



HHS Public Access

Author manuscript

J Hosp Manag Health Policy. Author manuscript; available in PMC 2018 August 10.

Published in final edited form as:

J Hosp Manag Health Policy. 2018 July ; 2: .

A review of cancer outcomes among persons dually enrolled in Medicare and Medicaid

Steven S. Coughlin^{1,2}, Lee Caplan³, and Lufei Young⁴

¹Department of Clinical and Digital Health Sciences, College of Allied Health Sciences, Augusta University, Augusta, GA, USA

²Research Service, Charlie Norwood Veterans Affairs Medical Center, Augusta, GA, USA

³Department of Community Health and Preventive Medicine, Morehouse College of Medicine, Atlanta, GA, USA

⁴College of Nursing, Augusta University, Augusta, GA, USA

Abstract

The fragmentation and lack of coordination of health care may result in less efficient and more costly care and lead to poorer outcomes. There has been increasing interest in examining cancer outcomes among persons who are dually enrolled in Medicare and Medicaid. Previous studies have identified disparities in the quality of cancer treatment according to race, ethnicity, socioeconomic status, and source of health insurance. This article, which is based upon bibliographic searches in PubMed, reviews the literature on dual enrollment in Medicare and Medicaid and cancer survival and quality of cancer treatment. A total of 65 articles were identified. Of the 65 articles that were screened using the full texts or abstracts, 13 studies met the eligibility criteria, one cross-sectional study and 12 cohort studies. The results of this systematic review indicate that there is only limited evidence that dual enrollment in Medicare and Medicaid is associated with poorer survival or quality of cancer care. The number of studies that have looked for associations between dual Medicare-Medicaid status and survival and quality of cancer treatment is still small. Outcomes and cancer site(s) varied among the studies. Additional studies are needed to determine the replicability of findings reported to date. Of particular interest are studies of major forms of cancer (breast, prostate, lung, colorectal) that include adequate numbers of patients described by insurance status, race, comorbidity, stage, receipt of appropriate cancer therapy, and survival.

Keywords

Cancer; dual-system use; mortality; Medicaid; Medicare; quality of care

Correspondence to: Dr. Steven S. Coughlin, Clinical and Digital Health Sciences, College of Allied Health Sciences, Augusta University, 1120 15th Street, EC-4324, Augusta, GA 30912, USA. scoughlin@augusta.edu.

Contributions: (I) Conception and design: SS Coughlin; (II) Administrative support: None; (III) Provision of study materials or patients: SS Coughlin; (IV) Collection and assembly of data: SS Coughlin; (V) Data analysis and interpretation: All authors; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Conflicts of Interest: The contents do not represent the views of the U.S. Department of Veterans Affairs or the U.S. Government. The authors have no conflicts of interest to declare.

Introduction

There are over 9.6 million seniors and adults with disabilities in the U.S. who are dually eligible for Medicare and Medicaid (1). About 20% of Medicare beneficiaries are dually eligible for Medicare and Medicaid, and about 15% of Medicaid enrollees are dually enrolled. They qualify for Medicaid because of their low incomes, disability status, and limited financial assets (2). Roughly two-thirds of dual eligibles are elderly people who meet the age requirement for Medicare, and the remaining third qualify for Medicare through the Social Security Disability Insurance Program. Persons who are dually enrolled in Medicaid and Medicare include many vulnerable patients who are more likely to be African American or Hispanic, low income, and to have multiple chronic conditions (e.g., depression, Alzheimer's, heart failure, diabetes, chronic obstructive pulmonary disease), complex care needs, and high levels of health care utilization (1). Elderly African Americans and Hispanics are six times more likely than elderly whites to be dual eligible (Wright *et al.* 2015). Dual eligibles are of particular concern to health care providers and policy makers because they have substantial health care needs that are often unmet and increased morbidity and mortality (3). Because of low incomes and lack of private health insurance, this is a population that is vulnerable to problems with access to care and loss of Medicaid coverage (4). About 5.4% of dual enrollees become disenrolled in Medicaid each year (5).

For dual eligible beneficiaries, Medicare provides primary coverage, and Medicaid absorbs remaining costs and covers services not available through Medicare, such as long-term care (6). For both Medicare and Medicaid, beneficiaries may be enrolled in fee-for-service or managed care, creating a variety of possible coverage models (7). Dually eligible beneficiaries account for a disproportionate share of spending in both Medicare and Medicaid. For example, despite making up only 18% of the Medicare population, dually enrolled beneficiaries account for 31 % of Medicare spending and incur higher annual expenditures than their peers who are enrolled only in Medicare (8,9). To control costs and improve the efficiency and quality of care, states are increasingly turning to integrated delivery for dually eligible beneficiaries (1). Integration entails both financial alignment across Medicare and Medicaid and coordination in the delivery of services (2).

There has been increasing interest in examining cancer outcomes among persons who are dually enrolled in Medicare and Medicaid. Several studies have identified disparities in the quality of cancer treatment according to race, ethnicity, socioeconomic status, and source of health insurance (10-13). Medical costs for patients with cancer have increased over the past decade, partly because of the development of expensive chemotherapy drugs (14). Spending on cancer care in the U.S. is expected to rise from \$125 billion in 2010 to \$207 billion by 2020 (15).

The goal of the current article was to review the literature on dual enrollment in Medicare and Medicaid and cancer outcomes among 4 most common types of cancer (i.e., breast, prostate, lung, colorectal cancer) (16). Of particular interest was whether dual enrollment improves or worsens outcomes, such as survival and the quality of cancer care.

Methods

This review is based upon PubMed bibliographic searches and appropriate search terms. Articles published in English from 1997 through May 2018 were identified using Boolean algebra commands and MeSH search terms: dual use AND (Medicare OR Medicaid) AND cancer. The searches were not limited to words appearing in the title of an article. The references of review articles were also reviewed (17). Information obtained from the bibliographic searches (information presented in abstract, key words, and study design) was used to determine whether to retain each identified article. Studies with a cohort or cross-sectional study design were included.

A total of 65 articles were identified and screened using either their full texts or abstracts. A total of 13 studies met the eligibility criteria for inclusion in this review.

Results

The 13 studies included one cross-sectional study and 12 cohort studies (Table 1). Bradley *et al.* (18) studied a cohort of 2,626 older patients with local and regional stage, non-small cell lung cancer (NSCLC). Dually eligible patients were half as likely to undergo resection as Medicare-only patients ($P < 0.001$) and were more likely to receive radiation than Medicare only patients. Surgically treated dually eligible patients had slightly poorer survival as compared with that of Medicare only patients.

In a population-based cohort study of 103,808 patients with incident breast, prostate, colorectal, and lung cancer, Bradley *et al.* (19) observed an excess cancer incidence for dually enrolled black patients relative to their white counterparts in every cancer site examined, except for lung cancer. The dually eligible patients were enrolled 12 or more months before the diagnosis.

Shugarman *et al.* (20) conducted a retrospective cohort study of 26,073 Medicare beneficiaries 65 years of age who were diagnosed with lung cancer. Increasing age, and comorbidity, Medicaid enrollment, and having been diagnosed with stage 3 or stage 4 lung cancer were associated with increased mortality risk.

Koroukian *et al.* (21) conducted a cross-sectional study of patients with incident breast, prostate, or colorectal cancer. Dually eligible patients were more likely than low income non-duals to have unknown stage/unstaged breast cancer (OR 1.43, 95% CI: 1.02–2.0) and more likely to have distant stage colorectal cancer (OR 1.74, 95% CI: 1.12–2.70).

In a retrospective cohort study of 2,568 patients with incident breast, colorectal, or prostate cancer, Koroukian *et al.* (22) found that, compared to Medicare only, dual Medicare-Medicaid status was associated with a lower likelihood of receiving definitive treatment for colorectal cancer (OR 0.60, 95% CI: 0.38–0.95) but not for breast or prostate cancer.

Manzano *et al.* (23) conducted a retrospective cohort study of 30,199 patients with gastrointestinal cancer. Unplanned hospitalization was associated with black race; residing in census tracts with poverty levels $>13.3\%$; esophageal, gastric, and pancreatic cancer;

advanced disease stage; comorbidity; and dual eligibility for Medicare and Medicaid ($P < 0.05$ in each instance).

In a retrospective study of 1,200 Medicare patients with incident cancer of the breast (stage IIB to III), colon (stage III), rectum (stage II to III), lung (stage II to IV), or ovary (stage II to IV), Warren *et al.* (14) found that dual-eligible patients were less likely to receive chemotherapy than were Medicare patients with private insurance.

Doll *et al.* (24) conducted a population-based cohort study of 4,522 women age >65 years dually enrolled in Medicare and Medicaid, with cancer of the uterus, ovary, cervix, or vulva/vagina. Compared to Medicare only, dual enrollees had increased all-cause mortality overall (HR 1.34, 95% CI: 1.19–1.49) and within each cancer site. Increased odds of advanced stage disease at diagnosis were only present in uterine cancer (OR 1.38, 95% CI: 1.06–1.79).

Guadagnolo *et al.* (25) conducted a retrospective cohort study of 69,572 patients dying of cancer. Medicaid patients were more likely to receive chemotherapy and radiation therapy, and more likely to have >1 emergency room visit than Medicare patients (OR 5.27, 95% CI: 4.76–5.84). Dual eligibles were more likely to have >1 emergency room visit than Medicare-only beneficiaries (OR 1.19, 95% CI: 1.07–1.33). Costs were higher for non-white Medicare, Medicaid, and dually eligible patients compared to white Medicare enrollees.

On the other hand, in a retrospective cohort study of 763,884 persons with cancer of the breast, ovary, endometrium, cervix, colon, lung, or stomach, Parikh-Patel (15) found that persons with Medicaid or Medicare-Medicaid dual-eligible coverage and the uninsured had lower odds of receiving recommended radiation and/or chemotherapy or surgery for breast, endometrial, and colon cancer, relative to those with private insurance.

In a retrospective cohort study of 10,618 patients age ≥ 65 years who underwent colon cancer resection, Ratnapradipa *et al.* (26) found that Medicare-Medicaid dual enrollment, age ≥ 85 years, and higher tumor stage and grade were associated with receipt of laparoscopic surgery.

In a retrospective cohort study of 1,452 patients with NSCLC who were treated with erlotinib, Hess *et al.* (27) found that low income subsidy status, having Medicare insurance, dual eligibility (compared to Medicare only), and higher erlotinib out of pocket costs were associated with longer treatment duration.

Somayaji *et al.* (28) conducted a retrospective cohort study of 262 adults undergoing a lung biopsy. Age and the number of comorbidities predicted outpatient use, and the number of comorbidities predicted emergency department use in patients with lung cancer. Patients with lung cancer who received a lung biopsy by a Commission on Cancer accredited organization had a longer time of survival from the biopsy event than those who received a lung biopsy by a non-accredited organization.

Discussion

The results of this systematic review indicate that there is only limited evidence that dual enrollment in Medicare and Medicaid is associated with poorer survival or quality of cancer care. The number of studies that have looked for associations between dual Medicare-Medicaid status and cancer survival and quality of care is still very modest. Dually eligible patients have been found to be less likely to undergo resection for local and regional stage NSCLC than Medicare only patients (18). In a separate study, dual Medicare-Medicaid status was associated with a lower likelihood of receiving definitive treatment for colorectal cancer but not for breast or prostate cancer (22). Dual Medicare-Medicaid status was associated with a lower likelihood of receiving chemotherapy in one study (14). In a study of patients with lung cancer (20), dual enrollees were found to have poorer survival.

The association between dual insurance status and survival may be through a couple mechanisms. According to evidence collected from this review, dual enrollees were more likely to be diagnosed at later stage of cancer, leading to lower survival. Patients with incident breast cancer have been reported to be less likely to be staged (21), which can adversely affect receipt of appropriate cancer therapy. Second, lower survival may result from disparity in access to high quality of care (e.g., inadequacy of staging, delays in initial treatment, inconsistency with treatment guidelines, etc.). It was reported that the program structure of Medicaid contributed to access barriers to high quality of cancer care, leading to worse prognosis and health outcomes (29). On the other hand, the finding that patients with dual coverage have a poorer survival rate than patients with single insurance coverage must be interpreted with caution. Studies rarely provide information on whether patients were diagnosed and treated with cancer before dual enrollment or vice versa. Ward *et al.* (Ward, 2008) found that patients with serious medical conditions such as cancer were more likely to have Medicaid and become dual insured, indicating dual enrollees had more complex medical issues and poorer overall health conditions than single insured. Therefore, their lower survival rate could be a result of poor health instead of insurance status.

Outcomes and cancer site(s) varied among the studies. Caution is therefore required in comparing results across studies. Potential sources of bias include under detection of cancer outcomes and procedures due to the sole use of administrative data in some studies. Thus, the jury is still out regarding the issue of whether dual enrollees have poorer or better cancer outcomes than those beneficiaries who have either Medicare or Medicaid but not both, and also regarding the issue of whether dual enrollees receive less aggressive cancer treatment than those Medicare or Medicaid beneficiaries. One might expect that some dual enrollees (e.g., those with Alzheimer's or other life-threatening, terminal disease) would have poorer cancer outcomes and would be treated less aggressively even though they have dual insurance coverage. In addition, Medicaid beneficiaries, being poor and having less access to care, might present with later stage cancers for which treatments are less effective.

Additional studies are needed to determine the replicability of findings reported to date. Of particular interest are studies of major forms of cancer (breast, prostate, lung, colorectal) that include adequate numbers of patients described by insurance status, race, stage, comorbidity, receipt of appropriate cancer therapy, and survival.

Acknowledgements

None.

References

1. Graham CL , Stewart HC , Kurtovich E , et al. Integration of Medicare and Medicaid for dually eligible beneficiaries: A focus group study examining beneficiaries' early experiences in California's dual financial alignment demonstration. *Disabil Health J* 2018;11:130–8.29137878
2. Grabowski DC , Joyce NR , McGuire TG , et al. Passive Enrollment Of Dual-Eligible Beneficiaries Into Medicare And Medicaid Managed Care Has Not Met Expectations. *Health Aff (Millwood)* 2017;36:846–54.28461351
3. Wright B , Potter AJ , Trivedi A . Federally Qualified Health Center Use Among Dual Eligibles: Rates Of Hospitalizations And Emergency Department Visits. *Health Aff (Millwood)* 2015;34:1147–55.26153309
4. Riley GF , Zhao L , Tilahun N . Understanding factors associated with loss of medicaid coverage among dual eligibles can help identify vulnerable enrollees. *Health Aff (Millwood)* 2014;33:147–52.24395947
5. Stuart B , Singhal P . The stability of Medicaid coverage for low-income dually eligible Medicare beneficiaries. Menlo Park, CA: Kaiser Family Foundation, 2006 Available online: <https://kaiserfamilyfoundation.files.wordpress.com/2013/01/7512.pdf>
6. Young K , Garfield R , Musemeci M , et al. Medicaid's role for dual eligible beneficiaries. Kaiser Commission on Medicaid and the Uninsured. Issue Brief 2012 Available online: <https://kaiserfamilyfoundation.files.wordpress.com/2013/01/7846-03.pdf>
7. Kim H , Charlesworth CJ , McConnell KJ , et al. Comparing Care for Dual-Eligibles Across Coverage Models: Empirical Evidence From Oregon. *Med Care Res Rev* 2017 [Epub ahead of print].
8. Samson LW , Chen LM , Epstein AM , et al. Dually Enrolled Beneficiaries Have Higher Episode Costs On The Medicare Spending Per Beneficiary Measure. *Health Aff (Millwood)* 2018;37:86–94.29309214
9. Congressional Budget Office. Dual-eligible beneficiaries of Medicare and Medicaid; characteristics, health care spending, and evolving policies. Washington, DC: CBO, 2013 Available online: <https://www.cbo.gov/sites/default/files/113th-congress-2013-2014/reports/44308dualeligibles2.pdf>
10. Roetzheim RG , Gonzalez EC , Ferrante JM , et al. Effects of health insurance and race on breast carcinoma treatments and outcomes. *Cancer* 2000;89:2202–13.11147590
11. Roetzheim RG , Pal N , Gonzalez EC , et al. Effects of health insurance and race on colorectal cancer treatments and outcomes. *Am J Public Health* 2000;90:1746–54.11076244
12. Coburn N , Fulton J , Pearlman DN , et al. Treatment variation by insurance status for breast cancer patients. *Breast J* 2008;14:128–34.18315690
13. Rhoads KF , Ngo JV Ma Y , et al. Do hospitals that serve a high percentage of Medicaid patients perform well on evidence-based guidelines for colon cancer care? *J Health Care Poor Underserved* 2013;24:1180–93.23974390
14. Warren JL , Butler EN , Stevens J , et al. Receipt of chemotherapy among medicare patients with cancer by type of supplemental insurance. *J Clin Oncol* 2015;33:312–8.25534387
15. Parikh-Patel A , Morris CR , Kizer KW . Disparities in quality of cancer care: The role of health insurance and population demographics. *Medicine (Baltimore)* 2017;96:e9125.29390313
16. Siegel R , Naishadham D , Jemal A . Cancer statistics, 2013. *CA Cancer J Clin* 2013;63:11–30.23335087
17. Slatore CG , Au DH , Gould MK; American Thoracic Society Disparities in Healthcare Group. An official American Thoracic Society systematic review: insurance status and disparities in lung cancer practices and outcomes. *Am J Respir Crit Care Med* 2010;182:1195–205.
18. Bradley CJ , Luo Z , Given CW . Cancer incidence in elderly Medicare and dually eligible beneficiaries. *Health Serv Res* 2008;43:1768–79.18479409

19. Bradley CJ , Dahman B , Given CW Treatment and survival differences in older Medicare patients with lung cancer as compared with those who are dually eligible for Medicare and Medicaid. *J Clin Oncol* 2008;26:5067–73.18794546
20. Shugarman LR , Sorbero ME , Tian H , et al. An exploration of urban and rural differences in lung cancer survival among medicare beneficiaries. *Am J Public Health* 2008;98:1280–7.17971555
21. Koroukian SM , Bakaki PM , Beaird H , et al. Cancer stage comparison between dual Medicare-Medicaid eligibles using Medicaid as a supplemental health insurance program and low-income nonduals. *J Public Health Manag Pract* 2011;17:479–91.21964357
22. Koroukian SM , Bakaki PM , Owusu C , et al. Cancel-outcomes in low-income elders: is there an advantage to being on Medicaid? *Medicare Medicaid Res Rev* 2012;2 pii: mmr.002.02.a06.
23. Manzano JG , Luo R , Elting LS , et al. Patterns and predictors of unplanned hospitalization in a population-based cohort of elderly patients with GI cancer. *J Clin Oncol* 2014;32:3527–33.25287830
24. Doll KM , Meng K , Basch EM , et al. Gynecologic cancel-outcomes in the elderly poor: A population-based study. *Cancer* 2015;121:3591–9.26230631
25. Guadagnolo BA , Liao KP , Giordano SH , et al. Variation in Intensity and Costs of Care by Payer and Race for Patients Dying of Cancer in Texas: An Analysis of Registry-linked Medicaid, Medicare, and Dually Eligible Claims Data. *Med Care* 2015;53:591–8.26067883
26. Ratnapradipa KL , Lian M , Jeffe DB , et al. Patient, Hospital, and Geographic Disparities in Laparoscopic Surgery Use Among Surveillance, Epidemiology, and End Results-Medicare Patients With Colon Cancer. *Dis Colon Rectum* 2017;60:905–13.28796728
27. Hess LM , Louder A , Winfree K , et al. Factors Associated with Adherence to and Treatment Duration of Erlotinib Among Patients with Non-Small Cell Lung Cancer. *J Manag Care Spec Pharn* 2017;23:643–52.
28. Somayaji D , Chang YP , Casucci S , et al. Exploring Medicaid claims data to understand predictors of healthcare utilization and mortality for Medicaid individuals with or without a diagnosis of lung cancer: a feasibility study. *Transl Behav Med* 2018;8:400–8.29800414
29. Ward E , Halpem M , Schrag N , et al. Association of insurance with cancer care utilization and outcomes. *CA Cancer J Clin* 2008;58:9–31.18096863

Table 1

Studies of cancer outcomes among persons dually enrolled in Medicaid and Medicare

| Study | Sample | Design | Outcomes | Results |
|--------------------------------|--|-----------------------------|---|--|
| Bradley <i>et al.</i> 2008 (a) | 2,626 older patients with local and regional stage NSCLC | Retrospective cohort | Receipt of resection, chemotherapy, radiation therapy, and survival | Dually eligible patients were half as likely to undergo resection as Medicare patients ($P<0.001$) and were more likely to receive radiation than Medicare patients. Surgically treated dually eligible patients had slightly poorer survival as compared with that of Medicare patients |
| Bradley <i>et al.</i> 2008 (b) | 103,808 patients in Michigan Tumor Registry with incident female breast, prostate, colorectal, and lung cancer | Population based cohort | Cancer incidence | In dually eligible patients enrolled 12 or more months before the diagnosis, an excess cancer incidence was observed for black patients relative to white patients in every cancer site examined except for lung cancer |
| Shugarman <i>et al.</i> 2008 | 26,073 Medicare beneficiaries age 65 years diagnosed with lung cancer | Retrospective cohort | Survival | Increasing age, comorbidity, Medicaid enrollment, and having been diagnosed with stage 3 or stage 4 lung cancer were associated with increased mortality risk |
| Koroukian <i>et al.</i> 2011 | Patients with incident breast, prostate, or colorectal cancer in Ohio, age 65 years_ | Cross-sectional | Unknown stage/unstaged cancer, and distant stage at diagnosis | Dually eligible patients were more likely to have unknown stage/unstaged breast cancer (OR 1.43, 95% CI: 1.02–2.0), and more likely to have distant stage colorectal cancer (OR 1.74, 95% CI: 1.12–2.70) |
| Koroukian <i>et al.</i> 2012 | 2,568 patients with incident breast, colorectal, or prostate cancer in Ohio | Retrospective cohort | Recommended cancer treatment | Dual Medicare-Medicaid status was associated with a lower likelihood of receiving definitive treatment for colorectal cancer (OR 0.60, 95% CI: 0.38–0.95) but not for breast or prostate cancer |
| Manzano <i>et al.</i> 2014 | 30,199 patients with gastrointestinal cancer in Texas | Retrospective cohort | Unplanned hospitalization | Unplanned hospitalization was associated with black race; residing in census tracts with poverty levels >13.3%; esophageal, gastric, and pancreatic cancer; advanced disease stage; comorbidity; and dual eligibility for Medicare and Medicaid ($P<0.05$ in each instance) |
| Warren <i>et al.</i> 2015 | 1,200 Medicare patients with incident cancer of the breast (stage IIB to III), colon (stage III), rectum (stage II to III), lung (stage II to IV), or ovary (stage II to IV) | Retrospective observational | Consultation with an oncologist and receipt of chemotherapy | Dual-eligible patients were less likely to receive chemotherapy than were Medicare patients with private insurance |
| Doll <i>et al.</i> 2015 | 4,522 women age >65 years dually enrolled in Medicare and Medicaid, with cancer of the uterus, ovary, cervix, or | Population based cohort | All-cause mortality and stage at diagnosis | Dual enrollees had increased all-cause mortality overall (HR 1.34, 95% CI: 1.19–1.49) and within each cancer site. Increased odds of advanced stage disease at diagnosis was |

| Study | Sample | Design | Outcomes | Results |
|---------------------------------|---|----------------------|--|--|
| Guadagnolo <i>et al.</i> 2015 | vulva/vagina residing in North Carolina 69,572 patients dying of cancer in Texas | Retrospective cohort | Receipt of chemotherapy and radiation therapy, acute care, and costs | only present in uterine cancer (OR 1.38, 95% CI: 1.06–1.79) Medicaid patients were more likely to receive chemotherapy and radiation therapy, and more likely to have >1 emergency room visit than Medicare patients (OR 5.27, 95% CI: 4.76–5.84). Dual eligibles were more likely to have >1 emergency room visit than Medicare-only beneficiaries (OR 1.19, 95% CI: 1.07–1.33). Costs were higher for non-white Medicare, Medicaid, and dually eligible patients compared to white Medicare enrollees |
| Parikh-Patel <i>et al.</i> 2017 | 763,884 persons with breast, ovary, endometrium, cervix, colon, lung, or gastric cancer in California | Retrospective cohort | Recommended radiation, chemotherapy, or surgery | Persons with Medicaid or Medicare-Medicaid dual eligible coverage and the uninsured had lower odds of receiving recommended radiation and/or chemotherapy or surgery for breast, endometrial, and colon cancer, relative to those with private insurance |
| Ratnapradipa <i>et al.</i> 2017 | 10,618 patients age 65 years who underwent colon cancer resection | Retrospective cohort | Laparoscopic or open resections for colon cancer | Medicare-Medicaid dual enrollment, age 85 years, and higher tumor stage and grade were associated with receipt of laparoscopic surgery |
| Hess <i>et al.</i> 2017 | 1,452 patients with NSCLC who were treated with erlotinib | Retrospective cohort | Treatment duration | Low income subsidy status, having Medicare insurance, dual eligibility, and higher erlotinib out of pocket costs were associated with longer treatment duration |
| Somayaji <i>et al.</i> 2018 | 262 adults having a lung biopsy in 8 counties in Western New York region | Retrospective cohort | Outpatient and emergency department use, survival time | Age and the number of comorbidities predicted outpatient use and the number of comorbidities predicted emergency department use in patients with lung cancer. Patients with lung cancer who received a lung biopsy by a Commission on Cancer accredited organization had a longer time of survival from the biopsy event |

CI, confidence interval; OR, odds ratio; HR, hazards ratio; NSCLC, non-small cell lung cancer.