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Racial and geographic disparities in the patterns of care and costs at the end of life for patients with lung cancer in 2007–2010 after the 2006 introduction of bevacizumab

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ABSTRACT

Objectives: To examine racial/ethnic and geographical disparities in cancer care and costs during the last 6 months of life for lung cancer decedents after the Food and Drug Administration's approval of expensive bevacizumab in October 2006.

Methods: We identified 37,393 cases from the Surveillance, Epidemiology and End Results (SEER) cancer registries and Medicare linked databases who were diagnosed with non-small cell lung cancer of all stages in 1991–2009 and died between July 2007 and December 2010.

Results: Overall, the proportion of patients receiving chemotherapy/targeted therapy (31.0%), bevacizumab (4.6%), growth factors (16.0%), surgery (2.8%), and hospice care (60.9) in the last 6 months of life was higher in whites than in other ethnic populations. Hospitalization rate was higher in blacks (83.2%) than in whites (76.0%) and others (78.0%). Those from metro areas had slightly higher percentages of receiving chemotherapy/targeted therapy, bevacizumab, growth factors, and hospice care, but had a higher hospitalization rate and lower emergency care visit. Mean total health care cost was $42,749 for the last 6 months of life in patients with lung cancer. Adjusted mean health care cost in the last 6 months of life was significantly higher in blacks or other ethnic population as compared to whites.

Conclusion: There were substantial racial/ethnic and geographic disparities in the types of cancer care and costs in the last 6 months of life among lung cancer decedents, regardless of the length of survival times and hospice care status. A clinical guideline may help the appropriate use of costly treatment modalities and minimize racial/geographic disparities.

1. Introduction

Over the past few years, there have been some research reports and debates about overuse of curative therapies and high costs at the end of life care for patients with terminal cancer [1–5]. For example, Emanuel and colleagues reported that 33% of cancer decedents received chemotherapy in the last 6 months of life and 23% did so in the last 3 months in Massachusetts and California [1]. The overuse of curative therapies at the end of life care was also reported in other areas of the United States [6–17] and in other countries as well [18–25]. Warren and colleagues [9] recently compared the end of life care for lung cancer patients between the United States and Canada and concluded that the use of hospital and emergency services were significantly higher in Ontario, Canada. They examined the rates of patients with emergency service visits and hospital admissions and inpatient mortality rate among those hospitalized patients in a large cohort of patients with lung cancer who died at age 65 or older during 1999–2003. One reason for overuse of chemotherapy or other cancer care services at the end of life may be that patients' families wanted to have these medical services regardless of their effectiveness or costs [17,18]. There are calls for stopping overtreatment at the end of life and for cutting cancer costs in the U.S. [26]. There also have been studies on the quality indicators [6,22,27] and some guidelines have been developed for cancer end-of-life care [26,27] in order to help the

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Abbreviations: AJCC, American Joint Committee on cancer; CPT, common procedure terminology; FDA, food and drug administration; GLM, generalized linear model; HMO, health maintenance organization; ICD-9-CM, international classification of diseases, 9th revision, clinical modification; SEER, surveillance; SES, socioeconomic status; US, United States.

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care providers, patients and their families make informed decisions and minimize the inconsistencies. Because a new and expensive (that can cost $100,000 per year [28]) antibody, bevacizumab, was approved by the Food and Drug Administration (FDA) for treating patients with lung cancer in October 2006 [29,30], it would be important to know how this costly medication was used towards the end of life care in the U.S. Hence, we undertook this study to examine whether racial/ethnic and geographical disparities exist in cancer care and costs following the introduction of bevacizumab during the last 6 months of life for patients with lung cancer who died between July 2007 and December 2010.

2. Materials and methods

2.1. Data sources

The National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) cancer registries and Medicare linked databases were used for this retrospective cohort study [31–33]. SEER program, supported by the National Cancer Institute, includes population-based tumor registries in selected geographic areas: San Francisco/Oakland, Detroit, Seattle, Atlanta, Rural Georgia, Los Angeles county, the San Jose-Monterey area, and the rest of California; and the states of Connecticut, Iowa, New Mexico, Utah, Hawaii, Kentucky, Louisianan and New Jersey. Medicare Program is administered by the Center for Medicare and Medicaid Services, and covers hospital, physician and other medical services for >97% of persons aged ≥65 years. The Committee for the Protection of Human Subjects at the University of Texas Health Science Center approved this study.

2.2. Study population

The study aimed to identify patients with lung cancer at all stages who died between July 2007 and December 2010 to allow assessment of the end of life care in the last 6 months after the FDA's October 2006 approval of bevacizumab for treating lung cancer. Hence, we identified 41,789 patients who were diagnosed with non-small cell lung cancer of all stages from January 1991 to December 2009 and died between July 2007 and December 2010. The study population inclusion and exclusion flowchart was shown in Appendix-Fig. A majority (85%) of patients were diagnosed in 2006–2009 and a small proportion of patients were diagnosed before 2001 and died between July 2007 and December 2010. Additional 1364 cases that were ascertained from autopsy or death certificate were excluded. To ensure complete information on health care utilization during the last six months of life, cases were included if they were continuously enrolled in Medicare part-A and part-B and were excluded if they were enrolled in a health maintenance organization during the last six months of life ($n = 2968$), leaving 37,457 cases in the final analytical file. The date of death was available from the Medicare enrolment data files, but because the SEER data only provided the month and year of cancer diagnosis, the 15th of each month is arbitrarily chosen as the day of diagnosis. As a result, 64 patients for whom date of death was more than 15 days earlier than the date of diagnosis were excluded. Of the remaining 37,393 cases, 37,387 cases were available for geographic disparity analysis by excluding 6 cases with missing information on geographic areas and 37,363 cases were available for racial disparity analysis by excluding 30 cases with unknown race/ethnicity.

2.3. Study variables

The main exposure variables for the study were race and geographic location. Race was categorized as whites, blacks and others. Geographic location variable in SEER-Medicare database was obtained from the Area Resource File (ARF) from the Bureau of Health Professions of the Department of Health and Human Services [34], was categorized "Big Metro"-metro area counties of 1 million populations or more; "Metro"-metro area counties of less than 1 million populations; "Urban"-urban population of 20,000 or more; "Less Urban"-urban population of 2500–19,999; "Rural"-urban population of less than 2500; and "Unknown"-missing value. In this study, we recoded them into metropolitan area (big metro or metro), urban area and less urban/rural area, and excluded 6 cases with missing value.

The outcome variables included the receipt of chemotherapy/targeted biologic, bevacizumab, radiation, growth factors, surgery, hospitalization and mean number of hospitalization, emergency department care, hospice care, and costs during the last six months before death. Procedure and revenue center codes were used to identify chemotherapy/targeted biologic, bevacizumab, radiation, growth factors, and surgery (see Appendix-Table) [35–38]. Hospitalization, emergency care and hospice use was defined if they initiated at least one inpatient admission or hospice admission during the last six months of life, respectively.

Total health care costs were defined as the sum of amount in dollars paid by the Medicare program for inpatient services, outpatient services, physician services, skilled nursing facility, hospice, and durable medical equipment for each patient for last six months of life, rather than the amount charged by the care providers. Costs were adjusted for geographical location and inflation using county level price adjusters developed by Brown and colleagues [39] because the study included patients across various regions in the U.S. Price adjusters were matched with the patient's county at diagnosis allowing cost adjustment to the 2009 U.S. dollars. Further inflation adjustment to the 2014 U.S. dollars was conducted using the medical care component of the consumer price index [39].

The weighted comorbidity scores from the 18 non-cancer conditions were generated from above Medicare claims in the last 6 months of care. The method was similar to what was reported before [40] . Other variables included age, gender, marital status, American Joint Committee on Cancer (AJCC) stage, historic stage, tumor grade, tumor size, number of positive nodes, SEER areas, year of diagnosis, and socioeconomic status (SES). SES was defined by using the percent of persons living below the poverty line at the census tract level from the 1990 census for cases in 1992–1999 and from the 2000 census for cases in 2000–2009, which were then classified into quartiles for SES.

2.4. Statistical analysis

Descriptive statistics were performed to compare the distribution of patient socio-demographic and tumor characteristics among racial/ethnic groups and geographic location categories. Multiple logistic regression analysis was conducted for each of the outcomes with race and geographic location as the primary independent variables, while adjusting for other socio-demographic and tumor characteristics. These analyses were stratified by the survival times (who survived at least six months after diagnosis and who died within six months of diagnosis) and by hospice care status (who received hospice care and who did not receive hospice care in the last six months). Generalized linear models (GLMs) were used to estimate the total health care cost using log link and gamma distribution, which are often used with cost data [41–43]. GLMs account for heteroscedasticity and skewness that usually occur with cost data [41]. The primary variables of interest for cost analyses were receipt of chemotherapy/targeted biologic, bevacizumab, radiation, growth factors, surgery, hospitalization and hospice care. Separate GLMs were estimated for patients who survived at least six months and who died within six months of diagnosis. All analyses were