resulted in negative consequences for patients, and the minority of studies

that reported negative consequences tended to use methodologies with limited ability to determine cause and effect. Mazurenko et al., 2018, observed significant increases in access to care, driven mainly by increases in insurance coverage and use of health services.

"Moreover, current evidence has reported minor differences across racial/ethnic groups in gaining health insurance coverage, suggesting only a small differential impact by race/ethnicity in gaining health insurance following Medicaid expansion".[37] Overall, gaining access to care is generally associated with improvements in health[38], a reduction in spending to manage chronic disease[39], improved work productivity[40], and better quality of life.[41] Similarly, recent evidence has shown that Medicaid expansion improved people's financial health, leading to lower payday loans and reduced loan debt in California.[42] No studies found lower quality of care following Medicaid expansion. Although this category contained relatively few studies, they reported improvements across a wide range of quality measures, including preventive care (for example, Pap testing), chronic care management (such as diabetes monitoring), and postoperative morbidity. In addition, patients who maintain Medicaid enrollment have more timely access to care, visit their doctor more frequently, and have their cancers diagnosed earlier, either through screening or evaluating clinical symptoms.[43]

Medicaid Expansion and Esophageal Cancer

In a California study, data from the Office of State-wide Health Planning and Development (OSHPD) hospital discharge database from 2005 to 2016, specific to California patients only, aided researchers in analyzing access to surgical care for esophageal cancer: patient travel patterns to reach higher volume health centers.[44] Researchers sought to evaluate the travel patterns among patients undergoing esophagectomy to assess the willingness of patients to travel for surgical care. In this study,10,569 individuals, 5.6% had a diagnosis of esophageal

cancer. Researchers concluded that Medicaid coverage increased from 12.4 to 20.2% in California following Medicaid expansion. There were no differences in age, sex, and race of Medicare beneficiaries pre- versus post-policy implementation.[45] Medicaid expansion was associated with increased Medicaid coverage, which resulted in more beneficiaries undergoing cancer operations at high-volume hospitals. While Medicaid expansion was associated with increased access to care, peri-operative outcomes were comparable pre- versus post-ME implementation.[46]

In another California study, Dawes et al., assembled a retrospective cohort of all incident cases of six cancers (colon, esophageal, lung, pancreatic, stomach, and ovarian) in California between 2002 and 2008. Three datasets were used: (1) the California Cancer Registry (CCR), (2) California's Patient Discharge Database (PDD), and (3) the state's monthly Medicaid enrollment file. The objective of this study was to examine the effect of Medicaid enrollment on the diagnosis, treatment, and survival of six surgically relevant cancers among poor and underserved Californians. The study looked at 291,565 new cancer diagnoses and found that continuous Medicaid enrollment for at least six months prior to diagnosis improves colon, stomach, and lung cancer survival. In addition, researchers found no difference in mortality by Medicaid status among pancreatic, esophageal, and ovarian cancer. Overall, "continuous insurance coverage under the Affordable Care Act is likely to improve both access and clinical outcomes for cancer patients in California”.
[47]

Schlottmann et al., performed a study to identify differences in disparities among patients with cancer where screening is widely recommended (colorectal cancer) and one in which screening is not widely recommended (esophageal cancer). Researchers conducted a retrospective study from 2004-2015 using data from the National Cancer Database. A total of 96,524 esophageal cancer patients compared to 361,187 colorectal cancer patients were studied participants. The study found

that “black patients, longer travel distances, and lower educational attainment were only associated with increased odds of stage IV colorectal cancer”.[48] It was also noted that while Medicaid and uninsured patients were more likely to be diagnosed with stage IV esophageal and colorectal cancer, the effect was larger in colorectal cancer patients. This paper concludes that disparities are more significant in colorectal cancer, and screening and cancer care should be prioritized.[49]

Annie et al., conducted a study using all West Virginia Cancer Registry patients between 2000-2013 diagnosed with colon (n=927), bladder (n=269), combined (anal, rectal, and esophageal) cancers (n=398) to better understand the effects of insurance coverage on the health of at-risk populations in the Application region of the United States. This study aimed to examine how different insurance coverage types (private, Medicare under 65, Medicare 65 or over, Medicaid, and self-pay) influence cancer survival over time. This study concluded that of the three different groupings, there was no significant survival difference for patients by insurance type.[50]

This thesis research will be different from previous published work.

1) This study will include national data from >1500 cancer programs across the US, representing 29 million records from hospital cancer registries and 181,586 patients in the NCDB dataset for esophageal cancer. This patient population is drastically different from previous studies because other studies have small esophageal cancer participants. Therefore, performing analysis on a study population of this size, specifically for esophageal cancer only, could produce significant correlations.
2) Unlike previous research, this study will specifically look at Medicaid expansion and esophageal cancer. Previous studies performed analysis which highlighted continuous Medicaid enrollment or Medicaid patients compared to other insurance coverage types like self-pay, private insurance, and Medicare.

3) This study will use data from patients diagnosed with esophageal cancer from 2004-2018. This study period is more recent than other papers published where their latest study period was 2016.
4) The methods in this thesis will focus on overall survival outcomes between Medicaid expanded states and non-Medicaid expanded states. This paper will use descriptive statistics, Kaplan-Meier analysis, and Cox-Proportional Hazard Models. Other studies used Cox-Proportional Hazard Models when looking at insurance types on survival outcomes for combined cancer and not esophageal cancer alone, logistic regressions, and likelihood ratio test to evaluate the variations between hospital risks. This thesis research analysis and methods will be drastically different from previous work.

National Cancer Database

The data used in this study is from the National Cancer Data Base (NCDB) Esophageal Participants USE Data File (PUF). The NCDB, a "joint program of the Commission on Cancer (CoC) of the American College of Surgeons (ACoS) and the American Cancer Society (ACS), is a nationwide oncology outcomes database for more than 1,500 Commission-accredited cancer programs in the United States and Puerto Rico".[51] The NCDB is one of the world's largest cancer registries, comprising approximately 29 million records from hospital cancer registries and is approximately 2.5 times bigger than the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) database.[52] The NCDB is also unique as being the largest clinical cancer database, representing a significant portion of esophageal cancer diagnoses.[53]

Using data from the NCDB is an advantage due to its high case coverage. Adversely, data from the NCDB can also bring on a potential limitation. The NCDB only includes overall survival, not disease-specific survival, so it is possible that deaths observed among the cohort

may represent deaths from other causes rather than esophageal cancer. However, because esophageal cancer has minimal survival associated with it, there is a high likelihood that those patients who are diagnosed with the disease may well ultimately die from esophageal cancer.

Summary

Esophageal cancer is the sixth leading cause of cancer-related deaths in the world and the eighth-most common cancer worldwide, with a current five-year survival rate of less than 25% (Then et al., 2020) (Arnal et al., 2015).[54] [55] For 2021, the American Cancer Society estimates 19,260 new esophageal cancer diagnoses in the US (15,310 in men and 3,950 in women). So far in 2021, about 15,530 deaths have occurred, with 12,410 deaths in men and 3,120 deaths in women. Research shows the benefits of Medicaid expansion in survival rate, and little to no research shows the disadvantages of Medicaid expansion and survival outcomes for Medicaid patients.

For this thesis, using the National Cancer Database, the research aims are: (1) to investigate if overall survival (OS) among esophageal cancer patients differ between Medicaid expansion states vs. non-Medicaid expansion states; and (2) to analyze if survival outcomes differ by esophageal cancer stage among those in Medicaid expansion compared to non-Medicaid expansion states. This thesis will add to the NCDB literature, and the national discussion and policies related to Medicaid expansion. Ideally, this thesis research will help contribute to new policies, potentially leading to lower treatment costs for esophageal cancer patients or helping to eliminate disparities through Medicaid expansion to additional states. In addition, findings are anticipated to highlight the importance of strategies that promote greater health care access and utilization for cancers, like esophageal cancer, with very low survival rates, and improve the public's health in the United States.

ABSTRACT

Importance: Medicaid expansion under the Patient protection and Affordable Care Act may be associated with improved access to earlier esophageal cancer treatment, but its impact on esophageal cancer survival is uncertain.

Objective: To determine whether there is an association between Medicaid expansion and improved survival rates among esophageal cancer patients.

Design, Setting, Participants: A retrospective study of adults (40-64 years) included in the National Cancer Database with newly diagnosed esophageal cancer from January 1, 2004, to December 31, 2018.

Exposure: Living in a Medicaid expansion state by December 31, 2018, vs a Medicaid non-expansion state.

Main Outcomes and Measures: The primary outcome was overall survival (OS) defined as years from diagnosis to death or last contact. We measured this outcome by constructing three Cox Proportional Hazard Models.

Results: The dataset included 12,760 patients, 8,216 in the Medicaid expansion group and 4,544 in the Medicaid non-expansion group. Approximately half of all participants (48% in the expansion group and 50% in the non-expansion group) were between 50- 59 years old and 82-83% of patients were male. We ran three Cox models: first adjusted for race, age and sex, then further adjusted for cancer stage, education and income levels based on 2008-2012 data, and finally replacing 2008-2012 education and income variables with corresponding variables for 2012-2016. The multivariable models demonstrated no appreciable difference in survival between expansion and non-expansion states with HR (95% CI) estimates of 0.98 (0.93, 1.03) in the first model 0.98 (0.93, 1.04) in the second model and 0.99 (0.93, 1.04) in the third model. Patients diagnosed with Stage 4 disease had a 76% higher mortality rate relative to patients who had early-stage cancer. Those living in zip codes with the highest proportion of person who did not finish high school had a 13% to 16% higher rates of death following diagnosis

Conclusion and Relevance: Esophageal cancer remains an important contributor to cancer-related mortality worldwide. Among adults with newly diagnosed esophageal cancer, Medicaid expansion was not associated with improved overall survival.

INTRODUCTION

Esophageal cancer is one of the least studied and deadliest cancers worldwide because of its aggressive nature and poor survival rate. While esophageal cancer represents only 1% of all invasive malignancies diagnosed in the Unities States, it is the sixth leading cause of cancer-related deaths and the eighth-most common cancer worldwide, with a 5-year survival rate of less than 25%.[56] For 2021, the United States estimates 19,260 new esophageal cancer diagnoses (15,310 in men and 3,950 in women). So far, in 2021, about 15,530 deaths have occurred; 12,410 in men and 3,120 in women.[57]

Esophageal cancer is a disease in which malignant cells form in the tissues of the esophagus, the hollow, muscular tube that moves food and liquid from the throat to the stomach. Esophageal cancer starts on the inside lining of the esophagus and spreads outward through the other layers as it grows.[58] [59] Esophageal cancer typically occurs in one of two forms, simple "squamous" cell carcinomas arising from the epithelial lining of the esophagus and adenocarcinomas affecting the columnar glandular cells. Squamous cell carcinoma is often in the upper and middle parts of the esophagus and is the most common histological type of esophageal cancer worldwide[60]. The incidence of squamous cell carcinoma increases with age and peaks around 70 years old. In addition, squamous cell esophageal cancer incidence is three times higher in blacks than whites, whereas adenocarcinomas are more common in white men. Cancers of the esophagus are relatively uncommon in the United States. Esophageal cancer age-adjusted incidence among US blacks is 8.63 per 100,000, about twice the corresponding estimate of 4.39 per 100,000 reported among whites.[61] Adenocarcinoma is the predominant form of esophageal cancer in the United States; however, African Americans commonly present with squamous cell carcinoma, which signifies a worse prognosis.[62] [63] Recent data indicate that African Americans

account for 15% of esophageal adenocarcinoma patients , and 86% of squamous cell carcinoma patients, and found to have worse survival outcomes compared to non-Hispanic whites.[64] There are no screening tests for esophageal cancer. For this reason, most patients are diagnosed because they have symptoms or during a clinical work up for other health problems.[65] The relatively subtle onset of disease underscores the importance of timely diagnosis and treatment, which in turn may be determined by access to care.

Medicaid, one of the nation's largest sources of health coverage, provided care to seventy-seven million individuals as of January 2017. [66] The Affordable Care Act (ACA) allowed states on January 1st, 2014, to expand Medicaid eligibility to nonelderly adults with incomes up to 138 percent of the federal poverty level.[67] Although the expansion was initially intended to be enacted nationwide, in 2012, the US Supreme Court ruled that states could opt out of it.[68] As of January 2022, thirty-nine states and the District of Columbia had opted to expand Medicaid eligibility. [69] Following the expansion, Medicaid enrollment grew by 14.5 million people by 2016.[70]

The purpose of the present study was to answer the research question: Do patients diagnosed with esophageal cancer in a Medicaid expansion state experience better survival compared to patients residing in a Medicaid non-expansion state? The specific aims of this study were to: (1) investigate if overall survival (OS) among esophageal cancer patients differs between Medicaid expansion states vs. Medicaid non-expansion states; and (2) analyze if survival outcomes differ by esophageal cancer stage among those in Medicaid expansion compared to Medicaid non-expansion states.

METHODS

Data Source

Data were obtained from the National Cancer Database (NCDB), a joint program of the Commission on Cancer (CoC) of the American College of Surgeons (ACoS) and the American Cancer Society (ACS). The NCDB is a nationwide oncology outcomes database for more than 1,500 CoC-accredited cancer programs in the United States and Puerto Rico. The NCDB is also unique as being the largest clinical cancer database, representing approximately 75% of all newly-diagnosed cases of esophageal cancer.[71]

The data from the NCDB included extensive information on demographic characteristics of esophageal patients, including insurance status, facility type/ location, ethnicity, age, race, sex, education, and Medicaid expansion status state group. In addition to demographic variables, the database also contains tumor characteristics, survival, 30 and 90-day mortality, treatment type delivered by facility, including surgery of primary site, systemic therapy, and radiation therapy. Overall survival (OS) time is defined in the NCDB as the number of months between the date of diagnosis and the date upon which the patient was last contacted or died.

Study Population

This retrospective cohort study included data on individuals diagnosed with esophageal cancer from 2004 – 2018 and registered in the NCDB. We identified 12,760 eligible patients. Patients were excluded if they 1) were younger than 40 or older than 65 years of age; 2) were diagnosed prior to Medicaid expansion and 3) had missing staging information, date of last contact, vital status, Medicaid expansion code, levels of education and income, and urban/ rural residency status.

Study Variables

The primary exposure of interest was residence in a state that expanded Medicaid (expansion state) vs. a state that did not (non-expansion state) The main outcome under study was overall survival (OS) with survival time, defined as months from diagnosis to death from any cause or last contact. Cause-specific mortality is not available in the NCDB.

Other participant characteristics included year of diagnosis, age at diagnosis, race, sex, median household income (based on patient's zip code and American Community Survey data), educational attainment (based on percentage of adults who did not graduate from high school residing in the patient's zip code), and rural/urban/metro residency (based on patients' zip code). Clinical stage of esophageal cancer was defined based on the American Joint Committee on Cancer (AJCC) guidelines. The AJCC guidelines on staging consist of four different types of staging: clinical staging, pathological staging, post-therapy or post-neoadjuvant therapy staging, and restaging. The T, N, M staging system, maintained by the AJCC, is the classification system tool for doctors to stage different cancer types based on standardized criteria based on the extent of the primary tumor (T), the extent of spread to the lymph nodes (N), and presence of metastasis (M). The T, N, and M categories analyze characteristics from tumor/lymph node/metastasis cannot be evaluated to the size of the tumor and extent of spread. Once T, N, and M are determined, they are combined, and an overall stage of 0, I, II, III, IV is assigned. [72]

Statistical Analysis

Descriptive statistics, expressed as frequencies and percentages, were generated to compare study participants residing in expansion and non-expansion states with respect to distributions of demographic, socioeconomic characteristics. Multivariable survival analyses of the association between residence in a Medicaid expansion state and all-cause mortality

following esophageal cancer diagnosis were performed using Cox proportional hazards models. To assess influence of various confounding factors three versions of the Cox model were used: 1) adjusted for age, gender and race (Table 2); 2) same as Table 2 but also adjusted for disease stage, rural/urban residence and 2008-2012 zip code-based levels of education and income (Table 3); and 3) same as Table 3 but using 2012-2016 (instead of 2008-2012) data on education and income (Table 4). The results of all Cox models were expressed as adjusted hazard ratios (HR) and the corresponding 95% confidence intervals (CI). Statistical analysis was performed using SAS 9.4 (SAS Institute Inc., Cary, NC), and statistical significance was assessed at the 0.05 level.

RESULTS

General Characteristics of the Study Population

The analysis dataset included 12,760 patients, with 8,216 in the Medicaid expansion group and 4,544 in the Medicaid non-expansion group. Approximately half of participants (48% in the expansion group and 50% in the non-expansion group) were between 50 and 59 years of age and 82-83% of patients were male. Residents of Medicaid expansion states differed from Medicaid non-expansion states with respect to a number of demographic factors (See Table 1), including a lower proportion of African American patients, higher average household median income and educational attainment rates, and greater proportion of patients living in urban and metro areas.

Multivariable Analyses

We ran three Cox proportional hazard models: first adjusted for race, age and sex (Table 2), then further adjusted for cancer stage, as well as education and income levels based on 2008-2012 data (Table 3), and finally replacing the 2008-2012 education and income variables with

the corresponding variables for 2012-2016 (Table 4). The multivariable models demonstrated no appreciable difference in survival between expansion and non-expansion states with HR (95% CI) estimates of 0.98 (0.93, 1.03) in the first model 0.98 (0.93, 1.04) in the second model and 0.99 (0.93, 1.04) in the third model. Similarly, sex, age and race were generally not associated with survival although persons whose race/ethnicity was marked as "other or unknown" had elevated post-diagnosis mortality relative to whites with HR estimates of 1.2 and 95% CIs excluding 1.0 in all three models (Tables 2-4). Factors consistently associated with poor survival in the fully adjusted models included advanced cancer stage at diagnosis and lower educational attainment. As shown in Table 3, patients diagnosed with Stage 4 disease had a 76% higher mortality rate (95% CI: 1.46, 2.12) relative to patients who had early-stage cancer; this result was essentially the same (HR=1.74; 95% CI: 1.45, 2.10) in the alternative model (Table 4). Although the cutoffs for the categories were slightly different in the two fully adjusted models (Tables 3-4) the pattern of associations remained the same. Compared to patients living in zip codes characterized by relatively low proportion of residents without a high school diploma (<7% in Table 3 and <6.3% in Table 4) those living in zip codes with the highest proportion of person who did not finish high school had a 13% to 16% higher rates of death following diagnosis with 95% CIs of 1.03-1.25 and 1.05-1.29, respectively.

DISCUSSION

In this retrospective cohort study, we sought to examine the relationship between Medicaid expansion and survival among esophageal cancer patients included in the NCDB. Patients with esophageal cancer living in a Medicaid expanded state experienced no appreciable survival benefit than patients residing in a Medicaid non-expanded state. In multivariable analyses, residence in zip codes with lower proportion of people who finished high school and

more Stage 4 disease were both independently associated with higher mortality rate. In addition, patients with undefined race and ethnicity had significantly lower survival than patients who were assigned to other racial/ethnic groups. This last observation is likely attributable to incomplete medical records, which may in turn serve as evidence of suboptimal or sporadic health care.

Although our findings suggest no appreciable influence of Medicaid expansion on survival following esophageal cancer diagnosis, it is possible that Medicaid expansion may have greater effect in other aspects of care. It is expected that Medicaid expansion may improve access to care and decrease financial toxicity of diagnosis and treatment.[73] [74] Previous evidence suggests that Medicaid expansion improves patients' financial health, leading to lower payday loans and a reduction in spending to manage chronic disease.[75] [76] In addition, Medicaid expansion has been shown to increase the numbers of Medicaid-covered cancer patients undergoing surgery at high-volume centers. [77] Research also indicates that Medicaid expansion may reduce racial/ethnic disparities as evidenced in more equitable health insurance coverage gains in states that opted to expand their Medicaid programs.[78]

In contrast to our findings, Medicaid expansion has been shown to produce significant improvement in outcomes for other cancers. In a similarly designed analysis of NCDB data, newly diagnosed colorectal cancer participants living in a Medicaid expanded state had a higher 5-year overall survival rate, significantly lower 30 and 90-day mortality rates, and improved stage I and stage II survival compared to patients that lived on non-expansion states.[79] In a different quasi-experimental, difference-in-difference, population-based study, also based on NCDB data, Medicaid expansion was associated with a decreased hazard of mortality mediated by early-stage diagnosis in patients with breast, colorectal, and lung cancer.[80]

It is important to acknowledge that this analysis has a notable limitation. The NCDB database only includes information on all-cause mortality, which precludes analyses of disease-specific survival. On the other hand, the relatively high fatality rate of esophageal cancer makes it unlikely that exclusions of deaths from other causes would have greatly affected the results.

CONCLUSION

Esophageal cancer remains an important contributor to cancer-related mortality worldwide. The Affordable Care Act has led to higher insurance coverage, higher access to care, lower debt for chronic disease management, a better quality of life, and improved work productivity for patients residing in Medicaid expansion states [81] [82]. Whereas Medicaid expansion was not associated with improved overall survival among esophageal cancer patients in this study, its impact on other factors, such as financial toxicity, risk of disease recurrence, and quality of life require further investigation.

[1] Then, Eric Omar, et al. “Esophageal Cancer: An Updated Surveillance Epidemiology and End Results Database Analysis.” World Journal of Oncology, Elmer Press, Apr. 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7141161/

[2] The American Cancer Society medical and editorial content team. Statistics for esophageal cancer: Esophageal cancer stats. American Cancer Society. https://www.cancer.org/cancer/esophagus-cancer/about/key-statistics.html. Accessed April 4, 2022.

[3] Cook MB. Non-acid reflux: the missing link between gastric atrophy and esophageal squamous cell carcinoma? Am J Gastroenterol. 2011;106:1930–1932.

[4] Cummings LC, Cooper GS. Descriptive epidemiology of esophageal carcinoma in the Ohio Cancer Registry. Cancer Detect Prev. 2008;32:87–92.

[5] Then, Eric Omar, et al. “Esophageal Cancer: An Updated Surveillance Epidemiology and End Results Database Analysis.” World Journal of Oncology, Elmer Press, Apr. 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7141161/

[6] Cesas A, Bagajevas A. [Combined treatment of esophageal cancer: a review] Medicina (Kaunas) 2004;40 Suppl 1:161–165.

[7] The American Cancer Society medical and editorial content team. Statistics for esophageal cancer: Esophageal cancer stats. American Cancer Society. https://www.cancer.org/cancer/esophagus-cancer/about/key-statistics.html. Accessed April 4, 2022.

[8] Zhang, Yuwei. “Epidemiology of Esophageal Cancer.” World Journal of Gastroenterology, Baishideng Publishing Group Co., Limited, 14 Sept. 2013, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3769895/#B50

[9] The American Cancer Society medical and editorial content team. Statistics for esophageal cancer: Esophageal cancer stats. American Cancer Society. https://www.cancer.org/cancer/esophagus-cancer/about/key-statistics.html. Accessed April 4, 2022.

[10] Blot WJ. Invited commentary: more evidence of increased risks of cancer among alcohol drinkers. Am J Epidemiol. 1999;150:1138–140; discussion 1141.

[11] Pandeya, Nirmala, et al. “Sex Differences in the Proportion of Esophageal Squamous Cell Carcinoma Cases Attributable to Tobacco Smoking and Alcohol Consumption.” *Cancer Epidemiology*, Elsevier, 2 July 2013, https://www.sciencedirect.com/science/article/pii/S1877782113000982.

[12] Kambhampati, Swetha, et al. “Risk Factors for Progression of Barrett's Esophagus to High Grade Dysplasia and Esophageal Adenocarcinoma.” *Nature News*, Nature Publishing Group, 17 Mar. 2020, https://www.nature.com/articles/s41598-020-61874-7.

[13] Hvid-Jensen F, Pedersen L, Drewes AM, Sørensen HT, Funch-Jensen P. Incidence of adenocarcinoma among patients with Barrett's esophagus. *N Engl J Med*. 2011;365(15):1375-1383. doi:10.1056/NEJMoa1103042

[14] Lagergren J, Lagergren P. Recent developments in esophageal adenocarcinoma. CA Cancer J Clin. 2013:Epub ahead of print.

[15] Nieman KM, Romero IL, Van Houten B, Lengyel E. Adipose tissue and adipocytes support tumorigenesis and metastasis. Biochim Biophys Acta. 2013:Epub ahead of print.

[16] Carr JS, Zafar SF, Saba N, Khuri FR, El-Rayes BF. Risk factors for rising incidence of esophageal and gastric cardia adenocarcinoma. J Gastrointest Cancer. 2013;44:143–151.

[17] Löfdahl HE, Lu Y, Lagergren P, Lagergren J. Risk factors for esophageal adenocarcinoma after antireflux surgery. Ann Surg. 2013;257:579–582.

[18] Pan, Rui, et al. "Cancer Incidence and Mortality: A Cohort Study in China, 2008–2013." *Wiley Online Library*, John Wiley & Sons, Ltd, 26 June 2017, https://onlinelibrary.wiley.com/doi/10.1002/ijc.30825.

[19] Abnet, Christian C, et al. "Epidemiology of Esophageal Squamous Cell Carcinoma." *Gastroenterology*, U.S. National Library of Medicine, Jan. 2018, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5836473/.

[20] Rustgi AK, El-Serag HB. Esophageal carcinoma. *N Engl J Med*. 2014;371(26):2499-2509. doi:10.1056/NEJMra1314530

[21] Rubenstein JH, Shaheen NJ. Epidemiology, Diagnosis, and Management of Esophageal Adenocarcinoma. *Gastroenterology*. 2015;149(2):302-17.e1. doi:10.1053/j.gastro.2015.04.053

[22] Zhang, Yuwei. "Epidemiology of Esophageal Cancer." World Journal of Gastroenterology, Baishideng Publishing Group Co., Limited, 14 Sept. 2013, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3769895/#B50

[23] Codipilly, Don. "Screening for Esophageal Squamous Cell Carcinoma: Recent Advances." *Gastrointestinal Endoscopy Journal*, https://www.giejournal.org/article/S0016-5107(18)32662-2/pdf#:~:text=1,2 Nearly 90% of,1).

[24] Moole, Harsha, et al. "Progression from Low-Grade Dysplasia to Malignancy in Patients with Barrett's Esophagus Diagnosed by Two or More Pathologists." *World Journal of Gastroenterology*, Baishideng Publishing Group Inc, 21 Oct. 2016, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5075558/.

[25] Shaheen NJ, Falk GW, Iyer PG, Gerson LB; American College of Gastroenterology. ACG Clinical Guideline: Diagnosis and Management of Barrett's Esophagus [published correction appears in Am J Gastroenterol. 2016 Jul;111(7):1077]. *Am J Gastroenterol*. 2016;111(1):30-51. doi:10.1038/ajg.2015.322

[26] Shaheen NJ, Falk GW, Iyer PG, Gerson LB; American College of Gastroenterology. ACG Clinical Guideline: Diagnosis and Management of Barrett's Esophagus [published correction appears in Am J Gastroenterol. 2016 Jul;111(7):1077]. *Am J Gastroenterol*. 2016;111(1):30-51. doi:10.1038/ajg.2015.322

[27] Bujanda, Daniel E, and Christine Hachem. "Barrett's Esophagus." *Missouri Medicine*, Journal of the Missouri State Medical Association, 2018, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6140158/.

[28] Lambert R. Endoscopy in screening for digestive cancer. World J Gastrointest Endosc. 2012;4:518–525.

[29] Allum, William H, et al. "Surgical Treatments for Esophageal Cancers." *Annals of the New York Academy of Sciences*, U.S. National Library of Medicine, Sept. 2014, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4384171/.

[30] Janmaat, Vincent T, et al. "Palliative Chemotherapy and Targeted Therapies for Esophageal and Gastroesophageal Junction Cancer." *The Cochrane Database of Systematic Reviews*, John Wiley & Sons, Ltd, 28 Nov. 2017, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6486200/.

[31] Deng, Wei, and Steven H Lin. "Advances in Radiotherapy for Esophageal Cancer." *Annals of Translational Medicine*, AME Publishing Company, Feb. 2018, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5890036/.

[32] Yang, Yan-Ming, et al. "Advances in Targeted Therapy for Esophageal Cancer." *Signal Transduction and Targeted Therapy*, Nature Publishing Group UK, 7 Oct. 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7542465/.

[33] Tramontano, Angela C, et al. "Esophageal Cancer Treatment Costs by Phase of Care and Treatment Modality, 2000-2013." Cancer Medicine, John Wiley and Sons Inc., Sept. 2019, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6718574/ #:~:text=in Table -,2.,411) for the terminal phase

[34] Congressional Budget Office. Detail of spending and enrollment for Medicaid for CBO's January 2017 baseline [Internet]. Washington (DC): CBO; [cited 2018 Apr 3]. Available from: https://www.cbo.gov/sites/default/files/recurringdata/51301-2017-01-medicaid.pdf Google Scholar

[35] Sommers BD, Gawande AA, Baicker K. Health insurance coverage and health—what the recent evidence tells us. N Engl J Med. 2017;377(6):586–93.

[36] Escarce, José J, et al. "Effects of the Affordable Care Act Medicaid Expansion on the Distribution of New General Internists Across States." *Medical Care*, Lippincott Williams & Wilkins, 1 July 2021, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8191468/.

[37] Mazurenko O;Balio CP;Agarwal R;Carroll AE;Menachemi N; "The Effects Of Medicaid Expansion Under The ACA: A Systematic Review." Health Affairs (Project Hope), U.S. National Library of Medicine, https://pubmed.ncbi.nlm.nih.gov/29863941/.

[38] Sommers BD, Gawande AA, Baicker K. Health insurance coverage and health—what the recent evidence tells us. N Engl J Med. 2017;377(6):586–93.

[39] Menachemi N, Blackburn J, Sen B, Morrisey MA, Becker DJ, Caldwell Cet al. The impact of CHIP coverage on children with asthma in Alabama. Clin Pediatr (Phila). 2012;51(3):247–53.

[40] Obama B. United States health care reform: progress to date and next steps. JAMA. 2016;316(5):525–32

[41] Sommers BD, Gawande AA, Baicker K. Health insurance coverage and health—what the recent evidence tells us. N Engl J Med. 2017;377(6):586–93.

[42] Allen H, A F, Al. E, et al. Early Medicaid expansion associated with reduced payday borrowing in California: Health Affairs Journal. Health Affairs. https://www.healthaffairs.org/doi/full/10.1377/hlthaff.2017.0369. Published October 1, 2017. Accessed April 15, 2022.

[43] Eisenberg JM, Power EJ. Transforming insurance coverage into quality health care: voltage drops from potential to delivered quality. *JAMA*. 2000;284(16):2100-2107. doi:10.1001/jama.284.16.2100

[44] Diaz A, Burns S, D'Souza D, et al. Accessing surgical care for esophageal cancer: patient travel patterns to reach higher volume center. Dis Esophagus Off J Int Soc Dis Esophagus. Published online February 25, 2020. https://doi.org/10.1093/dote/doaa006

[45] Diaz A, Burns S, D'Souza D, et al. Accessing surgical care for esophageal cancer: patient travel patterns to reach higher volume center. Dis Esophagus Off J Int Soc Dis Esophagus. Published online February 25, 2020. https://doi.org/10.1093/dote/doaa006

[46] Diaz A, Burns S, D'Souza D, et al. Accessing surgical care for esophageal cancer: patient travel patterns to reach higher volume center. Dis Esophagus Off J Int Soc Dis Esophagus. Published online February 25, 2020. https://doi.org/10.1093/dote/doaa006

[47] Dawes, Aaron J., et al. "The Impact of Continuous Medicaid Enrollment on Diagnosis, Treatment, and Survival in Six Surgical Cancers." Health Services Research, 2014, https://doi.org/10.1111/1475-6773.12237.

[48] Schlottmann F;Gaber C;Strassle PD;Charles AG;Patti MG; "Health Care Disparities in Colorectal and Esophageal Cancer." *American Journal of Surgery*, U.S. National Library of Medicine, https://pubmed.ncbi.nlm.nih.gov/31898942/.

[49] Schlottmann F;Gaber C;Strassle PD;Charles AG;Patti MG; "Health Care Disparities in Colorectal and Esophageal Cancer." *American Journal of Surgery*, U.S. National Library of Medicine, https://pubmed.ncbi.nlm.nih.gov/31898942/.

[50] Annie, Frank H, et al. "Survival Analysis of Cancer Patients of Differing Payer Type in South West Virginia, Between 2000 and 2013." *Cureus*, Cureus, 22 July 2018, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6150748/.

[51] Hepatology, 1Division of Gastroenterology and. "ACG Clinical Guideline: Diagnosis and Management of... : Official Journal of the American College of Gastroenterology: ACG." *LWW*, https://journals.lww.com/ajg/pages/articleviewer.aspx?year=2016&issue=01000&article=00017&type=Fulltext.

[52] Hepatology, 1Division of Gastroenterology and. "ACG Clinical Guideline: Diagnosis and Management of... : Official Journal of the American College of Gastroenterology: ACG." *LWW*, https://journals.lww.com/ajg/pages/articleviewer.aspx?year=2016&issue=01000&article=00017&type=Fulltext.

[53] Hepatology, 1Division of Gastroenterology and. "ACG Clinical Guideline: Diagnosis and Management of... : Official Journal of the American College of Gastroenterology: ACG." *LWW*, https://journals.lww.com/ajg/pages/articleviewer.aspx?year=2016&issue=01000&article=00017&type=Fulltext.

[54] Then, Eric Omar, et al. "Esophageal Cancer: An Updated Surveillance Epidemiology and End Results Database Analysis." World Journal of Oncology, Elmer Press, Apr. 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7141161/

[55] Domper Arnal, María José, et al. "Esophageal Cancer: Risk Factors, Screening and Endoscopic Treatment in Western and Eastern Countries." *World Journal of Gastroenterology*, Baishideng Publishing Group Inc, 14 July 2015, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4499337/.

[56] Then, Eric Omar, et al. "Esophageal Cancer: An Updated Surveillance Epidemiology and End Results Database Analysis." World Journal of Oncology, Elmer Press, Apr. 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7141161/

[57] The American Cancer Society medical and editorial content team. Statistics for esophageal cancer: Esophageal cancer stats. American Cancer Society. https://www.cancer.org/cancer/esophagus-cancer/about/key-statistics.html. Accessed April 4, 2022.

[58] Esophageal cancer-patient version. National Cancer Institute. https://www.cancer.gov/types/esophageal. Accessed April 12, 2022.

[59] Esophageal cancer: Symptoms, causes, tests and treatment. Cleveland Clinic. https://my.clevelandclinic.org/health/diseases/6137-esophageal-cancer. Accessed April 12, 2022.

[60] Cook MB. Non-acid reflux: the missing link between gastric atrophy and esophageal squamous cell carcinoma? Am J Gastroenterol. 2011;106:1930–1932.

[61] Cummings LC, Cooper GS. Descriptive epidemiology of esophageal carcinoma in the Ohio Cancer Registry. Cancer Detect Prev. 2008;32:87–92.

[62] Greenstein AJ, Litle VR, Swanson SJ, et al. Racial disparities in esophageal cancer treatment and outcomes. *Ann Surg Oncol* 2008;15:881-8. 10.1245/s10434-007-9664-5

[63] Siewert JR, Stein HJ, Feith M, et al. Histologic tumor type is an independent prognostic parameter in esophageal cancer: lessons from more than 1,000 consecutive resections at a single center in the Western world. *Ann Surg* 2001;234:360-7; discussion 368-9. 10.1097/00000658-200109000-00010

[64] Delman AM, Ammann AM, Turner KM, Vaysburg DM, Van Haren RM. A narrative review of socioeconomic disparities in the treatment of esophageal cancer. J Thorac Dis. 2021 Jun;13(6):3801-3808. doi: 10.21037/jtd-20-3095. PMID: 34277070; PMCID: PMC8264668.

[65] The American Cancer Society medical and editorial content team. Statistics for esophageal cancer: Esophageal cancer stats. American Cancer Society. https://www.cancer.org/cancer/esophagus-cancer/about/key-statistics.html. Accessed April 4, 2022.

[66] Congressional Budget Office. Detail of spending and enrollment for Medicaid for CBO's January 2017 baseline [Internet]. Washington (DC): CBO; [cited 2018 Apr 3]. Available from: https://www.cbo.gov/sites/default/files/recurringdata/51301-2017-01-medicaid.pdf Google Scholar

[67] Blavin F, Karpman M, Kenney GM, Sommers BD. Medicaid Versus Marketplace Coverage For Near-Poor Adults: Effects On Out-Of-Pocket Spending And Coverage. Health Aff (Millwood). 2018;37(2):299-307. doi:10.1377/hlthaff.2017.1166

[68] Rosenbaum S, Westmoreland TM. The Supreme Court's surprising decision on the Medicaid expansion: how will the federal government and states proceed? Health Aff (Millwood). 2012;31(8):1663–72.

[69] Escarce JJ, Wozniak GD, Tsipas S, Pane JD, Brotherton SE, Yu H. Effects of the Affordable Care Act Medicaid Expansion on the Distribution of New General Internists Across States. Med Care. 2021;59(7):653-660. doi:10.1097/MLR.0000000000001523

[70] Uberoi N, Finegold K, Gee E. Health insurance coverage and the Affordable Care Act, 2010–2016 [Internet]. Washington (DC): Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation; 2016 Mar 3 [cited 2018 Apr 3]. (ASPE Issue Brief). Available from: https://aspe.hhs.gov/system/files/pdf/187551/ACA2010-2016.pdf Google Scholar

[71] Pathak R, Canavan ME, Walters S, Salazar MC, Boffa DJ. Chemoradiation as a nonsurgical treatment option for early-stage esophageal cancers: a retrospective cohort study. J Thorac Dis. 2021 Jan;13(1):140-148. doi: 10.21037/jtd-20-1187. PMID: 33569194; PMCID: PMC7867841.

[72] Cancer staging system. American College of Surgeons. https://www.facs.org/quality-programs/cancer/ajcc/cancer-staging. Accessed April 12, 2022.

[75] Allen H, Baicker K, Finkelstein A, Taubman S, Wright BJ. What the Oregon health study can tell us about expanding Medicaid. Health Aff (Millwood). 2010;29(8):1498–506

[76] Menachemi N, Blackburn J, Sen B, Morrisey MA, Becker DJ, Caldwell Cet al. The impact of CHIP coverage on children with asthma in Alabama. Clin Pediatr (Phila). 2012;51(3):247–53.

[77] Diaz A, Burns S, D'Souza D, et al. Accessing surgical care for esophageal cancer: patient travel patterns to reach higher volume center. Dis Esophagus Off J Int Soc Dis Esophagus. Published online February 25, 2020. https://doi.org/10.1093/dote/doaa006

[78] Mazurenko O;Balio CP;Agarwal R;Carroll AE;Menachemi N; "The Effects Of Medicaid Expansion Under The ACA: A Systematic Review." Health Affairs (Project Hope), U.S. National Library of Medicine, https://pubmed.ncbi.nlm.nih.gov/29863941/.

[79] Reitz ACW, Switchenko JM, Gillespie TW. Is Medicaid Expansion Associated with Improved Nonmetastatic Colon Cancer Survival? An Analysis of the National Cancer Database [published online ahead of print, 2022 Feb 25]. *Am Surg*. 2022;31348211050816. doi:10.1177/00031348211050816

[80] Lam MB, Phelan J, Orav EJ, Jha AK, Keating NL. Medicaid Expansion and Mortality Among Patients With Breast, Lung, and Colorectal Cancer. *JAMA Netw Open*. 2020;3(11):e2024366. Published 2020 Nov 2. doi:10.1001/jamanetworkopen.2020.24366

[81] Sommers BD, Gawande AA, Baicker K. Health insurance coverage and health—what the recent evidence tells us. N Engl J Med. 2017;377(6):586–93.

[82] Obama B. United States health care reform: progress to date and next steps. JAMA. 2016;316(5):525–32.

TABLES

Table 1: Characteristics of study participants by state Medicaid expansion status

Participant characteristics	Expansion states n	Expansion states %	Non-expansion states n	Non-expansion states %
Age (years)				
40-49	791	9.6%	555	12.2%
50-59	3926	47.8%	2287	50.3%
60+	3299	40.2%	1702	37.5%
Gender				
Male	66742	82.1%	3753	82.6%
Female	1474	17.9%	791	17.4%
Race				
Whites	7488	91.1%	4070	89.6%
African-Americans	385	4.7%	376	8.3%
Asians	187	2.3%	34	0.8%
Other/unknown	156	1.9%	64	1.4%
Stage of diagnosis				
0-1	2884	35.1%	1566	34.5%
2-3	4770	58.1%	2588	56.9%
4	562	6.8%	390	8.6%
Education (2008-2012)				
Less than 7% no high school degree	2094	25.5%	831	18.3%
7%-20.9%	5190	63.2%	2807	61.8%
21% or more with no high school degree	932	11.3%	906	18.3%
Education (2012-2016)				
Less than 6.3% no high school degree	2139	26.0%	874	19.2%
6.3%-17.5%	4941	60.1%	2559	56.3%
17.6% or more with no high school degree	1136	13.8%	1111	24.5%
Income (2008-2012)				
Less than $38,000	967	11.8%	1018	22.4%
$38,000-$62,999	4225	51.4%	2536	55.8%
$63,000 or more	3024	36.8%	990	21.8%
Income (2012-2016)				
Less than $40,227	1048	12.8%	1079	23.8%
$40,227-$63,332	3872	34.9%	2536	51.8%
$63,333 or more	3296	40.1%	1113	24.5%
Rural/Urban (2013)				
Metro	6819	82.9%	3563	78.4%
Urban	1300	15.8%	867	19.1%
Rural	97	1.2%	114	2.5%
Total	8216		4544	

Table 2: Association between mortality following diagnosis of esophageal cancer and state Medicaid expansion status adjusted for adjusted for age, sex, race, stage of diagnosis,

Participant characteristics	OR	95% Confidence Interval		P-value
Medicaid expansion				
No	1	(reference)		
Yes	0.98	0.93	1.03	0.376
Age (years)				
40-49	1	(reference)		
50-59	1.01	0.93	1.09	0.903
60+	0.99	0.92	1.08	0.937
Gender				
Male	1	(reference)		
Female	1.03	0.97	1.09	0.366
Race				
Whites	1	(reference)		
African-Americans	1.05	0.93	1.17	0.449
Asians	1.09	0.91	1.31	0.369
Other/unknown	1.22	1.03	1.45	0.025

Table 3: Association between mortality following diagnosis of esophageal cancer and state Medicaid expansion status adjusted for adjusted for age, sex, race, stage of diagnosis, level of urbanization and 2008-2012 zip-code-based levels of income of education

Participant characteristics	OR	95% Confidence interval		P-value
Medicaid expansion				
No	1	(reference)		
Yes	0.98	0.93	1.04	0.552
Age (years)				
40-49	1	(reference)		
50-59	1.01	0.94	1.09	0.765
60+	1.01	0.93	1.09	0.852
Gender				
Male	1	(reference)		
Female	1.03	0.97	1.10	0.302
Race				
Whites	1	(reference)		
African-Americans	1.03	0.91	1.15	0.672
Asians	1.08	0.90	1.30	0.388
Other/unknown	1.22	1.02	1.45	0.028
Stage of diagnosis				
0-1	1	(reference)		
2-3	0.95	0.90	1	0.052
4	1.76	1.46	2.12	<.001
Education (2008-2012)				
Less than 7% no high school degree	1	(reference)		
7%-20.9%	1.14	1.07	1.22	0.0001
21% or more with no high school degree	1.16	1.05	1.29	0.005
Income (2008-2012)				
Less than $38,000	1	(reference)		
$38,000-$62,999	0.98	0.90	1.07	0.673
$63,000 or more	1.05	0.94	1.16	0.399
Rural/Urban (2013)				
Metro	1	(reference)		
Urban	1.05	0.97	1.13	0.217
Rural	0.93	0.76	1.14	0.491

Table 4: Association between mortality following diagnosis of esophageal cancer and state Medicaid expansion status, adjusted for age, sex, race, stage of diagnosis, level of urbanization, and 2012-2016 zip-code-based levels of income of education

Participant characteristics	OR	95% Confidence interval		P-value
Medicaid expansion				
No	1	(reference)		
Yes	0.99	0.93	1.04	0.583
Age (years)				
40-49	1	(reference)		
50-59	1.01	0.93	1.09	0.805
60+	1.00	0.93	1.09	0.939
Gender				
Male	1	(reference)		
Female	1.03	0.97	1.10	0.323
Race				
Whites	1	(reference)		
African-Americans	1.03	0.92	1.2	0.605
Asians	1.08	0.90	1.30	0.394
Other/unknown	1.23	1.03	1.46	0.022
Stage of diagnosis				
0-1	1	(reference)		
2-3	0.95	0.90	1	0.052
4	1.74	1.45	2.10	<.001
Education (2012-2016)				
Less than 6.3% no high school degree	1	(reference)		
6.3%-17.5%	1.06	0.99	1.14	0.087
17.6% or more with no high school degree	1.13	1.03	1.25	0.012
Income (2012-2016)				
Less than $40,227	1	(reference)		
$40,227-$63,332	1.02	0.94	1.10	0.697
$63,333 or more	1.05	0.96	1.16	0.288
Rural/Urban (2013)				
Metro	1	(reference)		
Urban	1.05	0.98	1.13	0.155
Rural	0.94	0.76	1.15	0.520