American Thoracic Society Documents

An Official American Thoracic Society Systematic Review: Insurance Status and Disparities in Lung Cancer Practices and Outcomes

Christopher G. Slatore, David H. Au, and Michael K. Gould, on behalf of the American Thoracic Society Disparities in Healthcare Group

THIS OFFICIAL SYSTEMATIC REVIEW WAS APPROVED BY THE AMERICAN THORACIC SOCIETY BOARD OF DIRECTORS, APRIL 2010

CONTENTS

***Rationale*: Insurance coverage is an important determinant of access to care and is one potential cause of disparities in lung cancer care outcomes.**

***Objectives*: We performed a systematic review of the available literature to examine the association between insurance status and lung cancer practices and outcomes.**

***Methods*: We searched multiple electronic databases through November 6, 2008 for studies that examined the association between lung cancer outcomes and insurance status. Two reviewers independently selected studies. One investigator evaluated their quality according to predetermined criteria, and abstracted data about study design, patients' demographic and clinical characteristics, and outcome measures.**

***Measurements and Main Results*: Of 3,798 potentially relevant studies, 23 met eligibility criteria and were included. Studies reported heterogeneous outcomes among heterogeneous samples of patients that precluded a quantitative synthesis. In general, compared with patients with private or Medicare insurance, patients with Medicaid or no insurance had poorer lung cancer outcomes, including higher incidence rates, later stage at diagnosis, and poorer survival. Overall, patients with Medicaid or no insurance were less likely to undergo curative procedures, but patients without insurance were more likely to receive guideline-concordant care.**

***Conclusions*: Patients with Medicaid or no insurance consistently had worse outcomes than other patients with lung cancer. Some of the disparities may be secondary to residual confounding from smoking and other health behaviors, but available data suggest that patients with lung cancer without insurance do poorly because access to care is limited and/or they present with more advanced disease that is less amenable to treatment.**

Keywords: lung cancer; insurance; disparities

Lung cancer is the second most common cancer among men and women in the United States and the leading cause of cancer-related mortality (1). Consequently, even small disparities in the incidence, mortality, and burden of this disease affect many individuals. The U.S. government has prioritized studying and remedying disparities in cancer care (2), and it is important to evaluate the reasons underlying these disparities.

Differences in insurance status may contribute directly to disparate cancer outcomes. In addition, differences in race, ethnicity, income, education, and other factors that are related to insurance status may also have an effect on processes and outcomes of care (1, 3–6). The insurance system in the United States is fragmented between public and private providers and is incomplete, with an estimated 20% of adults under 65 who are uninsured (7). Documenting differences in lung cancer care based on insurance status is important for planners and providers of health care, given that policies can be designed and implemented to reduce disparities.

Our objective was to systematically review and critically appraise all available studies that have examined the association between insurance status and practices and outcomes in patients with lung cancer.

METHODS

Study Identification

We followed the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) guidelines in the development of this systematic review (8). Systematic methods were used to identify relevant studies, assess study eligibility for inclusion, and evaluate study quality (9, 10). We attempted to find all published studies examining care and outcomes for patients with and/or at risk for lung cancer associated with individual insurance status.

This study was sponsored by the American Thoracic Society (ATS). C.G.S. received salary support from the National Institutes of Health (NIH) [CA130328] for his work on a separate project. D.H.A. and M.K.G. were supported by the Department of Veterans Affairs. This study is the result of work supported by resources from the VA Puget Sound Health Care System, Seattle, Washington. Neither the NIH nor the Department of Veterans Affairs had a role in the conduct of the study, in the collection, management, analysis, or interpretation of data, or in the preparation of the manuscript. The sponsor provided documents review processes and, after satisfactory revision, forwarded to the ATS Board of Directors for final approval.

The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs.

This article has an online supplement, which is accessible from this issue's table of contents at www.atsjournals.org

Am J Respir Crit Care Med Vol 182. pp 1195–1205, 2010
DOI: 10.1164/rccm.2009-038ST
Internet address: www.atsjournals.org

One investigator (CGS), with the help of a professional medical librarian, searched the online databases of MEDLINE, ProQuest (which includes dissertations), EBSCOHost (which includes CINAHL), CSA Illumina, EMBASE, and ISI Web of Knowledge, from January 1970 to November 6, 2008 (some manuscripts were e-published and listed in the database but not published in print form until after November 2008). We used the most general search terms to be all-inclusive. The specific terms entered for the searches are included (*see* Part A of the online supplement). Articles that were repeated in different database searches were not tallied separately. We captured additional articles by reviewing reference lists from identified studies and pertinent review articles.

Study Eligibility

Two investigators (either C.G.S./D.H.A. or C.G.S./M.K.G.) independently assessed original research studies for eligibility according to predefined criteria (Part B of the online supplement), with disagreements resolved by discussion. We included studies that analyzed aspects of care for patients with and/or at risk of lung cancer according to differences in individual insurance status. Studies that used nonindividual measures of insurance status such as geographic correlates were excluded. Studies that enrolled patients with diagnoses other than lung cancer were eligible for inclusion if the outcomes from the patients with lung cancer were reported separately or if patients with lung cancer constituted at least 80% of the sample. As the insurance system in the United States was the focus of the analysis, only studies of patients in the United States were eligible.

Data Abstraction

We abstracted data about demographic characteristics, insurance status, specific care outcomes, statistical tests and significance, and adjustment for confounders. We also collected data about how the outcomes and insurance status were recorded. We divided care outcomes into the following categories: incidence, stage at diagnosis, mortality, access to care, and delivery of care. The delivery of care category was broken into subcategories related to procedures and treatments, hospice care, and other.

Study Quality

To measure study quality we developed a 16-item inventory. These items included measures of cohort assembly, exposure measurement, outcome measurement, adjustment for confounding, statistical analysis, funding, and conflict of interest disclosure. Each question was graded either "Yes," "No," "Unsure," or "Not applicable" by one investigator (C.G.S.). Individual questions are listed in Figure 2 and quality was graded as the total number of "Yes" responses over the possible number. Many studies were cross-sectional, so the question regarding appropriate follow-up was not relevant.

Statistical Analysis

Median values and ranges for summary statistics are reported based on information provided by each of the primary study authors. We did not attempt to pool data across studies because there was substantial heterogeneity in exposure and outcome measures, and few studies provided raw data that would be necessary for quantitative synthesis.

RESULTS

We identified 3,798 potentially relevant citations, of which 3,739 were judged not to be relevant after reviewing their title and abstract. Twenty-three of 59 remaining manuscripts were deemed eligible using our predefined inclusion criteria (Part B of the online supplement) following full-text review (Figure 1). One article was excluded after we determined that two articles reported the same results (11, 12), 27 were excluded because they did not compare groups defined by insurance status, 5 were excluded because they did not include enough lung cancer cases, and 3 were excluded because they were not research studies (Figure 1). The characteristics of the studies that were included are listed chronologically in Table 1. Table 2 lists the studies, outcomes measured, insurance status, and results.

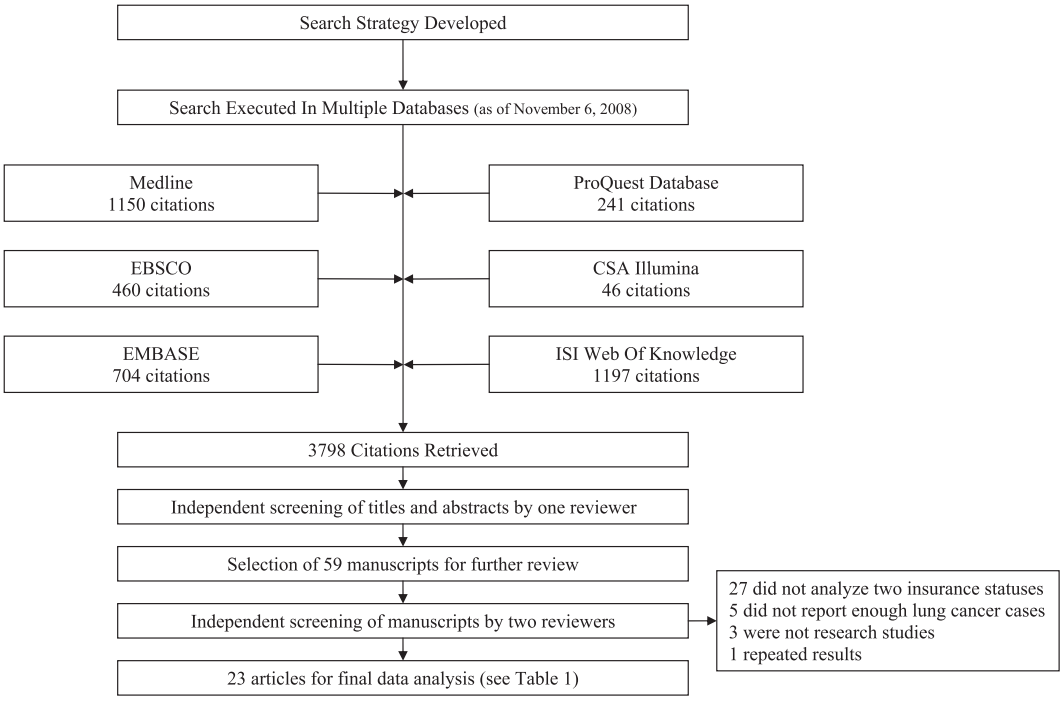

Figure 1. Flow chart of the process that was used to select the relevant studies.

TABLE 1. CHARACTERISTICS OF INCLUDED STUDIES

Study	Methodology · Study Design · Source(s) of Data	Subjects · Number Enrolled · Age · Cancer specifics	Comparison	Outcome(s)	Quality Score*
Spraberry, 1987 (33)	· Cohort · University of Alabama Hospital	· 249 · All ages · White males · All stages	· Medicare · Non-Medicate	· Length of Stay · Costs†	10/15
Greenberg, 1988 (20)	· Cross-sectional · New Hampshire–Vermont Central Tumor Registry	· 1,403 · All Ages · NSCLC	· Private Insurance · Other Insurance	· Surgery · Radiation Therapy · Mortality	13/15
Greenberg, 1988 (29)	· Cross-sectional · New Hampshire–Vermont Central Tumor Registry	· 1,615 · All ages · All stages	· Private Insurance · Other Insurance	· Diagnosis at a university cancer center · Treatment at university cancer center	13/15
Bradley, 2001 (13)	· Cohort · Michigan Cancer Registry · Michigan Medicaid Database	· 12,096 · All ages · All stages	· Medicaid, < 65 yr · Medicaid, > 65 yr · Medicare · Other, < 65 yr	· Incidence · Late stage at diagnosis · Mortality	13/16
Bradley, 2003 (15)	· Cross-sectional · Michigan Cancer Registry · Michigan Medicaid Database	· 3,801 · 25–64 yr · All stages	· Medicaid before diagnosis · Medicaid after diagnosis · Non-Medicaid	· Late stage at diagnosis	11/15
Du, 2003 (26)	· Case-Control · Chart Review from Karmanos Cancer Institute (Detroit, MI)	· 336 · All ages · ⩾ Stage II NSCLC	· Commercial · Other	· Mortality · Cost	12/16
McCarthy, 2003 (12)	· Cohort · SEER & Medicare Database	· 62,117 · > 65 yr · All stages	· Medicare, HMO · Medicare, FFS	· Hospice enrollment · Length of hospice stay	14/16
McDavid, 2003 (23)	· Cohort · Kentucky Cancer Registry	· 12,477 · All ages · All stages	· Private · Medicare + supplemental · Medicare · Federally Funded · Medicaid · Uninsured · Unknown	· Survival‡ · Risk of death within 3 yr of diagnosis	13/16
Potosky, 2004 (31)	· Cross-sectional · SEER · Patterns of Care (random chart review conducted by NCI)	· 898 · All ages · NSCLC	· Private · Public · Public + Private	· Percentage receiving recommended initial therapy	13/15
Bradley, 2005 (21)	· Cohort · Michigan Cancer Registry · Michigan Medicaid Database	· 3,702 · < 65 yrs · All stages	· Medicaid before diagnosis · Medicaid after diagnosis · Non-Medicaid	· Mortality	12/15
Harlan, 2005 (32)	· Cross-Sectional · SEER · Patterns of Care (random chart review conducted by NCI)	· 882 · All Ages · All Ages · Medicare	· None · Private · Medicaid · Other	· Adherence to NCCN guidelines	12/15
Liu, 2006 (27)	· Cross-sectional · California's Office of Statewide Health Planning and Development patient discharge database	· 16,405 · All ages · NSCLC resection	· Medicare · Medicaid · Private · Uninsured	· Hospital volume of surgical lung resections	14/15
Bradley, 2007 (16)	· Cross-sectional · Michigan Cancer Registry · Michigan Medicaid & Medicare Database	· 11,940 · > 65 yr · All stages	· Medicaid ⩾ 12 mo before diagnosis · Medicaid < 12 mo before diagnosis · Medicaid after diagnosis · Medicare	· Death same month as diagnosis · Invasive but unknown stage at diagnosis · Regional or distant stage at diagnosis	11/15
Neighbors, 2007 (28)	· Cross-sectional · Nationwide Inpatient Sample Database	· 50,245 · All ages · Patients in hospital for surgical resection	· Medicare · Medicaid · Private insurance · Other (self-pay, no charge, etc.)	· Hospital volume of surgical lung resections	11/15
Bradley, 2008 (14)	· Cohort · Michigan Cancer Registry · Michigan Medicaid & Medicare Database	· 12.713 · > 65 yr · All stages	· Medicare · Medicaid & Medicare	· Incidence · Incidence rate ratios	15/16
Bradley, 2008 (22)	· Cohort · Michigan Cancer Registry · Michigan Medicaid & Medicare Database	· 3,094 · > 65 yr · NSCLC, Stage III or less	· Medicare · Medicaid & Medicare	· Mortality · Resection · Chemotherapy · Radiation	13/16

(*Continued*)

TABLE 1. (CONTINUED)

Study	Methodology · Study Design · Source(s) of Data	Subjects · Number Enrolled · Age · Cancer specifics	Comparison	Outcome(s)	Quality Score*
Cheung, 2008 (25)	· Cohort · Florida Cancer Data System · Florida Agency for Health Care Administration	· 13,469 · All ages · Surgery for cure	· Private · None · Medicaid · Medicare/VA/Military	· Mortality	13/16
Elkin, 2008 (34)	· Cohort · SEER-Medicare	· 31,243 · > 65.5 yr · All stages	· Medicare, HMO · Medicare, FFS	· Transfer of care plan from Medicare, HMO to Medicare, FFS	16/16
Esanola, 2008 (30)	· Cohort · South Carolina Central Cancer Registry · South Carolina Inpatient Files and Outpatient Surgery Files	· 3,006 · All ages · Localized NSCLC	· Commercial · HMO · Medicare · Medicaid · Self Pay · Other	· Surgery	11/15
Halpern, 2008 (17)	· Cross-sectional · US National Cancer Data Base	· 693,697 · All ages · All stages	· Medicaid · Medicare, < 65 yr · Medicare, > 65 yr · Private · Uninsured	· Stage at diagnosis	13/15
Roetzheim, 2008 (18)	· Cohort · SEER-Medicare (limited to Medicare Disability)	· 10,229 · All ages · All stages	· Medicare, HMO · Medicare, FFS · Medicare, Mixed FFS/HMO	· Late stage · Procedures · Mortality	14/16
Shugarman, 2008 (24)	· Cohort · SEER-Medicare · Area Resource File (maintained by Bureau of Health Professionals)	· 26,073 · > 65 yr · All stages	· Medicare · Medicare + Medicaid	· Mortality	14/16
Ramsey, 2008 (19)	· Cross-Sectional · Washington State Cancer Registry · Medicaid	· 6775 · < 65 yr · All stages	· Non-Medicaid · Medicaid	· Stage at diagnosis	12/15

Definition of abbreviations: FFS = fee-for-service; HMO = Health Maintenance Organization; NCI = National Cancer Institute; NCCN = National Comprehensive Cancer Network; NSCLC = non–small cell lung cancer; SEER = Surveillance Epidemiology and End Results; VA = Veterans Affairs.

* The Quality Score lists the total number of "Yes" answers to the quality questions over the total possible score.

† The focus of this study was to compare changes in care outcomes after a diagnosis-related group cost assessment was changed. Only outcomes looking at the post-change outcomes are presented in Table 2.

‡ Survival outcomes not shown in Table 2 due to space considerations.

Study Quality

In general, study quality was very good. Twelve of 16 quality criteria were met by more than 75% of the studies. Most studies used a cross-sectional or cohort design. Twenty-one of 23 studies used registry data to analyze large populations and employed appropriate methods to characterize both the outcomes of interest and insurance status. Seventy-three percent of studies adjusted for confounders, though many were not able to adjust for individual smoking behaviors, comorbid conditions, socioeconomic status, and education. Seventy percent provided information about funding sources, 39% included a conflict of interest statement, and very few (4%) reported the results of power calculations. Figure 2 shows the percentage of studies that met each pre-specified quality measure.

Incidence

Two studies examined the association between insurance status and lung cancer incidence rates. Using data from Michigan, Bradley and coworkers compared Medicaid- to non–Medicaid-insured patients stratified by age and sex, and found that lung cancer incidence rates were higher for all groups of patients with Medicaid (13). In a similar study, patients with Medicare alone had consistently lower incidence rates compared with patients with Medicaid/Medicare, but the incidence rates were similar when the comparison group was restricted to patients covered by Medicaid for more than 12 months before diagnosis (14) (Table 2). Neither study was able to adjust for smoking behaviors.

Stage at Diagnosis

Several studies identified associations between insurance status and lung cancer stage. Bradley and colleagues (13) found that advanced-stage disease was more common in Medicaid patients younger than 65 years of age compared with patients younger than 65 with non-Medicaid insurance. In another study of patients with lung cancer between 25 and 64 years of age who were included in the Michigan Medicaid and Cancer Registries, those who received Medicaid after being diagnosed with lung cancer were more likely to have advanced-stage disease at the time of diagnosis (15). There was no significant difference between patients who had Medicaid insurance at the time of diagnosis compared with non-Medicaid patients. A similar study limited to patients over 65 years of age showed that compared with patients only on Medicare, Medicaid patients were more likely to have unknown, regional, or distant stage (16) (Table 2).

A cross-sectional study of the U.S. National Cancer Database of almost 700,000 patients with lung cancer found that compared with patients with private insurance, those with Medicaid or no insurance were more likely to be diagnosed with more advanced-stage disease (17). The risk for Medicare patients was similar to that of patients with private insurance. In another study of patients with Medicare Disability insurance, there were no differences in stage comparing a fee-for-service (FFS) status with health maintenance organization (HMO) or a combination insurance status (18). Finally, a study of nonelderly

TABLE 2. OUTCOMES OF INCLUDED STUDIES

Study	Outcome	Comparison	Measurement (95% CI)	Important Confounder Adjustment
Incidence				
Bradley, 2001 (13)	Incidence; women < 65 yr (per 1,000)	Medicaid Non-Medicaid	Rate: 1.21 Rate: 0.27	No
Bradley, 2001 (13)	Incidence; women > 65 yr (per 1,000)	Medicaid Non-Medicaid	Rate: 3.74 Rate: 2.19	No
Bradley, 2001 (13)	Incidence; men < 65 yr (per 1,000)	Medicaid Non-Medicaid	Rate: 2.09 Rate: 0.40	No
Bradley, 2001 (13)	Incidence; men > 65 yr (per 1,000)	Medicaid Non-Medicaid	Rate: 8.41 Rate: 4.34	No
Bradley, 2008 (14)	Incidence, white women (per 100,000)	Medicare Medicaid/Medicare	Rate: 225 Rate: 398 IRR: 1.77 (1.52–2.06)	No
Bradley, 2008 (14)	Incidence, black women (per 100,000)	Medicare Medicaid/Medicare	Rate: 233 Rate: 367 IRR: 1.57 (1.17–2.11)	No
Bradley, 2008 (14)	Incidence, white men (per 100,000)	Medicare Medicaid/Medicare	Rate: 407 Rate: 808 IRR: 1.96 (1.68–2.33)	No
Bradley, 2008 (14)	Incidence, black men (per 100,000)	Medicare Medicaid/Medicare	Rate: 485 Rate: 971 IRR: 2.00 (1.49–2.69)	No
Bradley, 2008 (14)	Incidence, white women (per 100,000)	Medicare Medicaid > 12 mo prior to diagnosis/Medicare	Rate: 236 Rate: 274 IRR: 1.16 (0.96–1.41)	No
Bradley, 2008 (14)	Incidence, black women (per 100,000)	Medicare Medicaid > 12 mo prior to diagnosis/Medicare	Rate: 261 Rate: 297 IRR: 1.14 (0.83–1.56)	No
Bradley, 2008 (14)	Incidence, white men (per 100,000)	Medicare Medicaid > 12 mo prior to diagnosis/Medicare	Rate: 423 Rate: 473 IRR: 1.12 (0.89–1.41)	No
Bradley, 2008 (14)	Incidence, black men (per 100,000)	Medicare Medicaid > 12 mo prior to diagnosis/Medicare	Rate: 521 Rate: 673 IRR: 1.29 (0.90–1.86)	No
Stage at Diagnosis				
Bradley, 2001 (13)	More advanced stage at diagnosis (Stage III/IV vs. I/II)	Other < 65 yr Medicaid, < 65 yr Medicaid, > 65 yr Medicare	Reference OR: 1.59 (1.30–1.96) OR: 1.19 (0.93–1.50) OR: 0.81 (0.68–0.96)	No
Bradley, 2003 (15)	More advanced Stage at Diagnosis (regional, distant, or invasive/unknown stages)	Medicaid before diagnosis Medicaid after diagnosis	Reference OR: 3.40 (2.13–5.43)	No
Bradley, 2003 (15)	More advanced State at Diagnosis (regional, distant, or invasive/unknown stages)	Non-Medicaid Medicaid after diagnosis	Reference OR: 3.70 (2.44–5.62)	No
Bradley, 2003 (15)	More advanced State at Diagnosis (regional, distant, or invasive/unknown stages)	Non-Medicaid Medicaid before diagnosis	Reference OR: 1.13 (0.89–1.44)	No
Bradley, 2007 (16)	Death from lung cancer same month as diagnosis	Medicare Medicaid ⩾ 12 mo before diagnosis Medicaid < 12 mo before diagnosis	Reference OR: 1.33 (1.04–1.68) OR 2.18 (1.45–3.29)	Yes
Bradley, 2007 (16)	Invasive but unknown stage at diagnosis	Medicare Medicaid ⩾ 12 mo before diagnosis Medicaid < 12 mo before diagnosis Medicaid after diagnosis	Reference OR: 1.75 (1.43–2.15) OR: 1.62 (1.05–2.49) OR: 1.39 (1.07–1.80)	Yes
Bradley, 2007 (16)	Regional or distant stage at diagnosis	Medicare Medicaid ⩾ 12 mo before diagnosis Medicaid < 12 mo before diagnosis Medicaid after diagnosis	Reference OR: 1.25 (1.01–1.54) OR: 1.07 (0.70–1.62) OR: 1.33 (1.02–1.75)	Yes

(*Continued*)

TABLE 2. (CONTINUED)

Study	Outcome	Comparison	Measurement (95% CI)	Important Confounder Adjustment
Halpern, 2008 (17)	Stage II vs. I at diagnosis	Private Medicaid Medicare, < 65 yr Medicare, > 65 yr Uninsured	Reference OR: 1.1 (1.0–1.1) OR: 0.9 (0.8–0.9) OR 1.0 (0.9–1.0) OR: 1.3 (1.2–1.4)	Yes
Halpern, 2008 (17)	Stage III/IV vs. I at diagnosis	Private Medicaid Medicare, < 65 yr Medicare, > 65 yr Uninsured	Reference OR: 1.3 (1.3–1.4) OR: 0.9 (0.9–0.9) OR 1.0 (0.9–1.0) OR: 2.2 (2.1–2.3)	Yes
Roetzheim, 2008 (18)	Less advanced stage at diagnosis (categorical AJCC stage)	Medicare FFS Medicare HMO Medicare, mixed FFS/HMO	Reference OR: 0.96 (0.83–1.11) OR: 1.01 (0.79–1.29)	Yes
Ramsey, 2008 (19)	Stage At Diagnosis (%)	Non-Medicaid vs. Medicaid *In situ* Localized Regional Distant Unstaged	0.1% vs. 0% 16.3% vs. 10.4% 28.3% vs. 25.9 50.5% vs. 57.7% 4.9% vs. 6% $P < 0.001$	No
Mortality				
Greenberg, 1988 (20)	Mortality (3–6 yr from diagnosis)	Other Insurance Private	Reference OR: 0.96 (0.85–1.08)	Yes
Bradley, 2001 (13)	Death from lung cancer (during 2 yr of study)	Other < 65 yrs Medicaid, < 65 yr Medicaid, > 65 yr Medicare	Reference OR: 1.87 (1.54–2.27) OR: 1.64 (1.27–2.11) OR: 0.85 (0.72–1.01)	No
Bradley, 2001 (13)	Death from lung cancer (Stage I/II) (during 2 yr of study)	Other < 65 yrs Medicaid, < 65 yr Medicaid, > 65 yr Medicare	Reference OR: 2.36 (1.55–3.59) OR: 2.19 (1.36–3.54) OR: 0.79 (0.56–1.11)	No
Bradley, 2001 (13)	Death from lung cancer (Stage III) (during 2 yr of study)	Other < 65 yrs Medicaid, < 65 yr Medicaid, > 65 yr Medicare	Reference OR: 2.31 (1.68–3.18) OR: 1.78 (1.16–2.74) OR: 0.97 (0.73–1.29)	No
Bradley, 2001 (13)	Death from lung cancer (Stage IV) (during 2 yr of study)	Other < 65 yrs Medicaid, < 65 yr Medicaid, > 65 yr Medicare	Reference OR: 1.37 (1.03–1.83) OR: 1.15 (0.77–1.71) OR: 0.78 (0.59–1.04)	No
Bradley, 2005 (21)	All-cause mortality: women diagnosed with local stage disease (not regional, distant, invasive/unknown stages)	Non-Medicaid Medicaid before Diagnosis Medicaid after diagnosis	Reference HR: 2.05 (1.65–2.56) HR: 1.64 (1.19–2.26)	Yes
Bradley, 2005 (21)	All-cause mortality: women diagnosed with advanced stage disease (regional, distant, invasive/unknown stages)	Non-Medicaid Medicaid before Diagnosis Medicaid after diagnosis	Reference HR: 1.36 (1.16–1.60) HR: 1.28 (1.08–1.52)	Yes
Bradley, 2005 (21)	All-cause mortality: men diagnosed with local stage disease (not regional, distant, invasive/unknown stages)	Non-Medicaid Medicaid before Diagnosis Medicaid after diagnosis	Reference HR: 1.85 (1.47–2.31) HR: 1.77 (1.29–2.42)	Yes
Bradley, 2005 (21)	All-cause mortality: men diagnosed with advanced stage disease (regional, distant, invasive/unknown stages)	Non-Medicaid Medicaid before Diagnosis Medicaid after diagnosis	Reference HR: 1.22 (1.05–1.42) HR: 1.38 (1.19–1.61)	Yes
Bradley, 2008 (22)	All-cause mortality if resection	Medicare Medicaid/Medicare	Reference HR: 1.42 (1.09–1.87)	Yes
Bradley, 2008 (22)	All-cause mortality if no resection	Medicare Medicaid/Medicare	Reference HR: 1.17 (0.96–1.37)	Yes

(*Continued*)

TABLE 2. (CONTINUED)

Study	Outcome	Comparison	Measurement (95% CI)	Important Confounder Adjustment
Bradley, 2008 (22)	Perioperative mortality	Medicare	Reference	Yes
		Medicaid/Medicare	OR: 1.67 (0.54–5.17)	
McDavid, 2003 (23)	Death (all-cause) within 3 yr of diagnosis	Private	Reference	Yes
		Medicare + supplement	RR: 1.13 (1.04–1.22)	
		Medicare	RR: 1.22 (1.12–1.31)	
		Federally Funded	RR: 1.09 (0.98–1.21)	
		Medicaid	RR: 1.14 (1.04–1.25)	
		Uninsured	RR: 1.19 (1.06–1.34)	
		Unknown	RR: 1.24 (1.12–1.38)	
Roetzheim, 2008 (18)	All-cause mortality	Medicare FFS	Reference	Yes
		Medicare HMO	HR: 0.97 (0.90–1.05)	
		Medicare, Mixed FFS/HMO	HR: 0.87 (0.78–0.98)	
Roetzheim, 2008 (18)	Lung cancer mortality	Medicare FFS	Reference	Yes
		Medicare HMO	HR: 1.01 (0.93–1.11)	
		Medicare, Mixed FFS/HMO	HR: 0.88 (0.77–1.01)	
Shugarman, 2008 (24)	Overall mortality	Medicare	Reference	Yes
		Medicare + Medicaid	HR: 1.06 ($P < 0.01$)	
Du, 2003 (26)	Overall 1 yr mortality	Commercial	Reference	Yes
		Other	HR: 1.10 ($P = 0.48$)	
Cheung, 2008 (25)	Overall mortality	Private	Reference	Yes
		None	HR: 1.24 (1.02–1.52)	
		Medicaid	HR: 1.41 (1.18–1.69)	
		Medicare/VA/Military	HR: 1.07 (1.00–1.14)	
Access to Care				
Liu, 2006 (27)	Surgical resection at a high-volume hospital (highest 20% of hospitals)	Medicare	Reference	Yes
		Medicaid	RR: 0.50 (0.40–0.62)	
		Private	RR: 0.84 (0.75–0.93)	
		Uninsured	RR: 0.70 (0.54–0.91)	
Liu, 2006 (27)	Surgical resection at a low-volume hospital (lowest 20% of hospitals)	Medicare	Reference	Yes
		Medicaid	RR: 2.35 (2.04–2.69)	
		Private	RR: 0.96 (0.85–1.07)	
		Uninsured	RR: 2.27 (1.83–2.73)	
Neighbors, 2007 (28)	Treatment at a hospital that performs more than the median number of lung resections	Private insurance	Reference	No
		Medicare	OR: 0.90 (0.78–1.04)	
		Medicaid	OR: 0.63 (0.52–0.77)	
		Other	OR: 0.63 (0.45–0.88)	
Greenberg, 1988 (29)	Diagnosis at a university cancer center	Other insurance	Reference	Yes
		Private insurance	OR: 0.71 (0.54–0.93)	
Greenberg, 1988 (29)	Treatment at a university cancer center	Other insurance	Reference	Yes
		Private insurance	OR: 0.97 (0.67–1.38)	
Delivery of Care				
Procedures and treatments				
Greenberg, 1988 (20)	Radiation therapy if no surgery	Other Insurance	Reference	Yes
		Private	OR: 1.57 (1.18–2.09)	
Roetzheim, 2008 (18)	Surgery	Medicare FFS	Reference	Yes
		Medicare HMO	OR: 1.06 (0.97–1.16)	
		Medicare, Mixed FFS/HMO	OR: 1.23 (1.02–1.49)	
Roetzheim, 2008 (18)	Radiation	Medicare FFS	Reference	Yes
		Medicare HMO	OR: 0.93 (0.77–1.12)	
		Medicare, Mixed FFS/HMO	OR: 1.11 (0.66–1.84)	
Roetzheim, 2008 (18)	Surgery or radiation	Medicare FFS	Reference	Yes
		Medicare HMO	OR: 1.00 (0.95–1.05)	
		Medicare, Mixed FFS/HMO	OR: 1.09 (1.02–1.17)	
Esanola, 2008 (30)	Surgery	Commercial	Reference	No
		HMO	OR: 0.50 (0.29–0.85)	
		Medicare	OR: 0.31 (0.24–0.38)	
		Medicaid	OR: 0.27 (0.17–0.43)	
		Self Pay	OR: 0.32 (0.21–0.48)	
		Other	OR: 0.59 (0.30–1.14)	

(*Continued*)

TABLE 2. (CONTINUED)

Study	Outcome	Comparison	Measurement (95% CI)	Important Confounder Adjustment
Bradley, 2008 (22)	Resection	Medicare Medicaid/Medicare	Reference OR: 0.50 (0.38–0.67)	Yes
Bradley, 2008 (22)	Chemotherapy	Medicare Medicaid/Medicare	Reference OR: 0.98 (0.71–1.36)	Yes
Bradley, 2008 (22)	Radiation	Medicare Medicaid/Medicare	Reference OR: 1.46 (1.09–1.95)	Yes
Potosky, 2004 (31)	Adjusted percent receiving recommended initial therapy	Public Private Public + Private	55% (47–63%) 49% (41–57%) 56% (48–64%)	Yes
Potosky, 2004 (31)	Adjusted percent of patients with Stage I/II receiving recommended initial therapy	Public Private Public + Private	71% (57–85%) 68% (52–84%) 70% (58–82%)	Yes
Potosky, 2004 (31)	Adjusted percent of patients with Stage III receiving recommended initial therapy	Public Private Public + Private	56% (42–70%) 43% (29–57%) 58% (44–72%)	Yes
Potosky, 2004 (31)	Adjusted percent of patients with Stage IV receiving recommended initial therapy	Public Private Public + Private	40% (26–54%) 40% (28–52%) 44% (28–60%)	Yes
Harlan, 2005 (32)	Weighted percent of patients receiving NCCN-recommended care	None Private Medicaid Medicare Other	83.6% 66.3% 53.4% 55.7% 55.2%	Yes
Hospice Care				
McCarthy, 2003 (12)	Length of hospice stay	Medicare, HMO Medicare, FFS	Median: 34 d (IQR = 11–87 d) Median: 24 d (IQR = 9–62 d) $P < 0.001$	Yes
McCarthy, 2003 (12)	Hospice enrollment within 7 d of death	Medicare, HMO Medicare, FFS	Rate: 18.2% Rate: 22.2% $P < 0.001$	Yes
McCarthy, 2003 (12)	Hospice enrollment more than 180 d before death	Medicare, HMO Medicare, FFS	Rate: 7.8% Rate: 5.4% $P < 0.001$	Yes
McCarthy, 2003 (12)	Hospice enrollment > 2 mo	Medicare, HMO Medicare, FFS	Rate: 30.3% Rate: 21.6% $P < 0.001$	Yes
McCarthy, 2003 (12)	Hospice enrollment	Medicare, FFS Medicare, HMO	Reference HR: 1.39 (1.32–1.45)	Yes
McCarthy, 2003 (12)	Length of hospice stay	Medicare, FFS Medicare, HMO	Reference HR: 0.86 (0.81–0.90)*	Yes
Other				
Du, 2003 (26)	Facility cost at 1 Year (Log)	Commercial Other	Reference Coef: 0.94 ($P = 0.41$)	Yes
Spraberry, 1987 (33)	Surgical length of stay (average days)	Medicare Non-Medicare	8.3 d (SD 7.0) 9.9 d (SD 8.4) Not adjusted	Yes
Spraberry, 1987 (33)	Medical length of stay (average days)	Medicare Non-Medicare	6.9 d (SD 6.0) 6.4 d (SD 6.4) Not adjusted	Yes
Spraberry, 1987 (33)	Surgical in-patient total charges (1967 dollars)	Medicare Non-Medicare	$1,856 $2,129	Yes
Spraberry, 1987 (33)	Medical in-patient total charges (1967 dollars)	Medicare Non-Medicare	$1,273 $1,303	Yes
Elkin, 2008 (34)	Transfer of care plan from Medicare, HMO to Medicare FFS	Matched cancer-free control subjects Medicare, HMO	Reference HR: 0.81 (0.76–0.86)	Yes

Definition of abbreviations: AJCC = American Joint Committee on Cancer; Coef = coefficient; FFS = fee-for-service; HMO = Health Maintenance Organization; HR = hazard ratio; IQR = interquartile range; IRR = incidence rate ratio; NSCLC = non–small cell lung cancer; OR = odds ratio; RR = relative risk; VA = Veterans Affairs.
* Indicates a longer hospice stay.

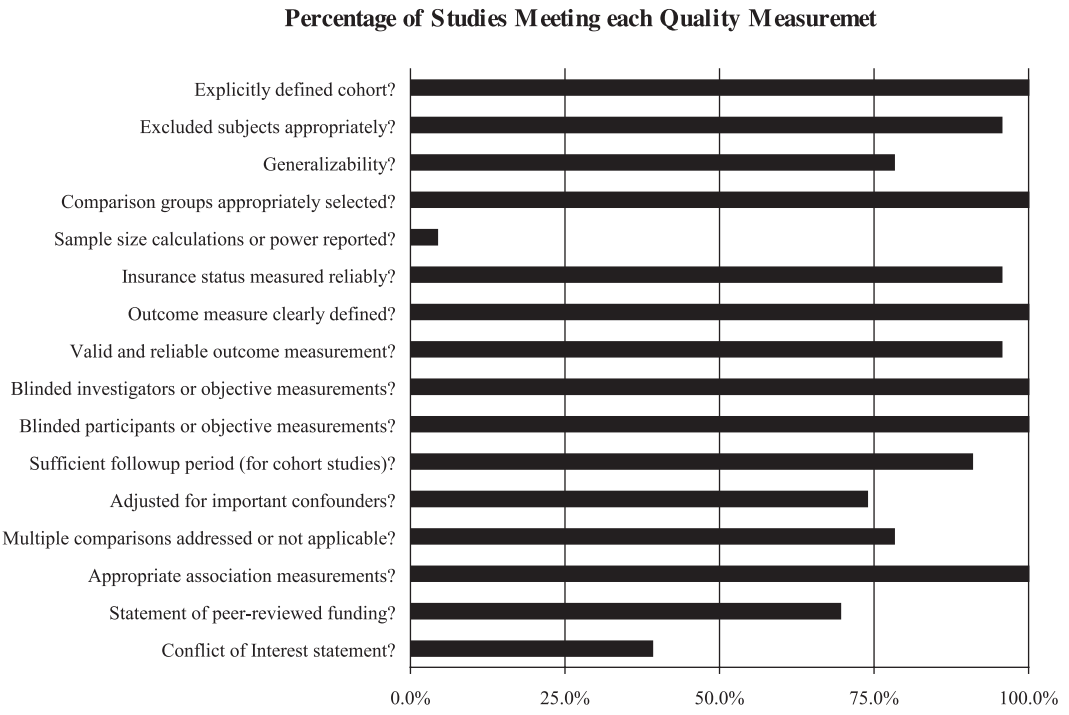

Figure 2. Bar graph of percentage of studies that fulfilled each quality measure.

patients with lung cancer in Washington state found that compared with non-Medicaid enrollees, patients with Medicaid were more likely to have advanced-stage disease (19) (Table 2).

Mortality

Several studies evaluated the association of insurance status with mortality. Greenberg and coworkers examined all-cause mortality 3 to 6 years after a lung cancer diagnosis, finding no association with insurance status (20). In contrast, Bradley and colleagues showed that Medicaid recipients had worse stage-specific and overall survival than Medicare patients, except for stage IV patients who were less than 65 years of age, for whom the difference was not statistically significant (13) (Table 2). Likewise, Bradley and coworkers found that among patients with lung cancer less than 65 years old, Medicaid coverage was associated with higher mortality for men and women diagnosed with both local and more advanced-stage disease compared with non-Medicaid insurance (21). In another study, Bradley and colleagues examined mortality in elderly patients with local or regional non–small cell lung cancer (NSCLC), finding that Medicaid/Medicare status was associated with higher all-cause mortality compared with Medicare for patients who underwent surgical resection. There were no differences among patients who did not undergo resection or in perioperative mortality (22). Finally, Bradley and coworkers showed that among patients over 65 with all stages of lung cancer, Medicaid patients had higher risks of dying the same month of diagnosis (16) (Table 2).

A study from the Kentucky Cancer Registry showed that patients with lung cancer without private health insurance were more likely to die within 3 years of diagnosis after adjusting for stage (23). Shugarman and colleagues, using a SEER-Medicare database and adjusting for stage, found a higher hazard ratio for overall mortality for patients with combined Medicare/Medicaid compared with Medicare (24). Cheung and coworkers used a state cancer database of patients undergoing curative-intent surgical resection that showed increased mortality associated with no insurance or Medicaid insurance compared with private insurance (25). Roetzheim and colleagues examined all-cause and lung cancer–specific mortality in patients with lung cancer with Medicare-Disability insurance, finding that mixed FFS/HMO insurance compared with an FFS plan was associated with increased all-cause mortality but no difference in lung cancer mortality (18). There was no difference between HMO-only and FFS-only plans. In contrast, Du and coworkers performed a single-center case-control study that showed no difference in overall 1-year mortality comparing patients with commercial insurance to other insurance statuses (26) (Table 2).

Access to Care

Several studies evaluated the association of insurance status with measures of access to care. Liu and colleagues used a state hospital discharge database to show that among patients who underwent surgical resection for NSCLC, patients with Medicare were more likely to be treated at high-volume hospitals (defined as the 20% of hospitals performing the most procedures) compared with patients with Medicaid, private insurance, and those who were uninsured (27). Neighbors and coworkers, using the Nationwide Inpatient Sample Database, found that compared with patients with private insurance, patients with Medicaid or other insurance (included self-pay, no-charge, and "other," but not Medicare) were less likely to receive treatment at a hospital that performs more than the median number of resections (28). Greenberg and colleagues used the New Hampshire–Vermont Central Tumor Registry to show that privately insured patients were less likely than patients with other insurance to be diagnosed at a university cancer center, but there was no difference in treatment location (29) (Table 2).

Delivery of Care

Procedures and Treatments. Several studies explored the association between insurance status and receipt of procedures and treatments. Greenberg and coworkers found that private compared with other insurance status was associated with increased rates of surgery and radiation (20). Roetzheim and colleagues showed that patients with Medicare-Disability insurance enrolled in mixed FFS/HMO plans were more likely to receive surgery compared with patients with only FFS plans (18).

Esnaola and coworkers used a state cancer registry to show that among patients with localized NSCLC, those with commercial insurance were more likely to receive surgery than patients with noncommercial insurance (30). Bradley and colleagues used a state cancer registry to show that patients over 65 years old with Medicaid/Medicare insurance were less likely to receive resection, more likely to receive radiation, and equally likely to receive chemotherapy compared with patients with only Medicare insurance (22) (Table 2).

Potosky and coworkers examined the records of almost 900 randomly identified patients with NSCLC from a SEER cancer registry (31). They found that in general, patients with only private insurance had lower rates of recommended therapy compared with patients with either public plus private insurance or public insurance alone. Using a SEER database, Harlan and colleagues found that patients with no insurance were more likely and those with nonprivate insurance were less likely than those with private insurance to receive National Cancer Care Network (NCCN)-guideline concordant care (32) (Table 2).

Hospice Care. McCarthy and coworkers (12) found more frequent and longer hospice enrollment for patients with Medicare-HMO plans compared with Medicare-FFS plans (*see* Table 2).

Other. Two studies examined the association of costs of care with insurance status for patients with lung cancer and one study evaluated transferring care from a HMO to a FFS plan. In patients with Stage II–IV NSCLC, Du and colleagues found no difference in the cost at 1 year between patients who did and did not have commercial insurance (26). In a dissertation, Spraberry found that compared with non-Medicare patients with lung cancer, Medicare recipients had shorter hospital lengths of stay after surgery, longer stays for a medical hospitalization, and decreased charges for both (33). Using a combined Surveillance Epidemiology End Results (SEER)-Medicare database to look at transfer of care from a Medicare HMO plan to a Medicare FFS plan, Elkin and coworkers found that HMO patients with lung cancer were more likely to switch than cancer-free control patients (34) (Table 2).

DISCUSSION

In this review, we found that patients with lung cancer with Medicaid insurance had poorer outcomes, including higher incidence rates, worse stage at diagnosis, and poorer survival even after adjustment for stage of diagnoses. Although we were not able to pool the results of these studies, the magnitude of the associations between Medicaid and both stage of diagnosis and mortality were similar. Patients with Medicaid were diagnosed with more advanced disease and were more likely to die the same month of diagnosis. Furthermore, the mortality of Medicaid patients was higher; some of the survival difference may be secondary to lead-time bias, since stage of diagnosis was worse for patients with Medicaid. However, this bias is unlikely to explain all the mortality difference, since several studies found higher rates of surgery and radiation therapy for patients with private and combined insurances. This mortality decrement may persist despite the findings from two studies that found patients with private insurance were less likely to receive guideline-concordant care.

Patients with Medicare appeared to have outcomes that were similar to patients with private insurance. Only two studies directly examined outcomes in patients with lung cancer with no insurance, finding that uninsured were more likely to be diagnosed with advanced-stage disease (17) and to die (23). Bradley and colleagues speculated that many or most patients who received Medicaid shortly before or after they received a lung cancer diagnosis were probably uninsured previously. If so, these studies add to the evidence that uninsured patients may be diagnosed with later stages of lung cancer and have an increased hazard of death (15, 16, 21).

Many studies did not adjust for patient-level characteristics such as smoking behaviors, comorbidities, socioeconomic status, and education. Several studies attempted to adjust for differences in groups by using geographic level variables, but this is unlikely to eliminate residual confounding. Importantly, it has been shown that patients with Medicaid are more likely to be current smokers (35), less likely to be offered comprehensive smoking cessation treatment (36), and less likely to receive cessation pharmacotherapy (37, 38). Current smoking at the time of surgical resection for stage I to IIIA NSCLC has been associated with an increased risk of death (39), as has active smoking at the time of receipt of chemotherapy (40). Thus, active smoking may confound the observed associations between Medicaid status and care outcomes, especially as they relate to incidence and mortality.

The mechanisms underlying care disparities for patients without insurance and for those who receive Medicaid are unclear but probably multifactorial (6, 41). There are likely patient-related factors, such as individual differences in health behaviors such as smoking, income, education, and comorbidities. Others may stem from a differential ability to interact with the healthcare system, differences in the care provided by institutions that serve Medicaid and uninsured patients, and less access to better-quality care. Our review indicates that some of these latter mechanisms may be important based on studies that show differential rates of receiving guideline-concordant care (31, 32), receiving care at a university cancer center (29), receipt of surgery or radiation therapy (20), and receipt of care at high-volume centers (27, 28). Although uninsured patients and those with Medicaid may be more likely to be treated at certain centers, no studies directly adjusted for center-level effects, so we cannot determine their role on the assessed outcomes (42).

Many of the included studies are likely generalizable to the adult population of the United States, though the generalizability of the studies that examined patients younger than 65 years is unclear, since this age group makes up a minority of patients with lung cancer (1).

In summary, we found that compared with other groups, patients with Medicaid or no insurance had higher lung cancer incidence rates, more advanced stage at diagnosis, and higher stage-specific and overall mortality rates. In addition, they were less likely to receive surgery or radiation, or to receive treatment at a high-volume center. Some of the disparities may be secondary to residual confounding from smoking, comorbidities, and other health behaviors, but available data suggest that patients with lung cancer without insurance do poorly because access to care is limited and they present with more advanced disease that is less amenable to treatment. Interestingly, patients with no insurance were more likely to receive guideline-concordant care than those with private insurance, suggesting that worse survival in these patients may be due to poor access, and not to receipt of poor quality care once they enter the healthcare system. More research focusing on specific aspects of access and delivery of care may help to clarify the underlying mechanisms that contribute to important lung cancer care disparities. Practicing physicians, quality managers, researchers, and policy makers should be cognizant of these disparities when attempting to improve care for patients with lung cancer. Overall, the preponderance of the evidence suggests that improving access to care by expanding health insurance coverage would result in better outcomes for patients with lung cancer.

This statement was prepared by an *ad hoc* subcommittee of the Behavioral Science Assembly.

Members of the committee included:
Christopher G. Slatore, M.D., M.S.
David H. Au, M.D., M.S.
Michael K. Gould, M.D., M.S.

Author Disclosure: C.G.S. received research grants from the National Institutes of Health (NIH) ($100,001 or more), the American College of Chest Physicians and LUNGevity Foundation ($50,001–$100,000), and the University of Washington ($1,001–$5,000). M.K.G. received research grants from the National Institutes of Health ($100,001 or more) and the Department of Veterans Affairs ($100,001 or more); he provided expert testimony and review of medical records for Leventhal, Brown & Puga ($1,001–$5,000 and $5,001–$10,000, respectively), and expert testimony for Burg, Simpson ($1,001–$5,000) and Cooper & Clough ($1,001–$5,000); his wife was employed by Genentech during 2006 and 2007, and received textbook royalties from Wolters and Kluwer (up to $1,000). D.H.A. was a consultant to GlaxoSmithKline ($1,001–$5,000) and Nexcura ($1,001–$5,000), and received research grants from the National Heart Lung & Blood Institute ($100,001 or more), the American Lung Association ($100,001 or more), and the Department of Veterans Affairs ($100,001 or more); he was employed by the Department of Veterans Affairs.

References

1. Ries LAGMD, Krapcho M, Mariotto A, Miller BA, Feuer EJ, Clegg L, Horner MJ, Howlader N, Eisner MP, Reichman M, Edwards BK, editors. Seer cancer statistics review, 1975–2004 (accessed July 15, 2008). Available from: http://seer.Cancer.Gov/csr/1975_2005/, based on November 2007 seer data submission, posted to the seer web site, 2008. Bethesda, MD: National Cancer Institute; 2008.
2. Anonymous. (accessed July 15, 2008). Making cancer health disparities history: report of the Trans-HHS Cancer Health Disparities Progress Review Group. Available from: http://www.Hhs.Gov/chdprg/pdf/chdprg.Pdf.
3. Kinsey T, Jemal A, Liff J, Ward E, Thun M. Secular trends in mortality from common cancers in the united states by educational attainment, 1993–2001. *J Natl Cancer Inst* 2008.
4. Anonymous. Cancer health disparities (accessed July 15, 2008). Available from: http://www.Cancer.Gov/cancertopics/factsheet/cancer-health-disparities.
5. Albano JD, Ward E, Jemal A, Anderson R, Cokkinides VE, Murray T, Henley J, Liff J, Thun MJ. Cancer mortality in the United States by education level and race. *J Natl Cancer Inst* 2007;99:1384–1394.
6. Woods LM, Rachet B, Coleman MP. Origins of socio-economic inequalities in cancer survival: a review. *Ann Oncol* 2006;17:5–19.
7. Anonymous. Lack of health insurance and type of coverage (accessed July 15, 2008). Available from: http://www.Cdc.Gov/nchs/data/nhis/earlyrelease/200706_01.Pdf.
8. Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, Moher D, Becker BJ, Sipe TA, Thacker SB; Meta-analysis Of Observational Studies in Epidemiology Group. Meta-analysis of observational studies in epidemiology: a proposal for reporting. *JAMA* 2000;283:2008–2012.
9. Counsell C. Formulating questions and locating primary studies for inclusion in systematic reviews. *Ann Intern Med* 1997;127:380–387.
10. Meade MO, Richardson WS. Selecting and appraising studies for a systematic review. *Ann Intern Med* 1997;127:531–537.
11. McCarthy EP, Burns RB, Davis RB, Phillips RS. Barriers to hospice care among older patients dying with lung and colorectal cancer. *J Clin Oncol* 2003;21:728–735.
12. McCarthy EP, Burns RB, Ngo-Metzger Q, Davis RB, Phillips RS. Hospice use among medicare managed care and fee-for-service patients dying with cancer. *JAMA* 2003;289:2238–2245.
13. Bradley CJ, Given CW, Roberts C. Disparities in cancer diagnosis and survival. *Cancer* 2001;91:178–188.
14. Bradley CJ, Luo Z, Given CW. Cancer incidence in elderly Medicare and dually eligible beneficiaries. *Health Serv Res* (In press).
15. Bradley CJ, Given CW, Roberts C. Late stage cancers in a Medicaid-insured population. *Med Care* 2003;41:722–728.
16. Bradley CJ, Given CW, Dahman B, Luo Z, Virnig BA. Diagnosis of advanced cancer among elderly Medicare and Medicaid patients. *Med Care* 2007;45:410–419.
17. Halpern MT, Ward EM, Pavluck AL, Schrag NM, Bian J, Chen AY. Association of insurance status and ethnicity with cancer stage at diagnosis for 12 cancer sites: a retrospective analysis. *Lancet Oncol* 2008;9:222–231.
18. Roetzheim RG, Chirikos TN, Wells KJ, McCarthy EP, Ngo LH, Li D, Drews RE, Iezzoni LI. Managed care and cancer outcomes for Medicare beneficiaries with disabilities. *Am J Manag Care* 2008;14:287–296.
19. Ramsey SD, Zeliadt SB, Richardson LC, Pollack L, Linden H, Blough DK, Anderson N. Disenrollment from Medicaid after recent cancer diagnosis. *Med Care* 2008;46:49–57.
20. Greenberg ER, Chute CG, Stukel T, Baron JA, Freeman DH, Yates J, Korson R. Social and economic factors in the choice of lung cancer treatment: a population-based study in two rural states. *N Engl J Med* 1988;318:612–617.
21. Bradley CJ, Gardiner J, Given CW, Roberts C. Cancer, Medicaid enrollment, and survival disparities. *Cancer* 2005;103:1712–1718.
22. 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; 26:5067–5073.
23. McDavid K, Tucker TC, Sloggett A, Coleman MP. Cancer survival in Kentucky and health insurance coverage. *Arch Intern Med* 2003;163: 2135–2144.
24. Shugarman LR, Sorbero ME, Tian H, Jain AK, Ashwood JS. An exploration of urban and rural differences in lung cancer survival among Medicare beneficiaries. *Am J Public Health* 2008;98:1280–1287.
25. Cheung MC, Hamilton K, Sherman R, Byrne MM, Nguyen DM, Franceschi D, Koniaris LG. Impact of teaching facility status and high-volume centers on outcomes for lung cancer resection: an examination of 13,469 surgical patients. *Ann Surg Oncol* 2009;16:3–13.
26. Du W, Reeves JH, Gadgeel S, Abrams J, Peters WP. Cost-effectiveness and lung cancer clinical trials. *Cancer* 2003;98:1491–1496.
27. Liu JH, Zingmond DS, McGory ML, SooHoo NF, Ettner SL, Brook RH, Ko CY. Disparities in the utilization of high-volume hospitals for complex surgery. *JAMA* 2006;296:1973–1980.
28. Neighbors CJ, Rogers ML, Shenassa ED, Sciamanna CN, Clark MA, Novak SP. Ethnic/racial disparities in hospital procedure volume for lung resection for lung cancer. *Med Care* 2007;45:655–663.
29. Greenberg ER, Dain B, Freeman D, Yates J, Korson R. Referral of lung cancer patients to university hospital cancer centers: a population-based study in two rural states. *Cancer* 1988;62:1647–1652.
30. Esnaola NF, Gebregziabher M, Knott K, Finney C, Silvestri GA, Reed CE, Ford ME. Underuse of surgical resection for localized, non-small cell lung cancer among whites and African Americans in South Carolina. *Ann Thorac Surg* 2008;86:220–226, discussion 227.
31. Potosky AL, Saxman S, Wallace RB, Lynch CF. Population variations in the initial treatment of non-small-cell lung cancer. *J Clin Oncol* 2004; 22:3261–3268.
32. Harlan LC, Greene AL, Clegg LX, Mooney M, Stevens JL, Brown ML. Insurance status and the use of guideline therapy in the treatment of selected cancers. *J Clin Oncol* 2005;23:9079–9088.
33. Spraberry M. The effect of a diagnosis related fixed payment system on charges and length of stay for hospitalized lung cancer cases [dissertation]. Epidemiology: University of Alabama at Birmingham; 1987.
34. Elkin EB, Ishill N, Riley GF, Bach PB, Gonen M, Begg CB, Schrag D. Disenrollment from medicare managed care among beneficiaries with and without a cancer diagnosis. *J Natl Cancer Inst* 2008;100:1013–1021.
35. Centers for Disease Control and Prevention. State Medicaid coverage for tobacco-dependence treatments–United States, 2006. *MMWR Morb Mortal Wkly Rep* 2008;57:117–122.
36. Chase EC, McMenamin SB, Halpin HA. Medicaid provider delivery of the 5a's for smoking cessation counseling. *Nicotine Tob Res* 2007;9:1095–1101.
37. Murphy JM, Mahoney MC, Hyland AJ, Higbee C, Cummings KM. Disparity in the use of smoking cessation pharmacotherapy among Medicaid and general population smokers. *J Public Health Manag Pract* 2005;11:341–345.
38. Cokkinides VE, Ward E, Jemal A, Thun MJ. Under-use of smoking-cessation treatments: results from the national health interview survey, 2000. *Am J Prev Med* 2005;28:119–122.
39. Sardari Nia P, Weyler J, Colpaert C, Vermeulen P, Van Marck E, Van Schil P. Prognostic value of smoking status in operated non-small cell lung cancer. *Lung Cancer* 2005;47:351–359.
40. Zhang Z, Xu F, Wang S, Li N, Wang C. Influence of smoking on histologic type and the efficacy of adjuvant chemotherapy in resected non-small cell lung cancer. *Lung Cancer* 2008;60:434–440.
41. Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? *J Health Soc Behav* 1995;36:1–10.
42. Asch DA, Armstrong K. Aggregating and partitioning populations in health care disparities research: differences in perspective. *J Clin Oncol* 2007;25:2117–2121.