EQUITY IN AN EQUAL ACCESS SYSTEM? – QUALITY & TIMELINESS OF
CANCER CARE IN THE VETERANS AFFAIRS HEALTHCARE SYSTEM

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ABSTRACT

LEAH L. ZULLIG: Equity in an Equal Access System? – Quality & Timeliness of
Cancer Care in the Veterans Affairs Healthcare System
(Under the direction of William R. Carpenter, PhD)

The objective of this dissertation was to examine the association between
patients' race and receipt of National Comprehensive Cancer Network guideline-
adherent and timely colorectal cancer (CRC) and non-small cell lung cancer
(NSCLC) care in the Veterans Affairs (VA) healthcare system. Data were from the
External Peer Review Program (EPRP) Special Study on CRC and NSCLC,
originally purposed for performance monitoring, examined in an observational,
retrospective study design. The sample consisted of African American (AA) and
Caucasian patients diagnosed with CRC between 2003 and 2006 or NSCLC
between 2006 and 2007 at VA hospitals nationwide. Statistical analysis approaches
included multivariate logistic regression and survival analysis methods.

Our first analysis used multivariable logistic regression to examine
associations between race and receipt of guideline-concordant care (computed
tomography scan, preoperative carcinoembryonic antigen, clear surgical margins,
medical oncology referral for Stages II-III; fluorouracil-based adjuvant chemotherapy
for Stage III; surveillance colonoscopy for Stages I-III). There were no significant
racial differences in receipt of guideline-concordant CRC care. Our second analysis
examined associations between race and CRC care timeliness. There were no racial

differences in time to chemotherapy initiation (HR 0.82, p=0.61) or surgery to death

(HR 0.94, p=0.0.49). Caucasian race was protective for shorter time to first

surveillance colonoscopy (HR 0.63, p=0.02). On average, the difference in time to

colonoscopy was sixteen days. Our third analysis examined associations between

race and NSCLC care timeliness. There were no racial differences in time to

initiation of treatment (72 days for AA versus 65 days for Caucasian patients, HR

1.03, p=0.80) or palliative care or hospice referral (129 versus 116 days, HR 1.10,

p=0.34). However, the adjusted model found longer survival for African American

compared to Caucasian patients (133 versus 117 days, HR 1.31, p=0.00).

In these data there were minimal statistically significant racial differences. We

identified no clinically meaningful racial differences in cancer care quality, timeliness,

or patient outcomes. This suggests that VA may be a leader in providing equitable

cancer care. Future studies could examine causal pathways for the VA's equal,

quality care and ways to translate the VA's success into other hospital systems.

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program, Morris graciously offered to meet with me and discuss all that the path would entail. Additionally, Morris has served as a bridge between institutions, making it possible for me to stay connected at both UNC and Veterans Affairs throughout my training. Throughout the inevitable bumps in the road, Morris has been a constant source of advice, offering sound wisdom that is deserving of my utmost respect. Thank you for providing such a sterling example of character, integrity, and insight extending well beyond the classroom. You are a true mentor.

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Dr. Dawn Provenzale was one of my first employers after completion of my master's degree. We have worked together for nearly eight years. Dawn is committed to fostering junior researchers and helping them cultivate an independent research agenda. My early experiences working with Dawn exposed me to the field of health services research and cancer care, providing the foundation for my desire to pursue this line of work. When I first joined Dawn's group, I knew little about the clinical quality guidelines, colorectal cancer, or the intricacies of the VA healthcare system. Dawn gave me opportunities for personal growth and professional development that are not available to many at such an early career stage. She has provided encouragement and support as I have undergone the metamorphosis from research assistant to doctoral candidate.

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ACO	Accountable Care Organization
ACE-27	Adult Comorbidity Evaluation-27
AJCC	American Joint Committee on Cancer
ASCO	American Society for Clinical Oncology
AVAHO	Association of Veterans Affairs Hematology and Oncology
CCM	Chronic Care Model
CBOC	Community-Based Outpatient Clinics
CDW	Corporate Data Warehouse
CEA	Carcinoembryonic Antigen
CPRS	Computerized Patient Record System
CRC	Colorectal Cancer
DSS	Decision Support System
EHR	Electronic Health Record
EPRP	External Peer Review Program
HSR&D	Health Services Research & Development
ICD	International Classification of Diseases
IRB	Institutional Review Board
NCCN	National Comprehensive Cancer Network
NCI	National Cancer Institute
NCPB	National Cancer Policy Board
NICCQ	National Initiative on Cancer Care Quality
NQF	National Quality Forum

NSCLC	Non-Small Cell Lung Cancer
OQP	Office of Quality and Performance
PCMH	Patient-Centered Medical Homes
PCS	Patient Care Services
PHI	Protected Health Information
UNC	University of North Carolina
VA	Veterans Affairs
VAMC	Veterans Affairs Medical Center
VHA	Veterans Health Administration
VINCI	Veterans Affairs Informatics and Computing Infrastructure
VISN	Veterans Integrated Service Network
VPN	Virtual Privacy Network
WVMI	West Virginia Medical Institute

CHAPTER 1: INTRODUCTION

In the United States, lung and colorectal cancer (CRC) are the second and third most commonly diagnosed cancers and the first and third leading causes of cancer-related death respectively (Jemal, Siegel, Xu, & Ward, 2010; Siegel, Naishadham, & Jemal, 2012). For both CRC and lung cancer, there is evidence that mortality rates at every stage of disease are higher among African Americans than Caucasian patients (Jemal et al., 2010; Shavers & Brown, 2002). Despite the existence of numerous evidence-based clinical practice guidelines for the treatment of CRC and lung cancer, standards for timeliness of care remain a matter of expert consensus, and there is wide variation in the quality and timeliness of care delivered to patients. Nationally, there is increasing pressure to improve the quality of cancer care delivered in the United States. The Institute of Medicine (IOM) report titled "Crossing the Quality Chasm" outlined six aims for high-quality healthcare— effective, safe, timely, efficient, equitable, and patient-centered (America & Medicine, 2001). A national panel of experts considered these aims and recommended that standardizing patient care and adhering to clinical practice guidelines are essential for improving cancer care quality (Aiello Bowles et al., 2008).

Research suggests that much of the variation in quality of cancer care is associated with patients' race and socioeconomic status (Shavers & Brown, 2002). An abundance of literature indicates that racial disparities in cancer care persist in private U.S. healthcare systems (Baldwin et al., 2005; Demissie et al., 2004; George

& Margolis, 2010; Govindarajan, Shah, Erkman, & Hutchins, 2003; Polite, Dignam, & Olopade, 2005; Schrag, Cramer, Bach, & Begg, 2001; Schwartz, Crossley-May, Vigneau, Brown, & Banerjee, 2003; Shih, Elting, & Halpern, 2009). Although the Veterans Affairs (VA) healthcare system is reputed as an equal-access system, there is a paucity of literature addressing differences in the quality of treatment for patients of diverse races with CRC or lung cancer. More than a decade ago, research results suggested that for patients receiving cancer care in the VA there was no association between race and whether patients received basic treatment elements like surgery, chemotherapy, and radiation therapy (Dominitz, Samsa, Landsman, & Provenzale, 1998; Page & Kuntz, 1980). However, the same study also reported that all-cause mortality was higher among African American veterans with CRC compared to Caucasian veterans (Dominitz et al., 1998). As time has progressed, treatment options and patterns of care have evolved and the association between quality of care and race may have changed. For example, in non-VA healthcare settings people of minority race are less likely to receive cutting-edge biologic drug agents like bevacizumab for the treatment of advanced CRC (Shih et al., 2009). More recent studies have found no racial difference in stage of disease at diagnosis, time to referral, or five-year survival among CRC patients. However, these studies have focused on a specific VA hospital rather than assessing a national cohort of patients, which limits generalizability to all VA healthcare settings (Robinson et al., 2010; Sabounchi, Keihanian, & Anand, 2012). Consequently, further examination is required to determine whether racial equity exists in the VA system on a national scale.

Globally, recent evidence suggests the overall quality of cancer care in the VA is equal to or exceeds the care offered in the private sector (Jackson, Melton, et al., 2010; Keating et al., 2011; Trivedi et al., 2011). A recent exploratory analysis indicated that African American race may be associated with lower odds of receiving surveillance colonoscopy (Zullig, Provenzale, McNeil, Abbott, & Jackson, 2011). However, little is known about the juxtaposition of race and quality of cancer treatment in the modern VA healthcare system. Thus, this dissertation will examine the relationship between patient characteristics (specifically race) and receipt of high-quality, timely cancer treatment and surveillance services among a VA patient population. The VA healthcare system, the nation's largest provider of cancer care, serves a distinctive population and has unique data collection abilities. Specifically, this dissertation will focus on the relationship between veterans' race and receipt of guideline-adherent and timely CRC and lung cancer care. Understanding this relationship is an essential step toward developing effective interventions to reduce racial disparities in quality and timeliness of cancer care, resulting in equity for all VA patients.

The central hypothesis of this dissertation is that African American patients will be less likely to receive guideline-adherent and timely CRC and lung cancer care and will have poorer health outcomes, than Caucasian patients in the VA healthcare system. The specific aims are to:

- Aim 1: Examine patient-level factors associated with receipt of National Comprehensive Cancer Network (NCCN) guideline-adherent CRC care (Chapter 4).
- Aim 2: Examine patient-level factors associated with (a) receipt of timely CRC care and (b) subsequent health outcomes (Chapter 5).

- Aim 3: Examine patient-level factors associated with (a) receipt of timely lung cancer care and (b) subsequent health outcomes (Chapter 6).

The primary data source for the dissertation was the External Peer Review Program (EPRP) data (Jackson, Melton, et al., 2010; Kussman, 2008). EPRP data have informed health services research assessing care for VA patients with diabetes, implications of a pneumonia screening program, and the diagnosis and treatment of CRC, among other health issues (Jackson, Melton, et al., 2010; Reed, Baumann, Petzel, & Weeks, 1996; Sawin, Walder, Bross, & Pogach, 2004). This dissertation followed a similar data linkage strategy.

The EPRP CRC data (Aims 1 and 2) were collected between July and August 2007. Retrospective chart abstraction was completed for approximately 2,492 patients with incident Stage I to III CRC. To be included in the EPRP data collection, patients had to: be diagnosed with CRC between October 1, 2003, and March 31, 2006; have undergone definitive CRC surgery; and been treated at one or more of 128 VA Medical Centers (VAMCs) (Goulet et al., 2007; Jackson, Melton, et al., 2010). Similarly, for the EPRP lung cancer data set (Aim 3), retrospective chart abstraction was completed for approximately 1,161 patients diagnosed with incident, non-metastatic, non-small cell lung cancer (NSCLC) diagnosed between October 1, 2006, and December 31, 2007, who underwent definitive lung cancer surgery and were treated in a VAMC. Retrospective data collection for the NSCLC cohort occurred between February 3, 2010 and August 11, 2010.

The analytic approach for Aim 1 included multivariable logistic regression models controlling for demographic characteristics, comorbid conditions, and health

characteristics. The analytic approach for Aim 2 included Cox proportional hazard models to examine racial differences in timeliness of care and subsequent health outcomes, controlling for demographic characteristics, comorbid conditions, and health characteristics. The Cox proportional hazard model enabled the assessment of two factors simultaneously: (1) whether or not an event occurred, and (2) if the event occurred, the time to the event (Kleinbaum, 1996). Furthermore, Cox proportional hazard models permitted censoring which is important in the current context. Censoring occurs when only part of the data is known. For example, the data may be right-censored because of an event occurring (i.e., the patient died) or because of when the data were collected (i.e., the patient was still alive at the time of data collection). Another advantage of the Cox proportional hazard model is that it allows for proportional effects to vary over time. For example, the effect of receiving a surveillance colonoscopy at twelve months post–surgical resection may have a different effect on likelihood of death compared to having a surveillance colonoscopy at eighteen months. As a result the Cox proportional hazard regression models can estimate the relative risks of a delay in treatment for patients of different races (i.e., Caucasian and African American), controlling for patient characteristics, regional characteristics, and health status. Because institutions or service networks may have different policies and organizational cultures affecting delivery of high-quality cancer care, use of clustered standard errors by geographic region was examined. The small numbers of patients at individual medical centers prevented clustering at the facility level.

Aim 3 used the NSCLC EPRP data set. The study sample consisted of male

patients who were diagnosed with incident, non-metastatic, NSCLC diagnosed between October 1, 2006, and December 31, 2007, who underwent definitive lung cancer surgery and were treated in at least one or more of the 128 VA medical centers nationwide. Mirroring the previous aim, Aim 3 also utilized a Cox proportional hazard model. Key explanatory variables and covariates were consistent across all three aims.

This research advances previous VA racial disparities literature in several regards. First, prior work in CRC care relied exclusively on VA administrative data (Dominitz et al., 1998). This dissertation will supplement administrative data with information that was manually collected from the electronic health record, thus providing insights into the patient care process. Second, prior research has focused on whether or not patients of minority and majority race received a specific component of cancer care such as chemotherapy or surgery. This dissertation enhances the current knowledge because examined not only whether cancer care was received but also whether that care was concordant with current clinical practice guidelines. Moreover, this dissertation examined not only processes of care but extends prior knowledge by examining health outcomes. By examining processes of care and health outcomes in tandem, it was possible to assess whether equality in health services creates equity in health outcomes.

It was anticipated that these aims would yield the following expected outcomes. First, this dissertation would identify modifiable characteristics that place patients at risk of not receiving guideline-adherent cancer care along the cancer care continuum (Zapka, Taplin, Solberg, & Manos, 2003). Identifying patients at risk for

poor quality of care is relevant to policy makers who seek to identify a target population most likely to benefit from future quality improvement interventions and, ultimately, save scarce resources. Second, this dissertation would generate new evidence about the timeliness of CRC (Aim 2) and NSCLC (Aim 3) care and subsequent health outcomes. This allowed us to examine whether timeliness of care has a meaningful effect on health outcomes, as well as identify a target population most likely to benefit from future timeliness of care interventions. Targeting vulnerable populations for interventions will ultimately conserve resources as interventions focus on patients and elements of the cancer care continuum with the greatest need.

Furthermore, the dissertation makes a timely contribution during a time of U.S. healthcare reform. As a result of the Patient Protection and Affordable Care Act of 2010, it is likely that some semblance of Accountable Care Organizations (ACOs) will be put in place ("Medicare program; Medicare Shared Savings Program: Accountable Care Organizations. Final rule," 2011). ACOs generally include a patient-centered medical home embedded in an integrated and organized health delivery system, including services like home health agencies and specialty care (Shortell, Casalino, & Fisher, 2010). Central to the concept of an ACO is timely performance measurement and feedback (Fisher & Shortell, 2010; Shortell et al., 2010). Feedback should be focused at an organizational level because poor performance is viewed as a consequent system failure rather than being the responsibility of any one clinician or administrator (Fisher & Shortell, 2010).

At its core, the VA is an ACO. Compared to other U.S. healthcare systems, the VA is unique because it is an integrated health care system that assumes responsibility for the distinctive veteran population. The VA is also unique because of its longstanding history and dedication to quality measurement and performance improvement. Because the VA serves as a model of an ACO, the methods and results of the dissertation will be applicable to future integrated health care systems or ACOs nationwide. Additionally, with the large number of veterans returning from current conflicts the VA will have to learn to efficiently manage its resources to continue as an exemplar ACO. This adds to the VA's national relevance. The American healthcare system will undergo similar struggles as it increases access to approximately 30 million American citizens (*An act entitled The Patient Protection and Affordable Care Act*, 2010).

Sections of the dissertation are organized as follows: Chapter 2 discusses current literature regarding CRC and lung cancer disparities, quality of cancer care, the VA healthcare system, the quality of care in the VA, and the multiplicity of factors that may have effect on the quality of care received. It concludes by exploring the limitations of existing studies and further provides support from existing literature and justification for the dissertation research. Chapter 3 provides an overview of the methods used throughout the dissertation. It includes a discussion of study design and rationale, data sources, hypotheses, and analytical approaches. Chapters 4-6 are manuscripts corresponding to Aims 1-3, respectively, and are intended for submission for peer-reviewed publication. Chapter 7 reviews the strengths and limitations of this dissertation, its policy relevance, and future research plans.

References are provided in a comprehensive bibliography at the conclusion of the dissertation.

CHAPTER 2: LITERATURE REVIEW

Overview

Racial disparities in cancer care are a complex and multifaceted issue. Evidence regarding the existence and severity of racial disparities is often inconsistent, making it difficult to disentangle the overall impact and sources of the problem. Racial disparities have been documented in stages of diagnosis (Berry et al., 2009; Bradley, Given, & Roberts, 2001; Polite et al., 2005), diagnostic evaluation procedures (Laiyemo et al., 2010), receipt of adjuvant chemotherapy for CRC patients (Baldwin et al., 2005; Govindarajan et al., 2003; Schrag et al., 2001), receipt of radiation therapy for rectal cancer patients (Ayanian et al., 2003), timeliness of care and receipt of surgery for early stage lung cancer patients (George & Margolis, 2010; Suga et al., 2010), participation in clinical trials (Murthy, Krumholz, & Gross, 2004), and survival (D. D. Alexander et al., 2007; Berry et al., 2009; Bradley et al., 2001; Pulte, Redaniel, Brenner, & Jeffreys, 2012). The impact of race on receipt of cancer care may be confounded by factors including socioeconomic status, geography, and organizational characteristics of healthcare services (Akerley, Moritz, Ryan, Henderson, & Zacharski, 1993; Ayanian et al., 2003; Berry et al., 2009; Du, Lin, Johnson, & Altekruse, 2011; Pagano et al., 2010; Schwartz et al., 2003; Shih et al., 2009). Despite these well-documented examples of racial disparities, numerous studies find no or slight racial differences in cancer care (Dominitz et al., 1998; Robinson et al., 2010; Sabounchi et al., 2012). Although

studies conducted in different settings and populations often yield incongruent results, one thing is clear; racial disparities in cancer care are a serious concern affecting the consistency and quality of cancer care nationwide.

Epidemiology

Following cardiovascular disease, cancer is the second most common cause of death for Americans (Jemal et al., 2010; Keating et al., 2011; Siegel et al., 2012; Wilson & Kizer, 1998). In fact, it is estimated that one in four deaths in the United States are due to cancer (Siegel et al., 2012). CRC and lung cancer are responsible for a tremendous portion of this disease burden. CRC is the third most commonly diagnosed cancer and the third leading cause of cancer-related death for both men and women (Siegel et al., 2012). Similarly, lung cancer is the second most commonly diagnosed cancer and the leading cause of cancer-related death for both genders (Siegel et al., 2012). It is expected that 226,160 Americans will be diagnosed with lung cancer, and 143,460 with CRC, in 2012 (Siegel et al., 2012).

Over the past decade, overall cancer death rates have declined by approximately one percent annually for both African American and Caucasian men and women (Siegel et al., 2012). Death rates for both CRC and lung cancer are also declining (Siegel et al., 2012). Despite this improvement, the impact of cancer on the American population and U.S. healthcare systems is evident.

Survival outcomes and treatment options are strongly associated with stage of disease at diagnosis. Staging for both CRC and lung cancer is generally based on either the American Joint Commission on Cancer (AJCC)(*AJCC Cancer Staging Manual*, 2002) or Surveillance, Epidemiology and End Results (SEER) summary

stage (Young, Roffers, Ries, Fritz, & Hurlbut, 2001). The AJCC staging system takes into account the number of tumors (T), lymph nodes positive for cancer (N), and metastases (M) present. The AJCC, or TNM, staging mechanism is most commonly used in clinical practice guidelines such as the NCCN guidelines (NCCN, 2011). Stages range from I to IV with IV indicating greater extent of disease and worse prognosis.

A more simplistic method of staging is the SEER summary stage. SEER is a constellation of geographically based cancer registries that collect information on incidence, prevalence, and survival from approximately one-fourth of the nation (Young et al., 2001). The SEER summary stage categorizes the extent of disease into one of three categories—localized, regional, and distant (Young et al., 2001). Regardless of the staging mechanism used, staging assessments include a variety of clinical data inputs like tumor biopsies and imaging studies.

Clinical Practice Guidelines

Clinical practice guidelines are designed to help clinicians make appropriate diagnosis, treatment, and surveillance decisions. These guidelines may be evidence-based, consensus-based, or a combination thereof. Evidence-based guidelines are developed by systematically reviewing existing research results and scientific literature. Different levels of evidence, the highest of which is considered to be clinical trial data, may support evidence-based guidelines. In the absence of such high-quality data, consensus-based guidelines may be developed. Consensus-based guidelines consider the limited evidence available but are largely based on the expert opinions of leaders in the field. A myriad of clinical practice guidelines,

both evidence- and consensus-based, exist to guide CRC and lung cancer treatment and surveillance.

There are many established cancer clinical practice guidelines. Measures developed by the Association of Clinical Oncology (ASCO) and National Quality Forum (NQF), which are commonly applied in both clinical practice and health services research, were considered. In 2008, the NQF developed nineteen standardized performance measures assessing the quality of cancer care in several areas (including CRC), symptom management, and end of life care (National Quality Forum, 2011). The NQF measures are based on expert panel consensus of the American College of Surgeons Commission on Cancer. The ASCO quality measures were developed as part of the National Initiative on Cancer Care Quality (NICCQ). They encompass breast, colon, and rectal cancer care. Representatives of both ASCO and NCCN have collaborated to create joint measures. Measures were selected based on their ability to impact survival, opportunities for quality improvement efforts, and feasibility of data collection (Desch et al., 2008). These joint measures advance the field because of their versatility and potential for implementation in a wide variety of health systems. Despite the advantages of the ASCO/NCCN joint measures, they are focused on a finite group of cancers and, thus, are relatively narrow in scope. Therefore, this research uses guidelines developed by the NCCN. The NCCN measures are more sophisticated both in terms of the breadth of diseases addressed and the comprehensiveness of the guidelines.

Although there is general agreement that timeliness of care is important, there is not much scientific evidence supporting specific timeliness of care guidelines

(Desch et al., 2008; Gould, Ghaus, Olsson, & Schultz, 2008; Pagano et al., 2010). In fact, at least one VA study found that timeliness of care had no measureable impact on lung cancer survival (Riedel et al., 2006). Despite this, the VA has made efforts to improve cancer care timeliness throughout the healthcare system, particularly for patients diagnosed with CRC (Powell, Nugent, Ordin, Noorbaloochi, & Partin, 2011). Measures of timeliness both for CRC (Aim 2) and NSCLC (Aim 3) are examined in this dissertation.

Veterans Affairs (VA) Healthcare System

History of the VA and Eligibility Process

The VA healthcare system is a unique organization from which to gain insight into the issue of racial disparities in cancer care. It is the country's largest integrated healthcare system (Goulet et al., 2007; McQueen, Mittman, & Demakis, 2004). In fact, VA healthcare is potentially available to 22.2 million veterans of service (Kizer, 2012). It is also the largest provider of cancer care in the nation, treating approximately three percent of U.S. cancer cases nationwide (Zullig et al., 2012).

Before the mid-1990s the VA was widely criticized for its overall organization and management, staffing, and the quality of care that it provided (Gardner, 1998; Holloway, Medendorp, & Bromberg, 1990; Perlin, 2006; Zook, Savickis, & Moore, 1980). In fact, it was purported that the "VA [was] worried more about touting its performance measures and customer feedback then about improving actual quality of care" (Gardner, 1998). Rather than being an integrated health system, the Veterans Health Administration (VHA) was largely an organization of distinct VA

hospitals operating independently; this resulted in a fragmented system (Jackson & Weinberger, 2009; Jha, Perlin, Kizer, & Dudley, 2003).

In response to these negative reports, in 1995 the VA began a system-wide transformation and redesign with emphasis on better using information technology systems, measuring and reporting quality of performance, and integrating services (Eisen & Francis, 2010; Jha et al., 2003). One of the key elements in the system redesign was the transition from independent medical centers into geographically based Veterans Integrated Service Networks (VISNs). These VISNs were developed to integrate policies, planning, and health services delivery among multiple VA hospitals. The VA has divided itself into twenty-two geographically arranged VISNs. These VISNs provide governance to ensure that quality improvement efforts and policies are enforced consistently and systematically. Furthermore, the VA also established Community Based Outpatient Clinics (CBOCs) that increased access to care by placing primary care providers in more diverse geographic areas (Jackson & Weinberger, 2009; Jha et al., 2003; Kizer & Dudley, 2009).

In addition to making structural changes, the VA also renewed its focus on health information technology and quality measurement. The Computerized Patient Record System (CPRS) is the VA's electronic health record (EHR). CPRS, which originated in 1997, is now considered one of the most advanced EHR systems in the United States (Jackson & Weinberger, 2009). CPRS includes the comprehensive clinical and demographic information required to provide high-quality patient care, data such as provider notes, medication information, imaging studies, and laboratory reports, among others. It also provides a platform for a robust clinical reminder

system that can facilitate care coordination and enhanced communication between patients and their care team (Jackson et al., 2011). Importantly, CPRS data is used extensively for quality measurement at the VA patient population level.

The redesigned VA system has been credited with emphasizing a balance of cost, access, and quality (Wilson & Kizer, 1998), which has had positive ramifications for the VA. A recent study of older adults indicated that in most aspects VA cardiovascular and cancer care is equal or superior to care in the private sector (Keating et al., 2011; Trivedi & Grebla, 2011). Much effort has been focused on quality improvement. For example, improving CRC cancer screening, diagnosis, and treatment within VA has been given great emphasis (Jackson, Powell, et al., 2010). National learning collaboratives, CRC toolkits, screening directives, and similar national VA projects have had considerable impact on improving the overall quality of CRC treatment in the VA. Scientific literature assessing CRC care in the VA found that rates of guideline-concordance ranged from a low of approximately 44% of patients receiving guideline-appropriate surveillance colonoscopy to nearly 83% of patients receiving a preoperative carcinoembryonic antigen (CEA) prior to surgical resection (Jackson, Melton, et al., 2010).

The high rates of cancer guideline adherence are, in part, due to the VA's focus on cancer quality measurement and its extensive oncology services. Mirroring the general population, cancer is the second highest cause of morbidity and mortality for the nation's veterans (Keating et al., 2011; Wilson & Kizer, 1998). As a result, the VA provides extensive oncology benefits to its patients and has considerable infrastructure to support this care. The VA system has approximately

140 hospitals. Of these hospitals, 132 host cancer registries, 60 have cancer

programs that are approved by the American College of Surgeons Commission on

Cancer (Keating et al., 2011), and 42 are designated as comprehensive cancer care

centers (Keating et al., 2011; Wilson & Kizer, 1998). This cancer care infrastructure

gives the VA the ability to provide care to nearly 40,000 newly diagnosed patients

with cancer who receive care in the VA annually (Zullig et al., 2012). Given the

breadth of the VA's large cancer patient population, the potential impact of the VA on

the overall quality of the nation's cancer care is substantial.

The affordability, range of services, and quality of care provided in the VA

make it appealing to many patients. To access VA healthcare, veterans must first

qualify to receive care. Eligibility for most VA health care benefits is based on active

military service in the Army, Navy, Air Force, Marines, or Coast Guard with an

honorable discharge. Members of the Reserve or National Guard may also qualify

for VA healthcare if they were called into active service. Under certain

circumstances, veterans' dependents or surviving spouse may also be eligible to

receive care in the VA. Upon entering the VA healthcare system, patients undergo a

financial assessment (i.e., means test) and a service-connected status will be

determined. Depending on the patient's previous calendar year gross household

income and net worth, patients are categorized according to income threshold for

their geographic region. This categorization, in tandem with the service-connected

status, is used to determine how much a patient will be charged in the form of co-

pays for the care they receive in the VA. Many patients, such as those who received

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a Purple Heart Medal, former prisoners of war, or low-income veterans, will receive healthcare completely free through the VA system (Veterans Affairs, 2009).

Veterans may be exempt from billing for additional reasons. Care for service-connected disabilities is often provided at no cost to the patient. Service connection essentially means that there is evidence that "a particular injury or disease resulting in disability was incurred coincident with service in the Armed Forces" (Veterans Affairs, 2011). Veterans with preexisting conditions that were aggravated by their military service may also qualify for service-connected status. These may be both physical and mental conditions. Some cancers are considered to be service connected, due to working conditions or environmental or chemical exposures (Veterans Affairs, 2002).

As a result of the eligibility process and sliding scale of fees, the VA is considered an equal access system (Dominitz et al., 1998; Rabeneck, Souchek, & El-Serag, 2003; Saha et al., 2008). Once a patient enrolls in the VA healthcare system they are granted access to affordable, high-quality care. In fact, the quality of care in the VA is consistently evaluated to be equal to or better than the private sector (Keating et al., 2011; Kizer & Dudley, 2009; Trivedi & Grebla, 2011; Trivedi et al., 2011). The VA's distinctive organizational structure, diverse patient population, and availability of comprehensive data sources make in an ideal setting in which to assess racial disparities in timeliness and quality of cancer care.

Importance of the VA to Health Services Research

Because of VA patients' unique qualification process, users of the VA healthcare system are not representative of the general U.S. population. Users of

VA healthcare are more likely to have poor health status, to have lower levels of education and income, to be African American, and to have higher rates of psychiatric illnesses and other disabilities (Agha, Lofgren, VanRuiswyk, & Layde, 2000; Jha et al., 2003). In short, VA patients tend to be more comparable to patients seeking care in the community setting rather than at academic institutions. Despite limitations in terms of both patient- and system-level generalizability, the VA makes a notable contribution to national health services research. As the United States moves toward national health care reform, there are many important lessons that can be learned by studying the VA. The VA has a longstanding history as an ACO, which uses patient-centered medical homes (PCMH). More important, because of the large number of veterans prepared to receive VA care, the VA will have to develop strategies to integrate patients efficiently. The United States will undergo a similar transition as it extends healthcare access to 30 million Americans (*An act entitled The Patient Protection and Affordable Care Act, 2010)*. The VA can serve as a model for this process.

Race/Ethnicity Differences in CRC

Evidence of racial disparities exists across the continuum of cancer care services—from diagnosis, to treatment, to surveillance and survival (Zapka et al., 2003). Although a few isolated studies have found no difference (Bradley et al., 2001; Schwartz et al., 2003), there is vast evidence that African Americans present with more advanced stages of disease than Caucasians (Berry et al., 2009; Jemal et al., 2010; Polite et al., 2005; Robinson et al., 2010; Siegel et al., 2012). Differences in stage at diagnosis may be a result of variances in screening patterns between

patients of minority and majority race. In the Medicare population, African Americans are 20% less likely to undergo a CRC screening colonoscopy and 40% less likely to undergo a flexible sigmoidoscopy than Caucasian patients (Richards & Reker, 2002; Robinson et al., 2010). Exacerbating this problem, African Americans have a higher proportion of right-sided cancers; right-sided cancers may be difficult to detect using common screening practices like flexible sigmoidoscopy which begin on the left side of the colon. This may inhibit early detection of CRC (Johnson & Carstens, 1986; Sabounchi et al., 2012; Shavers, 2007). This is because right-sided cancers, which occur in the ascending segment of the colon, are more difficult for physicians to reach with the colonoscope making detecting CRC during screening difficult. Perhaps as a result of differences in screening patterns, symptoms at CRC diagnosis also differ between races. African Americans present more frequently with rectal bleeding, heme-positive stools, and anemia (Sabounchi et al., 2012).

Late presentation at diagnosis may be reduced in the VA because the VA offers access to preventive care services, such as CRC screening, and integrated care without the financial burden often experienced in the private sector. In fact, a recent national study of veterans determined that over 80% of patients receiving VA healthcare received some form of CRC screening (Long et al., 2012). This is much higher than the approximately 60% of Americans screened in the general population (Center for Disease Control and Prevention, 2008). Moreover, most veterans were being screened using colonoscopy, which is the gold standard technique for CRC screening (Long et al., 2012). Again, the story of racial differences in CRC screening is complex. Several studies have showed equal rates of CRC screening and, in

some cases, similar proportions of surgery and chemotherapy among patients of minority and majority races in the VA and, to a lesser extent, in the private sector (Dolan et al., 2005; Dominitz et al., 1998; Gornick, Eggers, & Riley, 2004; Robinson et al., 2010; Sabounchi et al., 2012). However, some of these studies have focused one VA medical center, thus limiting generalizability of findings to the VA system as a whole (Robinson et al., 2010; Sabounchi et al., 2012). Although these results are important, it is possible that practices across VA medical centers nationwide may differ.

Even after receiving a cancer diagnosis, there is evidence that patients of different races may receive different cancer treatment. African American patients often have more comorbid conditions, which may contraindicate receipt of adjuvant chemotherapy (Ayanian et al., 2003; Morris et al., 2008). Although at least one study shows racial equality in receipt of chemotherapy (Landrum, Keating, Lamont, Bozeman, & McNeil, 2012), the majority of evidence shows that even after controlling for comorbidities African Americans remain 10% less likely to receive adjuvant therapy for Stage II CRC (Baldwin et al., 2005; Govindarajan et al., 2003; Sabounchi et al., 2012; Schrag et al., 2001). Similarly, African Americans are two times less likely to get surgery for Stage I and are also less like to get surgery for metastases of Stage IV CRC (Demissie et al., 2004). African Americans are also less likely to undergo radiation therapy and surgery for the treatment of rectal cancer (Ayanian et al., 2003; Govindarajan et al., 2003; Landrum, Keating, Lamont, Bozeman, Krasnow, et al., 2012; Landrum, Keating, Lamont, Bozeman, & McNeil, 2012). Broadening the racial divide, refusal of cancer-related treatment is higher

among African American patients with early stage CRC than among Caucasian patients (Demissie et al., 2004).

After completing active treatment, patients transition into ongoing disease monitoring and surveillance. Adhering to surveillance guidelines is critical to detect potentially harmful recurrences and metastases. Compared to minority patients, Caucasians are more likely to undergo CEA surveillance after completion of CRC treatment (Elston Lafata, Cole Johnson, Ben-Menachem, & Morlock, 2001).

There are significant racial differences in five-year survival rates as well. Though CRC mortality rates are universally decreasing across all racial groups, racial disparities in CRC mortality rates have progressively increased (Berry et al., 2009; Siegel et al., 2012). Despite a few studies finding data to the contrary (Govindarajan et al., 2003; Robinson et al., 2010; Sabounchi et al., 2012), there are worse relative five-year survival rates for African Americans with CRC compared to Caucasian patients in both the private sector (Alexander et al., 2004; Dayal, Polissar, Yang, & Dahlberg, 1987; Govindarajan et al., 2003; Siegel et al., 2012) and the VA populations (Alexander et al., 2007; Dominitz et al., 1998).

Race/Ethnicity Differences in Lung Cancer Care

As in CRC, racial differences in lung cancer span from diagnosis, to active treatment, through patient outcomes. Unlike CRC, there are no effective screening techniques to detect lung cancer and, as such, many lung cancer patients present with advanced disease at diagnosis (Dransfield, Lock, & Garver, 2006). Treatment options for lung cancer are limited relative to CRC. Surgical resection is the only treatment modality that offers the potential of a cure (Dransfield et al., 2006).

However, many lung cancer patients are not suitable surgical candidates because of metastatic disease, comorbid conditions such as cardiovascular disease, and limited pulmonary function, all of which are clinical contraindications for surgery (Beckles, Spiro, Colice, & Rudd, 2003; Dransfield et al., 2006; Iizasa et al., 2004; Landrum, Keating, Lamont, Bozeman, & McNeil, 2012). As a result, lung cancer surgical resection rates in the United States remain quite low at an estimated 30% or less (Dransfield et al., 2006; Fry, Menck, & Winchester, 1996).

There has been some evidence of racial equality of lung cancer care (Dransfield et al., 2006), but there is general consensus that rates of surgical referral (Lathan, Neville, & Earle, 2006), completion of surgery, and timeliness of lung cancer treatment vary by race (Bach, Cramer, Warren, & Begg, 1999; Farjah et al., 2009; George & Margolis, 2010). One recent national VA study found conflicting results. Patients of diverse races with Stages I and II lung cancer were equally likely to be referred to a surgeon in the VA, but African American patients were less likely to be evaluated by the surgeon and, subsequently, were less likely to be recommended for surgery (Landrum, Keating, Lamont, Bozeman, & McNeil, 2012).

There are also differences in wait times to undergo lung cancer surgical resection. In general, there is evidence that median wait times from diagnosis to treatment are on the rise for both CRC and lung cancer (Bilimoria et al., 2011). Among lung cancer patients, those diagnosed at earlier stages tend to have longer wait times for cancer care (Bilimoria et al., 2011; Powell et al., 2008). Racial differences in wait times exist as well, and the reasons for this are multifaceted.

There is qualitative indication that cultural and racial differences in patient perspectives surrounding lung cancer surgery may impact timeliness of care. African American patients often question the efficacy of surgery and, furthermore, believe that exposure of a cancerous tumor to air during the surgical procedure may cause the tumor to spread (George & Margolis, 2010). Conversely, Caucasian patients tend toward impatience with surgical wait times (George & Margolis, 2010). These racial differences in perspectives of surgery persist after controlling for income, education, gender, and other potentially confounding covariates. Additionally, African American patients are more likely to refuse lung cancer surgical resection (George & Margolis, 2010; Landrum, Keating, Lamont, Bozeman, Krasnow, et al., 2012; Margolis et al., 2003). Differences in cultural views about lung cancer surgery and in patient-provider trust may exacerbate racial differences in receipt of appropriate, timely lung cancer treatment.

One VA study of African American and Caucasian lung cancer patients found that patient-reported levels of trust in their physician were equal before their visit, but after the visit African Americans reported lower levels of trust in their physician than their Caucasian counterparts. Moreover, African American patients reported that communication with their physician was less informative, less supporting, and less partnering than similar Caucasian patients (Gordon, Street, Sharf, Kelly, & Souchek, 2006). Although these issues of patient perception are outside the realm of this dissertation, it is worth noting that there may be patient-initiated delays that affect lung cancer care timeliness and therefore subsequent survival rates.

Lung cancer is a fairly grim disease. The overall five-year survival rate across all stages of disease and races is approximately 16% (Siegel et al., 2012). As with CRC, survival for lung cancer is largely based dependent upon stage at diagnosis. In addition, receipt of surgical resection also has a dramatic impact on survival. For example, a single-site VA study found that patients with Stage IA lung cancer had an 80% survival rate (Dransfield et al., 2006).

The relationship between timeliness of lung cancer care and subsequent survival rates is complex (Olsson, Schultz, & Gould, 2009), perhaps because lung cancer patients diagnosed at earlier stages tend to have longer wait times for cancer care (Bilimoria et al., 2011; Powell et al., 2008). Several studies have shown that there is no association between timeliness of care and survival (Aragoneses, Moreno, Leon, Fontan, & Folque, 2002; Pita-Fernandez, Montero-Martinez, Pertega-Diaz, & Verea-Hernando, 2003; Quarterman, McMillan, Ratcliffe, & Block, 2003; Salomaa, Sallinen, Hiekkanen, & Liippo, 2005), while others report that shorter times to treatment are associated with improved survival (Buccheri & Ferrigno, 2004; Kanashiki et al., 2003; Kashiwabara et al., 2003), and still other studies have found that longer times to treatment negatively impact patient outcomes (Annakkaya et al., 2007; Comber, Cronin, Deady, Lorcain, & Riordan, 2005; Salomaa et al., 2005). However, there are dramatic differences in lung cancer five-year survival rates by race for patients that do not undergo surgical resection, with Caucasians surviving at a higher percentage than African Americans (Farjah et al., 2009; Siegel et al., 2012).

In short, findings of racial disparities are somewhat mixed depending on the element of care examined (i.e., surgery, chemotherapy), the setting of care (i.e.,

private, VA, urban, rural), and the specific population of patients being studied (Alexander et al., 2007). Examining racial disparities in a large national cohort of veteran patients, as examined in this dissertation, provided a complement to and advantage over much of the existing literature.

Race/Ethnicity Differences in CRC and Lung Cancer Survival

The American Cancer Society reported that from 2000 to 2007, African American patients were diagnosed at later stages than their Caucasian counterparts (Table 1) (Siegel et al., 2012). Moreover, five-year relative survival rates were lower for African Americans at every stage of diagnosis for CRC, lung, and many other cancer types (Pulte et al., 2012; Siegel et al., 2012).

Table 1.

Stage Distribution and Five-Year Survival Rates by Stage at Diagnosis for Colorectal and Lung Cancers. (Siegel et al., 2012)

	Colon & Rectum				Lung & Bronchus			
	Stage Distribution		Five-Year Survival		Stage Distribution		Five-Year Survival	
	Caucasian	AA	Caucasian	AA	Caucasian	AA	Caucasian	AA
Localized	39%	35%	91%	85%	15%	12%	53%	44%
Regional	37%	34%	69%	64%	22%	22%	24%	22%
Distant	19%	24%	12%	9%	55%	60%	4%	3%

These data support the existence of racial disparities, which may arise from differences in access to care, receipt of quality cancer care, and/or patients' underlying comorbid conditions (Siegel et al., 2012).

It is important to note that overall survival rates are better in the VA healthcare system compared to fee-for-service SEER-Medicare patients. Landrum and colleagues compared all-cause and cancer-specific mortality rates among VA

and fee-for-service Medicare patients and found that, for both colon and NSCLC,

survival rates were higher in among patients receiving care in the VA healthcare

system (Landrum, Keating, Lamont, Bozeman, Krasnow, et al., 2012). Survival rates

were similar for both groups of rectal cancer patients (Landrum, Keating, Lamont,

Bozeman, Krasnow, et al., 2012). This improved survival rate may be because VA

patients tend to be diagnosed with earlier stage disease, which often leads to better

patient outcomes (Zullig et al., 2012).

CHAPTER 3: STUDY DESIGN AND METHODS

Overview and Rationale

This study was a secondary analysis of data collected for ongoing care quality measurement and performance efforts and administrative data. The study employed a retrospective design using EPRP data to identify men diagnosed with primary CRC and NSCLC receiving cancer care in the VA healthcare system. The binary dependent variables of interest were receipt of NCCN guideline-adherent colorectal cancer care, timeliness of receipt of colorectal cancer care and subsequent all-cause mortality, and timeliness of receipt of NSCLC care and subsequent all-cause mortality. The key explanatory variable is race. Analyses examine the association between race and guideline-concordance/timeliness controlling for regional characteristics, health status characteristics, and other independent covariates.

Conceptual Framework

In the context of observational, retrospective research studies, a conceptual model facilitates the identification of areas for potential system failure and future intervention. Racial disparities in quality and timeliness of cancer care are largely a function of three overarching factors: 1) healthcare system factors, 2) patient-level factors, and 3) the interaction between patient- and system-level factors.
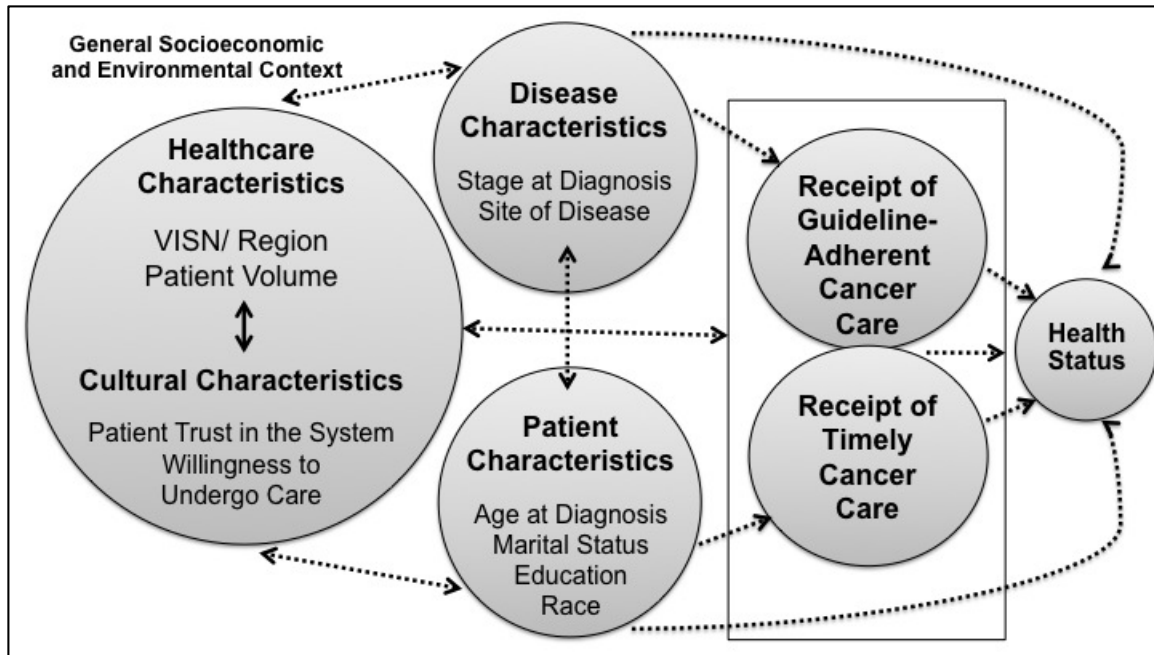
Figure 1. A conceptual model depicting the role of patient, disease, and healthcare characteristics on the receipt of guideline-adherent and timely cancer care and subsequent health outcomes.

The Chronic Care Model (CCM) was developed to help health systems

change their standard delivery of care practices through system redesign. The

compilation of these practice-changing efforts results in a patient-centered,

evidence-based healthcare system that proactively provides population-based care

(Coleman, Austin, Brach, & Wagner, 2009; Wagner et al., 2001; Wagner et al.,

2005). Wagner and colleagues purport that most healthcare systems have been

designed to treat acute illnesses rather than for ongoing management and

coordination of care for patients with chronic conditions. Given the dramatic rise in

chronic conditions, including cancer, the complexity and integration of services

required to provide high-quality care are often inadequate within healthcare systems.

Broadly, healthcare systems are often fragmented, poorly organized, and

constrained by modern information technology (America & Medicine, 2001; Wagner et al., 2001; Wagner et al., 2005).

Wagner and colleagues assert that "high-quality chronic illness care is characterized by productive interactions between practice team and patients" (Wagner et al., 2001). The authors state that effective healthcare systems ensure access to timely and relevant data on both individual patients and patient populations based on clinical information systems like electronic health records and disease registries (Wagner et al., 2001). Moreover, the CCM contains six elements—the healthcare organization, community resources, self-management support, delivery system design, decision support, and clinical information systems. These six elements inform our examination of racial disparities in cancer care quality and timeliness in the integrated VA healthcare system.
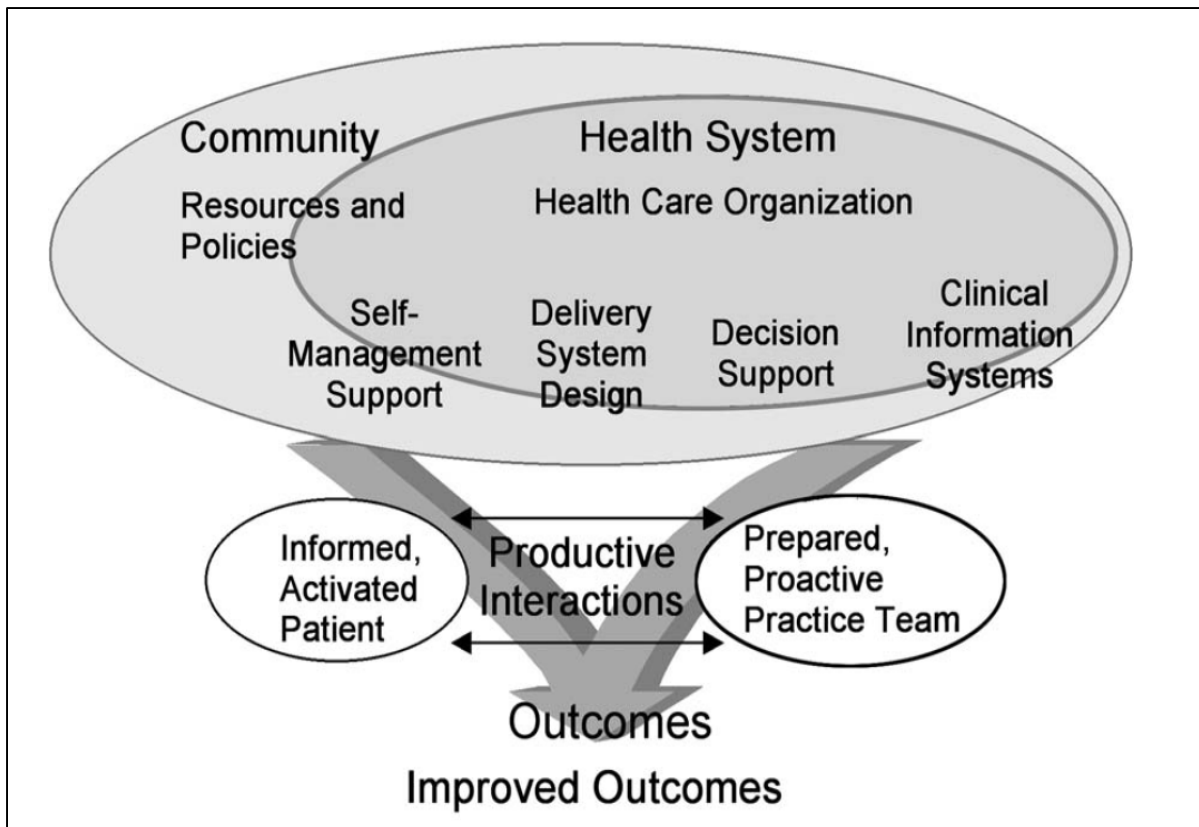
Figure 2. Chronic care model. Adapted from Wagner and colleagues, 2005. (Wagner et al., 2005)

Research Questions and Hypotheses

Research Question 1: Do patient-level factors, such as race, affect the odds of receiving NCCN guideline-adherent CRC care, controlling for known covariates?

H1: African American race will be associated with reduced odds of receiving guideline-adherent CRC care compared to Caucasian race after controlling for known covariates.

Research Question 2a: Do patient-level factors, like race, affect the timing of receipt of CRC care, controlling for known covariates?

H2a: African American race will be associated with longer times to CRC care compared to Caucasian race after controlling for known covariates.

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Research Question 2b: Do patient-level factors, like race, affect all-cause mortality among CRC patients, controlling for known covariates?

H2b: African American race will be associated with higher all-cause mortality than Caucasian race among CRC patients, controlling for known covariates.

Research Question 3a: Do patient-level factors, like race, affect the timing of receipt of lung cancer care, controlling for known covariates?

H3a: African American race will be associated with longer times to CRC care compared to Caucasian race, controlling for known covariates.

Research Question 3b: Do patient-level factors, like race, effect all-cause mortality among lung cancer patients, controlling for known covariates?

H3b: African American race will be associated with higher all-cause mortality than Caucasian race among lung cancer patients, controlling for known covariates.

Data

This dissertation relies on several data sources including two distinct EPRP data sets assessing quality of care for CRC and lung cancer patients. This EPRP data was supplemented with administrative data that will be obtained from the Veterans Affairs Informatics and Computing Infrastructure (VINCI) warehouse. An explanation of each of these data sets is provided below.

The EPRP was authorized by Congress and the VA to provide quality of care information that can be used by the VA for quality improvement, evaluation, and benchmarking with external organizations (Kussman, 2008). Data are manually abstracted from CPRS, the VA's electronic health record, and paper shadow charts. A contracting, non-federal agency conducts the data collection. The West Virginia

Medical Institute (WVMI), under the auspices of the VA Office of Quality and Performance (OQP), has conducted the data collection for both the CRC and lung cancer EPRP datasets (Jackson, Melton, et al., 2010). These data represent substantial investment for the VA healthcare system (Goulet et al., 2007), both in terms of a financial and labor commitment. EPRP selects a random sample of VA patients nationwide that were treated or diagnosed with a specific condition in a given fiscal year (Goulet et al., 2007; Kussman, 2008).

Quality measurement and improvement is the central focus of EPRP. As such, patients are not asked to provide consent for participation in the medical record review process. Individual research projects may use EPRP data and link with additional administrative and other datasets as indicated in IRB-approved protocols (Goulet et al., 2007).

Although EPRP lung cancer data contains information about patients' comorbidity and vital status, the EPRP CRC data does not contain this data. Therefore, the EPRP CRC data set will be supplemented with administrative data from the VINCI warehouse to create a comprehensive data set containing information on patients' comorbidity and vital status.

VINCI is a nontraditional data warehouse. VINCI is a mechanism through which VA researchers and operations can request access to myriad data sets. VINCI houses administrative data sets like the Corporate Data Warehouse (CDW), the Medical SAS files, and the Decision Support System (DSS). The CDW contains vital signs, clinical reminders, and consultation data. The Medical SAS data sets include inpatient and outpatient treatment information, and the DSS encompasses

laboratory values, health service utilization information, and healthcare costs. VINCI also includes other data sources such as EPRP.

VINCI provides a secure, high-performance computing environment for VA researchers to access administrative data. The data requested from VINCI contained comorbidity information necessary to determine a comorbidity index score, which was used in all analyses (Klabunde, Legler, Warren, Baldwin, & Schrag, 2007). The presence of specific comorbid conditions may impact patients' ability to tolerate certain cancer treatments. Moreover, these comorbidities may affect clinical decision making regarding receipt of certain chemotherapeutic agents and other aspects of cancer care (Carpenter et al., 2012). For example, sensory neuropathy is a known side effect of oxaliplatin (Koopman & Punt, 2009). A patient with a low comorbidity index score (i.e., lower score indicates better health) might still not be a good candidate to receive oxaliplatin if they already suffer from diabetic neuropathy. Therefore, comorbidity was measured in two ways—using the NCI Combined Comorbidity Index, and by considering individual health conditions that comprise the index (Klabunde et al., 2007).

In an effort to ensure that data for analysis was timely, patients' vital status information and date of death was also attained from VINCI. VINCI data are electronically extracted from administrative and medical records on a nightly basis, making this an ideal mechanism to attain accurate and current vital status information.
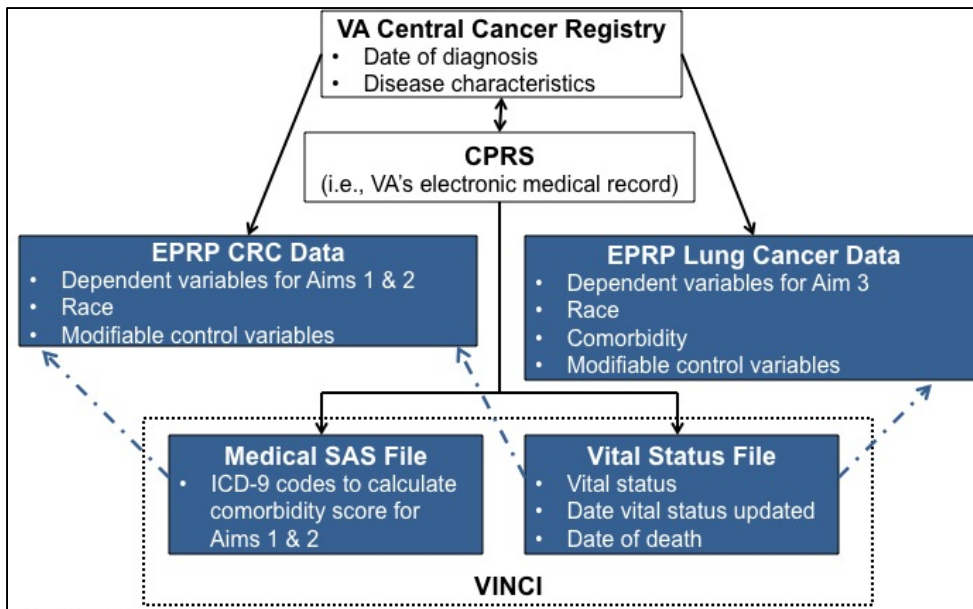
Figure 3. Dissertation data sources. Blue shading indicates that a data source was used in the dissertation. Data sources with white shading are provided for reference.

The EPRP data sets were supplemented with information from the vital status file, which was obtained via VINCI. The data requested include current vital status (i.e., living or deceased) and, when applicable, the date of death. Comorbidity information, measured as an ACE-27 and Charlson Index, is already included in the lung cancer EPRP data set. Information needed to calculate a comorbidity score (i.e., ICD-9 codes) for the CRC EPRP cohort was obtained in the form of ICD-9 scores from the Medical SAS files. This information was obtained through VINCI.

In summary, this dissertation requires data obtained through VINCI from four primary sources: 1) the CRC EPRP data file, 2) the lung cancer EPRP data file, 3) the vital status file, and 4) the Medical SAS files (Figure 3).

Study Sample and Inclusion/Exclusion Criteria

The general description of the study inclusion criteria is provided below (Table 2).

Table 2.

Inclusion Criteria.

	Inclusion Criteria
Healthcare System	Must have received some portion of their cancer care within the VA
Cancer Diagnosis	ICD-9 classification for cancer of the colon or rectum (Aims 1 and 2) or lung (Aim 3)
Diagnosis Time Window	Diagnosed between October 1, 2003 and March 31, 2006 (Aims 1 and 2); Diagnosed between October 1, 2006 and December 31, 2007 (Aim 3)
Cancer Stage	Must be invasive (i.e., not in situ) and non-metastatic (i.e., not Stage IV) (Aims 1 and 2); Must have advanced disease (i.e., Stage III or IV) (Aim 3)
Surgery	Must have undergone surgical resection (Aims 1 and 2)
Gender	Male

The study sample for Aims 1 and 2 includes patients diagnosed with incident CRC between October 1, 2003, and March 31, 2006 (Hynes, Perrin, Rappaport, Stevens, & Demakis, 2004; Jackson, Powell, et al., 2010). Patients must have been diagnosed with an International Classification of Disease (ICD-9) code for colon and/or rectal cancer (Perlin, Kolodner, & Roswell, 2004) between three months before and three months after the diagnosis during the study period. To further confirm a CRC diagnosis, eligible patients must have evidence of visiting one or more of the following VA medical services within three months before or after diagnosis: medical oncology, surgery, hospice, pathology, gastroenterology, and/or colonoscopy. Furthermore, patients had to have definitive surgical resection of their CRC and be diagnosed with Stage I, II, or III disease. The patients' diagnosis dates were based on the date of a signed pathology report that indicated diagnosis of invasive CRC. A surgical pathology report date was recorded for all patients included in this study (Jackson, Powell, et al., 2010). Although men and women may

have different patterns of healthcare use (Friedemann-Sanchez, Griffin, & Partin, 2007), the small number of women in the EPRP data did not enable statistical inferences about them. Therefore, all analyses are restricted to males.

The study sample for Aim 3 includes patients with invasive NSCLC (Hynes et al., 2004). Patients for Aim 3 must have been diagnosed with advanced NSCLC (i.e., Stage III or Stage IV) between October 1, 2006, and December 31, 2007.

Sample Size

EPRP data for CRC (Aims 1, 2a, and 2b) and NSCLC (Aims 3a and 3b) were used to examine receipt of NCCN guideline-adherent and timely cancer care. For Aims 1 and 2, we used EPRP CRC data for patients diagnosed between October 1, 2003, and March 31, 2006, with vital status and comorbidity follow-up through May 2012. The vital status and comorbidity information were obtained through administrative data sources based on electronically extracted information from the VA electronic medical record. From previous studies using the EPRP CRC data set, we anticipated that 2,492 non-metastatic CRC patients will be available for analysis;(Jackson, Melton, et al., 2010) we estimated that: ~13% will be African American (n=326), 72% Caucasian (n=1,793), fewer than 1% from other minority races (n=16), and ~14% of unknown race (n=357) (Jackson, Melton, et al., 2010).

Jackson and colleagues examined several overall quality measures using the EPRP CRC data set. Although they did develop models to identify patient or organizational characteristics associated with likelihood of receipt of guideline-adherent, timely care, their work provided insight into the expected sample size per quality measure. For example, in Aim 1, from three of the outcome measures

(described in greater detail in the subsequent section)—preoperative CT scan of the abdomen and pelvis prior to definitive surgical resection, preoperative CEA determination prior to definitive surgical resection, and referral to a medical oncologist—approximately 1,729 cases are expected. The smallest expected sample size for a specific dependent variable is approximately 808 cases for a measure of adjuvant 5FU or capecitabine administered after definitive surgical resection (Jackson, Melton, et al., 2010).

In Aim 2, we examined timeliness of CRC care. Elements of recommended care, such as receipt of adjuvant chemotherapy, are dictated based on a patient's stage of disease (NCCN, 2011). Therefore, measuring time to care is dependent on patients receiving the two relevant elements of recommended care. Sample sizes for each timeliness measure varied depending on the number of relevantly staged patients. Based on previous work using the EPRP colorectal cancer data set, we anticipated the following sample sizes: days from diagnosis to initiation of treatment (n=1,729), days from definitive surgical resection to start of adjuvant chemotherapy (n=767), and days from definitive surgical resection to surveillance colonoscopy for colonoscopies performed at least 7 months after surgical resection (n=644) (Jackson, Melton, et al., 2010).

Aim 3 used the EPRP NSCLC data set. EPRP NSCLC data for patients diagnosed between October 1, 2006, and December 31, 2007, with vital status and comorbidity follow-up through February 2010 were used. As for the colorectal cancer cohort, the vital status and comorbidity information were obtained through administrative data sources based on electronically extracted information from the

VA electronic medical record.

There are no known published studies to date that use the EPRP NSCLC cancer data set to examine care among patients with advanced disease. However, a previously published report described cancer incidence in the VA as reported in the VA Central Cancer Registry (VACCR) in 2007 (Zullig et al., 2012). Following prostate cancer, the report identified lung cancer (n=7,437) as the second most commonly diagnosed cancer among male veterans. The report also described the racial distribution of VA lung cancer cases as follows: 19.7% Caucasian (n=6,118), 15.5% African American (n=1169), and 15.4% other minority or unknown race (n=150) (Zullig et al., 2012).

Variables and Measurement

National Comprehensive Cancer Network Measures

Constructing the NCCN measures requires a great deal of detailed staging and treatment information that may not be readily available in all healthcare systems. However, the VA's nationwide electronic health record system and administrative data sources (Eisen & Francis, 2010; Jackson & Weinberger, 2009) give the VA the ability to assess a more comprehensive spectrum of measures than the ASCO/NCCN joint measures. In addition to the previously discussed measures, the NCCN measures were also considered for use as dependent variables for this dissertation. The benefit of NCCN guidelines is that they are based on scientific evidence when available and on the consensus of an expert panel when there is insufficient evidence to make a scientific recommendation (Cruse, Winiarek, Marshburn, Clark, & Djulbegovic, 2002; Jackson, Melton, et al., 2010; Winn, Botnick,

& Dozier, 1996). NCCN measures are divided into three categories of evidence and consensus. Category 1 represents the highest level of evidence, where there is uniform consensus based on high-level evidence that the intervention is appropriate. The quality of care measures examined in this dissertation have at least an NCCN evidence category of 2A, indicating that there is uniform consensus about the appropriateness of the intervention, but some of the evidence is lower level (NCCN, 2011).

Dependent Variables

For Aim 1, the outcome variables of interest are binary indicators (whether or not the patient received guideline-concordant care). Six distinct quality metrics were used to describe guideline-concordant care (Table 3). An example metric is "documentation that radial margins were free of tumor at the time of definitive surgical resection." Because stage of disease dictates appropriate care, each quality indicator had a distinct sample population.

For Aims 2 and 3, the outcome variables were the number of days elapsed between two events derived from the manually abstracted medical records data in EPRP (Table 3). An example of a timeliness measure is the number of days between definitive surgical resection to start of adjuvant therapy. Time from surgical resection to death will be examined for both the NSCLC and CRC cohorts. Vital status and date of death, when applicable, will be obtained from VINCI.

Table 3.

Outcome Variables and Measures.

Aim	Outcome Measure	Variable	Sample Population
Aim 1	Preoperative CT scan of the abdomen and pelvis prior to definitive surgical resection.	Binary 1=received 0=did not	Stages II and III CRC
Aim 1	Preoperative CEA determination prior to definitive surgical resection.	Binary 1=received 0=did not	Stages II and III CRC
Aim 1	Documented radial margins were free of tumor at the time of definitive surgical resection.	Binary 1=received 0=did not	Stages II and III CRC
Aim 1	Referral to a medical oncologist.	Binary 1=received 0=did not	Stages II and III CRC
Aim 1	Adjuvant 5FU or capecitabine administered after definitive surgical resection.	Binary 1=received 0=did not	Stage III CRC
Aim 1	Surveillance colonoscopy within 7 to 18 months after definitive surgical resection for patients with documentation of no preoperative obstructing lesion.	Binary 1=received 0=did not	Stages I, II, and III CRC with no preoperative obstructing lesion documented
Aim 2a	Days from definitive surgical resection to start of adjuvant chemotherapy.	Count (number of days between events)	Stages II and III CRC
Aim 2a	Days from definitive surgical resection to surveillance colonoscopy for colonoscopies performed at least 7 months after surgical resection.	Count (number of days between events)	Stages I, II, and III CRC with no preoperative obstructing lesion documented
Aim 2b	Days from definitive surgical resection to death.	Count (number of days between events)	Stages I, II, and III CRC
Aim 3a	Days from diagnosis to first treatment.	Count (number of days	Stages III and IV NSCLC

			between events)
Aim 3a	Days from diagnosis to referral to palliative care.	Count (number of days between events)	Stages III and IV NSCLC
Aim 3b	Days from diagnosis to death.	Count (number of days between events)	Stages III and IV NSCLC

The quality indicator outcome measures for Aim 1 were derived from NCCN measures (NCCN, 2011).

Though there is general agreement that timeliness of care is important, there is limited scientific evidence supporting specific timeliness of care guidelines (Desch et al., 2008; Gould et al., 2008; Pagano et al., 2010). In fact, at least one VA study found that timeliness of care had no measureable impact on lung cancer survival (Riedel et al., 2006). Despite this, the VA has made efforts to improve cancer care timeliness throughout the healthcare system, particularly for patients diagnosed with CRC (Powell et al., 2011). Measures of timeliness for both CRC (Aim 2) and lung cancer (Aim 3) were included in this dissertation.

Key Independent Variables

For each aim, the main independent variable of interest was race. Reflective of the racial composition of VA healthcare system users, the dissertation included race as a binary variable (i.e., Caucasian=1, African American=0). A more granular, categorical measure of race was not feasible due to the small numbers of patients within each minority group. An earlier manuscript using the EPRP CRC cohort

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reported that 72% of the patient cohort was Caucasian, approximately 13% were African American, and approximately 15% were of other minority or unknown race (Jackson, Melton, et al., 2010). Given the small numbers of patients of other minority races (i.e., not African American) this dissertation focuses on Caucasian and African American comparisons. The race variable will be based on the EPRP race, which used race as reported in the VACCR. A major strength of these VA data sources over Medicare or traditional other administrative data is the relatively low amount of missing race information.

Control Variables

The control variables are similar across all three aims. Patient characteristics, regional characteristics, and disease characteristics were included to control for their association with receipt of guideline-adherent, timely cancer care and subsequent health outcomes (Table 4).

Table 4.

Independent Variables and Measures.

Construct	Dimension	Variable	Data Source
Patient characteristics	Race (key independent)	Caucasian (binary)	EPRP
	Age	Age at diagnosis (categorical)	EPRP
	Social support	Marital status (categorical)	EPRP
Regional characteristics	Geographic area (i.e., VISN)	West (binary) South (binary) East (binary) Central (binary)	EPRP
Health status	Comorbid conditions	NCI comorbidity index (categorical) Liver disease (binary) Renal disease (binary) Paralysis (binary) CHF or acute MI or CVD or COPD (binary) Neuropathy (binary) Diabetes (binary)	VINCI
	Cancer characteristics	Stage of disease (categorical)	EPRP

Age

Patients' age at diagnosis was extracted from EPRP and used in all analyses. Current clinical guidelines do not contain upward age boundaries after which point patients should receive different or no care. For example, guidelines do not state that after age 90 a patient should no longer receive surveillance colonoscopy. Rather, guidelines stress the importance of assessing patients' performance or functional status. However, there is evidence that patients who are older at the time of diagnosis may receive less cancer care, particularly in regard to adjuvant chemotherapy (Ayanian et al., 2003; Esnaola, Stewart, Feig, Skibber, & Rodriguez-

Bigas, 2008; Potosky, Harlan, Kaplan, Johnson, & Lynch, 2002; White et al., 2008).

This age disparity is well documented across several cancer types and healthcare

settings despite there being no evidence that older people experience greater

chemotherapy-related toxicity (Chang et al., 2011; Cronin et al., 2006; Kohne,

Folprecht, Goldberg, Mitry, & Rougier, 2008; Scheithauer et al., 2003; Twelves et al.,

2005).

Social Support

Social support has been positively associated with receipt of high-quality care

and better patient outcomes (Ayanian et al., 2003; Potosky et al., 2002). Adequate

social support can be protective against traditional barriers to cancer care like having

accessible transportation—a prerequisite for receipt timely and guideline-adherent

care (Zullig et al., 2011). As a result, all analyses controlled for patients' marital

status as abstracted in the EPRP data.

Geographic Area

There is evidence of geographic variation in the delivery of high-quality

cancer care (Egede et al., 2011; Potosky et al., 2002). In an effort to control for

geographic orientation, the EPRP data set associates cases with their originating

facility and VISN (Veterans Affairs, 2010). As previously discussed in Chapter 2,

VISNs are the VA's geographical divisions of the country. As a proxy for region,

cases were assigned to a geographic quadrant based on VISN of origin (Figure 3).

Specially, the Northern region was defined as VISNs 1, 2, 3, and 4. The Southern

region was defined as VISNs 5, 6, 7, 8, 9, 16, and 17. VISNs 10, 11, 12, 15, and 23

were considered as the Central region. Lastly, VISNs 18, 19, 20, 21, and 22 were

deemed the Western region. These regions are not equally distributed based on landmass or patient population, but approximate standard geographical divisions of the U.S.
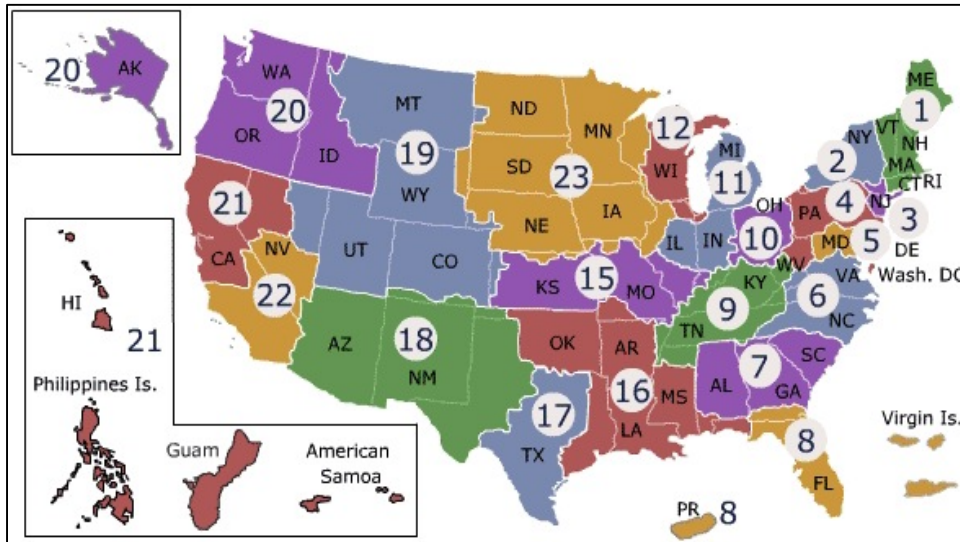
Figure 4. Veterans Integrated Service Network (VISN) map.
Source: http://www2.va.gov/directory/guide/map.aspdnum=1 (Accessed Sept. 30, 2011)*.*

Comorbid Conditions

Comorbidities, including pre-existing chronic or acute conditions that are distinct from the primary illness of interest (Feinstein, 1970; Iezzoni et al., 1992), can affect clinical decision making, treatment options, and treatment outcomes. Patients with a higher number of, or more severe, comorbidities may be less likely to tolerate certain therapies, may be at greater risk of complications, and may be less responsive to treatment.

Many comorbidity measures have been developed over the past 35 years. Choosing a comorbidity measure should reflect the research question, patient population, available data, validity, and feasibility. Perhaps the measure most widely

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used by health services researchers and epidemiologists is the Charlson comorbidity

index (Charlson, Pompei, Ales, & MacKenzie, 1987). Based on medical record

review data, the Charlson Index creates a weighted measure that was predictive of

one-year all-cause mortality. Many adaptations to the Charlson Index have been

developed (Deyo, Cherkin, & Ciol, 1992; Klabunde et al., 2007; Klabunde, Potosky,

Legler, & Warren, 2000). For example, Deyo and colleagues used ICD-9-CM

procedural and diagnosis codes from hospital claims data in lieu of medical record

data (Deyo et al., 1992). Notably, although the Deyo adaptation of the Charlson

Index has been widely used, the majority of studies have been conducted with

inpatients' setting, thus limiting its utility in cancer, which includes substantial

outpatient care.

Another adaption of the Charlson is the Elixhauser Index (Elixhauser, Steiner,

Harris, & Coffey, 1998). Elixhauser and colleagues expanded the Charlson to

include thirty comorbid conditions with the aim of making the index applicable to a

broader array of diseases. They included mental health problems, drug abuse, and

alcohol abuse, to name a few. Unlike previous adaptations, Elixhauser did not create

a summary score index but instead maintained separate metrics for each comorbid

condition to enable customization to patients with specific diseases. However, this

adaptation has not gained traction in the cancer health services research scientific

literature.

Based on the Charlson Index, Klabunde used data from Medicare Part B

physician claims and customary hospital claims to create the NCI Index, which uses

those data sources to calculate two separate comorbidity indices (Klabunde et al.,

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2000). Klabunde used a cohort of prostate and breast cancer patients to validate this NCI Index. As such, the authors used a different weighting procedure than the original Charlson index (Charlson et al., 1987). The list of comorbid conditions also differed. The NCI Index excludes diagnoses of solid tumors and metastases because the focus of the adapted comorbidity index is on non-cancer comorbidities. It therefore reduces the number of included conditions from the nineteen based on the original Charlson Index to sixteen conditions deemed relevant for a cancer patient population. In addition to changing the number of included comorbidities, the authors also demonstrated that condition weights differed by cancer site.

A modified NCI Index has now been validated in the four most common anatomical cancer sites—breast, prostate, colorectal, and lung. This adaptation, called the NCI Combined Index (Klabunde et al., 2007), compressed the comorbidity scores into a single, unified comorbidity index score. The authors compared four analytic approaches to construct comorbidity indices and concluded that there is justification for using cancer site-specific weights when calculating comorbidity scores. In part, this is because certain comorbid conditions may have a pattern of multicollinearity with a specific type of cancer (Klabunde et al., 2007). The authors also stress the importance of including other baseline measures, like patient age and stage at diagnosis, to further underscore the implications of comorbidity index score. The NCI Combined Index has been a respected comorbidity index for cancer patients and others who receive care including both in- and outpatient settings.

In addition to the Charlson comorbidity index and its myriad other adaptations (Charlson et al., 1987; Deyo et al., 1992; Klabunde et al., 2007; Klabunde et al.,

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2000), the ACE-27 relies on medical record data for its calculation (Fleming et al., 2011; Piccirillo, Creech, Zequeira, Anderson, & Johnston, 1999). The ACE-27 includes twenty-six comorbid conditions and three grades of severity. Some studies have shown the ACE-27 to be more accurate than the Charlson in predicting mortality in groups of critically ill patients (Pinckney, O'Brien, Piccirillo, & Littenberg, 2004; Soares et al., 2005). However, its reliance on medical record data has limited its feasibility and widespread adoption. A recent study developed a Medicare claim–based version of the ACE-27 measures using a breast and prostate cancer cohort. The study found higher reporting of comorbidities in medical records compared with Medicare claims data, however the sensitivity was approximately 80% (Fleming et al., 2011).

After careful consideration, the NCI Combined Index was favored for all analyses throughout the dissertation. This is because: (1) it has been validated in different groups of patients with cancer; (2) a cancer-specific measure is likely to be more meaningful than generic measures; and (3) the data to calculate this index are available.

Recent literature has illustrated the importance of considering not only a patient's overall comorbidity index score but also the presence of specific comorbid conditions that may impact one's ability to withstand cancer treatments. Specific comorbid conditions may influence clinical decision making (Carpenter et al., 2012). As previously described, chemotherapeutic agents like oxaliplatin have documented clinical side effects such as sensory neuropathy (Koopman & Punt, 2009). A patient suffering from diabetic neuropathy may not be a strong candidate for oxaliplatin even

with an otherwise low comorbidity index score (i.e., lower score indicates better health). Because of these important factors, comorbidity was measured in two ways—by using the NCI Combined Comorbidity Index and by considering individual health conditions that comprise the index (Klabunde et al., 2007). Specific conditions are listed in Table 5. Relevant diagnostic codes for this analysis primarily came from the ICD-9-CM (Table 5) (Corporation, 2006).

Table 5.

ICD-9-CM Codes Used to Identify Comorbid Conditions.

Condition	ICD-9 Diagnosis Codes	ICD-9 Procedural Codes
Myocardial infarction	"410" - "41099"	
Old myocardial infarction	"412" - "41299"	
Congestive heart failure	"428" - "42899"	
Peripheral vascular disease	"441" - "44199", "4439"-"44399", "7854"-"78549", "V434"	"3813","3814","3816","3818","3843","3844","3846", "3848","3833","3834","3836","3838","3922"-"3926","3928","3929"
Cerebrovascular disease	"430" - "438"	"3812", "3842"
Chronic obstructive pulmonary disease	"490" - "49699", "500"-"50599", "5064"-"50649"	
Paralysis	"342" - "34299", "3441"-"34419"	
Diabetes	"250", "2500"-"25039", "2507" - "25079"	
Diabetes with sequelae	"2504" - "25069", "2508"-"25099"	
Chronic renal failure	"582" - "58399", "585"-"58699", "588"-"58899"	

Various cirrhodites	"5712" -"57129", "5714"-"57169"	
Moderate-severe liver disease	"5722" - "57289", "4560"- "45619", "4562","45620","45621"	"391", "4291"
Ulcers	"5310" - "53139", "5320"-"53239", "5330"-"53339", "5340"-"53439", "531", "5319"-"53199","532","5329"-"53299","533","5339"-"53399","534","5349"-"53499", "5314" - "53179", "5324"-"53279","5334"-"53379","5344"-"53479"	
Rheumatoid Arthritis	"71481", "725", "7100", "7101", "7104", "7140"-"71429"	

Stage

AJCC stage was included as a control variable in all analyses (*AJCC Cancer Staging Manual*, 2002). Stage is one of the first inputs involved in determining where a patient falls within the NCCN guidelines (NCCN, 2011). Patients were included in specific guideline-adherence analysis based on their stage at diagnosis. The AJCC staging for lung and CRC is described in Table 6. Because diagnosis and treatment patterns are dramatically different for patients with non-invasive cancers, stage 0 (i.e., in situ) patients were excluded from all analyses (NCCN, 2011).

Table 6.

Lung and Colorectal Cancer Staging.

Colorectal Cancer	
AJCC Stage	**Description**
Stage 0*	Tis: Tumor confined to mucosa; cancer-*in-situ.*
Stage I	T1: Tumor invades submucosa.
Stage I	T2: Tumor invades muscularis propria.
Stage II-A	T3: Tumor invades subserosa or beyond (without other organs involved).
Stage II-B	T4: Tumor invades adjacent organs or perforates the visceral peritoneum.
Stage III-A	N1: Metastasis to 1 to 3 regional lymph nodes. T1 or T2.
Stage III-B	N1: Metastasis to 1 to 3 regional lymph nodes. T3 or T4.
Stage III-C	N2: Metastasis to 4 or more regional lymph nodes. Any T.
Stage IV	M1: Distant metastases present. Any T, any N.
Lung Cancer	
AJCC Stage	**Description**
Stage 0	Tis: Tumor confined to mucosa; cancer-in-situ.
Stage IA	T1a–T1b: Tumor 3 cm or less in greatest dimension.
Stage IB	T2a: Tumor more than 3 cm but less than 5 cm in greatest dimension.
Stage IIA	Tumor more than 3 cm and less than 7 cm in greatest dimension; may be nodal involvement.
Stage IIB	Tumor between 5 cm and 7 cm; tumor may directly invade the parietal pleural, chest wall, and other adjacent areas.
Stage IIIA	Tumor of any size that invades the mediastinum, heart, great vessels, and other adjacent areas; may be nodal involvement.
Stage IIIB	Tumor of any size that invades the mediastinum, heart, great vessels, and other adjacent areas; with nodal involvement.
Stage IV	M1: Distant metastases present. Any T, any N.

Adapted from: http://www.cancerstaging.org/staging/posters/lung8.5x11.pdf
(Accessed 10/2/2011).
*Patients with Stage 0 are excluded from all analyses.

Statistical Analyses by Aim

Summary statistics were reviewed before running regression models to determine

proportions and means of patient demographics and disease characteristics across

the sample. The summary statistics were stratified by race (i.e., Caucasian and

African American). Statistical significance of differences in study variables between the two time periods were assessed using t-tests for continuous variables and chi-square tests for categorical variables (Wooldridge, 2008). Statistical significance was set between 0.01 and 0.05, as indicated in each specific analysis.

Aims 1, 2a, and 2b were examined using the EPRP colorectal cancer data. In Aim 1, multivariate logistic regression with odds ratios was used for each binary dependent variable (Table 3) (Hosmer & Lemeshow, 2000). The appropriateness of including specific interaction terms (i.e., race*age, race*comorbidity score) was assessed by examining changes in the likelihood ratio (LR) test statistic and Wald test statistics (Mickey & Greenland, 1989). Likelihood ratio test statistics were also used to examine the suitability of using clustered standard errors and, similarly, Huber-White robust standard errors to adjust for heteroskedasticity. Previous research has illustrated the importance of adjusting for multiple factors (i.e., demographic information and comorbidities) simultaneously when examining racial disparities (Jean-Jacques, Persell, Hasnain-Wynia, Thompson, & Baker, 2011). Therefore, adjusted predicted probabilities were examined. A threshold of 0.01 was used to assess the statistical significance of each covariate (Wooldridge, 2008).

Aims 2a and 2b used Cox proportional hazard models (Cleves, Gould, Gutierrez, & Marchenko, 2010; D.W. Hosmer & Lemeshow, 1999). Each model was examined for the most appropriate variable functional forms, interaction terms, and higher-order terms as previously discussed. The Kaplan-Meier method (Cleves et al., 2010; D.W. Hosmer & Lemeshow, 1999) was used to plot time to event curves for patients of each race and to test each independent variable of interest for the

proportional hazards assumption. The logrank test was used to examine consistent differences between survival curves, by race, using a 5% level of significance.

Aims 3a and 3b were examined using the EPRP lung cancer data. The analyses employed for Aim 3 mirror those described in Aim 2. All analyses were performed using Stata version 10.0 (Stata Corporation, College Station, Texas) and SAS version 9.2 (SAS Institute, Inc., Cary, North Carolina).

CHAPTER 4: EXAMINING POTENTIAL COLORECTAL CANCER CARE DISPARITIES IN THE VETERANS AFFAIRS HEALTHCARE SYSTEM

OVERVIEW

Racial disparities in cancer treatment and outcomes are a national problem. The nationwide Veterans Affairs (VA) health system seeks to provide equal access to quality care. However, the relationship between race and care quality for veterans with colorectal cancer (CRC) treated within the VA is poorly understood. We examined the association between race and receipt of NCCN guideline-concordant CRC care.

This was an observational, retrospective medical record abstraction of CRC patients treated in the VA. Subjects included 2,022 patients (n=1,712, Caucasian; n=310, African American) diagnosed with incident CRC between October 1, 2003, and March 31, 2006, from 128 VA medical centers. We used multivariable logistic regression to examine associations between race and receipt of guideline-concordant care (computed tomography scan, preoperative carcinoembryonic antigen, clear surgical margins, medical oncology referral for Stages II-III, fluorouracil-based adjuvant chemotherapy for Stage III, surveillance colonoscopy for Stages I-III). Explanatory variables included demographic and disease characteristics.

There were no significant racial differences for receipt of guideline-concordant CRC care. Older age at diagnosis was associated with reduced odds of medical

oncology referral and surveillance colonoscopy. Presence of cardiovascular comorbid conditions was marginally associated with reduced odds of medical oncology referral (OR 0.65, 95% CI 0.50-0.89).

In these data, we observed no evidence of racial disparities in CRC care quality, suggesting that the VA may be a leader in providing equitable CRC care. Future studies could examine causal pathways for the VA's equal, quality care and ways to translate the VA's success into other hospital systems.

Introduction

The Veterans Affairs (VA) healthcare system is the largest provider of integrated cancer care in the United States, treating approximately 3% of newly diagnosed cancer cases nationwide (Zullig et al., 2012). Colorectal cancer (CRC) is responsible for a substantial amount of cancer-related morbidity and mortality. It is the third most commonly diagnosed cancer and third most common cause of cancer-related death for both men and women nationwide (Siegel et al., 2012).

Racial differences in CRC screening, diagnosis, treatment, and mortality have been widely documented in non-federal U.S. healthcare systems (Benarroch-Gampel et al., 2012; Berry et al., 2009; Berry et al., 2010; Crawford, Jones, & Richardson, 2010; Dimou, Syrigos, & Saif, 2009; Du et al., 2011; Kim et al., 2011; Obeidat et al., 2010; Rhoads, Cullen, Ngo, & Wren, 2012; Singh, Williams, Siahpush, & Mulhollen, 2011; White, Vernon, Franzini, & Du, 2010). Fewer AAs receive adjuvant chemotherapy for CRC compared to Caucasians (Dimou et al., 2009; Jessup, Stewart, Greene, & Minsky, 2005; Obeidat et al., 2010). Compared to Caucasian patients, cancer surveillance is lower and cancer-related mortality is

higher among African American patients (Dimou et al., 2009; Singh et al., 2011; White et al., 2010). It has been hypothesized that a key reason for such disparities has been unequal access to healthcare services (Benarroch-Gampel et al., 2012; Laiyemo et al., 2010; Landrum, Keating, Lamont, Bozeman, & McNeil, 2012). Standard eligibility criteria and relatively narrow distribution of family income among VA patients make differences in access among individuals of different races narrower than for non-VA systems (Agha et al., 2000). Although racial disparities in care have been noted for some conditions or procedures, the degree of racial disparities in the overall quality of VA care is thought to be less than for other U.S. healthcare systems (Rabeneck et al., 2003; Robinson et al., 2010).

There is paucity of information examining racial disparities in the quality of CRC care for VA patients of diverse race. Previous studies that have found some evidence that racial difference in CRC treatment may be attenuated in the VA (Alexander et al., 2007; Dominitz et al., 1998; Landrum, Keating, Lamont, Bozeman, & McNeil, 2012). However, these studies were based on a limited number of quality measures that could be assessed using administrative data alone. Thus, we extend previous research by using more comprehensive review of electronic health record data, supplemented with administrative data, to examine racial differences for receipt of guideline-concordant CRC care across the CRC care continuum.

Methods

Data Sources

We obtained data from the VA EPRP, the national program for tracking quality of VA healthcare (Kussman, 2008). Between July and August 2007, medical

record abstraction was conducted under the guidance of the VA Office of Quality and Performance to assess the quality of CRC care. Abstractors accessed the electronic health record remotely to collect data on disease characteristics and healthcare delivery provided to individuals across the VA nationwide. We supplemented EPRP data with clinical comorbidity and demographic information from the VACCR and administrative data (specifically inpatient and outpatient Medical SAS files).

Patient Sample

The sample has previously been described in detail (Jackson, Melton, et al., 2010). Briefly, patients were identified for inclusion in EPRP based on a search algorithm that defined a representative sample of VA patients diagnosed with CRC between October 1, 2003, and March 31, 2006, using administrative diagnosis, procedure, and encounter data stored in the centralized VA Decision Support System (Hynes et al., 2004; Jackson, Melton, et al., 2010). Eligible patients had an ICD code for colon and/or rectal cancer within three months (prior to or after) the study diagnosis time period (AHRQ, 2012; Jackson, Melton, et al., 2010). Further, eligible patients must have had a clinic visit, surgical procedure, or pathology report in the VA that corresponded with a specific visit or receipt of medical services within the aforementioned time frame. These combinations of services could have occurred in any temporal order. To be in the final analytic data set, patients also must have: had non-metastatic CRC (Stages I to III), had an incident occurrence (first diagnosis of CRC occurred during the study time period), received definitive surgical resection for CRC, and have successfully linked with information from VA administrative data

sources. Because of the small number of non-African American minorities and

females, we restricted the study to Caucasian and African American male patients
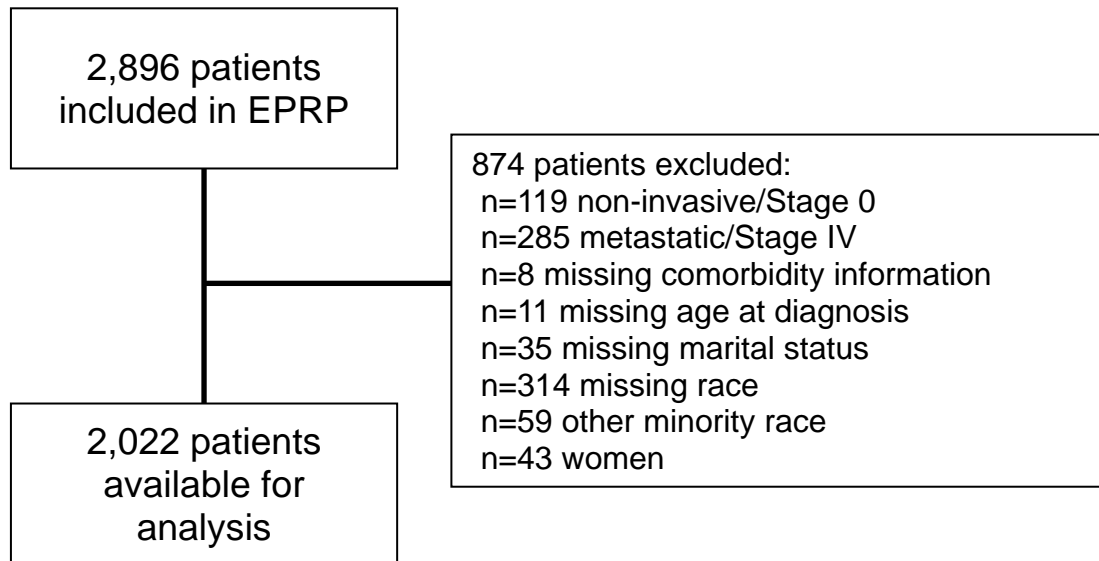
(Figure 5).

Figure 5. Colorectal cancer cohort assembly*.*

Dependent Variables: Quality Indicators

We used six distinct CRC quality indicators based on the 2003 NCCN

guidelines (National Comprehensive Cancer Network, 2003a, 2003b) that have

scientific evidence and/or NCCN panel consensus (Jackson, Melton, et al., 2010;

National Comprehensive Cancer Network, 2003a, 2003b). Each indicator applied to

a subset of patients as determined by stage and other factors. The specific quality

indicators, by stage, were:

- Stage II and Stage III CRC: (1) preoperative computed tomography (CT) scan of the abdomen and pelvis prior to definitive surgical resection; (2) preoperative carcinoembryonic antigen (CEA) determination prior to definitive surgical resection; (3) documented radial margins free of tumor at the time of definitive surgical resection; and (4) referral to a medical

oncologist. Because our intent was to evaluate equity in access to quality care, patients with documentation of a refusal (e.g., refused CT scan) in the electronic medical record were included in the quality indicator as having received guideline-concordant care.

- Stage III CRC: receipt of adjuvant fluorouracil- (5-FU) or capecitabine-based chemotherapy administered after definitive surgical resection. If the medical record contained a documented reason that 5-FU was not administered, that was included in the quality indicator calculation as having received guideline-concordant care.

- Stages I-III CRC who did not have documentation of an obstructing preoperative lesion: receipt of surveillance colonoscopy within seven to eighteen months after definitive surgical resection. Consistent with previous analyses (Jackson, Melton, et al., 2010), seven months was used as a minimum because colonoscopies performed earlier might not be intended for surveillance, and eighteen months was chosen because surveillance colonoscopies may not occur exactly within one year (e.g., due to scheduling or patient preference). To be included in the surveillance colonoscopy measure, patients must have survived at least one-year post-surgical resection.

Independent Variables

The primary independent variable of interest was patient race. We used a hierarchy of data sources to determine the most accurate measure of race. Because data were obtained through health record review by trained cancer registrars, the VACCR was considered the most valid source of race information and was available for most patients. If race was not reported in VACCR, then race was extracted from the inpatient medical record. If race was still unknown, then outpatient medical record information was used.

Other covariates included marital status (married or not), age at diagnosis (less than 55 years, 55 to 64 years, 65 to 74 years, or 75 years or older), geographic region (west, south, east, or central), comorbid conditions, and, when applicable, stage of disease (I, II, or III). The included comorbid conditions were based on the NCI Combined Comorbidity Index, which has been validated with CRC patients

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(Klabunde et al., 2007). We identified diagnoses for comorbid conditions with ICD

codes from medical inpatient and outpatient administrative data files (AHRQ, 2012).

To be included, comorbid conditions must have been diagnosed within the year prior

to the CRC diagnosis, excluding those comorbidities occurring in the thirty days

leading up to diagnosis (e.g., diagnosis-365 days to diagnosis-30 days). This is

because the thirty days prior to a cancer diagnosis often involve multiple interactions

with the healthcare system and patients may be diagnosed, sometimes erroneously,

with comorbidities that are actually cancer symptoms or sequelae. To ensure that

our analysis had adequate statistical power to address our study question, we

aggregated conditions based on consultation with a medical oncologist and

statistical examination to ensure that no valuable information was lost (e.g., by

collapsing a positively correlated condition with a negatively correlated condition)

(Carpenter et al., 2012). Individual comorbid conditions included: 1) liver disease; (2)

rheumatoid disease or AIDS; (3) renal disease; (4) dementia or paralysis; (5)

congestive heart failure, acute myocardial infarction, cardiovascular disease, or

chronic obstructive pulmonary disease; and (6) diabetes. This approach enabled us

to examine the effect of specific conditions on receipt of guideline-concordant care,

an advantage over an aggregate comorbidity index score.

Data Analysis

Multivariable logistic regression was used to determine the association

between race and receipt of guideline-concordant CRC care. To determine the best-

specified model, Likelihood Ratio (LR) tests were conducted and pseudo R-squared

variables were compared. Pearson's chi-square tests were used to determine

whether there were significant differences between groups for background demographic and clinical characteristics (e.g., age groups). Pearson and phi correlations between variables were assessed to examine potential for multicollinearity. We report odds ratios (OR) and 95% confidence intervals (CI). This paper examines multiple comparisons among the independent variables (e.g., race, age at diagnosis), which may increase the likelihood of Type 1 error (e.g., rejecting the null hypothesis when it is true). As a result, we considered using either the Šidák or Bonferroni correction. The Šidák correction relies on the assumption that the tests are independent. This claim is questionable in the current context. Sensitivity analyses using the Šidák (Sidak, 1967) and Bonferroni (Miller, 1981) corrections yielded results that were essentially identical and yielded no difference in interpretation of results. Therefore, we used the Bonferroni multiple comparison correction to control for family-wise error (i.e. the probability of making a false discovery). As a result of this correction, we only consider an association between independent variables and a specific quality indicator to be statistically significant if the p-value is <0.01 as opposed to the conventional value of <0.05. Stata 11 (StataCorp LP, College Station, TX) and SAS version 9.2 (SAS Institute, Cary, NC) were used for data management and analyses.

Results

The final sample consisted of 2,022 men with incident CRC (Figure 5). The mean age at diagnosis was 68 years (range: 34—94 years). Reflecting the overall VA patient population, the sample was predominately Caucasian (85%), married (52%), and lived in the South (38%). Stage was approximately evenly distributed.

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The most commonly diagnosed comorbid conditions were diabetes (27%) and cardiovascular-related diseases (24%). Few patients were affected by other comorbid conditions (Table 7). The correlation matrix between independent variables suggested that there was no unanticipated impact of multicollinearity (results not shown).

There were no significant racial differences in receipt of quality CRC care in the VA (Table 8 and Table 9). In these data, race was not associated with receipt of guideline concordant care for the examined quality indicators.

Compared to patients 75 years or older at diagnosis, patients aged 55—64 years at diagnosis had marginally greater odds of having a preoperative CT scan (OR 1.51, 95% CI 1.11-2.05). Similarly, compared to patients age 75 years or older, younger patients had greater odds of a medical oncology referral (under 55 years, OR 2.45, 95% CI 1.42-4.23; 55 years to 64 years, OR 1.89, 95% 1.34-2.65; 65 years to 74 years, OR 1.66, 95% CI 1.18-2.35) (Table 8). Patients who were 65 years to 74 years old had greater odds of receiving surveillance colonoscopy than patients who were 75 years or older (OR 1.47, 95% CI 1.14-1.89) (Table 9). For the remaining quality measures there were no associations between age at diagnosis and receipt of guideline-concordant care.

For the majority of quality indicators, there was no association between presence of an individual comorbid condition and receipt of guideline-concordant care. Patients with cardiovascular-related comorbidities had marginally lower odds of referral to a medical oncologist (OR 0.65, 95% CI 0.50-0.89) than patients without cardiovascular conditions (Table 8).

Limited associations between stage and receipt of guideline-concordant care may be reflective of severity of disease. Patients with Stage III disease had lower odds of having clear surgical margins (OR 0.44, 95% CI 0.31-0.62) than those with Stage II disease (Table 8). Additionally, patients with Stage III disease had increased odds of referral to medical oncology (OR 2.70, 95% CI 2.03-3.60) compared to those with Stage II disease (Table 8). Odds of receiving surveillance colonoscopy were lower among patients with Stage I disease (OR 0.71, 95% CI 0.56-0.90) compared to Stage II (Table 9).

DISCUSSION

Prior to 1995, VA care was criticized for its overall organization and management and providing poor quality of care. Gardner, 1998; Perlin, 2006). In 1995 the VA began a system-wide transformational redesign with emphasis on using information technology, measuring and reporting quality performance, and integrating services across medical specialties (Anderson, 2005; Eisen & Francis, 2010; Jackson & Weinberger, 2009; Jha et al., 2003). More recent reports suggest that the VA is now a leader in information technology and the delivery of high-quality care (Asch et al., 2004; Jackson, Melton, et al., 2010; Jha et al., 2003; Keating et al., 2011). The question that we address is whether this transformation in overall quality also reduced racial disparities in the guideline-concordant CRC care.

We found a lack of evidence of racial disparities in receipt of guideline-concordant CRC care. The lack of evidence of racial disparity contrasts with numerous prior studies in non-federal hospitals that observed racial differences in receipt of CRC care, for example, in receipt of screening colonoscopies (Benarroch-

Gampel et al., 2012; Rich, Kuyateh, Dwyer, Groves, & Steinberger, 2011; White, Vernon, Franzini, & Du, 2011). However, there is a dearth of information about racial differences in receipt of surveillance colonoscopy following surgical resection. Our study found no racial differences for surveillance colonoscopy.

Colonoscopy is not without risks; differences in receipt of surveillance colonoscopy based on stage and age at diagnosis may be appropriate. There is evidence that intensive post-surgery surveillance can increase survival (Figueredo et al., 2003; Jeffery, Hickey, & Hider, 2002; Renehan, Egger, Saunders, & O'Dwyer, 2002), but a direct clinical benefit for surveillance colonoscopy alone has not been established. Despite this, clinical guidelines assert that surveillance colonoscopy is an important component of guideline-concordant surveillance for CRC patients (Desch et al., 2005; National Comprehensive Cancer Network, 2003a, 2003b).

Studies from the Surveillance Epidemiology and End Results-Medicare registry found differences in oncologist evaluation rates between Caucasian and African American patients, but the gap decreased substantially over time. Moreover, contingent on consulting with a medical oncologist, there were no racial differences in receipt of treatment (Davidoff et al., 2009). However, there are differences based on age at diagnosis. Clinical trials generally do not enroll elderly people. As a result, the clinical benefit of adjuvant chemotherapy on older people has not been tested extensively in a trial setting and older patients often do not receive 5-FU–based chemotherapy in the private healthcare setting (Ades, 2009). Regarding race, there is evidence that the clinical benefit of 5-FU may be lower for African American patients than for Caucasian patients (Jessup et al., 2005; Yothers et al., 2011).

In our analysis, age and stage at diagnosis were associated with referral to a medical oncologist. The difference in stage, where patients with Stage III disease have greater odds of referral than patients with Stage II disease, is likely clinically appropriate. Our study sample was diagnosed in 2003—2006. At the time that these patients received treatment, chemotherapy for patients with Stage II disease was somewhat controversial. This association may reflect clinicians' knowledge of clinical practice guidelines. However, differences in referral patterns based on stage, age, and specific cancer type (e.g., colon, rectal) need to be examined further. We found no association between race and referral to medical oncology. Referral to a medical oncologist typically precedes receipt of chemotherapy. In this VA population, we also found no association between race or age and receipt of 5-FU—based chemotherapy.

We found differences in receipt of care based on the presence of specific comorbid conditions, specifically; patients with cardiovascular conditions were less likely to be referred to a medical oncologist. This may be related to contraindications for chemotherapy use in those with cardiovascular conditions. The clinical appropriateness of this was not addressed in our study.

There are several limitations to this study. First, we were unable to control for potentially confounding socio-demographic status (e.g., annual household income, level of education), which may affect the relationship between race and quality of care. This potential omission bias is likely mitigated because VA patients receive care on a sliding fee scale based on their ability to pay, as evaluated by a financial needs assessment, and by their service-connected status (e.g., any physical or

mental military service—related injuries, illnesses, or traumas) (Veterans Affairs, 2011). Nearly one-half of VA patients have family incomes of less than $20,000 (Agha et al., 2000). Second, we did not have information regarding Hispanic ethnicity. Third, data were abstracted from VA electronic medical record and administrative data; we lacked data on care outside of the VA healthcare system or care not documented in the available data sources. Our results are based on a modest sample size. Moreover, although we examined the potential associations between race and receipt of quality VA CRC cancer, we could not address possible reasons for the VA's lack of disparities. The VA strives to be an equal-access system, which may be one reason for the success in this area. Other reports have hypothesized that this is a potential reason for reduced levels of healthcare disparities in the VA (Dominitz et al., 1998; Jackson, Powell, et al., 2010; Page & Kuntz, 1980). Generalizability of findings has been questioned in studies of VA populations; however, it is notable that our sample population is of similar age (e.g., 68 years in our sample, 69 nationally) and stage distribution to that of the United States male colon cancer population.

Table 7.

Description of CRC Patient Cohort and Key Variables. (n=2,022)

	n	Percent
Dependent variables		
CT scan	1022	72.48
Preoperative CEA	1175	83.33
Clear surgical margins	1155	87.83
Referral to a medical oncologist	1103	78.23
Adjuvant 5-FU chemotherapy	487	74.58
Surveillance colonoscopy	2022	43.31
Independent variable		
Caucasian race	1712	84.67
Other control variables		
Age at Diagnosis		
<55 years	180	8.90
55-64 years	615	30.42
65-74 years	576	28.49
75+ years	651	32.20
Married	1045	51.68
Region		
South	760	37.59
North	386	19.09
Central	451	22.30
West	425	21.02
Stage at Diagnosis		
Stage I	612	30.27
Stage II	757	37.44
Stage III	653	32.29
Individual Comorbid Conditions		
Liver disease	11	0.54
Rheumatoid disease or AIDS	23	1.14
Renal disease	53	2.62
Dementia or paralysis	5	0.25
CHF, acute MI, CVD, or COPD	485	23.99
Diabetes	541	26.76

In summary, we observed no evidence of racial disparities in receipt of quality

CRC care provided by the VA healthcare system. As other clinical programs within

the VA seek to strengthen or refine their approach to quality management and

improvement, they may evaluate the lessons that can be learned from successful

colorectal cancer programs and specific changes such as electronic reminder systems, multidisciplinary collaborative improvement groups, and electronic tools for quality monitoring. Given that the VA treats 3% of newly diagnosed cancers annually (Zullig et al., 2012) it is plausible that the benefit of widespread quality improvement within the VA would influence the landscape of cancer care and outcomes nationally. Moreover, other healthcare systems could also consider aspects of VA care that could be translatable to reduce racial disparities in cancer care. Future studies with larger sample sizes are needed to examine causal pathways for the VA's equal, quality care and ways to translate the VA's success into other hospital systems.

TABLE 8.

Multivariable logistic regression results for measures involving Stage II and III CRC patients.

	Preoperative CT Scan			Preoperative CEA			Clear Surgical Margins			Referral to Medical Oncologist		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Demographic Characteristics												
Caucasian	1.22	0.88-1.70	0.23	1.17	0.80-1.72	0.41	0.71	0.43-1.19	0.19	1.46	1.00-2.13	0.05
Married	0.82	0.64-1.04	0.11	1.13	0.84-1.50	0.42	1.02	0.73-1.44	0.90	0.85	0.64-1.11	0.23
Age at Diagnosis												
<55 years	1.03	0.67-1.58	0.88	1.04	0.62-1.80	0.87	0.70	0.39-1.25	0.23	2.45	1.42-4.23	<0.01*
55-64 years	1.51	1.11-2.05	0.01	1.33	0.91-1.93	0.14	0.90	0.58-1.38	0.62	1.89	1.34-2.65	<0.01*
65-74 years	1.20	0.59-1.63	0.24	0.87	0.61-1.24	0.44	1.00	0.63-1.60	1.00	1.66	1.18-2.35	<0.01*
75+ years (referent)												
Region												
North	1.71	1.20-2.43	<0.01*	1.32	0.88-1.98	0.18	2.25	1.22-4.14	0.01	3.22	1.96-5.30	<0.01*
Central	1.91	1.37-2.67	<0.01*	0.98	0.69-1.41	0.93	0.93	0.60-1.43	0.73	1.25	0.86-1.82	0.23
West	1.21	0.88-1.66	0.24	2.88	1.79-4.64	<0.01*	0.85	0.55-1.31	0.46	0.42	0.30-0.58	<0.01*
South (referent)												
Comorbid Conditions												
Liver disease	1.15	0.23-5.82	0.86	0.37	0.08-1.61	0.18	0.47	0.09-2.48	0.38	0.78	0.14-4.34	0.78
Rheumatoid disease or AIDS	0.99	0.34-2.91	0.99	0.63	0.20-1.99	0.43	--	--	--	1.53	0.42-5.59	0.52
Renal disease	0.60	0.30-1.24	0.17	3.43	0.80-14.65	0.10	1.80	0.41-7.85	0.43	1.08	0.46-2.54	0.85
Dementia or paralysis	0.67	0.11-4.20	0.67	0.13	0.02-0.83	0.03	0.18	0.03-1.15	0.07	1.27	0.13-12.15	0.84
CHF, acute MI, CVD, or COPD	0.82	0.63-1.09	0.19	0.96	0.69-1.35	0.82	0.86	0.58-1.29	0.47	0.65	0.50-0.89	0.01
Diabetes	0.93	0.71-1.23	0.62	1.03	0.73-1.43	0.88	1.20	0.80-1.80	0.38	1.02	0.74-1.40	0.90
Stage at Diagnosis												
Stage III	1.06	0.83-1.35	0.63	1.04	0.78-1.38	0.81	0.44	0.31-0.62	<0.01*	2.70	2.03-3.60	<0.01*
Stage II (referent)												
N	1410			1410			1393			1410		

--Due to perfect prediction between the Rheumatoid disease or AIDS variable and the dependent variable, 17 observations were dropped from the regression model.

*Indicates statistical significance at the <0.01 alpha level. We utilized the Bonferroni adjustment for multiple comparisons of independent variables, controlling for familywise error (e.g., Type I error, the probability of making a false discovery).

Table 9.

Multivariate Logistic Regression Results for Receipt of Adjuvant 5-FU–based Chemotherapy and Surveillance Colonoscopy.

Adjuvant 5-FU Chemotherapy†				Surveillance Colonoscopy			
	OR	95% CI	p		OR	95% CI	p
Demographic Characteristics				**Demographic Characteristics**			
Caucasian race	1.23	0.77-1.97	0.40	Caucasian race	1.32	1.01-1.73	0.04
Married	1.30	0.90-1.88	0.16	Married	1.00	0.82-1.22	1.00
Age at Diagnosis				**Age at Diagnosis**			
<55 years	1.70	0.86-3.38	0.13	<55 years	1.12	0.77-1.62	0.55
55-64 years	1.03	0.65-1.62	0.91	55-64 years	1.20	0.93-1.53	0.16
65-74 years	1.15	0.71-1.87	0.57	65-74 years	1.47	1.14-1.89	<0.01*
75+ years (referent)				75+ years (referent)			
Region				**Region**			
North	1.75	1.00-3.07	0.05	North	1.28	0.96-1.71	0.09
Central	1.52	0.95-2.42	0.08	Central	0.84	0.65-1.08	0.18
West	1.30	0.79-2.14	0.31	West	1.01	0.77-1.33	0.93
South (referent)				South (referent)			
Comorbid Conditions				**Comorbid Conditions**			
Liver disease	0.28	0.04-2.11	0.22	Liver disease	--	--	--
Rheumatoid disease or AIDS	1.11	0.20-6.17	0.90	Rheumatoid disease or AIDS	1.00	0.40-2.46	0.99
Renal disease	0.68	0.22-2.14	0.51	Renal disease	0.87	0.49-1.56	0.65
Dementia or paralysis	0.17	0.01-2.03	0.16	Dementia or paralysis	--	--	--
CHF, acute MI, CVD, or COPD	0.82	0.53-1.25	0.35	CHF, acute MI, CVD, or COPD	0.84	0.67-1.06	0.14
Diabetes	0.84	0.56-1.26	0.40	Diabetes	0.86	0.69-1.08	0.20
				Stage at Diagnosis			
				Stage I	0.71	0.56-0.90	<0.01*
				Stage II (referent)			
				Stage III	0.97	0.77-1.24	0.83
N	653			N	2006		

†Stage is not included as a covariate in the regression model examining adjuvant 5-FU–based chemotherapy. This is because only patients with Stage III CRC were included per NCCN guidelines.
--Due to perfect prediction between liver disease and the dependent variable, 11 observations were dropped from the regression model; due to perfect prediction with dementia or paralysis, 5 observations were dropped.
*Indicates statistical significance at the <0.01 alpha level. We used the Bonferroni adjustment for multiple comparisons of independent variables, controlling for family-wise error (e.g., Type I error, the probability of making a false discovery).

CHAPTER 5: RELATIONSHIP BETWEEN RACE AND TIMELINESS OF COLORECTAL CANCER CARE IN THE VETERANS AFFAIRS HEALTHCARE SYSTEM

OVERVIEW

Veterans Affairs (VA) manages the largest United States integrated healthcare system. Although quality of VA colorectal cancer (CRC) care is well chronicled, there is a paucity of research examining racial differences in VA CRC care. This study examines racial differences in two dimensions of quality of VA CRC care: processes (time to treatment) and outcomes (survival).

Retrospective data were from the VA EPRP, a nationwide VA quality-monitoring program. Study patients were Caucasian and African American men diagnosed with non-metastatic CRC between 2003 and 2006 and received definitive CRC surgery. We examined three quality indicators—time from: 1) surgery to initiation of adjuvant chemotherapy (Stage II-III); 2) surgery to surveillance colonoscopy (Stage I-III); and 3) surgery to death (Stage I-III). Unadjusted analyses used Log-rank and Wilcoxon tests. Adjusted analyses used Cox proportional hazard models.

In unadjusted analyses, there was no evidence of racial differences across the three quality measures. In adjusted Cox regression there were no racial differences in time to initiation of chemotherapy (HR 0.82, p=0.61) or surgery to death (HR 0.94, p=0.49). In adjusted Cox regression, Caucasian patients experienced slightly shorter median times to surveillance colonoscopy than African

American patients (367 versus 383 days, HR 0.63, p=0.02). Other than a small racial difference in timing of surveillance colonoscopy, there was little evidence of racial differences in quality of CRC care among VA healthcare system users.

INTRODUCTION

The Department of Veterans Affairs (VA) manages the largest integrated healthcare system in the United States, treating approximately 3% of patients with cancer (Zullig et al., 2012). Since its national reorganization and transformation in the mid-1990s (Kizer & Dudley, 2009), the VA has been a leader in providing high-quality, equitable care. The quality of cancer care provided in the VA has been extensively examined, with the VA generally performing equal to or better than the private sector (Keating et al., 2011; Landrum, Keating, Lamont, Bozeman, Krasnow, et al., 2012). Quality of colorectal cancer (CRC) care in particular has been lauded as an area in which the VA provides excellent care (Keating et al., 2011; Landrum, Keating, Lamont, Bozeman, Krasnow, et al., 2012). In addition to providing quality care overall, there is evidence that racial disparities in CRC care quality may be less significant in the VA compared with non-federal healthcare systems (Alexander et al., 2007; Dominitz et al., 1998; Landrum, Keating, Lamont, Bozeman, & McNeil, 2012).

An important process measure reflecting quality care is timeliness in receiving evidence-based treatments. The VA has longstanding processes for quality monitoring and performance improvement, focused on achieving guideline-concordant clinical care, which may support its success as a leader in provision of quality care (Francis & Perlin, 2006; McQueen et al., 2004; Trivedi & Grebla, 2011;

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Trivedi et al., 2011). There is a system-wide emphasis on adhering to guidelines based on strong scientific and clinical evidence. However, standards for timeliness of care are largely consensus-based. Perhaps as a result, timeliness standards have not been widely implemented in the VA or other large, integrated healthcare systems. The VA has evaluated several CRC interventions and collaborative efforts to address delays in diagnosis and follow-up on positive screening tests (Fisher et al., 2010; Partin, Powell, Nugent, & Ordin, 2011; Powell, Gravely, Ordin, Schlosser, & Partin, 2009). Less attention has been focused on timeliness of care during CRC treatment and early surveillance phases.

Survival can be considered an outcome measure of quality. Although several studies examining survival have produced mixed results about the presence of racial differences (Dominitz, Maynard, Billingsley, & Boyko, 2002; Dominitz et al., 1998; Robinson et al., 2010), there is a paucity of literature describing racial differences in timeliness of VA CRC care. Landrum and colleagues compared cancer-specific and all-cause mortality rates for men older than 65 years receiving care in the VA versus fee-for-service Medicare. Compared with similar fee-for-service Medicare patients, survival rates for VA users with CRC were equal or better (Landrum, Keating, Lamont, Bozeman, Krasnow, et al., 2012). In the 1990s, Dominitz and colleagues examined potential racial differences in CRC survival rates, finding similar relative five-year survival rates for African American and Caucasian CRC patients seeking care in the VA healthcare system (Dominitz et al., 1998). Jackson and colleagues examined the timeliness of treatment for non-metastatic CRC patients in the VA healthcare system. For patients with Stage II and III disease, they found a median of

twenty days between diagnosis and initiation of CRC treatment. There was a median of fifty days between definitive surgical resection and start of adjuvant chemotherapy (Jackson, Melton, et al., 2010). The authors did not examine patient or disease characteristics associated with timeliness of care.

We expand previous work by examining racial differences in two dimensions of quality of VA CRC care: processes (time to treatment) and outcomes (survival).

METHODS

Data Source and Patient Sample

The VA EPRP, the national program for assessing quality of VA healthcare, was the primary data source (Kussman, 2008). In 2007, the VA Office of Quality and Performance oversaw a national medical record abstraction effort to assess the quality of CRC care. Abstractors accessed the electronic health record remotely, collecting data on disease characteristics and healthcare delivery provided to patients throughout the VA healthcare system. We augmented EPRP data with clinical comorbidity and demographic information contained in the VACCR and administrative data (specifically inpatient and outpatient Medical SAS files).

The sample has previously been described in detail (Jackson, Melton, et al., 2010). Succinctly, patients were identified for inclusion in EPRP based on a search algorithm that defined a representative sample of VA patients diagnosed with CRC between October 1, 2003, and March 31, 2006. The algorithm made use of administrative diagnosis, procedure, and encounter data stored in the centralized VA Decision Support System (Hynes et al., 2004; Jackson, Melton, et al., 2010). Eligible patients had an ICD-9 code for colon and/or rectal cancer within three months

(before or after) the study diagnosis time period (AHRQ, 2012). Eligible patients

must also have had a clinic visit, surgical procedure, or pathology report in the VA

that corresponded to receipt of medical services within the aforementioned

timeframe. The final analytic data set included patients with: non-metastatic CRC

(Stages I to III); an incident occurrence (first diagnosis of CRC occurred during the

study time period); receipt of definitive surgical resection for CRC; and a successful

link with information from VA administrative data sources. Because of the small

number of non-African American minorities and females, analyses were restricted to

Caucasian and African American male patients (Figure 5). We did not have

information regarding Hispanic ethnicity.

Measures

We examined three stage-specific quality metrics for CRC care: 1) time from

definitive CRC surgical resection to initiation of 5-FU-based adjuvant (e.g., post-

operative) chemotherapy (Stage II or III) (Biagi et al., 2011), 2) time from definitive

surgical resection to receipt of surveillance colonoscopy (Stage I, II, or III) (Desch et

al., 2005; Figueredo et al., 2003; National Comprehensive Cancer Network, 2003a,

2003b; Salz, Woo, Starr, Jandorf, & Duhamel, 2012; Winawer et al., 2003), and 3)

time from definitive CRC surgical resection to death (Stage I, II, or III). The first two

measures reflect process indicators of quality while the third indicator measures

survival as a critical outcome. We also examined whether comorbidities and

demographic factors were mediators of differences in survival and other timeliness

of care events.

The date of surgical resection was used as the anchor date for all three measures for several reasons. First, the date of surgery is a decisive date, unlike the date of diagnosis, which is often difficult to define (e.g., date of positive screening test, date of pathology report, date of physician's suspicion of CRC, etc.). Exploratory analysis of these data confirmed that for many patients the date of surgery preceded the date of diagnosis, likely due to ambiguity about the date of diagnosis. Second, all patients in the sample underwent surgical resection, making it a feasible anchor date. Finally, some patients may have been diagnosed outside of the VA healthcare system but then entered the VA healthcare system for their cancer care. Using the surgery date as the index enables a better examination of processes of care within the VA.

Additional inclusion and exclusion criteria were applied for each of the three quality measures. For surveillance colonoscopy, patients must have survived at least one-year post-surgery to be included in analysis. Most clinical guidelines during this time period, including NCCN (National Comprehensive Cancer Network, 2003a, 2003b) and the American Cancer Society (Rex et al., 2006), recommended a surveillance colonoscopy at one-year post-surgery. We limited surveillance colonoscopies to those occurring within seven to eighteen months post-surgery because colonoscopies occurring prior to seven months post-surgery might be diagnostic; the maximum of eighteen months reflects pragmatic challenges to receiving this test within the recommended twelve months (e.g., scheduling challenges, patient preference). For each of the three quality indicators, we calculated the number of days between the surgery date and the date of the event.

Covariates, identified a priori, included patient characteristics associated with timeliness of cancer care (Cooper, Kou, & Reynolds, 2008; Long et al., 2012; Salz et al., 2010). We considered both demographic (age at diagnosis, marital status, geographic region) and disease (stage at diagnosis, comorbidity) characteristics. The comorbidity measure was the NCI Combined Comorbidity score, created from inpatient and outpatient medical record data from one year prior to CRC diagnosis until one month prior to diagnosis. This weighted comorbidity score has previously been validated among a CRC cohort (Klabunde et al., 2007).

Statistical Analysis

Multicollinearity between the covariates was examined as part of a previous analysis and no collinearity was identified. We used the Kaplan-Meier method to estimate time-to-event curves. To compare differences in unadjusted survival curves, we used the Log-rank and Wilcoxon tests. Multivariate Cox proportional hazards models were employed to assess the prognostic power of race for time-to-event in the presence of the aforementioned covariates. The Efron method was used to handle ties (Cleves et al., 2010; Kleinbaum, 1996). Data management and analyses were conducted in Stata 11 (StataCorp LP, College Station, TX) and SAS version 9.2 (SAS Institute, Cary, NC).

RESULTS

The final sample consisted of 2,022 men who met eligibility criteria (Figure 5). Reflecting the overall VA patient population, the sample had a mean age at diagnosis of 68 years. The majority of patients were Caucasian (85%), married (52%), and lived in the South (38%). Stage was approximately evenly distributed.

The mean NCI combined comorbidity index score was 0.27 (Table 10). The most commonly diagnosed individual comorbid conditions were diabetes (27%) and cardiovascular-related diseases (24%) (results not shown).

Across the sample, the median time from surgery to initiation of adjuvant 5-FU–based chemotherapy was forty-nine days; medians were not statistically different for African American and Caucasian patients (55 versus 49 days, respectively; p=0.71). In unadjusted analyses, there were no statistically significant racial differences in time-to-event curves for surgery to initiation of adjuvant 5-FU–based chemotherapy (Wilcoxon p=0.78; Log-rank p=0.10). Similarly, in adjusted multivariable Cox regression, race was not associated with time from surgery to start of adjuvant 5-FU–based chemotherapy (HR=0.82, p=0.61). The region in which patients received care was significant. Compared to those living in the South, patients living in the North (HR=0.06, p=0.01) and Central (HR=0.33, p=0.04) regions had shorter times from surgery to chemotherapy. Small sample sizes did not permit us to explore race by region interactions.

When examining colonoscopies occurring within seven to eighteen months following surgical resection, the median time from surgery to first surveillance colonoscopy was 367 days. Unadjusted analyses found no statically significant differences in medians between African American and Caucasian patients (374 versus 367 days, p=0.10) or in time-to-event curves for time from surgery to first surveillance colonoscopy (Wilcoxon p=0.23; Log-rank p=0.05). In adjusted multivariable regression analyses, a racial difference in time to receipt of first surveillance colonoscopy was suggested. Caucasian race was protective for shorter

time to surveillance colonoscopy (HR=0.63, p=0.02; Table 11). Though the association was statistically significant, the magnitude of the difference is small (16 days) and not likely clinically meaningful. Compared to patients living in the South, those living in the Central region (HR=1.84, p=0.00) had longer times from surgery to colonoscopy. Compared to patients aged 75 or older, patients (HR=1.60, p=0.04) aged 65–74 years had slightly longer times to colonoscopy.

Across the sample, the median time from surgery to death was 1,053 days, and the unadjusted difference was similar for African American and Caucasian patients (1,050 versus 1,062 days, respectively; p=0.04). In unadjusted analyses, there were no statistically significant racial differences in time-to-event curves in time from surgery to death (Wilcoxon p=0.32; Log-rank p=0.33).

Similarly, in adjusted multivariable Cox regression, race was not associated with time from surgery to death (HR=0.94, p=0.49). Notably, several covariates were significant. Patients aged 55 years or younger had a lower hazard of death compared to patients 75 years or older (HR=0.76, p=0.04). Compared to patients with Stage II disease, those with Stage I disease had reduced hazards of death (HR=0.83, p=0.04) and those with Stage III disease had increased hazards of death (HR=1.32, p=0.00), which would be expected based on known clinical outcomes for cancer stage (Table 11).

DISCUSSION

We examined whether racial differences existed in the quality of CRC care delivered by the VA, the largest integrated health care system in the United States. Using two stage-specific, evidence-based process measures (time to adjuvant

chemotherapy and time to colonoscopy) and patient outcome (survival following surgery), we found no meaningful racial disparities with respect to these three quality measures. These findings support the perception of the VA as an "equal access system" committed to the provision of quality, timely CRC care (Kizer & Dudley, 2009; Perlin et al., 2004; Robinson et al., 2010).

The first process quality measure examined was time from surgery to initiation of 5-FU–based adjuvant chemotherapy. Consistent with previous literature, we found that the VA provides racially equal care on this metric (Dominitz et al., 1998). We identified possible geographic variations in care. Due to the sample size, this analysis aggregated regional data at a relatively high level (e.g., four geographic regions nationwide). Based on these data, we do not know whether patients of different race who are receiving healthcare in the VA system disproportionately live in specific geographic regions. It is possible that these regional differences confound the ability to accurately assess racial differences. Future analyses could further investigate this phenomenon using more granular regional data.

In our analyses, potential racial differences were only identified for one process measure—receipt of surveillance colonoscopy. The difference in elapsed time to colonoscopy between the two groups (approximately sixteen days on average) is small and the clinical significance of this difference is likely minimal. To ensure that this gap does not widen, additional research is needed to understand underlying mechanisms creating this time difference. Though not the focus of our analyses, there is nearly universal evidence that CRC survivors receive inadequate colonoscopic surveillance. The under-provision of surveillance colonoscopy has

been documented among Medicare users, population-based patient samples, and among users of the VA healthcare system (Cooper et al., 2008; Jackson, Melton, et al., 2010; Salz et al., 2010; Salz et al., 2012). Although surveillance colonoscopy is generally under-received, previous studies have suggested patients of Caucasian and African American race receive colonoscopy equitably within the VA healthcare system (Dominitz et al., 1998). This is important contextual information for interpreting our study findings. This finding is consistent with previous studies on the subject. A recent systematic literature review by Salz and colleagues examined differences in timeliness of colonoscopy use among CRC survivors receiving care at multiple types of healthcare institutions (Salz et al., 2012). The authors identified eight studies addressing racial differences in time to colonoscopy. Half of the articles described a small but significant racial difference in receipt of timely colonoscopy; the remaining half showed a non-significant trend in the same direction (Salz et al., 2012). There is no scientific evidence suggesting that a narrow difference in time (e.g., sixteen days on average) would impact care quality or patient outcome. There were also differences in age at diagnosis and receipt of surveillance colonoscopy, where older people were less likely to receive a timely colonoscopy than their younger counterparts. This is as anticipated. Increasing age is often associated with decreased performance status and increased comorbidity burden. Therefore, it is possible that few patients aged 75 or older would be expected to receive surveillance colonoscopy and, for those that do receive surveillance colonoscopy, the timeline may be extended.

As an outcome of care quality, we examined post-surgical survival times and identified similar times among different racial groups. In non-federal healthcare settings, including integrated systems serving Medicare patients, there have been mixed findings regarding racial differences in CRC survival (Bradley et al., 2001; Dominitz et al., 1998; Pulte et al., 2012; Rabeneck et al., 2003). Our finding of similar post-surgical survival rates between Caucasian and African American patients may suggest that the VA provides similar processes of quality care to patients throughout their disease trajectory translating into comparable survival times. This hypothesis is supported by existing literature (Jackson, Melton, et al., 2010; Rabeneck et al., 2003).

This analysis has several limitations. First, veterans who receive care through the VA healthcare system have greater comorbidity than the general population (Agha et al., 2000). We adjusted for comorbidity, but some patients may have appropriately not received care (e.g., too frail to undergo colonoscopy). Our analysis was limited to care received in the VA. Some patients receiving care in the VA healthcare system may also receive a portion of their cancer care elsewhere. Future research should endeavor to include information from multiple data sources.

Despite these limitations, our analysis provided important insight into the quality and timeliness of VA CRC care. We assessed key process and outcome measures of care quality and observed no evidence of clinically meaningful racial differences in timeliness of CRC care provided by the VA healthcare system. This may be a testament to the VA's history as an "equal access system" (Kizer &

Dudley, 2009; Perlin et al., 2004; Robinson et al., 2010) and its established

commitment to ongoing quality monitoring and improvement.

Table 10.

Description of CRC Patient Cohort and Key Variables.

	Caucasian Patients (n=1,712)	African American Patients (n=310)	Full Sample (n=2,022)
	% (n) or Mean (SD)	**% (n) or Mean (SD)**	**% (n) or Mean (SD)**
Dependent variables			
Days from surgery to adjuvant 5-FU chemotherapy	63.5 (55.1)	65.6 (45.6)	63.8 (53.6)
Days from surgery to surveillance colonoscopy	375.9 (77.2)	376.4 (78.6)	376.0 (77.3)
Days from surgery to death	1,136.6 (730.4)	988.0 (1,258.6)	1,112.9 (838.1)
Independent variable			
Caucasian race	100% (1,712)	0% (0)	84.7% (1,712)
Other control variables			
Age at Diagnosis			
<55 years	8.1% (138)	13.6% (42)	8.9% (180)
55-64 years	30.5% (522)	30.0% (93)	30.4% (615)
65-74 years	28.7% (492)	27.1% (84)	28.5% (576)
75+ years	32.7% (560)	29.4% (91)	32.2% (651)
Married	53.9% (922)	39.7% (123)	51.7% (1,045)
Region			
South	34.2% (586)	56.1% (174)	37.6% (760)
North	19.7% (337)	15.8% (49)	19.1% (386)
Central	22.7% (388)	20.3% (63)	22.3% (451)
West	23.4% (401)	7.8% (24)	21.0% (425)
Stage at Diagnosis			
Stage I	30.3% (518)	30.3% (94)	30.3% (612)
Stage II	38.4% (657)	32.3% (100)	37.4% (757)
Stage III	31.4% (537)	37.4% (116)	32.3% (653)
NCI Combined Comorbidity Score	0.28 (0.43)	0.25 (0.40)	0.27 (0.43)

[1]Descriptive analysis is limited to surveillance colonoscopies occurring within 7 to 18 months after surgery. The sample size is larger in the Cox regression models because colonoscopies occurring outside of this time window are included as failures.

Table 11.

Cox Proportional Hazard Model Regression Results.

	Surgery to Chemotherapy[1]			Surgery to Colonoscopy[2]			Surgery to Death[3]		
	HR	95%CI	p	HR	95%CI	p	HR	95%CI	p
Demographic Characteristics									
Caucasian	0.82	0.38-1.76	0.61	0.63	0.43-0.94	0.02*	0.94	0.79-1.12	0.49
Married	0.70	0.35-1.39	0.30	1.28	0.91-1.78	0.15	0.97	0.86-1.10	0.66
Age at Diagnosis									
<55 yrs	2.78	0.71-10.94	0.14	1.58	0.89-2.81	0.12	0.76	0.56-0.99	0.04*
55-64 yrs	2.36	0.66-8.36	0.18	1.28	0.82-1.99	0.27	0.99	0.84-1.18	0.96
65-74 yrs	1.76	0.46-6.70	0.41	1.60	1.03-2.47	0.04*	0.90	0.77-1.06	0.21
75+ yrs (ref)									
Region									
North	0.06	0.01-0.49	0.01*	0.90	0.56-1.44	0.65	1.10	0.92-1.33	0.29
Central	0.33	0.11-0.97	0.04*	1.84	1.23-2.76	0.00*	0.99	0.84-1.18	0.96
West	0.39	0.15-0.99	0.05	1.13	0.68-1.87	0.64	1.02	0.86-1.21	0.85
South (ref)									
NCI Combined Comorbidity Score									
	1.69	0.68-4.19	0.26	1.44	0.92-2.26	0.11	1.01	0.89-1.15	0.83
Stage at Diagnosis									
Stage I	--	--	--	1.17	0.81-1.69	0.41	0.84	0.71-0.99	0.04*
Stage II (ref)									
Stage III	--	--	--	0.85	0.55-1.32	0.48	1.32	1.13-1.53	0.00*
N	632			1,083			991		

1-This measure was time from definitive surgical resection to initiation of 5-FU-based chemotherapy (Stage II-III).
2-This measure was time from surgery to receipt of surveillance colonoscopy within 7-18 months (Stage I-III).
3-This measure was time from surgery to death (Stage I-III).
* Indicates statistical significance at the <0.05 alpha level.
--Indicates that stage was not included in the surgery to chemotherapy timeliness measure because analysis was limited to patients with Stage II and III disease.

CHAPTER 6: THE ASSOCIATION OF RACE WITH TIMELINESS OF CARE AND SURVIVAL AMONG VETERANS AFFAIRS HEALTHCARE SYSTEM PATIENTS WITH LATE-STAGE NON-SMALL CELL LUNG CANCER

OVERVIEW

NSCLC is the leading cause of cancer-related mortality in the United States. Patients with late-stage disease (Stage III/IV) have five-year survival rates of 2–15%. Care quality may be measured as time to receiving recommended care and, ultimately, survival. This study examined the association between race and receipt of timely NSCLC care and survival among Veterans Affairs (VA) healthcare system patients.

Data were from a nationwide VA quality-monitoring program. We included Caucasian or African American (AA) patients diagnosed with pathologically confirmed late-stage NSCLC in 2006 and 2007. We examined three quality measures—time from diagnosis to: 1) treatment initiation, 2) palliative care or hospice referral, and 3) death. Unadjusted analyses used Log-rank and Wilcoxon tests. Adjusted analyses used Cox proportional hazard models.

After controlling for patient and disease characteristics using Cox regression, there were no racial differences in time to initiation of treatment (72 for AA versus 65 days for Caucasian patients, HR 1.03, p=0.80) or palliative care or hospice referral (129 versus 116 days, HR 1.10, p=0.34). However, our adjusted model found longer

survival for African American patients than for Caucasian patients (133 versus 117 days, HR 1.31, p=0.00).

For process measures of care quality such as time to initiation of treatment and referral to supportive care, the VA provides racially equitable care. The small racial difference in survival time of approximately two weeks is not clinically meaningful. Future work should validate this possible trend prospectively, with longer periods of follow-up, in other veteran groups.

INTRODUCTION

Lung cancer is the leading cause of cancer-related death, accounting for 29% of all cancer-related deaths among men (Siegel et al., 2012). NSCLC is responsible for approximately 85% of lung cancers (American Cancer Society, 2013). NSCLC has a dismal prognosis with five-year survival rates ranging from 49% for patients with Stage IA of the disease to approximately 1% for those with Stage IV (American Cancer Society, 2013). Because survival rates are poor, the goal of much therapy for late-stage NSCLC patients is palliative, often focusing on formal referrals to palliative care and/or hospice services. For patients with the late-stage disease recommended treatment ranges from chemotherapy and radiation with or without surgery (Stage IIIA), to chemotherapy and radiation without surgery or chemotherapy alone (Stage IIIB), to chemotherapy alone for patients with metastatic disease (Stage IV) (Cooper et al., 2002; Pfister et al., 2004).

There is a clear link between quality of care and patient outcomes. Receipt of timely, stage-appropriate care for NSCLC patients can increase the length of survival (Hardy et al., 2009). Despite the IOM prioritizing the receipt of timely

treatment as a measure of quality (Institute of Medicine, 2001), many studies have identified differences in care quality among NSCLC patients of diverse races that may contribute to racial differences in outcomes (Olsson et al., 2009). In fact, there is evidence of racial disparities in care quality measures throughout the NSCLC treatment trajectory. Proper staging is essential for effective treatment planning, yet there are racial differences in receipt of positron emission tomography (PET) imaging to accurately stage patients (Gould et al., 2011). Once a patient has been staged, for those with early stage NSCLC, timely receipt of surgical resection has a critical impact on survival outcomes. Several studies have shown that African American patients are less likely to receive surgical resection than their Caucasian counterparts (Farjah et al., 2009; Margolis et al., 2003). Racial differences also exist in terms of patient treatment refusal rates (Landrum, Keating, Lamont, Bozeman, & McNeil, 2012) appropriateness and timeliness of care among Medicare beneficiaries, and survival (Shugarman et al., 2009). One study found that, relative to Caucasian patients, African American patients were 34% less likely to receive timely surgery, chemotherapy, or radiation for Stage III NSCLC and were 51% less likely to receive chemotherapy in a timely fashion for Stage IV disease (Shugarman et al., 2009).

Although the existence of racial disparities in NSCLC is well documented, the etiology of these racial differences is complex. Reasons include a cumulative effect of both patient and health system factors. Evidence suggests that when patients receive the right care at the right time, there is little racial difference in survival rates. For example, among SEER patients, there was a 3% absolute difference in survival

favoring Caucasian patients over minorities (Morris, Rhoads, Stain, & Birkmeyer, 2010). In an analysis of late-stage NSCLC Medicare beneficiaries, the five-year survival rates for Caucasian and African American patients were 17.7% and 19.6% respectively. After controlling for socioeconomic status, this difference entirely dissipated (Hardy et al., 2009). Similarly, after controlling for receipt of surgery, differences in survival rates for early-stage NSCLC patients were comparable across racial groups (Bach et al., 1999). Similar survival rates by race were found among veterans with early-stage disease who received surgery (Jahanzeb, Virgo, McKirgan, & Johnson, 1997; Williams, Provenzale, Stechuchak, & Kelley, 2012).

The Veterans Affairs (VA), the largest integrated U.S. healthcare system, is reputed as an equal access provider (Kizer & Dudley, 2009). As such, the VA provides an excellent environment in which to study quality of cancer care among patients with NSCLC. We hypothesize that if patients received equitable and timely care, there will subsequently be similar survival rates by race. Focusing on patients with late-stage NSCLC (Stage III and IV), we expand previous work by examining racial differences in two dimensions of quality of VA NSCLC care: processes of care (time to treatment) and outcomes (survival).

METHODS

Data Source

The Veterans Health Administration (VHA) Office of Analytics and Business Intelligence (formerly the Office of Quality and Performance) conducted the EPRP Lung Cancer Special Study to evaluate the quality of lung cancer care provided in the VA. As previously described (Williams, Stechuchak, Zullig, Provenzale, & Kelley,

2012), patients were identified through the VA Central Cancer Registry (Zullig et al., 2012). Patients were eligible for the EPRP study if they were: diagnosed with lung cancer between October 1, 2006, and December 31, 2007; documented pathologic confirmation of lung cancer in the electronic medical record; and survived at least thirty-one days post-diagnosis. Patients were excluded for any of the following reasons: lung cancer diagnosed during autopsy; enrollment in hospice less than thirty-one days post-diagnosis; enrollment into a cancer clinical trial; pre-existing or concurrent diagnosis of metastatic cancer (other than lung cancer), documentation of comfort measures only, or life expectancy of six months or less. Data were manually abstracted from a national electronic medical record by trained abstractors between February 3, 2010, and August 11, 2010.

Measures

The analytic data set consisted of African American and Caucasian patients with pathologically confirmed late-stage (Stage III or Stage IV) NSCLC. We assessed three dependent variables. We included two process measures of care timeliness: 1) time from diagnosis to initiation of treatment (surgery, chemotherapy, radiation therapy, or admission into palliative care or hospice); and 2) time from diagnosis to referral to palliative care or hospice. The third measure was time from diagnosis to death. Death information was obtained during data abstraction, approximately two years from diagnosis. For all measures, time was expressed as the number of days between events.

The primary independent variable of interest was patients' race. Because there were relatively few non–African American minority patients in the cohort

(n=56), we restricted our analyses to African American and Caucasian patients; we lacked data on Hispanic ethnicity. Covariates included demographic characteristics (age at diagnosis, marital status, and geographic region) and clinical factors (stage at diagnosis and performance status) previously associated with timeliness of care (Pagano et al., 2010; Zheng et al., 2012). Patients were considered to have poor performance status if the medical record contained documentation of any of the following: Eastern Cooperative Oncology Group (ECOG) score greater than two, Karnofsky Performance Status Scale of less than 60%, and/or an Adult Evaluation Comorbidity-27 (ACE-27) score of moderate or severe (2 or 3). Non–African American minority patients, those missing race information, and duplicate records were excluded from the final analytic data set.

Statistical Analysis

The Kaplan-Meier method was used to estimate time-to-event curves. The models did not converge when attempting to control for geographic clustering. We present the racial distribution of key variables (stage at diagnosis, performance stage, age). To compare differences in unadjusted survival curves between African American and Caucasian patients, we used the Log-rank and Wilcoxon tests. Multivariate Cox proportional hazard models were used to examine the association between race and time-to-event after controlling for the previously mentioned covariates. The Efron method was used to handle ties (Cleves et al., 2010; Kleinbaum, 1996). Statistical significance was assessed at a conventional alpha level of ≤ 0.05. Data management and analyses were conducted in Stata 11 (StataCorp LP, College Station, TX) and SAS version 9.2 (SAS Institute, Cary, NC).

RESULTS

Our final analytic sample consisted of 2,200 patients with NSCLC (Figure 6). At the time of diagnosis, 83% were Caucasian; 46% were married; 33% were aged 55–64 years; and 47% lived in the South (Table 1). The majority of patients (89%) were diagnosed with metastatic disease and 65% had documentation of poor performance status. Overall, the mean time from diagnosis to initiation of treatment (defined as first date of chemotherapy, radiation therapy, or admission to palliative care or hospice; patients may have had multiple treatment modalities) was sixty-six days, or approximately two months. When examining racial groups separately, the mean times to initiation of treatment were similar for Caucasian and African American patients (65 versus 71 days, respectively). The mean time between diagnosis and referral to palliative care or hospice was 188 days with Caucasian patients being referred an average of fourteen days earlier (115 days versus 129 days). The mean time from diagnosis to death was approximately 120 days, or four months, with Caucasian patients dying sixteen days sooner than African American patients (117 versus 133 days) (Table 12). Patients were similar by race with regard to stage at diagnosis (p=0.48) and performance status (p=0.85).

Approximately 70% of patients received treatment for their NSCLC. For patients who received treatment, the mean time to initiation of treatment was forty-four days. In unadjusted analysis, there were no racial differences in time to initiation of treatment (Wilcoxon p=0.94; Log-rank p=0.99). After adjustment there remained no association between time to initiation of treatment and race (HR 1.03, p=0.80),

marital status (HR 1.00, p=0.98), age at diagnosis, region, stage at diagnosis (HR 0.87, p=0.47), or performance status (HR 0.81, p=0.09) (Table 12).

Over half (54%, n=1,178) of patients were referred to palliative care or hospice, with referral occurring approximately 118 days after diagnosis. In unadjusted analyses, there were no racial differences in time to palliative care or hospice referral (Wilcoxon p=0.29; Log-rank p=0.57). The lack of association by race remained in the adjusted Cox models (HR 1.10, p=0.34) (Table 13). Compared to patients with Stage IV disease, those with Stage III had approximately a 36% higher hazard of referral (HR 1.37, p=0.00) to palliative care or hospice. Compared to patients with documentation of poor performance status, healthier patients had approximately a 20% reduced hazard of referral (HR 0.81, p=0.01) to palliative care or hospice. There were no other associations between referral and patients' socio-demographic characteristics.

At the time of data collection, approximately 78% of the sample was deceased, with a mean time from diagnosis to death of approximately 120 days or four months. In unadjusted analysis, Caucasians died sooner than African Americans (Wilcoxon p=0.00; Log-rank p<0.01). This finding remained after adjusting for covariates (HR 1.31, p<0.01). Being married (HR 0.89, p=0.02) and under 55 years of age (HR 0.76, p=0.01) were protective against death compared to being unmarried and/or over 75 years old at diagnosis. Geographic region was not associated with time to death. Compared to those with metastatic disease, patients with Stage III disease had approximately a 50% reduced hazard of death (HR 0.53,

p<0.01). Poor performance status was also associated with time to death (HR 0.80, p<0.01) (Table 12).

DISCUSSION

We examined two dimensions of quality of VA NSCLC care: processes of care (time to treatment) and outcomes (survival). Among patients with late-stage NSCLC, we observed no racial differences in processes of care. In fact, there were no significant associations between time from diagnosis to initiation of treatment and any patient-level characteristics. This supports the VA's reputation as an equal access system. The mean time to first treatment that we observed, approximately sixty-six days, is consistent with a previous VA study of advanced NSCLC (Schultz et al., 2009). While some have argued that a two-month delay may negatively effect patients' emotional state (Gould, 2009) there are no formalized guidelines regarding timeliness of treatment for NSCLC. Thus, these findings suggest that the VA provides equitable and timely access to critical health services for patients with late-stage NSCLC.

Palliative care is critical for effective management of pain and other distressing symptoms and is often provided in conjunction with other therapies. Recent literature has suggested that enrollment in hospice does not compromise the length of survival for patients following advanced lung cancer diagnosis (Saito et al., 2011) and may in fact extend life by two months (Temel et al., 2010). As a result, some have suggested that patients be referred to palliative care within four to six weeks of diagnosis (von Gunten, Lutz, & Ferris, 2011). In the absence of timeliness standards, it is clear that the VA is committed to referring all patients in a common

timeframe. We found that over half of patients with advanced NSCLC were referred to palliative care or hospice services, with no significant racial differences. Moreover, these data suggest that patients seem to be appropriately referred based on their health status as patients with metastatic disease and/or poor performance status were sent to palliative care and/or hospice more quickly.

We also examined survival rates up to two years from diagnosis. As anticipated, we found that metastatic disease, poor performance status, and increased age at diagnosis were associated with shorter survival times. Marriage had a protective effect, which has also been demonstrated in prior studies (Siddiqui et al., 2010). In these data, African American patients survived at mean of sixteen days longer compared to Caucasian patients, even after controlling for pre-specified covariates. Though racial differences in survival time have been documented in non-federal healthcare systems, our finding is consistent with several studies suggesting that once equal access to care has been obtained, survival rates are similar for patients of diverse races (Akerley et al., 1993; Bradley et al., 2001; Zheng et al., 2012).

Our study has several limitations. First, our analysis was limited to care received in the VA. Some patients receiving care in the VA healthcare system may also receive a portion of their cancer care in the private sector. Analysis was also limited to patients of African American and Caucasian race without regard to Hispanic ethnicity. Geographic regions were defined based on land mass, not distribution of this sample or VA patients. Future research should endeavor to include information from multiple data sources on a more diverse patient cohort. We

obtained death information two years post-diagnosis, however, this seems reasonable as 78% of our sample died within this timeframe.

Our findings provided important insights on the quality and timeliness of VA NSCLC care. We assessed key process and outcome measures of care quality and observed no evidence of clinically meaningful racial differences in timeliness of NSCLC care provided by the VA healthcare system. To validate these findings, future studies that follow patients longitudinally should be conducted. These results may reflect the VA's history as an equal access system (Kizer & Dudley, 2009; Perlin et al., 2004; Robinson et al., 2010) and its established commitment to ongoing quality monitoring and improvement.
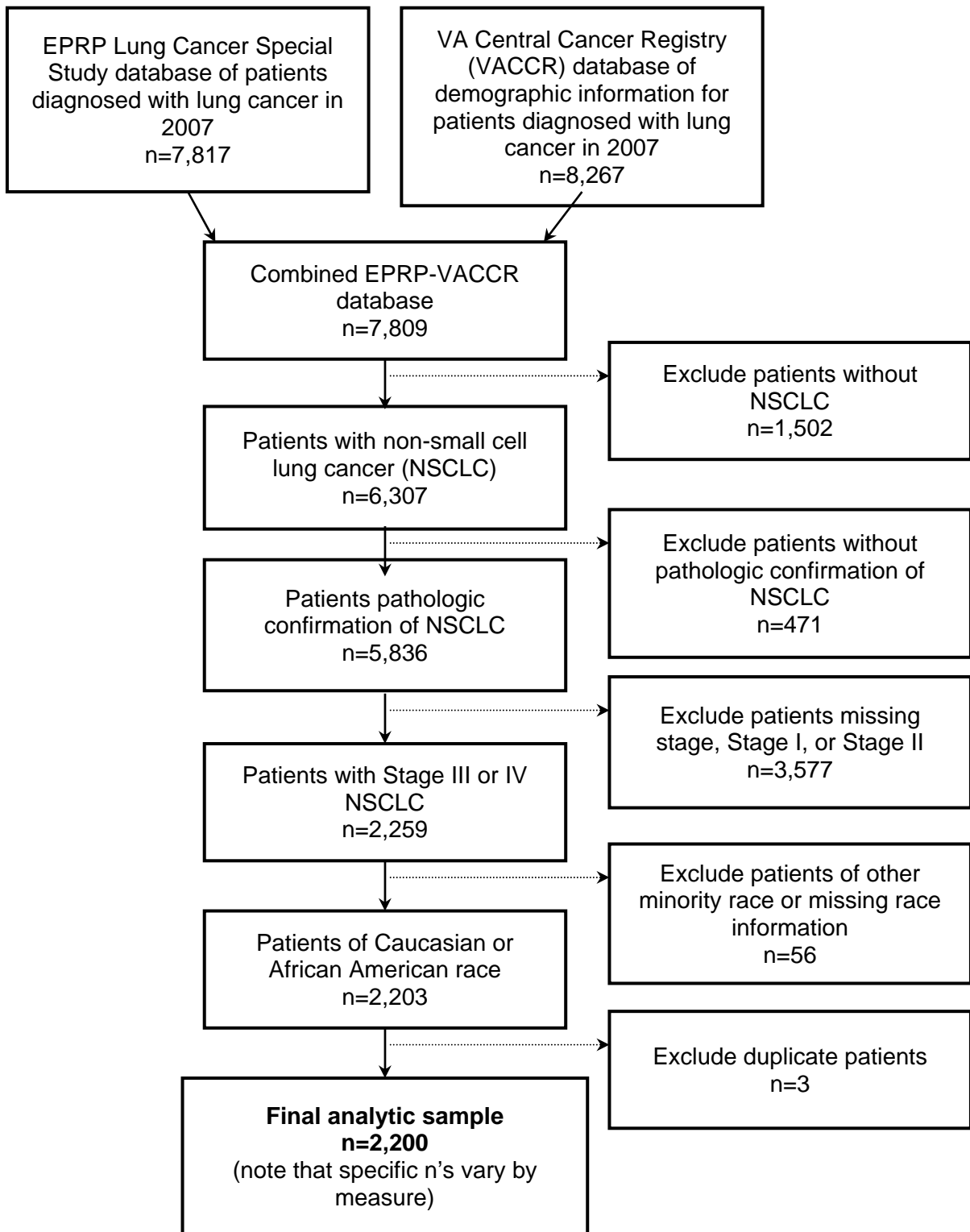
Figure 6. Lung cancer cohort assembly.

TABLE 12.

Description of NSCLC Patient Cohort and Key Variables.

	Caucasian Patients (n=1,826)	AA Patients (n=374)	Full Sample (n=2,200)
	% (n) or Mean (SD)	% (n) or Mean (SD)	% (n) or Mean (SD)
Dependent variables			
Days from diagnosis to initiation of treatment[1]	64.9 (84.2)	71.5 (89.8)	66.0 (85.2)
Days from diagnosis to referral to palliative care or hospice	115.5 (102.5)	129.4 (108.1)	117.8 (103.6)
Days from diagnosis to death	116.8 (92.0)	132.9 (100.5)	119.5 (93.7)
Independent variable			
Caucasian race	100.0% (1,826)	0.0% (374)	83.0% (1,826)
Other control variables			
Age at Diagnosis			
<55 years	7.0% (127)	12.3% (46)	7.9% (173)
55-64 years	32.7% (597)	36.9% (138)	33.4% (735)
65-74 years	26.0% (475)	23.8% (89)	25.6% (564)
75+ years	27.2% (496)	21.4% (80)	26.2% (576)
Married	47.5% (866)	35.4% (132)	45.5% (998)
Region			
South	43.8% (799)	62.0% (232)	46.9% (1,031)
North	13.3% (243)	10.2% (38)	12.8% (281)
Central	23.4% (428)	16.0% (60)	22.2% (488)
West	19.5% (356)	11.8% (44)	18.2% (400)
Stage at Diagnosis			
Stage III	11.3% (206)	12.6% (47)	11.5% (253)
Stage IV	88.7% (1,620)	87.4% (327)	88.5% (1,947)
Poor Performance Status[2]	65.0% (1,186)	64.4% (241)	64.9% (1,427)

1-Treatment included initiation of lung cancer surgery, chemotherapy, radiation therapy, admission into palliative care, or admission into hospice.
2-Patients were considered to have poor performance if the medical record contained documentation of an ECOG score >2, a Karnofsky of <60%, or an ACE-27 score of 2 (moderate) or 3 (severe).

Table 13.

Cox Proportional Hazard Model Regression Results.

	Diagnosis to Treatment Initiation[1]			Diagnosis to Referral to Palliative Care or Hospice			Diagnosis to Death		
	HR	95%CI	p	HR	95%CI	p	HR	95%CI	p
Demographic Characteristics									
Caucasian race	1.04	0.78-1.37	0.80	1.10	0.91-1.34	0.34	0.31	1.14-1.50	0.00*
Married	1.00	0.81-1.25	0.98	1.02	0.88-1.12	0.78	0.89	0.81-0.99	0.02*
Age at Diagnosis									
<55 years	0.82	0.56-1.22	0.34	0.83	0.63-1.10	0.19	0.76	0.62-0.92	0.01*
55-64 years	0.97	0.75-1.27	0.83	0.90	0.75-1.09	0.27	0.89	0.80-1.00	0.06
65-74 years	1.04	0.79-1.37	0.79	0.99	0.82-1.20	0.92	0.88	0.78-1.00	0.06
75+ years (ref)									
Region									
North	1.02	0.71-1.46	0.92	0.87	0.67-1.13	0.29	1.10	0.95-1.28	0.19
Central	0.89	0.67-1.18	0.40	0.89	0.73-1.08	0.24	1.13	1.00-1.27	0.06
West	0.87	0.64-1.17	0.36	0.96	0.78-1.18	0.69	1.08	0.95-1.24	0.23
South (ref)									
Poor Performance Status	0.81	0.64-1.03	0.09	0.81	0.69-0.95	0.01*	0.80	0.72-0.89	0.00*
Stage at Diagnosis									
Stage III	0.87	0.59-1.28	0.47	1.37	1.13-1.64	0.00*	0.53	0.45-0.63	0.00*
Stage IV (ref)									
N	2,098			2,149			2,190		

1-First treatment could have been chemotherapy, radiation therapy, or admission to palliative care or hospice.

* Indicates statistical significance at the <0.05 alpha level.

CHAPTER 7: SUMMARY OF FINDINGS AND IMPLICATIONS FOR POLICY, PRACTICE, AND RESEARCH

Summary of Findings

This dissertation examined racial differences in quality and timeliness of VA cancer care. We assessed these issues among patients with CRC and advanced NSCLC, two common and often deadly diseases. In Chapter 4, we examined the association between race and receipt of NCCN guideline–concordant CRC care. In non-federal U.S. healthcare systems, racial differences throughout the continuum of CRC care have been extensively documented (Benarroch-Gampel et al., 2012; Berry et al., 2009; Berry et al., 2010; Crawford et al., 2010; Dimou et al., 2009; Du et al., 2011; Kim et al., 2011; Obeidat et al., 2010; Rhoads et al., 2012; Singh et al., 2011; White et al., 2010). As an integrated healthcare system and an accountable-care organization, the VA provides a unique platform from which to study potential racial differences in cancer care quality.

We used observational, retrospectively abstracted data on a national cohort of veterans diagnosed with incident CRC to assess the association between race and several stage-specific quality measures. For patients with Stage II or III disease these measures included receipt of computed tomography scan, preoperative carcinoembryonic antigen, clear surgical margins, and referral to medical oncology. For patients with Stage III disease we examined receipt of fluorouracil-based adjuvant chemotherapy, and for patients with Stages I–III disease, we examined

receipt of guideline-appropriate surveillance colonoscopy.

Across all NCCN measures, we identified few significant associations between patient characteristics and quality care. For example, older age at diagnosis was associated with reduced odds of medical oncology referral and surveillance colonoscopy. Presence of cardiovascular comorbid conditions was marginally associated with reduced odds of medical oncology referral (OR 0.65, 95% CI 0.50-0.89). Odds of receiving surveillance colonoscopy were lower among patients with Stage I disease (OR 0.71, 95% CI 0.56-0.90) compared to Stage II. The key finding presented in Chapter 4 was that there were no significant racial differences in receipt of guideline-concordant CRC care. This lack of disparity is in contrast to care received in much of the private sector, suggesting that the VA may be a leader in providing racially equitable care.

In Chapter 5 we further studied potential racial differences in care by delving beyond simple receipt of care, as measured in Chapter 4, and incorporated a time element. Chapter 5 examined two unique aspects of VA CRC quality care: processes (time to treatment) and outcomes (survival). We examined three quality indicators—time from: 1) surgery to initiation of adjuvant chemotherapy (Stage II-III); 2) surgery to surveillance colonoscopy (Stage I-III); and 3) surgery to death (Stage I-III).

In unadjusted analyses across all three timeliness measures, there was no evidence of racial differences. In adjusted Cox proportional hazard regression models, there were no racial differences in time to initiation of chemotherapy (HR 0.82, p=0.61) or surgery to death (HR 0.94, p=0.49). However, we found that

Caucasian patients experienced slightly shorter median times to surveillance colonoscopy than African American patients (367 versus 383 days, HR 0.63, p=0.02). This equates with an average difference of approximately sixteen days, or slightly over two weeks, in time to surveillance colonoscopy between racial groups. This difference is small and there is no scientific evidence to suggest that a two-week delay would have a negative impact on patient outcome. However, this potential difference is worth validation and further monitoring in prospective studies of veteran populations.

As an outcome of care quality, we examined post–CRC surgical resection survival times and identified similar times among patients of Caucasian and African American race. This critical finding may signal that the VA provides similar processes of quality care to patients throughout their disease trajectory. Subsequently, this comparable care may translate into equivalent survival times.

Paralleling Chapter 5, in Chapter 6 we examined process (time to treatment) and outcomes (survival) measures among VA patients with advanced NSCLC. NSCLC is responsible for nearly 19% of all cancers diagnosed and treated in the VA healthcare system (Zullig et al., 2012) and is the leading cause of cancer-related death (Siegel et al., 2012), making it an important disease in which to understand potential racial differences in care quality. As in the previous chapters, we used observational, retrospectively data abstracted from the VA's national electronic health record. We examined three quality measures—time from diagnosis to: 1) treatment initiation; 2) palliative care or hospice referral; and 3) death among VA patients with advanced NSCLC.

In adjusted Cox proportional hazard regression models there were no racial differences in time to initiation of treatment (HR 1.03, p=0.80; difference of seven days on average between racial groups) or palliative care or hospice referral (HR 1.10, p=0.34; difference of thirteen days on average between racial groups). However, the adjusted Cox proportional hazard regression model revealed slightly longer survival for African American patients (133 days) compared to Caucasian patients (117 days; HR 1.31, p=0.00). The difference was a mere sixteen days, or slightly more than two weeks. This small racial difference in survival time is not clinically meaningful and may be the result of unmeasured differences between patient groups at the time of diagnosis.

Echoing findings from the CRC patient cohort (Chapter 5), for process measures of care quality such as time to initiation of treatment and referral to supportive care, the VA provides racially equitable NSCLC care. We identified a slight dissimilarity in survival times among NSCLC patients of diverse races; however this difference is unlikely to have clinical meaning. Our analysis focused on two-year survival rates. Though few patients were living two years post-diagnosis, future studies could build on these findings by considering a longer-range survival time and by confirming this possible trend prospectively in other veteran groups.

Implications for Policy, Practice, and Research

The key finding of this dissertation was that the VA provides quality cancer care to patients regardless of race. This result has considerable implications for health services policy, clinical practice, and future research. The VA serves a racially diverse population within the structure of an ACO. Many private U.S. healthcare

systems are restructuring to become more comparable to the VA's ACO model. There may be opportunity for the VA and the private sector to learn from each other's successes in delivering quality, equitable care. Specifically, there may be quality improvement initiatives, electronic reminder systems, or other projects developed within the VA healthcare system that may be readily translatable for use in other hospitals or healthcare systems.

The causal pathways to the VA's racial equity or care quality were not assessed in our analyses. However, our findings may suggest that the VA's efforts for continuous quality improvement and universal accessibility are successful in assuring delivery of high-quality cancer care. The VA has a centralized plan for ongoing quality monitoring and improvement. This focus on quality improvement includes many strategies such as the EPRP and national collaboratives targeting improved delivery of cancer care. Future research studies should examine which strategies are most effective in ensuring quality care.

Largely due to improved methods for early detection and treatment of many cancers, the number of cancer survivors treated within the VA system is increasing. In fiscal year 2007, approximately 11% of VA patients were cancer survivors (Moye, Schuster, Latini, & Naik, 2010). This increasing population of cancer survivors may instigate a shift in demand for health services—critical information given the potential shortage of both primary care physicians and medical oncologists. Future studies should examine ways to integrate existing quality improvement strategies into assuring quality care for cancer survivors, reconnecting them with primary care services while still obtaining recommended cancer surveillance.

Conclusion

Racial disparities in healthcare are a serious problem. Over a decade ago, the Institute of Medicine asserted that there is no singular etiology underlying health and mortality disparities. There are a host of patient-, provider-, and system-generated reasons for these disparities, but chief among the potential causal factors was lower quality of care delivered to patients of racial minority groups (Nelson, 2003). There have been many initiatives, both at the local and national level, to document and reduce disparities in all aspects of healthcare.

The findings of this dissertation suggest that VA cancer care may be an exemplar of an equal-access healthcare delivery system. Across myriad metrics, the VA provided racially equitable cancer care. The VA healthcare system provides evidence that a large, integrated healthcare system can serve a diverse patient population and deliver quality cancer care to all of its patients.

REFERENCES

Agency for Healthcare Research and Quality (AHRQ). (2012). Clinical Classifications Software (CCS) for ICD-9-CM. Retrieved August 2, 2012, from http://www.hcupus.ahrq.gov/toolssoftware/ccs/ccs.jsp.

An act entitled The Patient Protection and Affordable Care Act, 111th Cong. 2 (2010).

Ades, S. (2009). Adjuvant chemotherapy for colon cancer in the elderly: moving from evidence to practice. *Oncology (Williston Park), 23*(2), 162–167.

Agha, Z., Lofgren, R. P., VanRuiswyk, J. V., & Layde, P. M. (2000). Are patients at Veterans Affairs medical centers sicker? A comparative analysis of health status and medical resource use. *Arch Intern Med, 160*(21), 3252–3257.

Aiello Bowles, E. J., Tuzzio, L., Wiese, C. J., Kirlin, B., Greene, S. M., Clauser, S. B., & Wagner, E. H. (2008). Understanding high-quality cancer care: a summary of expert perspectives. *Cancer, 112*(4), 934–942. doi: 10.1002/cncr.23250

Akerley, W. L., 3rd, Moritz, T. E., Ryan, L. S., Henderson, W. G., & Zacharski, L. R. (1993). Racial comparison of outcomes of male Department of Veterans Affairs patients with lung and colon cancer. *Arch Intern Med, 153*(14), 1681–1688.

Alexander, D., Chatla, C., Funkhouser, E., Meleth, S., Grizzle, W. E., & Manne, U. (2004). Postsurgical disparity in survival between African Americans and Caucasians with colonic adenocarcinoma. *Cancer, 101*(1), 66–76. doi: 10.1002/cncr.20337

Alexander, D. D., Waterbor, J., Hughes, T., Funkhouser, E., Grizzle, W., & Manne, U. (2007). African-American and Caucasian disparities in colorectal cancer mortality and survival by data source: an epidemiologic review. *Cancer Biomark, 3*(6), 301–313.

American Cancer Society. (2013). Non-Small Cell Lung Cancer. Retrieved January 31, 2013, from http://www.cancer.org/cancer/lungcancer-non-smallcell/index.

Anderson, M. (2005). Lessons learned from the Veterans Health Administration. *Healthc Pap, 5*(4), 30–37.

Annakkaya, A. N., Arbak, P., Balbay, O., Bilgin, C., Erbas, M., & Bulut, I. (2007). Effect of symptom-to-treatment interval on prognosis in lung cancer. *Tumori, 93*(1), 61–67.

Aragoneses, F. G., Moreno, N., Leon, P., Fontan, E. G., & Folque, E. (2002). Influence of delays on survival in the surgical treatment of bronchogenic carcinoma. *Lung Cancer, 36*(1), 59–63.

Asch, S. M., McGlynn, E. A., Hogan, M. M., Hayward, R. A., Shekelle, P., Rubenstein, L., . . . Kerr, E. A. (2004). Comparison of quality of care for patients in the Veterans Health Administration and patients in a national sample. *Ann Intern Med, 141*(12), 938–945.

Ayanian, J. Z., Zaslavsky, A. M., Fuchs, C. S., Guadagnoli, E., Creech, C. M., Cress, R. D., . . . Wright, W. E. (2003). Use of adjuvant chemotherapy and radiation therapy for colorectal cancer in a population-based cohort. *J Clin Oncol, 21*(7), 1293–1300.

Bach, P. B., Cramer, L. D., Warren, J. L., & Begg, C. B. (1999). Racial differences in the treatment of early-stage lung cancer. *N Engl J Med, 341*(16), 1198–1205. doi: 10.1056/nejm199910143411606

Baldwin, L. M., Dobie, S. A., Billingsley, K., Cai, Y., Wright, G. E., Dominitz, J. A., . . . Taplin, S. H. (2005). Explaining black-white differences in receipt of recommended colon cancer treatment. *J Natl Cancer Inst, 97*(16), 1211–1220. doi: 10.1093/jnci/dji241

Beckles, M. A., Spiro, S. G., Colice, G. L., & Rudd, R. M. (2003). The physiologic evaluation of patients with lung cancer being considered for resectional surgery. *Chest, 123*(1 Suppl), 105S–114S.

Benarroch-Gampel, J., Sheffield, K. M., Lin, Y. L., Kuo, Y. F., Goodwin, J. S., & Riall, T. S. (2012). Colonoscopist and primary care physician supply and disparities in colorectal cancer screening. *Health Serv Res, 47*(3 Pt 1), 1137–1157. doi: 10.1111/j.1475-6773.2011.01355.x

Berry, J., Bumpers, K., Ogunlade, V., Glover, R., Davis, S., Counts-Spriggs, M., . . . Flowers, C. (2009). Examining racial disparities in colorectal cancer care. *J Psy Oncol, 27*(1), 59–83. doi: 10.1080/07347330802614840

Berry, J., Caplan, L., Davis, S., Minor, P., Counts-Spriggs, M., Glover, R., . . . Flowers, C. (2010). A black-white comparison of the quality of stage-specific colon cancer treatment. *Cancer, 116*(3), 713–722. doi: 10.1002/cncr.24757

Biagi, J. J., Raphael, M. J., Mackillop, W. J., Kong, W., King, W. D., & Booth, C. M. (2011). Association between time to initiation of adjuvant chemotherapy and survival in colorectal cancer: a systematic review and meta-analysis. *JAMA, 305*(22), 2335–2342. doi: 10.1001/jama.2011.749

Bilimoria, K. Y., Ko, C. Y., Tomlinson, J. S., Stewart, A. K., Talamonti, M. S., Hynes, D. L., . . . Bentrem, D. J. (2011). Wait times for cancer surgery in the United States: trends and predictors of delays. *Ann Surg, 253*(4), 779–785. doi: 10.1097/SLA.0b013e318211cc0f

Bradley, C. J., Given, C. W., & Roberts, C. (2001). Disparities in cancer diagnosis and survival. *Cancer, 91*(1), 178–188.

Buccheri, G., & Ferrigno, D. (2004). Lung cancer: clinical presentation and specialist referral time. *Eur Respir J, 24*(6), 898–904. doi: 10.1183/09031936.04.00113603

Carpenter, W.R., Meyer, A.M., Wu, Y., Qaqish, B., Sanoff, H.K., Goldberg, R.M., & Weiner, B.J. (2012). Translating research into practice: the role of provider based research networks in the diffusion of an evidence-based colon cancer treatment innovation. *Medical Care 50*(8):737–748. doi: 10.1097/MLR.0b013e31824ebe13

Center for Disease Control and Prevention. Use of colorectal cancer tests--United States, 2002, 2004, and 2006. (2008). *MMWR Morb Mortal Wkly Rep, 57*(10), 253–258.

Chang, H. J., Lee, K. W., Kim, J. H., Bang, S. M., Kim, Y. J., Kim, D. W., . . . Lee, J. S. (2011). Adjuvant capecitabine chemotherapy using a tailored-dose strategy in elderly patients with colon cancer. *Ann Oncol.* 23(4):911–918. doi: 10.1093/annonc/mdr329

Charlson, M. E., Pompei, P., Ales, K. L., & MacKenzie, C. R. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis, 40*(5), 373–383.

Cleves, M., Gould, W., Gutierrez, R. G., & Marchenko, Y. V. (2010). *An Introduction to Survival Analysis Using Stata*, 3rd ed. College Station, TX: Stata Press.

Coleman, K., Austin, B. T., Brach, C., & Wagner, E. H. (2009). Evidence on the Chronic Care Model in the new millennium. *Health Aff (Millwood), 28*(1), 75–85. doi: 10.1377/hlthaff.28.1.75

Comber, H., Cronin, D. P., Deady, S., Lorcain, P. O., & Riordan, P. (2005). Delays in treatment in the cancer services: impact on cancer stage and survival. *Ir Med J, 98*(8), 238–239.

Cooper, G. S., Kou, T. D., & Reynolds, H. L., Jr. (2008). Receipt of guideline-recommended follow-up in older colorectal cancer survivors : a population-based analysis. *Cancer, 113*(8), 2029–2037. doi: 10.1002/cncr.23823

Cooper, G. S., Virnig, B., Klabunde, C. N., Schussler, N., Freeman, J., & Warren, J. L. (2002). Use of SEER-Medicare data for measuring cancer surgery. *Med Care, 40*(8 Suppl), IV-43–IV-48. doi: 10.1097/01.mlr.0000020943.21850.f1

Crawford, N. D., Jones, C. P., & Richardson, L. C. (2010). Understanding racial and ethnic disparities in colorectal cancer screening: Behavioral Risk Factor Surveillance System, 2002 and 2004. *Ethn Dis, 20*(4), 359–365.

Cronin, D. P., Harlan, L. C., Potosky, A. L., Clegg, L. X., Stevens, J. L., & Mooney, M. M. (2006). Patterns of care for adjuvant therapy in a random population-based sample of patients diagnosed with colorectal cancer. *Am J Gastroenterol, 101*(10), 2308–2318. doi: 10.1111/j.1572-0241.2006.00775.x

Cruse, H., Winiarek, M., Marshburn, J., Clark, O., & Djulbegovic, B. (2002). Quality and methods of developing practice guidelines. *BMC Health Serv Res, 2*, 1.

Davidoff, A. J., Rapp, T., Onukwugha, E., Zuckerman, I. H., Hanna, N., Pandya, N., & Mullins, C. D. (2009). Trends in disparities in receipt of adjuvant therapy for elderly stage I colon cancer patients: the role of the medical oncologist evaluation. *Med Care, 47*(12), 1229–1236. doi: 10.1097/MLR.0b013e3181b58a85

Dayal, H., Polissar, L., Yang, C. Y., & Dahlberg, S. (1987). Race, socioeconomic status, and other prognostic factors for survival from colo-rectal cancer. *J Chronic Dis, 40*(9), 857–864.

Demissie, K., Oluwole, O. O., Balasubramanian, B. A., Osinubi, O. O., August, D., & Rhoads, G. G. (2004). Racial differences in the treatment of colorectal cancer: a comparison of surgical and radiation therapy between Whites and Blacks. *Ann Epidemiol, 14*(3), 215–221. doi: 10.1016/j.annepidem.2003.08.002

Desch, C. E., Benson, A. B., 3rd, Somerfield, M. R., Flynn, P. J., Krause, C., Loprinzi, C. L., . . . Petrelli, N. J. (2005). Colorectal cancer surveillance: 2005 update of an American Society of Clinical Oncology practice guideline. *J Clin Oncol, 23*(33), 8512–8519. doi: 10.1200/jco.2005.04.0063

Desch, C. E., McNiff, K. K., Schneider, E. C., Schrag, D., McClure, J., Lepisto, E., . . . Edge, S. B. (2008). American Society of Clinical Oncology/National Comprehensive Cancer Network Quality Measures. *J Clin Oncol, 26*(21), 3631–3637. doi: 10.1200/jco.2008.16.5068

Deyo, R. A., Cherkin, D. C., & Ciol, M. A. (1992). Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol, 45*(6), 613–619.

Dimou, A., Syrigos, K. N., & Saif, M. W. (2009). Disparities in colorectal cancer in African-Americans vs Whites: before and after diagnosis. *World J Gastroenterol, 15*(30), 3734–3743.

Dolan, N. C., Ferreira, M. R., Fitzgibbon, M. L., Davis, T. C., Rademaker, A. W., Liu, D., . . . Bennett, C. L. (2005). Colorectal cancer screening among African-American and White male veterans. *Am J Prev Med, 28*(5), 479–482. doi: 10.1016/j.amepre.2005.02.002

Dominitz, J. A., Maynard, C., Billingsley, K. G., & Boyko, E. J. (2002). Race, treatment, and survival of veterans with cancer of the distal esophagus and gastric cardia. *Med Care, 40*(1 Suppl), I14–I26.

Dominitz, J. A., Samsa, G. P., Landsman, P., & Provenzale, D. (1998). Race, treatment, and survival among colorectal carcinoma patients in an equal-access medical system. *Cancer, 82*(12), 2312–2320.

Dransfield, M. T., Lock, B. J., & Garver, R. I., Jr. (2006). Improving the lung cancer resection rate in the US Department of Veterans Affairs health system. *Clin Lung Cancer, 7*(4), 268–272.

Du, X. L., Lin, C. C., Johnson, N. J., & Altekruse, S. (2011). Effects of individual-level socioeconomic factors on racial disparities in cancer treatment and survival: findings from the National Longitudinal Mortality Study, 1979-2003. *Cancer, 117*(14), 3242–3251. doi: 10.1002/cncr.25854

Egede, L. E., Gebregziabher, M., Hunt, K. J., Axon, R. N., Echols, C., Gilbert, G. E., & Mauldin, P. D. (2011). Regional, geographic, and ethnic differences in medication adherence among adults with type 2 diabetes (February). *Ann Pharmacother*, *45*, 169178. doi: 10.1345/aph.1P442

Eisen, S., & Francis, J. (2010). Transformation of VHA health data into clinically useful information to provide quality veteran care. *J Rehabil Res Dev, 47*(8), xiii-xv.

Elixhauser, A., Steiner, C., Harris, D. R., & Coffey, R. M. (1998). Comorbidity measures for use with administrative data. *Med Care, 36*(1), 8–27.

Elston Lafata, J., Cole Johnson, C., Ben-Menachem, T., & Morlock, R. J. (2001). Sociodemographic differences in the receipt of colorectal cancer surveillance care following treatment with curative intent. *Med Care, 39*(4), 361–372.

Esnaola, N. F., Stewart, A. K., Feig, B. W., Skibber, J. M., & Rodriguez-Bigas, M. A. (2008). Age-, race-, and ethnicity-related differences in the treatment of nonmetastatic rectal cancer: a patterns of care study from the national cancer

data base. *Ann Surg Oncol, 15*(11), 3036–3047. doi: 10.1245/s10434-008-0106-9

Farjah, F., Wood, D. E., Yanez, N. D., 3rd, Vaughan, T. L., Symons, R. G., Krishnadasan, B., & Flum, D. R. (2009). Racial disparities among patients with lung cancer who were recommended operative therapy. *Arch Surg, 144*(1), 14–18. doi: 10.1001/archsurg.2008.519

Feinstein, M.D. (1970). The pre-therapeutic classification of co-morbidity in chronic disease. *J of Chronic Dis, 23*(7), 455–468.

Figueredo, A., Rumble, R. B., Maroun, J., Earle, C. C., Cummings, B., McLeod, R., . . . Zwaal, C. (2003). Follow-up of patients with curatively resected colorectal cancer: a practice guideline. *BMC Cancer, 3*, 26. doi: 10.1186/1471-2407-3-26

Fisher, D. A., Zullig, L. L., Grambow, S. C., Abbott, D. H., Sandler, R. S., Fletcher, R. H., . . . Provenzale, D. (2010). Determinants of medical system delay in the diagnosis of colorectal cancer within the Veterans Affairs health system. *Dig Dis Sci, 55*(5), 1434–1441. doi: 10.1007/s10620-010-1174-9

Fisher, E. S., & Shortell, S. M. (2010). Accountable care organizations: accountable for what, to whom, and how. *JAMA, 304*(15), 1715–1716. doi: 10.1001/jama.2010.1513

Fleming, S. T., Sabatino, S. A., Kimmick, G., Cress, R., Wu, X. C., Trentham-Dietz, A., . . . Liff, J. (2011). Developing a claim-based version of the ACE-27 comorbidity index: a comparison with medical record review. *Med Care, 49*(8), 752–760. doi: 10.1097/MLR.0b013e318215d7dd

National Quality Forum. (2011). National Quality Forum: Cancer Care Phase II. Retrieved November 4, 2011, from http://www.qualityforum.org/Projects/c-d/Cancer_Care_Phase_II/Cancer_Care_Phase_II.aspx.

Francis, J., & Perlin, J. B. (2006). Improving performance through knowledge translation in the Veterans Health Administration. *J Contin Educ Health Prof, 26*(1), 63-71. doi: 10.1002/chp.52

Friedemann-Sanchez, G., Griffin, J. M., & Partin, M. R. (2007). Gender differences in colorectal cancer screening barriers and information needs. *Health Expect, 10*(2), 148–160. doi: 10.1111/j.1369-7625.2006.00430.x

Fry, W. A., Menck, H. R., & Winchester, D. P. (1996). The National Cancer Data Base report on lung cancer. *Cancer, 77*(9), 1947–1955. doi: 10.1002/(sici)1097-0142(19960501)77:9<1947::aid-cncr27>3.0.co;2-z

Gardner, J. (1998). VA on the spot. Care quality, oversight to be probed by Congress. *Mod Healthc, 28*(5), 39.

George, M., & Margolis, M. L. (2010). Race and lung cancer surgery--a qualitative analysis of relevant beliefs and management preferences. *Oncol Nurs Forum, 37*(6), 740–748. doi: 10.1188/10.onf.740-748

Gordon, H. S., Street, R. L., Jr., Sharf, B. F., Kelly, P. A., & Souchek, J. (2006). Racial differences in trust and lung cancer patients' perceptions of physician communication. *J Clin Oncol, 24*(6), 904–909. doi: 10.1200/jco.2005.03.1955

Gornick, M. E., Eggers, P. W., & Riley, G. F. (2004). Associations of race, education, and patterns of preventive service use with stage of cancer at time of diagnosis. *Health Serv Res, 39*(5), 1403–1427. doi: 10.1111/j.1475-6773.2004.00296.x

Gould, M. K. (2009). Delays in lung cancer care: time to improve. *J Thorac Oncol, 4*(11), 1303–1304. doi: 10.1097/JTO.0b013e3181bbaff4

Gould, M. K., Ghaus, S. J., Olsson, J. K., & Schultz, E. M. (2008). Timeliness of care in veterans with non-small cell lung cancer. *Chest, 133*(5), 1167–1173. doi: 10.1378/chest.07-2654

Gould, M. K., Schultz, E. M., Wagner, T. H., Xu, X., Ghaus, S. J., Wallace, R. B., . . . Au, D. H. (2011). Disparities in lung cancer staging with positron emission tomography in the Cancer Care Outcomes Research and Surveillance (CanCORS) study. *J Thorac Oncol, 6*(5), 875–883. doi: 10.1097/JTO.0b013e31821671b6

Goulet, J. L., Erdos, J., Kancir, S., Levin, F. L., Wright, S. M., Daniels, S. M., . . . Justice, A. C. (2007). Measuring performance directly using the veterans health administration electronic medical record: a comparison with external peer review. *Med Care, 45*(1), 73-–79. doi: 10.1097/01.mlr.0000244510.09001.e5

Govindarajan, R., Shah, R. V., Erkman, L. G., & Hutchins, L. F. (2003). Racial differences in the outcome of patients with colorectal carcinoma. *Cancer, 97*(2), 493–498. doi: 10.1002/cncr.11067

Greene, F. L., Page, D. L., & Fleming, I. D. (Eds). (2002) *AJCC Cancer Staging Manual*, 6th ed. New York: Springer-Verlag.

Hardy, D., Xia, R., Liu, C. C., Cormier, J. N., Nurgalieva, Z., & Du, X. L. (2009). Racial disparities and survival for nonsmall-cell lung cancer in a large cohort of black and white elderly patients. *Cancer, 115*(20), 4807–4818. doi: 10.1002/cncr.24521

Holloway, J. J., Medendorp, S. V., & Bromberg, J. (1990). Risk factors for early readmission among veterans. *Health Serv Res, 25*(1 Pt 2), 213–237.

Hosmer, D. W. , & Lemeshow, S. (2000). *Applied Logistics Regression*, 2nd ed. NY: John Wiley & Sons.

Hosmer, D. W., & Lemeshow, S. (1999). *Applied Survival Analysis: Regression Modeling of Time to Event Data*. NY: John Wiley & Sons.

Hynes, D. M., Perrin, R. A., Rappaport, S., Stevens, J. M., & Demakis, J. G. (2004). Informatics resources to support health care quality improvement in the veterans health administration. *J Am Med Inform Assoc, 11*(5), 344–350. doi: 10.1197/jamia.M1548

Iezzoni, L. I., Foley, S. M., Daley, J., Hughes, J., Fisher, E. S., & Heeren, T. (1992). Comorbidities, complications, and coding bias. Does the number of diagnosis codes matter in predicting in-hospital mortality? *JAMA, 267*(16), 2197–2203.

Iizasa, T., Suzuki, M., Yasufuku, K., Iyoda, A., Otsuji, M., Yoshida, S., . . . Fujisawa, T. (2004). Preoperative pulmonary function as a prognostic factor for stage I non-small cell lung carcinoma. *Ann Thorac Surg, 77*(6), 1896–1902; discussion 1902-1893. doi: 10.1016/j.athoracsur.2003.10.014

Institute of Medicine, Committee on Quality of Health Care in America. (2001). *Crossing the Quality Chasm: A New Health System for the 21st Century*: Washington, DC: National Academies Press.

Jackson, G. L., Krein, S. L., Alverson, D. C., Darkins, A. W., Gunnar, W., Harada, N. D., . . . Bosworth, H. B. (2011). Defining core issues in utilizing information technology to improve access: evaluation and research agenda. *J Gen Intern Med, 26 Suppl 2*, 623–627. doi: 10.1007/s11606-011-1789-3

Jackson, G. L., Melton, L. D., Abbott, D. H., Zullig, L. L., Ordin, D. L., Grambow, S. C., . . . Provenzale, D. (2010). Quality of nonmetastatic colorectal cancer care in the Department of Veterans Affairs. *J Clin Oncol, 28*(19), 3176–3181. doi: 10.1200/jco.2009.26.7948

Jackson, G. L., Powell, A. A., Ordin, D. L., Schlosser, J. E., Murawsky, J., Hersh, J., . . . Provenzale, D. (2010). Developing and sustaining quality improvement partnerships in the VA: the Colorectal Cancer Care Collaborative. *J Gen Intern Med, 25 Suppl 1*, 38–43. doi: 10.1007/s11606-009-1155-x

Jackson, G. L., & Weinberger, M. (2009). A decade with the chronic care model: some progress and opportunity for more. *Med Care, 47*(9), 929–931. doi: 10.1097/MLR.0b013e3181b63537

Jahanzeb, M., Virgo, K., McKirgan, L., & Johnson, F. (1997). Evaluation of outcome by race in early-stage non-small cell lung cancer. *Oncol Rep, 4*(1), 183–186.

Jean-Jacques, M., Persell, S. D., Hasnain-Wynia, R., Thompson, J. A., & Baker, D. W. (2011). The implications of using adjusted versus unadjusted methods to measure health care disparities at the practice level. *Am J Med Qual, 26*(6), 491–501. doi: 10.1177/1062860611403135

Jeffery, G. M., Hickey, B. E., & Hider, P. (2002). Follow-up strategies for patients treated for non-metastatic colorectal cancer. *Cochrane Database Syst Rev*(1), CD002200. doi: 10.1002/14651858.cd002200

Jemal, A., Siegel, R., Xu, J., & Ward, E. (2010). Cancer statistics, 2010. *CA Cancer J Clin, 60*(5), 277–300. doi: 10.3322/caac.20073

Jessup, J. M., Stewart, A., Greene, F. L., & Minsky, B. D. (2005). Adjuvant chemotherapy for stage I colon cancer: implications of race/ethnicity, age, and differentiation. *JAMA, 294*(21), 2703–2711. doi: 10.1001/jama.294.21.2703

Jha, A. K., Perlin, J. B., Kizer, K. W., & Dudley, R. A. (2003). Effect of the transformation of the Veterans Affairs health care system on the quality of care. *N Engl J Med, 348*(22), 2218–2227. doi: 10.1056/NEJMsa021899

Johnson, H., Jr., & Carstens, R. (1986). Anatomical distribution of colonic carcinomas. Interracial differences in a community hospital population. *Cancer, 58*(4), 997–1000.

Kanashiki, M., Satoh, H., Ishikawa, H., Yamashita, Y. T., Ohtsuka, M., & Sekizawa, K. (2003). Time from finding abnormality on mass-screening to final diagnosis of lung cancer. *Oncol Rep, 10*(3), 649–652.

Kashiwabara, K., Koshi, S., Itonaga, K., Nakahara, O., Tanaka, M., & Toyonaga, M. (2003). Outcome in patients with lung cancer found on lung cancer mass screening roentgenograms, but who did not subsequently consult a doctor. *Lung Cancer, 40*(1), 67–72.

Keating, N. L., Landrum, M. B., Lamont, E. B., Bozeman, S. R., Krasnow, S. H., Shulman, L. N., . . . McNeil, B. J. (2011). Quality of care for older patients with cancer in the Veterans Health Administration versus the private sector: a cohort study. *Ann Intern Med, 154*(11), 727–736. doi: 10.1059/0003-4819-154-11-201106070-00004

Kim, J., Artinyan, A., Mailey, B., Christopher, S., Lee, W., McKenzie, S., . . . Garcia-Aguilar, J. (2011). An interaction of race and ethnicity with socioeconomic

status in rectal cancer outcomes. *Ann Surg, 253*(4), 647–654. doi: 10.1097/SLA.0b013e3182111102

Kizer, K. W. (2012). Veterans and the Affordable Care Act. *JAMA, 307*(8), 789–790. doi: 10.1001/jama.2012.196

Kizer, K. W., & Dudley, R. A. (2009). Extreme makeover: transformation of the veterans health care system. *Annu Rev Public Health, 30*, 313–339. doi: 10.1146/annurev.publhealth.29.020907.090940

Klabunde, C. N., Legler, J. M., Warren, J. L., Baldwin, L. M., & Schrag, D. (2007). A refined comorbidity measurement algorithm for claims-based studies of breast, prostate, colorectal, and lung cancer patients. *Ann Epidemiol, 17*(8), 584–590. doi: 10.1016/j.annepidem.2007.03.011

Klabunde, C. N., Potosky, A. L., Legler, J. M., & Warren, J. L. (2000). Development of a comorbidity index using physician claims data. *J Clin Epidemiol, 53*(12), 1258–1267.

Kleinbaum, David G. (1996). *Survival Analysis—A Self-Learning Text*. NY: Springer-Verlag.

Kohne, C. H., Folprecht, G., Goldberg, R. M., Mitry, E., & Rougier, P. (2008). Chemotherapy in elderly patients with colorectal cancer. *Oncologist, 13*(4), 390–402. doi: 10.1634/theoncologist.2007-0043

Koopman, M., & Punt, C. J. (2009). Chemotherapy, which drugs and when. *Eur J Cancer, 45 Suppl 1*, 50–56. doi: 10.1016/s0959-8049(09)70016-4

Kussman, M. J. (2008). *External Peer Review Program (EPRP)*. (VHA Directive 2008-032). Retrieved from http://www.va.gov/vhapublications/ViewPublication.asp?pub_ID=1708.

Laiyemo, A. O., Doubeni, C., Pinsky, P. F., Doria-Rose, V. P., Bresalier, R., Lamerato, L. E., . . . Berg, C. D. (2010). Race and colorectal cancer disparities: health-care utilization vs different cancer susceptibilities. *J Natl Cancer Inst, 102*(8), 538-546. doi: 10.1093/jnci/djq068

Landrum, M. B., Keating, N. L., Lamont, E. B., Bozeman, S. R., Krasnow, S. H., Shulman, L., . . . McNeil, B. J. (2012). Survival of older patients with cancer in the Veterans Health Administration versus fee-for-service Medicare. *J Clin Oncol. 30*(10), 1072-1079. doi: 10.1200/JCO.2011.35.6758.

Landrum, M. B., Keating, N. L., Lamont, E. B., Bozeman, S. R., & McNeil, B. J. (2012). Reasons for underuse of recommended therapies for colorectal and

lung cancer in the Veterans Health Administration. *Cancer, 118*(13), 3345–3355. doi: 10.1002/cncr.26628

Lathan, C. S., Neville, B. A., & Earle, C. C. (2006). The effect of race on invasive staging and surgery in non-small-cell lung cancer. *J Clin Oncol, 24*(3), 413–418. doi: 10.1200/jco.2005.02.1758

Long, M. D., Lance, T., Robertson, D., Kahwati, L., Kinsinger, L., & Fisher, D. A. (2012). Colorectal cancer testing in the national veterans health administration. *Dig Dis Sci, 57*(2), 288–293. doi: 10.1007/s10620-011-1895-4

Margolis, M. L., Christie, J. D., Silvestri, G. A., Kaiser, L., Santiago, S., & Hansen-Flaschen, J. (2003). Racial differences pertaining to a belief about lung cancer surgery: results of a multicenter survey. *Ann Intern Med, 139*(7), 558–563.

McQueen, L., Mittman, B. S., & Demakis, J. G. (2004). Overview of the Veterans Health Administration (VHA) Quality Enhancement Research Initiative (QUERI). *J Am Med Inform Assoc, 11*(5), 339–343. doi: 10.1197/jamia.M1499

Medicare program. Medicare Shared Savings Program: Accountable Care Organizations. Final rule. (2011). *Fed Regist, 76*(212), 67802–67990.

Mickey, R. M., & Greenland, S. (1989). The impact of confounder selection criteria on effect estimation. *Am J Epidemiol, 129*(1), 125–137.

Miller, R.G. (1981). *Simultaneous Statistical Inference*, 2nd ed. NY: Springer-Verlag.

Morris, A. M., Billingsley, K. G., Hayanga, A. J., Matthews, B., Baldwin, L. M., & Birkmeyer, J. D. (2008). Residual treatment disparities after oncology referral for rectal cancer. *J Natl Cancer Inst, 100*(10), 738–744. doi: 10.1093/jnci/djn145

Morris, A. M., Rhoads, K. F., Stain, S. C., & Birkmeyer, J. D. (2010). Understanding racial disparities in cancer treatment and outcomes. *J Am Coll Surg, 211*(1), 105–113. doi: 10.1016/j.jamcollsurg.2010.02.051

Moye, J., Schuster, J. L., Latini, D. M., & Naik, A. D. (2010). The future of cancer survivorship care for veterans. *Fed Pract, 27*(3), 36–43.

Murthy, V. H., Krumholz, H. M., & Gross, C. P. (2004). Participation in cancer clinical trials: race-, sex-, and age-based disparities. *JAMA, 291*(22), 2720–2726. doi: 10.1001/jama.291.22.2720

National Comprehensive Cancer Network (NCCN) (2011). Your Best Resource in the Fight Against Cancer) Retrieved September 13, 2011, from http://www.nccn.org/index.asp.

National Comprehensive Cancer Network. (2003a). Clinical Practice Guidelines in Oncology 2003: Colon Cancer (National Comprehensive Cancer Network ed., Vol. 2003-1). Fort Washington, PA.

National Comprehensive Cancer Network. (2003b). Clinical Practice Guidelines in Oncology 2003: Rectal Cancer (National Comprehensive Cancer Network ed., Vol. 2003-1). Fort Washington, PA.

Nelson, A. R. (2003). Unequal treatment: report of the Institute of Medicine on racial and ethnic disparities in healthcare. *Ann Thorac Surg, 76*(4), S1377–S1381.

Obeidat, N. A., Pradel, F. G., Zuckerman, I. H., Trovato, J. A., Palumbo, F. B., DeLisle, S., & Mullins, C. D. (2010). Racial/ethnic and age disparities in chemotherapy selection for colorectal cancer. *Am J Manag Care, 16*(7), 515–522.

Olsson, J. K., Schultz, E. M., & Gould, M. K. (2009). Timeliness of care in patients with lung cancer: a systematic review. *Thorax, 64*(9), 749–756. doi: 10.1136/thx.2008.109330

Pagano, E., Filippini, C., Di Cuonzo, D., Ruffini, E., Zanetti, R., Rosso, S., . . . Ciccone, G. (2010). Factors affecting pattern of care and survival in a population-based cohort of non-small-cell lung cancer incident cases. *Cancer Epid, 34*(4), 483–489. doi: 10.1016/j.canep.2010.04.002

Page, W. F., & Kuntz, A. J. (1980). Racial and socioeconomic factors in cancer survival. A comparison of Veterans Administration results with selected studies. *Cancer, 45*(5), 1029-1040.

Partin, M. R., Powell, A. A., Nugent, S., & Ordin, D. L. (2011). Colorectal cancer diagnosis improvement project evaluation demonstrates the importance of using multiple measures to track progress toward timeliness goals. *J Healthc Qual.* doi: 10.1111/j.1945-1474.2011.00188.x.

Perlin, J. B. (2006). Transformation of the US Veterans Health Administration. *Health Econ Policy Law, 1*(Pt 2), 99–105. doi: 10.1017/s1744133105001222

Perlin, J. B., Kolodner, R. M., & Roswell, R. H. (2004). The Veterans Health Administration: quality, value, accountability, and information as transforming strategies for patient-centered care. *Am J Manag Care, 10*(11 Pt 2), 828–836.

Pfister, D. G., Johnson, D. H., Azzoli, C. G., Sause, W., Smith, T. J., Baker, S., Jr., . . . Somerfield, M. R. (2004). American Society of Clinical Oncology treatment of unresectable non-small-cell lung cancer guideline: update 2003. *J Clin Oncol, 22*(2), 330–353. doi: 10.1200/jco.2004.09.053

Piccirillo, J. F., Creech, C., Zequeira, R., Anderson, S., & Johnston, A.S. (1999). Inclusion of comorbidity into oncology data registries. *J of Reg Mgmt, 26*(2), 66–70.

Pinckney, R. G., O'Brien, R., Piccirillo, J. F., & Littenberg, B. (2004). Evaluation of co-morbidity indices in patients admitted for chronic obstructive pulmonary disease. *Monaldi Arch Chest Dis, 61*(4), 209–212.

Pita-Fernandez, S., Montero-Martinez, C., Pertega-Diaz, S., & Verea-Hernando, H. (2003). Relationship between delayed diagnosis and the degree of invasion and survival in lung cancer. *J Clin Epid, 56*(9), 820–825.

Polite, B. N., Dignam, J. J., & Olopade, O. I. (2005). Colorectal cancer and race: understanding the differences in outcomes between African Americans and whites. *Med Clin North Am, 89*(4), 771–793. doi: 10.1016/j.mcna.2005.03.001

Potosky, A. L., Harlan, L. C., Kaplan, R. S., Johnson, K. A., & Lynch, C. F. (2002). Age, sex, and racial differences in the use of standard adjuvant therapy for colorectal cancer. *J Clin Oncol, 20*(5), 1192–1202.

Powell, A. A., Gravely, A. A., Ordin, D. L., Schlosser, J. E., & Partin, M. R. (2009). Timely follow-up of positive fecal occult blood tests strategies associated with improvement. *Am J Prev Med, 37*(2), 87–93. doi: 10.1016/j.amepre.2009.05.013

Powell, A. A., Nugent, S., Ordin, D. L., Noorbaloochi, S., & Partin, M. R. (2011). Evaluation of a VHA collaborative to improve follow-up after a positive colorectal cancer screening test. *Med Care, 49*(10), 897–903. doi: 10.1097/MLR.0b013e3182204944

Powell, A. A., Schultz, E. M., Ordin, D. L., Enderle, M. A., Graham, B. A., Partin, M. R., & Gould, M. K. (2008). Timeliness across the continuum of care in veterans with lung cancer. *J Thorac Oncol, 3*(9), 951–957. doi: 10.1097/JTO.0b013e3181839b60

Practice Management Information Corporation. (2006). *ICD-9-CM: International Classification of Diseases, 9th revision; Clinical Modification*, 6th edition (Hospital ed.). Los Angeles, CA: National Center for Health Statistics.

Pulte, D., Redaniel, M. T., Brenner, H., & Jeffreys, M. (2012). Changes in survival by ethnicity of patients with cancer between 1992–1996 and 2002–2006: is the

discrepancy decreasing? *Ann Oncol. 23*(9), 2428–2434. doi: 10.1093/annonc/mds023

Quarterman, R. L., McMillan, A., Ratcliffe, M. B., & Block, M. I. (2003). Effect of preoperative delay on prognosis for patients with early stage non-small cell lung cancer. *J Thorac Cardiovasc Surg, 125*(1), 108–113; discussion 113-114. doi: 10.1067/mtc.2003.93

Rabeneck, L., Souchek, J., & El-Serag, H. B. (2003). Survival of colorectal cancer patients hospitalized in the Veterans Affairs health care system. *Am J Gastro, 98*(5), 1186–1192. doi: 10.1111/j.1572-0241.2003.07448.x

Reed, J. F., 3rd, Baumann, M., Petzel, R., & Weeks, H. S., Jr. (1996). Data management of a pneumonia screening algorithm in Veterans Affairs medical centers. *J Med Syst, 20*(6), 395–401.

Renehan, A. G., Egger, M., Saunders, M. P., & O'Dwyer, S. T. (2002). Impact on survival of intensive follow up after curative resection for colorectal cancer: systematic review and meta-analysis of randomised trials. *BMJ, 324*(7341), 813.

Rex, D. K., Kahi, C. J., Levin, B., Smith, R. A., Bond, J. H., Brooks, D., . . . Winawer, S. J. (2006). Guidelines for colonoscopy surveillance after cancer resection: a consensus update by the American Cancer Society and US Multi-Society Task Force on Colorectal Cancer. *CA Cancer J Clin, 56*(3), 160–167; quiz 185–186.

Rhoads, K. F., Cullen, J., Ngo, J. V., & Wren, S. M. (2012). Racial and ethnic differences in lymph node examination after colon cancer resection do not completely explain disparities in mortality. *Cancer, 118*(2), 469–477. doi: 10.1002/cncr.26316

Rich, S. E., Kuyateh, F. M., Dwyer, D. M., Groves, C., & Steinberger, E. K. (2011). Trends in self-reported health care provider recommendations for colorectal cancer screening by race. *Prev Med, 53*(1-2), 70–75. doi: 10.1016/j.ypmed.2011.05.014

Richards, R. J., & Reker, D. M. (2002). Racial differences in use of colonoscopy, sigmoidoscopy, and barium enema in Medicare beneficiaries. *Dig Dis Sci, 47*(12), 2715-2719.

Riedel, R. F., Wang, X., McCormack, M., Toloza, E., Montana, G. S., Schreiber, G., & Kelley, M. J. (2006). Impact of a multidisciplinary thoracic oncology clinic on the timeliness of care. *J Thorac Oncol, 1*(7), 692–696.

Robinson, C. N., Balentine, C. J., Marshall, C. L., Anaya, D. A., Artinyan, A., Awad, S. A., . . . Berger, D. H. (2010). Ethnic disparities are reduced in VA colon cancer patients. *Am J Surg, 200*(5), 636–639. doi: 10.1016/j.amjsurg.2010.07.020

Sabounchi, S., Keihanian, S., & Anand, B. S. (2012). Impact of race on colorectal cancer. *Clin Colorectal Cancer, 11*(1), 66–70. doi: 10.1016/j.clcc.2011.03.026

Saha, S., Freeman, M., Toure, J., Tippens, K. M., Weeks, C., & Ibrahim, S. (2008). Racial and ethnic disparities in the VA health care system: a systematic review. *J Gen Intern Med, 23*(5), 654–671. doi: 10.1007/s11606-008-0521-4

Saito, A. M., Landrum, M. B., Neville, B. A., Ayanian, J. Z., Weeks, J. C., & Earle, C. C. (2011). Hospice care and survival among elderly patients with lung cancer. *J Palliat Med, 14*(8), 929–939. doi: 10.1089/jpm.2010.0522

Salomaa, E. R., Sallinen, S., Hiekkanen, H., & Liippo, K. (2005). Delays in the diagnosis and treatment of lung cancer. *Chest, 128*(4), 2282–2288. doi: 10.1378/chest.128.4.2282

Salz, T., Weinberger, M., Ayanian, J. Z., Brewer, N. T., Earle, C. C., Elston Lafata, J., . . . Sandler, R. S. (2010). Variation in use of surveillance colonoscopy among colorectal cancer survivors in the United States. *BMC Health Serv Res, 10*, 256. doi: 10.1186/1472-6963-10-256

Salz, T., Woo, H., Starr, T. D., Jandorf, L. H., & Duhamel, K. N. (2012). Ethnic disparities in colonoscopy use among colorectal cancer survivors: a systematic review. *J Cancer Surviv*. doi: 10.1007/s11764-012-0231-0

Sawin, C. T., Walder, D. J., Bross, D. S., & Pogach, L. M. (2004). Diabetes process and outcome measures in the Department of Veterans Affairs. *Diabetes Care, 27 Suppl 2*, B90–B94.

Scheithauer, W., McKendrick, J., Begbie, S., Borner, M., Burns, W. I., Burris, H. A., . . . Twelves, C. (2003). Oral capecitabine as an alternative to i.v. 5-fluorouracil-based adjuvant therapy for colon cancer: safety results of a randomized, phase III trial. *Ann Oncol, 14*(12), 1735–1743.

Schrag, D., Cramer, L. D., Bach, P. B., & Begg, C. B. (2001). Age and adjuvant chemotherapy use after surgery for stage I colon cancer. *J Natl Cancer Inst, 93*(11), 850–857.

Schultz, E. M., Powell, A. A., McMillan, A., Olsson, J. K., Enderle, M. A., Graham, B. A., . . . Gould, M. K. (2009). Hospital characteristics associated with timeliness of care in veterans with lung cancer. *Am J Respir Crit Care Med, 179*(7), 595–600. doi: 10.1164/rccm.200806-890OC

Schwartz, K. L., Crossley-May, H., Vigneau, F. D., Brown, K., & Banerjee, M. (2003). Race, socioeconomic status and stage at diagnosis for five common malignancies. *Cancer Causes Control, 14*(8), 761–766.

Shavers, V. L. (2007). Racial/ethnic variation in the anatomic subsite location of in situ and invasive cancers of the colon. *J Natl Med Assoc, 99*(7), 733–748.

Shavers, V. L., & Brown, M. L. (2002). Racial and ethnic disparities in the receipt of cancer treatment. *J Natl Cancer Inst, 94*(5), 334–357.

Shih, Y. C., Elting, L. S., & Halpern, M. T. (2009). Factors associated with immunotherapy use among newly diagnosed cancer patients. *Med Care, 47*(9), 948–958. doi: 10.1097/MLR.0b013e31819a5b2b

Shortell, S. M., Casalino, L. P., & Fisher, E. S. (2010). How the Center for Medicare and Medicaid Innovation should test accountable care organizations. *Health Aff (Millwood), 29*(7), 1293–1298. doi: 10.1377/hlthaff.2010.0453

Shugarman, L. R., Mack, K., Sorbero, M. E., Tian, H., Jain, A. K., Ashwood, J. S., & Asch, S. M. (2009). Race and sex differences in the receipt of timely and appropriate lung cancer treatment. *Med Care, 47*(7), 774-781. doi: 10.1097/MLR.0b013e3181a393fe

Sidak, Z. (1967). Rectangular confidence regions for the means of multivariate normal distributions. *Journal of the American Statistical Association, 62*(31), 626–633.

Siddiqui, F., Bae, K., Langer, C. J., Coyne, J. C., Gamerman, V., Komaki, R., . . . Movsas, B. (2010). The influence of gender, race, and marital status on survival in lung cancer patients: analysis of Radiation Therapy Oncology Group trials. *J Thorac Oncol, 5*(5), 631–639.

Siegel, R., Naishadham, D., & Jemal, A. (2012). Cancer statistics, 2012. *CA Cancer J Clin, 62*(1), 10–29. doi: 10.3322/caac.20138

Singh, G. K., Williams, S. D., Siahpush, M., & Mulhollen, A. (2011). Socioeconomic, rural-urban, and racial inequalities in US cancer mortality: part I-all cancers and lung cancer and part II-colorectal, prostate, breast, and cervical cancers. *J Cancer Epidemiol, 2011*, 107497. doi: 10.1155/2011/107497

Soares, M., Salluh, J. I., Ferreira, C. G., Luiz, R. R., Spector, N., & Rocco, J. R. (2005). Impact of two different comorbidity measures on the 6-month mortality of critically ill cancer patients. *Int Care Med, 31*(3), 408–415. doi: 10.1007/s00134-005-2554-z

Suga, J. M., Nguyen, D. V., Mohammed, S. M., Brown, M., Calhoun, R., Yoneda, K., . . . Lara, P. N., Jr. (2010). Racial disparities on the use of invasive and noninvasive staging in patients with non-small cell lung cancer. *J Thorac Oncol, 5*(11), 1772–1778. doi: 10.1097/JTO.0b013e3181f69f22

Temel, J. S., Greer, J. A., Muzikansky, A., Gallagher, E. R., Admane, S., Jackson, V. A., . . . Lynch, T. J. (2010). Early palliative care for patients with metastatic non-small-cell lung cancer. *N Engl J Med, 363*(8), 733–742. doi: 10.1056/NEJMoa1000678

Trivedi, A. N., & Grebla, R. C. (2011). Quality and equity of care in the Veterans Affairs health-care system and in Medicare Advantage health plans. *Med Care, 49*(6), 560–568. doi: 10.1097/MLR.0b013e31820fb0f6

Trivedi, A. N., Matula, S., Miake-Lye, I., Glassman, P. A., Shekelle, P., & Asch, S. (2011). Systematic review: comparison of the quality of medical care in Veterans Affairs and non-Veterans Affairs settings. *Med Care, 49*(1), 76–88. doi: 10.1097/MLR.0b013e3181f53575

Twelves, C., Wong, A., Nowacki, M. P., Abt, M., Burris, H., 3rd, Carrato, A., . . . Scheithauer, W. (2005). Capecitabine as adjuvant treatment for stage III colon cancer. *N Engl J Med, 352*(26), 2696–2704. doi: 10.1056/NEJMoa043116

U.S. Department of Veterans Affairs. (2002). Diseases specific to radiation-exposed veterans. Final rule. *Fed Regist, 67*(17), 3612–3616.

U.S. Department of Veterans Affairs. (2010). Veterans Health Administration interactive U.S. map. Retrieved September 30, 2011, from http://www2.va.gov/directory/guide/map.asp?dnum=1.

U.S. Department of Veterans Affairs. (2011). Ratings and Evaluations; Service Connection 3.303-1. Retrieved October 30, 2011, from http://www.benefits.va.gov/WARMS/docs/regs/38cfr/bookb/part3/s3_303.doc.

U.S. Department of Veterans Affairs. (2009). VA Health Care Eligibility & Enrollment. Retrieved October 30, 2011 from http://www.va.gov/healthbenefits.

von Gunten, C. F., Lutz, S., & Ferris, F. D. (2011). Why oncologists should refer patients earlier for hospice care. *Oncology (Williston Park), 25*(13), 1278–1280, 1282-1275.

Wagner, E. H., Austin, B. T., Davis, C., Hindmarsh, M., Schaefer, J., & Bonomi, A. (2001). Improving chronic illness care: translating evidence into action. *Health Aff (Millwood), 20*(6), 64–78.

Wagner, E. H., Bennett, S. M., Austin, B. T., Greene, S. M., Schaefer, J. K., & Vonkorff, M. (2005). Finding common ground: patient-centeredness and evidence-based chronic illness care. *J Altern Comp Med, 11 Suppl 1*, S7–S15. doi: 10.1089/acm.2005.11.s-7

White, A., Liu, C. C., Xia, R., Burau, K., Cormier, J., Chan, W., & Du, X. L. (2008). Racial disparities and treatment trends in a large cohort of elderly African Americans and Caucasians with colorectal cancer, 1991 to 2002. *Cancer, 113*(12), 3400–3409. doi: 10.1002/cncr.23924

White, A., Vernon, S. W., Franzini, L., & Du, X. L. (2010). Racial disparities in colorectal cancer survival: to what extent are racial disparities explained by differences in treatment, tumor characteristics, or hospital characteristics? *Cancer, 116*(19), 4622–4631. doi: 10.1002/cncr.25395

White, A., Vernon, S. W., Franzini, L., & Du, X. L. (2011). Racial and ethnic disparities in colorectal cancer screening persisted despite expansion of Medicare's screening reimbursement. *Cancer Epidemiol Biomarkers Prev, 20*(5), 811–817. doi: 10.1158/1055-9965.epi-09-0963

Williams, C. D., Provenzale, D., Stechuchak, K. M., & Kelley, M. J. (2012). Impact of race on early-stage lung cancer treatment and outcome. *Federal Practitioner.* Retrieved January 31, 2013, from http://www.fedprac.com/AVAHO/PDF/Williams.pdf.

Williams, C. D., Stechuchak, K. M., Zullig, L. L., Provenzale, D., & Kelley, M. J. (2012). Influence of comorbidity on racial differences in receipt of surgery among US veterans with early-stage non-small-cell lung cancer. *J Clin Oncol. 31*(4), 475–481. doi: 10.1200/JCO.2012.44.1170.

Wilson, N. J., & Kizer, K. W. (1998). Oncology management by the "new" Veterans Health Administration. *Cancer, 82*(10 Suppl), 2003–2009.

Winawer, S., Fletcher, R., Rex, D., Bond, J., Burt, R., Ferrucci, J., . . . Simmang, C. (2003). Colorectal cancer screening and surveillance: clinical guidelines and rationale-update based on new evidence. *Gastroenterology, 124*(2), 544–560. doi: 10.1053/gast.2003.50044

Winn, R. J., Botnick, W., & Dozier, N. (1996). The NCCN Guidelines Development Program. *Oncology (Williston Park), 10*(11 Suppl), 23–28.

Wooldridge, J.M. (2008). *Introductory Econometrics: A Modern Approach*, 4th ed. Mason, OH: South-Western.

Yothers, G., Sargent, D. J., Wolmark, N., Goldberg, R. M., O'Connell, M. J., Benedetti, J. K., . . . Blackstock, A. W. (2011). Outcomes among Black

patients with stage II and III colon cancer receiving chemotherapy: an analysis of ACCENT adjuvant trials. *J Natl Cancer Inst, 103*(20), 1498–1506. doi: 10.1093/jnci/djr310

Young, J. L., Roffers, S. D., Ries, L. A. G., Fritz, A. G., & Hurlbut, A. A. (2001). *SEER Summary Staging Manual - 2000: Codes and Coding Instructions* (N. C. Institute, Trans.). Bethesda, MD: National Cancer Institute.

Zapka, J. G., Taplin, S. H., Solberg, L. I., & Manos, M. M. (2003). A framework for improving the quality of cancer care: the case of breast and cervical cancer screening. *Cancer Epidemiol Biomarkers Prev, 12*(1), 4–13.

Zheng, L., Enewold, L., Zahm, S. H., Shriver, C. D., Zhou, J., Marrogi, A., . . . Zhu, K. (2012). Lung cancer survival among Black and White patients in an equal access health system. *Cancer Epidemiol Biomarkers Prev, 21*(10), 1841–1847. doi: 10.1158/1055-9965.epi-12-0560

Zook, C. J., Savickis, S. F., & Moore, F. D. (1980). Repeated hospitalization for the same disease: a multiplier of national health costs. *Milbank Mem Fund Q Health Soc, 58*(3), 454–471.

Zullig, L. L., Jackson, G. L., Dorn, R. A., Provenzale, D. T., McNeil, R., Thomas, C. M., & Kelley, M. J. (2012). Cancer incidence among patients of the U.S. Veterans Affairs health care system. *Mil Med, 177*(6), 693–701.

Zullig, L. L., Jackson, G. L., Provenzale, D., Griffin, J. M., Phelan, S., & van Ryn, M. (2011). Transportation - a vehicle or roadblock to cancer care for VA patients with colorectal cancer? *Clin Colorectal Cancer. 11*(1), 60–65. doi: 10.1016/j.clcc.2011.05.001

Zullig, L. L., Provenzale, D. T., McNeil, R. B., Abbott, D., & Jackson, G. L. (2011). *The Effect of Race on Receipt of Guideline-Concordant Surveillance Colonoscopy [abstract]*. Association of Veterans Affairs Hematology & Oncology. Oral presentation given in Kansas City, MO.