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Variations in Health Services Utilization by Patients with Prostate Cancer

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VARIATIONS IN HEALTH SERVICES UTILIZATION BY PATIENTS WITH PROSTATE CANCER

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ABSTRACT

Among men living in the United States, prostate cancer is the second leading cause of cancer death, and, excluding skin cancers, it is the cancer diagnosed most frequently. While incidence and mortality rates have been declining, the American Cancer Society estimated that there were 220,800 men diagnosed with prostate cancer and more than 27,500 prostate cancer deaths in 2015. Various patient-level and community-level factors have been shown to influence the differential patterns of diagnosis, care, and outcomes for men with prostate cancer. Detailed information regarding the utilization of health services by prostate cancer patients, particularly those with higher propensity for health services use, could be used to inform efforts intended to improve the coordination and delivery of care to work towards the elimination of disparities. The purpose of the study is to facilitate a better understanding of the determinants of health services utilization by older males with prostate cancer in the United States by examining the relative influence and interaction effects of factors characterizing individual patients and their county of residence.

Andersen's behavioral model of health services utilization is used as a framework to guide this study. A cross-sectional design is used to analyze administrative claims data from the 2008 Medicare Provider Analysis Review (MEDPAR) file (n=5,754). County-level data from Area Health Resources File (ARHF) are merged to include the community and contextual characteristics. American Hospital Association (AHA) annual survey data are also used to examine the importance of hospital attributes in a subset analysis (n=555). A two-stage approach is used for analyzing the data. First, several social and demographic variables are included in automatic interaction detector (AID) analysis to identify relatively homogenous subgroups of patients with similar service utilization patterns for emergency room visits and hospital length of stay. Second, regression analysis is performed in the full dataset including all patients, and in each subgroup to determine the amount of variance explained by predictor variables categorized as predisposing, enabling, and need-for-care factors. Hierarchical logistic regression is performed to analyze the variability in emergency room use, and hierarchical multiple regression is performed to analyze the variability in hospital length of stay.

The results show that the need-for-care factors are dominant predictors of service use. However, the relative importance of the predictor variables varies by subgroups of prostate cancer patients identified in the initial AID analysis. The findings lend some support of the use of an integrated approach to examine the personal and social determinants of health services utilization by prostate cancer patients enrolled in the U.S. Medicare program. The theoretical framework and analytic approach employed in this study make it possible to obtain an in-depth understanding of the influential factors associated with emergency room use and length of stay for all-cause hospitalizations, which can be used to inform future research and efforts aimed at developing targeted interventions to improve the coordinated care and to reduce health disparities among Medicare beneficiaries with prostate cancer.

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LIST OF ACRONYMS/ABBREVIATIONS

AA	African American
AHA	American Hospital Association
AHRF	Area Health Resources File
AHRQ	Agency for Healthcare Research and Quality
AID	Automatic Interaction Detector
ACoS	American College of Surgeons
CMS	Centers for Medicare and Medicaid Services
ER	Emergency Room
FIPS	Federal Information Processing Standard
HPSA	Health Professional Shortage Area
HRSA	Health Resources and Services Administration
ICD-9-CM	International Classification of Disease, 9th edition, Clinical Modification
ICU	Intensive Care Unit
MEDPAR	Medicare Provider Analysis Review
NCI	National Cancer Institute
OR	Odds Ratio
PEDSF	Patient Entitlement and Diagnosis Summary File
PSA	Prostate-Specific Antigen
SEER	Surveillance, Epidemiology and End Results
SSA	Social Security Administration
VIF	Variance Inflation Factor

CHAPTER ONE: INTRODUCTION

Problem and Its Significance

Among males living in the U.S., prostate cancer is the second leading cause of cancer death, and, excluding skin cancers, remains the cancer diagnosed most frequently. In 2015, an estimated 220,800 men will be diagnosed with prostate cancer and more than 27,500 will die from it. According to the American Cancer Society, approximately 25 years ago, prostate cancer incidence numbers increased considerably as a result of more screening using the prostate-specific antigen (PSA) blood test, but since then, there has been a decline in the rates of incidence as well as death. Incidence rates have decreased by 2.8% each year in men 65 and older and were stable in those younger than 65 from 2007 to 2011; death rates have declined by 3.2% each year during that same time period. Although there have been declines in prostate cancer incidence and death rates, in black men, the incidence rates are approximately 60% higher and death rates are more than twice that of other racial and ethnic groups (American Cancer Society, 2015, p.20).

The burden of prostate cancer is quite complex. There are numerous issues confounding the problem, such as the lack of consensus about screening to diagnose prostate cancer and which of the multiple treatment options is optimal, challenges identifying and reaching those who are most at risk, variations in access to the providers and quality care needed to reduce adverse health outcomes, and high costs to both the patient and health care system. Most often, it is believed that when cancer is diagnosed early, treatment is more effective and less costly.

Screening with PSA test to diagnose prostate cancer, however, has been met with greater uncertainty. Randomized clinical trials have not found there to be survival increases using this screening test, and there are conflicting views on whether or not the risk of potential treatment side effects is greater than the benefit of diagnosing and treating the cancers found through PSA based screening (Ross, Taylor & Howard, 2011, p. 229).

While increasing age, African ancestry, a family history, and genetic susceptibility due to certain inherited conditions are said to be the only well-established risk factors for prostate cancer, studies have provided evidence suggesting a number of other potentially impactful factors, such as particular dietary choices also increase risk, a higher risk of aggressive prostate cancer due to obesity, association between smoking and prostate cancer death, and disparities in health practices and the delivery and utilization of care between groups according to race/ethnicity, socioeconomics, and/or geography (American Cancer Society, 2015, p. 20; DeChello, Gregorio, & Samociuk, 2006, pp. 59-60). Although “the literature has contradictory findings” and “the reasons why the poor present with more advanced stages are unclear,” studies have identified factors such as diet, race, lack of health insurance, being poor, and, low literacy as being possible influences (Brawley & Jani, 2007, p. 214).

Most prostate cancer patients, 93%, are diagnosed with local or regional stage, which has a 5-year relative survival rate of nearly 100%, and research into new biologic markers to improve the distinction between indolent and aggressive prostate cancer is underway (American Cancer Society, 2015, p. 20). However, it currently remains that some patients will have prostate cancer that is at an advanced stage and/or has spread, and thus have distinct needs which may impact the utilization of health services. Metastasis to the bone can put patients at risk for various complications which are associated with impaired health-related quality of life, greater comorbidity, decreased survival, and increased healthcare costs. Improved coordination across various clinical services and care settings can be supported through detailed information concerning the health services utilized following the diagnosis of advanced-stage prostate cancer (Hagiwara, Delea, Saville & Chung, 2013, p. 23; Yong, Onukwugha, Mullins, Seal & Hussain, 2014, p. 297). The costs to Medicare for care of prostate cancer patients in the last year of life is estimated to be $34,000 (American Cancer Society Cancer Action Network, 2012, p.19).

The various aspects and issues that may potentially make it challenging to adequately identify the specific individuals and populations likely to be faced with this disease are met with the additional difficulties associated with the development of targeted interventions to better coordinate care and control costs. Variations in the use of services, care patterns and survival outcomes of prostate cancer patients have been documented, indicating that there is a lack of equality in the health and healthcare for men diagnosed with this disease. There have been observed differences in the use of specialist services by race among older men with prostate cancer due to patient-level and community factors (Onukwugha, et al., 2014), and in the use of mental health services by cancer patients who are disadvantaged ethnic minorities and are potentially not receiving the same recommendations for mental health problems as other cancer patients (Nakash, Nagar, Alon, Gottried, & Levav, 2012). Care and mortality differences have been found to exist across individual-level factors, such as race, age, and marital status, as well as across area-level factors, like the number of physicians, poverty rate, and racial distribution. On the issue of care patterns for prostate cancer, Brawley and Jani (2007) state, “There are significant data to show disparities in the amount and type of treatment given by a number of parameters. There are clear age, racial, and SES differences in patterns of care received” (p. 218).

Researchers have reported observed disparities in prostate cancer treatment and survival for different racial/ethnic groups, health care settings, and socioeconomic classes (Onega, et al., 2010; Rapiti, et al., 2009). The utilization of therapies for localized prostate cancer has also been found to vary by race, geography, and health care setting; when differences in disease biology cannot be used to explain such variations, it is possible that there are inequities in care delivery (Spencer, et al., 2008, p. 3736). The factors that have been shown to influence such variabilities are attributes of not only the individual, but also the social structure and contextual environment.

It is important to understand the determinants of racial and ethnic disparities in health resource utilization, treatment, cost, and mortality when developing policies intended to effectively improve the quality of care prostate cancer patients receive (Jayadevappa, Chhatre, Johnson, & Malkowicz, 2011, p. 97). After reviewing numerous studies, the Institute of Medicine disclosed that racial and ethnic disparities actually decline to some degree when variation in health insurance coverage and system attributes that influence access to and quality of healthcare are accounted for in analyses (Onega, et al., 2010, p.2698). This highlights the need for contextual factors to be included in research, as availability of resources and way in which care is delivered can account for some of the variation that may otherwise attributed to personal or social factors.

The health care delivery system is common topic among researchers, decision makers, politicians, and individuals; it often seems like an almost unavoidable topic. A massive effort to reform the U.S. health care system began in 2010 when the Patient Protection and Affordable Care Act was signed into law. This legislation impacted oncology in several ways. By broadening cancer care to millions of additional Americans and expanding Medicaid, more patients with cancer are able to have coverage, which eliminates ethical dilemmas associated with the care they receive, and could help with earlier diagnosis and improved outcomes. Insurers must cover at least one drug of each type, thus granting broader treatment coverage, and they are prohibited from denying coverage for investigational trials, preexisting conditions, or technicalities. Annual or lifetime caps on coverage are also prohibited. Closing the hole in Medicare Part B eliminates high out of pocket expenses, making costly drugs more affordable. Important necessities in cancer care such physical therapy are covered, and preauthorization for emergency room care is no longer required (Kantarjian, Steensma, & Light, 2014, p. 1601). As provisions of the Affordable Care Act are implemented and evolve, and new ideas and proposals are put forth, there will continue to be a need for reliable and useful information.

Policy makers and public health professionals are often tasked with determining how resources, which are often limited, should be dispensed, and which strategies are best for individuals, communities, and society as a whole. The Agency for Healthcare Research and Quality (AHRQ) reported in 2009 that in comparison to other conditions, cancer care-related hospitalizations are lengthier and cost $5,700 more for each stay, and for nearly half of these hospital stays Medicare was identified as the payer. In 2010, national expenditures for cancer care were estimated to be $124 billion; this amount is expected to rise to $173 billion in 2020 (Manzano, Lou, Elting, George, & Suarez-Almazor, 2014, p. 3527). Medicare spending for cancer care totaled $34.4 billion in 2011. Prostate cancer accounted for 10% of these expenditures. The out-of-pocket costs are 15% higher for Medicare beneficiaries with cancer compared to those who do not have cancer; for prostate cancer patients, out-of-pocket costs are estimated to be 18% higher (American Cancer Society Cancer Action Network, 2012, pp. 15-16). Given the high costs associated with cancer care, and the need for equitable and effective public policies, efforts to better understand factors that impede or facilitate the utilization of services, and modify and/or develop interventions as necessary continue to be important.

Health behavior research has been approached from multiple perspectives. As such, the way in which health is defined may differ based on the profession or discipline. “Physicians, sociologists, anthropologists, and psychologists offer different definitions of health and illness” according to Gochman (1997), describing the emphasis that physicians place on pathology, while the emphasis by psychologists is feelings of well-being, perceptions, and equilibrium, sociologists give emphasis to the ability to adhere to expected behavioral norms or perform roles and tasks, and symptom responses in relation to cultural implications is emphasized by anthropologists (pp. 9-10). Cancer has been widely studied by researchers across disciplines. The attention given to prostate cancer specifically has been ongoing and consistent over the years, and it too has been approached from multiple perspectives, such as psychology, sociology, and economics. These research efforts have contributed significantly to understanding the many issues surrounding the health and health care of prostate cancer patients. However, the problems that need to be addressed often occur in an environment that must simultaneously consider the aspects of individuals and communities, as well as costs and the care delivery system.

Despite what is already known about why variations might exist in the utilization of services, treatment and survival of prostate cancer patients, there are gaps remaining in the current level of knowledge surrounding specific characteristics and predictors contributing to such differences. Group differences in chronic disease outcomes are often attributed to variations in the utilization of health services, access to care, and treatment patterns (Freeman, Durazo-Arvizu, Arozullah, & Keys, 2003, p. 1706). The examination of health services utilization is needed for understanding access to services, identifying possible gaps in services, and improving organizational efficiency and cost-effectiveness (Treanor & Donnelly, 2012, p. 1). Decision makers and clinicians need to maintain an awareness of health resource utilization as new treatment patterns evolve, as comprehensive information on utilization of health services in patients with prostate cancer can help inform the conversation about resource use and emerging care patterns (Seal, et al., 2014, p. 556). Detailed information regarding the utilization of health services by prostate cancer patients, particularly those with higher propensity for health services use, could be used to support the coordination of health care delivery by considering the relative importance of various personal and societal factors.

Aday and Andersen (1974) describe health services utilization research as providing "a framework to describe those factors that inhibit of facilitate entrance to the health care delivery system as well as measurements of where, how often, and for what purposes entry is gained and how these inhibiting (or facilitating) factors operate to affect admittance" (p. 216). In order to develop appropriate, evidence-based public policies and other health interventions to support equitable and appropriate care needed by patients with the burdensome and complex disease of prostate cancer, information regarding the individual and contextual factors impacting the utilization of health services could be of great value.

Theoretical Framework

The behavioral model of health services use has been widely used by researchers as a framework to examine the use of various types of health services for numerous illnesses and conditions for an array of populations. Developed by Andersen in the late 1960's, this model was initially intended to support efforts aimed at understanding the reasons families use health services and the development of policies that encourage equitable access, and to address how equitable access is defined and measured (Andersen, 1995, p.1). According to the model, use depends on an individual's predisposition to use services based on demographic, social, and health belief factors, the ability to secure services given the personal and community resources available, and the level of need the illness presents as perceived by the individual and evaluated by medical professionals. These predisposing, enabling, and need-for-care factors constitute a sequence of conditions that contribute to whether or not people use services and the volume of services used (Andersen & Aday, 1978, p. 534). Andersen's initial behavioral model of the 1960s (Andersen, 1995, p. 2) is shown in Figure 1.

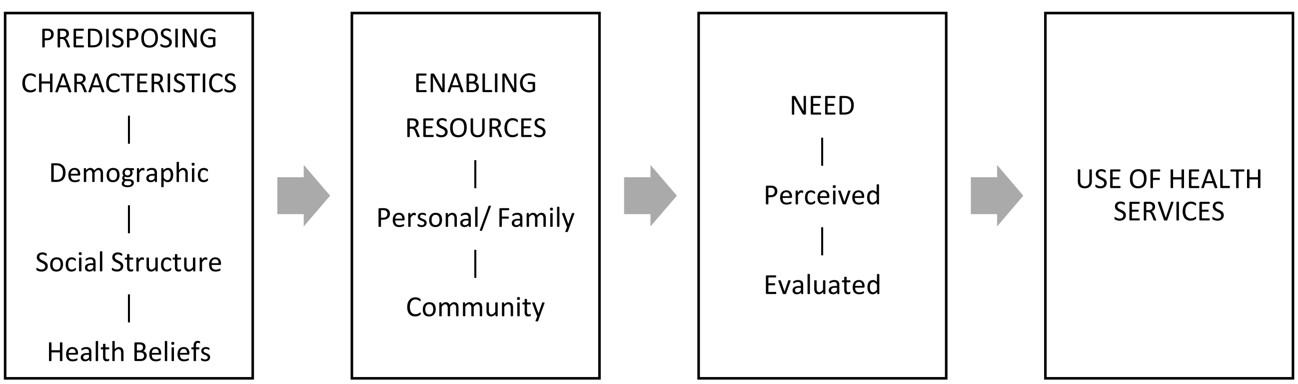

Figure 1. Andersen's Initial Behavioral Model

In the initial model, health services use is a function of predisposing characteristics, enabling resources, and need-for-care factors. These three categories of predictors remain to be a fundamental component in subsequent phases of the model. Over time, revisions were made to the model. Additions in phase two were the health care system, more detailed measures of use, and consumer satisfaction as an outcome of health services use. Outcome was expanded upon in the third phase with the addition of perceived and evaluated health status. Phase three also included the external environment and personal health practices (Andersen, 1995, pp. 5-6). These developments to the model are particularly relevant from a policy perspective given that not just the individual, but also many important factors regarding society, system organization, and resource use must be taken into consideration.

Aday and Awe (1997) describe several defining contributions of this model to research in the field of health service use as: 1) systematic characterization of service utilization predictors as predisposing, enabling, and need factors; 2) delineation of utilization indicators based on type of service and reason for use; 3) specifying the hypothesized relationship between predictive factors and indicators of use; and 4) provision of an integrated theoretical and empirical approach that is generalizable to various populations and health policy problems (p. 154). The ability to provide an integrated approach is of particular importance as it prevents analyses from being restricted by a single discipline or dimension of a problem. While this model has been frequently employed in studies of health services utilization, its application has been less frequent in prostate cancer studies, which are often approached from a single perspective such as the psychological perspective, sociological perspective, or economic perspective. The broad perspectives in prostate cancer research will be discussed in greater detail in Chapter Two.

A comprehensive understanding of the individual and societal determinants of use can provide new information that offers a valuable contribution to distinguishing variations in health services utilization patterns by prostate cancer patients. Andersen and Newman (1973) describe that in this model, the utilization of services is recognized as “a type of individual behavior,” and societal determinants are also taken into account, as these factors "are shown to affect the individual determinants both directly and through the health services system" (Andersen & Newman, 1973, pp. 96-97). A social behavior system model provides an integrated approach that is not confined by a single perspective.

Figure 2 shows the schematic diagram for the modified model that is used in this analysis of health services utilization by prostate cancer patients. The modified model does not include the causal relationships among predictors that are hypothesized in Andersen's model, in order to allow for its use with the cross-sectional data available for this study. This model does, however, still provide the opportunity to use an integrated approach to examine the individual and social factors that are influential predictors of health services use.

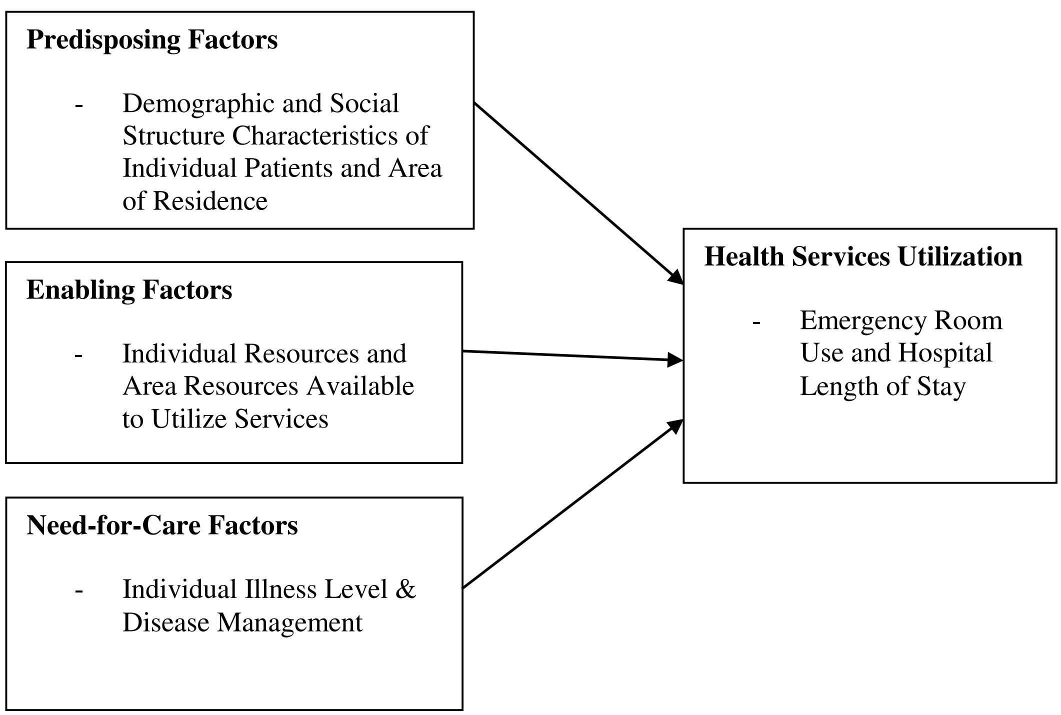

Figure 2. Schematic diagram of modified model for analyzing utilization of inpatient health services by prostate cancer patients

Aims of the Study

The purpose of this study is to facilitate a better understanding of the determinants of health services utilization by older males with prostate cancer in the United States. The research problem explored focuses on reasons for differential use patterns of services by examining predisposing factors, enabling factors, and need-for-care factors characterizing individual patients and their county of residence to determine which factors are the most important predictors, the degree to which they impact use, and their interaction effects. Distinguishing the sources of variation in hospital length of stay and use of emergency room services may make it possible to identify personal and/or social aspects impacting health services utilization behaviors and determine the relative importance of such factors to provide an indication of use patterns in the sample population and possible homogenous subgroups. The sample population includes patients that have been diagnosed with prostate cancer. These patients are Part A Medicare beneficiaries who have been admitted to the hospital for any condition at least once in the 2007 calendar year.

The following research questions are addressed:

1. What is the relative importance of predisposing factors, enabling factors, and need-for-care factors in accounting for variability in emergency room use among prostate cancer patients?

2. What is the relative importance of predisposing factors, enabling factors, and need-for-care factors in accounting for variability in hospital length of stay among prostate cancer patients?

3. To what degree does emergency room use have an effect on hospital length of stay among prostate cancer patients?

4. Do predisposing, enabling, and need-for-care factors show any important interaction effects accounting for the variability in the use of health services in specific subgroups of prostate cancer patients?

5. To what degree do hospital attributes influence the utilization of health services among prostate cancer patients?

Analytic Approach

This is a non-experimental study using a cross-sectional design, and a two stage approach for data analysis. Prostate cancer patients with inpatient records in administrative claims data from a single year are studied to observe influential factors associated with differential patterns of emergency room use and hospital length of stay. Based on the theoretical framework, the independent variables are categorized as predisposing, enabling and need-for-care factors, and take into account both personal and societal characteristics. This approach is intended to more precisely identify which factors are influential, their relative importance, and any important interaction effects to better understand variations in health services utilization by prostate cancer patients.

The analysis uses data from the Medicare Provider Analysis Review (MEDPAR) file. This file includes one summarized record per admission for all Medicare Part A inpatient hospital visits and skilled nursing facility bills during a single calendar year. Patient records that are excluded from the dataset include those that do not include a diagnosis of prostate cancer and skilled nursing facility admissions. The MEDPAR claims records make it possible to analyze variabilities in emergency room use and length of hospital stay by prostate cancer patients. Although a longitudinal analysis would have been more desirable, the 2008 MEDPAR file is the only year that is available to use for this project.

Two additional data sources are included in this study. Data regarding the contextual environment of the counties in which patients live is obtained from Area Health Resources Files (AHRF), which is generated by the U.S. Department of Health and Human Services, Health Resources and Services Administration (HRSA) using a collection of other data sources. American Hospital Association (AHA) Survey Data is used for information pertaining to hospital attributes. Analysis of hospital variables categorized as enabling factors is performed in only a subset of the administrative claims data due to the fact that only a portion of patient records are able to be matched with the facility information in the AHA survey dataset.

The first stage of data analysis uses the predictive modeling computer software DTREG to build classification and regression decision trees to identify subgroups of prostate cancer patients having homogeneous patterns of health services use through automatic interaction detector (AID) analysis. Several social and demographic variables are used as predictors to subdivide the sample into clusters presented in a single-tree model that includes a node for each split. By examining of the terminal nodes and information pertaining to the split points, it is possible to identify influential predictors and any important interaction effects between the variables. This stage of analysis is intended to identify subgroups of prostate cancer patients with similar use patterns and assess which factors and interactions of factors may be associated higher or lower utilization of emergency room services and hospital length of stay hospital by partitioning prostate cancer patients into subgroups with similar use patterns.

In the second stage of analysis, the computer software IBM SPSS Statistics version 23 Premium Grad Pack is used to analyze the influence and relative importance of the predisposing factors, enabling factors, and need-for-care factors as predictors of the dependent variables that have been selected to measure utilization of health services by prostate cancer patients. For each of the subgroups identified in stage one and for the entire sample, hierarchical binary logistic regression is performed for emergency room use, and hierarchical multiple regression analysis is performed for hospital length of stay. The hierarchical technique allows the researcher to enter blocks of predictor variables into the equation sequentially in order to assess their contribution in predicting the dependent variable while controlling for the factors entered in previous blocks (Pallant, 2007, p. 147). These methods make it possible to assess the amount of variance explained by predisposing, enabling, and need-for-care factors independently and when categories are combined by observing the change in pseudo R Square and R Square values as each group of independent variables is added to the model, as well as to identify the predictors that make a statistically significant unique contribution to the explained variance. Performing the regression analyses within each subgroup makes it possible to see how the relative influence of predictors changes based on the specific social and/or demographic characteristics of patient groups.

Hierarchical regression has been used in previous research guided by the Andersen model in order to examine the amount of variance in health services use that is explained by predisposing, enabling, and need-for-care factors as the groups of variables are entered sequentially and factors entered previously are controlled for (Chan & Wong, 2014; Staudt, 2000). Employing the hierarchical regression procedure allows for the influence of each category of independent variables to be assessed, as well as their joint influence. Health policy looks to alter characteristics that are more easily manipulated, such as enabling factors like income or health insurance coverage, when trying to impact access to care for population groups (Aday & Andersen, 1974, p. 214). The extent to which health services utilization is influenced by predisposing, enabling, and need-for-care is relevant from a policy perspective given the practicality of altering certain aspects versus other aspects. The use of hierarchical regression in this analysis makes it possible to assess the influence of each category of predictors as well as the relative influence of individual predictors.

Previous health services utilization research has also demonstrated that, through the use of multivariate analytical techniques, the complexity of factors influencing health services utilization behaviors can be examined to better understand what the most important determinants of utilization are, the magnitude of effects of particular factors, and possible interaction effects of factors (Wan & Soifer, 1975, p. 229). The interaction effects of certain variables can provide information that is of greater detail and useful for addressing issues. For example, the observed interactions between age, race, and socioeconomic status in prostate cancer research regarding the temporal trends in late-stage diagnosis can be applied to enhance local interventions or develop new strategies to improve the health of prostate cancer patients based on finding higher prevalence in patients who are black, aged 40 to 64, and of lower socioeconomic status (Goovaerts, et al., 2015). Given the complex burden of prostate cancer and need for specific information to better understand the differences of individual patients and populations, this analytical approach is appropriate to address the specific research questions in this study. The research design and methodology are described in detail in Chapter Three.

Significance of the Study

The potential theoretical, methodological, policy, and practical implications of conducting this research help to illustrate its relevance and usefulness. First, it does not appear that the utilization of health services by Medicare enrollees with prostate cancer has been studied using the theoretical framework and analytic approach employed in this analysis. The contributions made by previous research have shown that a comprehensive understanding of the predictors influencing the use health services by individuals and groups can be obtained using the behavioral model of health services utilization to examine predisposing, enabling, and need-for-care factors, as this integrated approach allows for the inclusion of both individual and societal determinants, while analytical techniques to determine the relative importance of predictors and their interaction effects can make it possible to identify individuals or groups with similar service utilization patterns (Andersen & Newman, 1973; Wan & Soifer, 1975; Wan & Yates, 1975).

The use of national administrative claims data to capture patient information and a national dataset to capture contextual factors provides the opportunity to further address the current gaps in understanding of the factors associated with variations in health services utilization patterns by Medicare beneficiaries with prostate cancer. The use of state-wide or state-based program data sets in previous research regarding the utilization of cancer services was reported to limit the ability to also account for area-level factors in which patients reside (Miller, et al., 2008; Mayer, Travers, Wyss, Leak & Waller, 2011). The inclusion of social aspects in analyses can be critical for understanding issues. Research has shown that difficulties in meeting health care needs were most likely to be encountered and reported by residents of disadvantaged counties, with challenges being related to factors like area level poverty and educational attainment more so than physician workforce and other health system characteristics, thus suggesting that policy interventions should not focus solely on increasing health system resources, but also seek to address contextual characteristics (Litaker & Love, 2005, pp. 188-191). Together, the data, analytical technique, and theoretical framework used in this study have the potential to yield new insightful information concerning the personal and social factors impacting the use of health services by prostate cancer patients and the ways in which the utilization patterns of these patients can better be studied and understood.

Additionally, the potential of this study to derive new information that is relevant to the existing body of research and ongoing efforts to understand and improve cancer care is significant from both a practical perspective and policy perspective. Information pertaining to trends in emergency room use and hospital length of stay can be important for understanding cost changes occurring over time and predicting future costs. Hospital stays are generally the greatest cost driver for any disease, and an awareness of patient populations that have a higher risk of seeking services through unplanned visits to the emergency room may enable health care providers to develop specific targeted strategies for symptom management, discharge planning, follow-up care (Lang, et al., 2009, p. 228; Bryant, et al., 2015, p. 410). This new information can potentially add to what is known about particular individual and contextual factors that influence aspects of prostate cancer service use and help to inform work concerning care and outcome disparities.

Existing research has highlighted the potential for such information to be applied to cancer care through policies and practices aimed at improving both patient health and costs. For example, better comorbidity management could reduce the number of hospitalizations among cancer patients. This could be achieved through sound coordination of oncologists, primary care providers, and impatient teams during patients' cancer trajectory. A better understanding of the factors that could lead to the use of a greater number of potentially avoidable inpatient services among cancer patients can aid policy makers and health care providers involved with resource allocation decisions, cancer care provider coordination, and patient education (Manzano, et al., 2014, p. 3532). Thus, identifying the relative importance of predisposing, enabling and need-for-care factors, and the ways in with their interactions impact use patterns by prostate cancer patients can be beneficial to inform the development of targeted interventions to improve health care delivery.

Finally, understanding the factors influencing service use by prostate cancer patients who are enrolled in Medicare is important from a public policy perspective The U.S. Medicare program was one of the federal government's major efforts to equalize access to health care through an economic approach, which mainly seeks to reduce the economic resources an individual or family must expend to receive care; thus, the design did not intend to directly address barriers considered noneconomic, like the geographic distribution of primary care providers or transportation issues (Aday & Andersen, 1974, p. 218). These types of factors, which would be considered enabling factors, may hold the greatest potential for policy change given that altering these aspects is generally more feasible than altering predisposing factors (Andersen & Newman, 1973, p. 119). Examining the characteristics of individuals and their contextual environment can help to clarify potential factors associated with the propensity for Medicare patients with prostate cancer utilize more health services.

Policy discussions related to Medicare frequently include the need for improvements in the coordination and delivery of care, and patient outcomes, as well concerns regarding costs for taxpayers and beneficiaries. Understanding the factors influencing service use, and the use patterns of certain patients can serve to inform such discussions. By identifying predictors of health care utilization, planned interventions to minimize certain factors can be carried out to minimize growing health care costs (de Boer, Wijket, & de Haes, 1997, p. 102). The approach for analyzing utilization variations proposed in this study can contribute to the existing knowledge surrounding how the specific needs and behaviors of distinct population subgroups might be better identified and understood in order to develop targeted intervention strategies that will deliver care and use resources more effectively and efficiently.

Studies have produced a substantial amount of information concerning variations in the utilization of health services for cancer care and, yet there are still gaps in what is known about the reasons for potential use pattern differences in prostate cancer patients. More in-depth analysis integrating the personal and social factors that impact utilization behaviors among men with prostate cancer is needed in order to develop a better understanding of what potentially predicts use and identify those with higher propensity for using health services in order to inform efforts aimed at better coordination of health care delivery. Currently, there appears to be no published studies that specifically address the predictors of health services utilization in prostate cancer patients who are enrolled in Medicare using the integrated approach, analytical methods, and data sources employed in this research study.

Organization of Chapters

Chapter two provides a review of the relevant literature, including discussion of the broad perspectives that are most prevalent in prostate cancer research, the contributions and potential limitations of these studies, the health behavior model, and the previous work that has demonstrated that has demonstrated the advantages of using this integrated approach.
Chapter three describes the research design and methodology this study employs. This includes discussion of the data sources, population and sample selection, measurement of the study variables, and methods for analysis. Chapter four describes the analytic procedures performed and the results obtained. Descriptive statistics, results of AID analysis and regression analysis, and conclusions of hypothesis testing are included in this chapter. Chapter five includes a discussion of the study findings, contributions, and limitations. This chapter concludes with recommendations for future research.

CHAPTER TWO: LITERATURE REVIEW

Introduction to Literature Review

Different approaches have been used to study the factors that may contribute to the variations in the utilization of health services among prostate cancer patients. The models used these analyses are frequently based on a perspective that focuses narrowly on attributes of the individual, societal elements, or economic and service resources of the contextual environment. The frameworks that are most prevalent in studies concerning the use of health services by men with prostate cancer can be broadly categorized as psychological, sociological, or economic approaches. While this research has produced valuable information to advance the understanding of the widely documented disparities in health and health care among patients facing this disease, there are limitations to what can be learned when analyses are confined to a single perspective.

Using an integrated approach to examine not only the individual and societal factors that may predict health services utilization, but also the context in which use occurs can provide a more comprehensive understanding of the important determinants of use which may be particularly important for influencing public policies. The behavior model of health services use incorporates demographic and social factors of individuals and their environment, the available personal and community resources that may facilitate or impede service use, and the level of need the illness presents. These predictors of utilization are systematically categorized as predisposing, enabling, and need-for-care factors. Previous research using this model has shown that various analytic techniques can be applied to determine the relative importance of predictors as well as their interaction effects to better understand the utilization patterns of individuals and subgroups within the population. Although the relevant prostate cancer literature does not include an ample number of studies using this model, this research and other analyses of health services utilization have provided empirical evidence to help guide the selection of predictors.

Approaches in Prostate Cancer Research

Prostate cancer research has been approached from numerous perspectives. The broad perspectives that can be used to categorize the frameworks most prevalently employed in studies include psychology, sociology, and economics. These studies have made important contributions to understanding factors associated with utilization of health services by men with prostate cancer. However, the influential predictors identified were not able to be fully analyzed along with additional determinants, thus limiting the knowledge gained regarding the relative influence and interactions of factors.

Psychological Approach

The utilization of health services by prostate cancer has been studied with focus on only the individual. Yong, Onukwugha, Mullins, Seal, and Hussain (2014) examined health services utilization among prostate cancer patients, focusing specifically on those who were diagnosed with stage four metastatic disease in order to better understand the relationship between the use of services and diagnosis of metastatic disease. This study aimed to address the utilization of services from the perspective of prior symptoms and illness state driving patients to seek using a conceptual framework based on Suchman's theory involving five stages an individual experiences when deciding whether or not to utilize health services. In this comparison of health services utilization between prostate cancer patients with metastatic disease and stage four prostate cancer patients without metastasis, the likelihood of skilled nursing facility use was found to be approximately double by those with metastasis. Greater comorbidity and poorer functional status were determined to be among the most influential predictors among men with advanced prostate cancer (pp. 291-296). Findings supported that increased disease burden can lead to greater utilization, which can inform decisions regarding the coordination of care for these patients. Additional attributes of the individuals and social structure or the contextual environment may also be influencing use, and a more complete understanding of these factors could enable even greater improvements for the coordination of care.

Examining a health education intervention to reduce the unnecessary utilization of health services, Inman, Maxon, Johnson, Myers, and Holland (2011) evaluated the use health care services 30 days following hospital discharge for radical prostatectomy to assess the effectiveness of an educational telephone follow-up intervention. Services included in this study were phone calls to doctor or nurse, clinic visits, emergency department visits, and hospitalization/ readmission. Among these prostate cancer patients, unplanned use of services was reported by 47% of those in the intervention group who received a follow-up telephone call and 60% of patients in the control group who received the usual care. The decrease in utilization of services was not found to be significant. (p. 90). Only the effectiveness of the intervention, which focused primarily on the individuals' behaviors, was assessed. Additional characteristics of the patient or contextual environment may have been influential.

Sociological Approach

Onukwugha, Osteen, Jayasekera, Mullis, Mair and Hussain (2014) evaluated the utilization of services by prostate cancer patients to determine the impact of race and ethnicity using the intersectionality perspective proposed by sociological theorists to depict how systems of inequality, such as race/ethnicity and class, overlap and result in unequal outcomes in society. This study focused on area-level deprivation and race/ethnicity, and found that the utilization of specialist services following prostate cancer diagnosis was lower among African American patients when compared to white patients. Factors associated with decreased likelihood of utilization of specialist visits following prostate cancer diagnosis include lack of reimbursement for services and not seeing a primary care physician. While this is consistent with previous findings regarding race differences in physician visits among older adults, it is of particular concern for prostate cancer given that disparities in treatment may result from differences in specialist visits. (pp. 1-6).

Using patient and community-level factors, this study made important contributions to the understanding of service utilization and disparities in prostate cancer. Given that the influential predictors are related to the availability of resources and the health care delivery system, the inclusion of factors characterizing these aspects may have provided an even greater level of understanding.

Economic Approach

The recent literature pertaining to the utilization of health services by prostate cancer patients has included a number of studies focused on advanced prostate cancer. In these analyses, increased costs associated with the utilization of services for care were the primary point of interest. Hagiwara, Delea, Saville and Chung (2013) conduced an episode of care analysis, which "represents a period initiated by patient presentation with a diagnosis of clinical condition and concluded when the condition is resolved" in order to determine the costs of skeletal-related events in patients with advanced prostate cancer that has metastasized to the bone. The intention was to understand the economic impact of providing care for patients with skeletal-related events and estimate potential cost savings from interventions to prevent these events (p.23). The findings regarding service utilization patterns were informative, showing that hospitalizations and costs are higher in patients with these particular complications. However, by not including any demographic factors or social structure characteristics in the analysis, it is not possible to examine the potential impact of other factors that may be associated with these care patterns.

Seal, et al. (2014) analyzed health care resource utilization and costs for patients with prostate cancer to compare those with bone metastasis to those without. The emergence of new therapies for prostate cancer and a lack of information regarding the costs associated with treatment patterns were the basis for this research focus of this evaluation Patients with bone metastasis were identified as having a greater likelihood of having inpatient care, emergency department admissions, and longer lengths of stay when hospitalized (pp.549-553). Again, there is new information that is of value, but only the economic resources required to provide care and patients' diagnosed health conditions were considered. These findings appear to consistently demonstrate that patients with more severe illness utilize more health services, and provide valuable information regarding the care patterns for prostate cancer patients. The lack of additional factors to better understand the individual and environment does not make it possible to assess whether or not need for care was the only influential factor.

Integrated Approach

Miller, et al., (2008) used the behavioral model of health services utilization to examine racial and ethnic disparities in health services utilization in men who are enrolled in a state program for uninsured low-income men with prostate cancer. In this study, the enabling factors were essentially the same for the entire study population because the program provides free and comprehensive prostate cancer treatment, including an assigned primary cancer care provider, a clinical care coordinator, and an enabling set of social service resources such as counseling and interpreter services, educational materials, and assistance with transportation, food, and housing. No association was found between race/ethnicity and either of the two utilization measures, use of emergency room care and frequency of surveillance PSA testing. Patient-reported outcomes did vary across race/ethnicity, with Hispanic men reporting very high satisfaction. The interpreter services and language-concordant educational materials provided through the program were presented as a possible explanation for this variation (pp. 319-326).

Although the use of an integrated model in this study did not enhance what is known about the effect of each predictor in differential use patterns, the lack of finding variation due to race and ethnicity when there are no differences in the necessary support and coverage related to care could underscore the importance of concepts regarding equitable access in the health care delivery system.

The prostate cancer literature reviewed was predominantly guided by frameworks drawing from a single perspective. The integrated approach of a social behavior system model allows for a more comprehensive analysis of the influential predictors and their relative importance health services utilization. A systematic review of health behavior research from 2000 to 2005 reported that theoretical frameworks including the community level were used in a relatively small number of articles, with the majority of articles employing individual-level or interpersonal-level theories (Painter, Borba, Hynes, Mays & Glanz, 2008, p. 361). While the community level was considered in the prostate cancer literature, few studies employed a model in which the community level and individual level were both incorporated.

Behavioral Model of Health Services Utilization

Andersen's behavioral model of health services utilization was selected as the theoretical framework to guide this analysis based on previous research which has demonstrated the model's capability to allow for the study of individual and social attributes as well as elements of the contextual environment. The ability to provide an integrated approach may be considered especially important for examination of health service use by prostate cancer patients given the various factors that could potentially be adding to the burden of this disease, and the lack of previous research that has used this model for this particular issue.

The literature highlights the versatility of this model and important contributions of research that has applied the framework. According to Andersen (1995), the model can be used to predict the utilization of health services given that each component can be viewed as contributing independently to predict use, but the model also suggests a causal ordering which may make it useful for explanatory purposes (pp. 1-2). Phillips, Morrison, Andersen and Aday (1998) describe model as a conceptual framework that "uses a systems perspective to integrate a range of individual, environmental, and provider-related factors associated with decisions to seek care" (p. 572). The inclusion of contextual variables, which are the environmental factors (i.e., characteristics of the healthcare delivery system, community, external environment) and provider-related factors (i.e., characteristics of the patients, providers, and their interactions) is of particular importance for research intended to develop or otherwise influence policies (Phillips, Morrison, Andersen, & Aday, 1998, pp. 572-573). Given that the decision making process involves consideration of not just the individual, but also the many contextual factors that may be involved, this may be an appropriate model for evaluations of numerous issues in the policy realm.

Health services utilization research has shown that an even greater level of understanding can be achieved, which may be of particular importance for the development of policy, through the use of the three categories of predictor variables (predisposing factors, enabling factors, and need-for-care factors) and application multivariate analysis techniques. The two-stage method used by Wan and Soifer (1975) to examine the predictors of physician utilization demonstrated that it is possible to obtain a more precise understanding of the factors that may impede or facilitate care by identifying the relative importance of predictors for the total study sample and for subgroups with similar utilization patterns (Wan & Soifer, 1975). This approach was also shown to be advantageous for the study of dental services utilization (Wan & Yates, 1975).

In the first stage, AID analysis was used to partition the sample into clusters with homogeneous patterns of use. Only social and demographic variables were used in this stage. In the second stage, multiple regression analysis was performed within each subgroup and on the entire study sample. Additional variables categorized as predisposing, enabling, and need-for-care factors were included for this stage, and all were considered simultaneously to determine the relative influence of predictors (Wan & Soifer, 1975; Wan & Yates, 1975). Understanding how the significance of predictors varies by subgroup makes it possible to better address the needs of these individuals by appropriately targeting the specific aspects that are influencing utilization patterns.

Predictors of Health Services Utilization

As described previously, according to the behavioral model of health services utilization, the use of health services depends on predisposing factors which include characteristics of demographics, social structure, and beliefs; enabling factors, which represent the availability of resources allowing for the use of services; and need-for-care factors, which represent the perceived or immediate illness level causing an individual to seek care. Although need-for-care factors appear to most consistently be the strongest predictors of utilization, throughout the literature, studies have shown variables from each category of these predictors to be influential in analyses of health services use. For example, in a review of studies regarding health services utilization patterns and determinants by cancer survivors, Treanor and Donnelly (2012) reported predictors of inpatient hospital care to include older age and impoverished residential area, as well as comorbid conditions (p. 17). The elements of these categories of predictors and their use in previous research that may be most relevant to the study of health services utilization by prostate cancer patients enrolled in Medicare is provided in this section.

Predisposing Factors

Predisposing factors include variables such as age, gender, race, ethnicity, and education. These are demographic and social structure factors and the health beliefs that may provide an indication of how likely it is that health services will be needed. Although not included in the initial model developed in the 1960s, genetic factors and psychological characteristics were later considered to be components that could be added as predisposing factors (Andersen, 1995, p. 2).

Age has often been reported to impact the utilization of health services in cancer care, with older patients being more likely to use health services. In two analyses health services utilization by prostate cancer patients with metastatic disease, hospitalization and skilled nursing facility use was found to be 12.6% and 0.3% respectively in a study population with a mean age of 78, while the respective estimates were much higher, 60.9% and 22.3% during the first year following diagnosis in a study population with a mean age of 59 (Hagiwara, et al., 2013, p. 25; Yong, et al., 2014, p. 297). Although the reported utilization differences may be attributable to various factors not captured in the research, these findings could also be reflective of the importance of age as a predictor of service use.

Differences in medical care utilized by men with prostate cancer have been found to exist between racial and ethnic groups. Incongruities in access and continuity in medical care have been suggested as a possible explanation for Hispanic men having lower utilization and awareness of prostate specific antigen (PSA) testing, and the increased likelihood for African-Americans to have care provided in public clinics or emergency departments and by different clinicians on subsequent visits related to their cancer (Miller, et al., 2008, pp. 318-319). Racial and ethnic disparities in prostate cancer treatment could potentially be associated with factors such as discrimination in the healthcare setting and uncertainty in clinical communication and decision making (Jayadevappa, et al., 2011, p. 104).

Enabling Factors

Enabling factors are the individual resources, such as health insurance and income, and measures of community resources, such as number of health facilities and personnel and the rural-urban nature of an area that can affect service utilization (Andersen & Newman, 1973, p.16). Obstacles pertaining to accessing the health care system and behaviors of patients and providers are often proposed to explain racial disparities in prostate cancer in the United States (Freeman, Durazo-Arvizu, Arozullah, & Keys, 2003, p. 1706). Sundmacher and Busse (2011) found that the rate of avoidable cancer deaths for most cancer types that are amenable to treatment was impacted by the number of physicians per 100,000 of the population. Areas with a higher number of physicians per capita may experience lower social and economic costs, such as decreased expenses for travel and wait times, to access health services, as well as better quality services if the larger supply leads to greater competition among physicians. This could serve to benefit cancer patients utilizing services in these areas, as they may be diagnosed earlier, have more specialized care, and increased number of necessary follow-up visits (Sundmacher & Busse, 2011, pp. 58-59).

The degree to which an area is considered to be rural or urban can present unique conditions which may facilitate or impede the use of health services. Compared to urban areas, rural areas often have higher levels of poverty and uninsured residents, fewer health care resources such as hospital beds, physicians, and specialists, and may face transportation challenges with accessing care. Despite urban areas having some of the greatest health care facilities and higher concentration of medical professionals, the distribution of these services is often not equal, and those living in poor inner-city communities may lack access to such care (Blumenthal & Kagen, 2002, p. 109). Contextual factors can be indicative of the resources available to individual and the community, and in turn may be important predictors of health service use.

Economic and health care system resources have been considered to explain variations in prostate cancer. For example, the lack of reimbursement for doctor visits has been associated with the decreased likelihood of prostate cancer patients' utilization of services by visiting specialists, and factors such as hospital location, size, and ownership may influence health resource utilization and treatment, as well as quality of care in prostate cancer patients (Onukwugha, et al., 2014, p.6; Jayadevappa, et al., 2011, p. 104). Furthermore, even individuals with benefits that ensure payment coverage of services may not have sufficient access to health care due to non-financial obstacles such as health behaviors, environmental factors, minority status, language, and availability of services, providers, and usual source of care (Miller, et al., 2008, p. 318).

Prostate cancer care decisions and patients' subsequent reactions to treatments can be impacted by genetic differences, as well as social and health system factors that affect access to and the availability of resources in a given area. Harlan, et al. (2001) examined factors associated with treatment for localized prostate cancer, finding that both clinical and nonclinical factors impacted the treatment men received. Additionally, it was reported that the use of particular treatments varied by geographic region and population subgroup, raising the question of whether or not access to all treatment options is provided to all patients. The lack of evidence concerning one method of treatment for prostate cancer over another is considered to be a probable cause for there being little agreement among healthcare providers as to how patients with this disease should be treated; in turn, treatment variations by geographic area, as well as a number of other nonclinical factors, could be attributable to this lack of consensus (Harlan, et al., 2001, pp. 1868-1870).

In a study of the use of treatment in older men with prostate cancer, Roberts, et al. (2011) found that comorbidity status did not predict the selection of treatment, while clinical factors, such as tumor characteristics, only slightly influenced such decisions; the most powerful predictor of therapy use was geographic area. A possible explanation for regional variations in treatment is that urologists and radiation oncologists are unevenly distributed across the U.S. given that the treatment suggested by these specialists tends to be that of their profession (Roberts, et al., 2011, p.242). Based on the current literature, the various individual and contextual characteristics that can be categorized as enabling factors have been influential predictors in studies concerning prostate cancer care.

Need-For-Care Factors

Need for care may include factors characterizing illness level, diagnoses, symptoms or complications. Wolinsky, et al. (2008) examined the emergency department utilization patterns and factors related to use among Medicare patients, and found that need-for-care factors were the strongest predictors of visits that required services deemed as life-threatening and appropriate for emergency care use, while residing in rural counties and small cities were among the most influential predictors of visits that required low intensity physician services which could have been provided in a setting outside of the emergency department and were presumed to be non-urgent or avoidable (pp.205-208). In a comprehensive review of studies concerning health services utilization in the chronically ill, de Boer, Wijker, and de Haes (1997) reported that the majority of research articles evaluated found predisposing and enabling factors to have very little impact on hospitalizations and physician visits, while need factors were consistently identified as major predictors of use for these services in chronically ill patients (pp.111-112).

For cancer patients, the severity of illness can rise to levels requiring the specialized care provided through intensive care units (ICU) due to conditions such as respiratory failure, infection, and bleeding (Kostakou, et al., 2014, pp. 817-818). Comorbidity is frequently identified as an influential predictor of health service use in cancer care. Shayne, et al. (2013) studied hospitalizations in cancer patients aged 65 and older, and reported comorbidity, advancing age, and race to be influential predictors of prolonged length of stay, with comorbidity having the greater impact (pp. 311-312). Legler, Bradley, and Carlson (2011) found inpatient hospitalizations and emergency room admissions to be high in cancer patients with multiple comorbid illnesses. The difficulties that these patients may face in managing a symptom crisis and the lack of necessary resources by some hospices to treat these patients at home were cited as possible explanations for the observed use patterns (p. 754). The effect of comorbidity on utilization shown in studies throughout the literature emphasizes the importance of need-for-care factors in predicting use.

Utilization of Health Services for Cancer Care

The utilization of health services can be described in terms of its type, site, purpose, and time interval. These distinctions can be helpful in understanding the demands that would be placed on the system, the care-seeking process, and the impact of various determinants (Aday & Andersen, 1974, pp. 214-215). Historically, the ability to successfully deliver the necessary and appropriate care to those who actually need it has been a challenge in America's health care system. From 1993 to 2003, there was a net decline in U.S. hospitals, impatient beds, and emergency departments of 11%, 17%, and 9% respectively. During this same time, the was a 12% increase in population size, 13% increase in hospital admissions, and 26% increase in emergency department visits. It has been reported that 91% of emergency departments experience overcrowding, with academic medical centers noting overcrowded emergency departments 35% of the time, and 40% of all emergency departments finding that this problem occurs on a daily basis (Wolinsky, et al., 2008, p. 204).

Emergency Room Services

Previous studies have offered information concerning factors that may cause cancer patients to utilize emergency services, as well as why an understanding of the determinants of use is important. Mayer, Travers, Wyss, Leak and Waller (2011) examined the reasons why cancer patients visit the emergency department using a state-wide population-based data set. Among prostate cancer patients, pain, respiratory problems, injury, and bleeding were the most common categories of chief complaints; the chief complaints most frequently cited by all cancer patients were in the categories of pain, respiratory problems, and gastrointestinal issues. The authors make the point that cancer care can be improved by understanding the reasons patients utilize emergency room services, as this information could make it possible to detect inadequacies in symptom management and/or the accessibility of regular oncology care, and then develop appropriate interventions (pp. 2685-2687).

Hospitalization

Assessments of hospitalization often focus on the costs related to care given the concern for health care expenditures and costliness of hospital stays. Hospitalizations are one of the most substantial cost drivers in cancer care. It has been reported that approximately 50% of costs during the first year after a cancer diagnosis and 60% of costs during the last year of life are due to hospitalizations (Manzano, et al., 2014, p. 3527). Inpatient services accounted for 22% of the $34.4 billion Medicare paid for cancer care in 2011(American Cancer Society Cancer Action Network, 2012, pp. 16-18). In addition to understanding costs, it is also important to understand patterns of use. Studies focusing on issues such as the length of hospital stay for prostate cancer patients following surgical treatment with radical prostatectomy have been viewed as important for identifying possible factors associated variations in utilization.

In a briefing on related to cancer-related hospital stays, Price, Strangers, & Elixhuser (2012) provided that hospitalizations due to cancer in adults declined by 4% between 2000 and 2009, which may be partially due to the rise in options for outpatient cancer treatment. In 2009, hospitalizations for adults with principal diagnosis of cancer were on 1.6 days longer than all other hospitalizations (6.6 days compared to 5 days), and $5,700 more per stay and $500 more per day ($16,400 compared to $10,700, $3,300 compared to $2,800). These costs for cancer hospitalizations represent approximately 6% of total adult inpatient hospital costs (pp. 1-2). Data specific to men with cancer was also included. The most common cancer hospitalizations among men were for prostate cancer and metastatic cancer, each listed as being the reason for 97,000 hospital stays. Compared to the average length of stay for all cancer hospitalizations, 6.6 days, the mean length of stay for hospitalizations listing prostate cancer as the principle diagnosis was lower, 2.4 days, while the mean stay for hospitalizations due to metastatic cancer was higher, 6.7

days. Prostate cancer hospitalizations, however, were the costliest per day ($4,600/day) compared to all other cancer hospitalizations. For hospitalizations with cancer as secondary diagnosis, prostate cancer was again most common among men (Price, Strangers & Elixhuser, 2012, pp. 4-7).

Variations in the length of hospital stay have been associated with numerous factors, such as degree of illness, certain hospital attributes, and geographic characteristics. Research efforts have aimed to better understand the variations in the length of hospital stay for prostate cancer patients following surgical treatment with radical prostatectomy. Mitchell, et al. (2009) analyzed centers in the University Health System Consortium Clinical Data Base and found that for centers from three tiers of lowest to highest case volumes the average length of stay was 3.77, 2.65 and 2.09 days, respectively. In this study, the centers with the highest case volume also had the lowest intensive care unit admission rates, while the highest rates were observed in centers with the lowest case volume (Mitchell, et al., p. 1443). Inman, et al. (2011) reported the length of stay after radical prostatectomy to range from 1 to 4 days for a patients treated at a large academic medical center in the Midwest United States (p. 89). Understanding hospital service use variations is important for addressing concerns related to cost and care patterns, and a clearer sense of the factors associated with longer or shorter stays can help to predict needs of patients and future use, as well as inform strategies to prevent recurrent hospital stays.

Disparities

Cancer health disparities are described by the NCI as “adverse differences in cancer incidence (new cases), cancer prevalence (all existing cases), cancer death (mortality), cancer survivorship, and burden of cancer or related health conditions that exist among specific population groups in the United States. These population groups may be characterized by age, disability, education, ethnicity, gender, geographic location, income, or race" (NCI, 2016). Disparities in healthcare are the result of a complex interplay of multiple factors and events that are met throughout the whole healthcare experience; these factors could be due to differences in patients, healthcare providers' actions and decisions, or the way in which the healthcare system is designed (Greenberg, Weeks, & Stain, 2008, p. 523). Factors such as stage of disease, duration of treatments, access to medical care and support, patient characteristics, and provider preferences can be linked to variations in care for cancer. Prostate cancer and the men faced with it are characterized by a number of distinct factors, such as the growing number of men living with this disease due to early detection (Krupski, et al., 2006, p. 121), needing to choose between several treatment options which all lack proof of "being superior in terms of overall survival" (Jayadevappa, et al., 2010, p. 711), and the many health related quality of life difficulties that are possible based simply on the location of the prostate gland and its treatments' sensitive nature (Eton and Lepore, 2002, p.307).

The critical role that access to health care has in understanding and managing prostate cancer has been emphasized throughout the literature. Patients' ability to reach and potentially use cancer care, considered access to cancer care, can be important to their utilization of services as well as their outcomes, and reducing access to care has significant adverse effects on cancer treatment outcomes, and increases disparities in cancer care (Wang & Onega, 2015, p. 110; Kantarijan, Steensma, & Light, 2014, p. 1602). The distinct meanings of access to health care and utilizing health services have been described as access, a process, referring to "the timely use of personal health services to achieve the best possible health outcomes" while utilization is "more commonly regarded as a measurable outcome that reflects the actual use of services"

(Litaker & Love, 2005, p. 184). According to Andersen (1995), the presence of enabling resources potential access, and the actual use of services is realized access. It is more likely that use will occur if more enabling resources are present, and the dominant predictors of realized access define whether or not access is equitable (p. 4).

Social aspects are not the only causes for the disparate cancer burden some groups face, but studies continue to show that they might be some of the most influential. While age, race, geographic area, and economic status are factors shown to be related to disparities in the treatment treatments cancer patients receive, a key determinant proposed for racial and ethnic disparities in screening, treatment, morbidity, and mortality in prostate cancer is variation in access to health care (Shayne, et at., 2013, p. 314; Miller, et al., 2008, pp. 318-319). Wang, Luo, and McLafferty (2010), reported that the risk diagnosis at a late-stage for many cancers, such as breast, prostate, and colorectal cancer, is often linked to two groups of factors: access to health care, which pertains to spatial factors, and socioeconomic and demographic characteristics, which are considered nonspatial factors. They also note that although socioeconomic status is a characteristic of individuals, it cannot be separated from a neighborhood context, as well (pp. 239-241). A more precise understanding the factors that are significant predictors of utilization, and the degree to which they are influential in subpopulations can be applied to what is known about disparities in prostate cancer in order to address the specific needs of patients.

Development of Hypotheses

This study of the determinants of health services utilization among older males with prostate cancer in the United States is guided by the theoretical framework of Andersen's behavior model of health services utilization, and examines the predisposing factors, enabling factors, and need-for-care factors that characterize individual patients and their county of residence in order to determine the relative importance of factors and their interaction effects. The relevant literature provides empirical evidence to suggest that the predisposing factors, enabling factors, and need-for-care factors included in this study may be influential predictors of health services utilization, and analysis of these factors may facilitate a more precise understanding of the reasons for differential use patterns of health services by prostate cancer patients.

To address the specific aims of this study outlined by the research questions, several hypotheses have been developed:

Research Question 1: What is the relative importance of predisposing factors, enabling factors, and need-for-care factors in accounting for variability in emergency room use among prostate cancer patients?

Need-for-care factors are frequently described as the most influential predictors of health services utilization, and empirical evidence supports this. Among Medicare patients, need-for-care factors have been identified as the strongest predictors of emergency room service use, and cancer patients and Medicare enrollees with greater comorbid illnesses have been shown to have higher rates of emergency room admission (Legler, Bradley & Carlson, 2011; Wolinsky, et al., 2008). Need-for-care factors such as comorbidity may influence utilization differences in emergency room services.

Hypothesis 1: Need-for-care factors are more influential predictors of emergency room use among prostate cancer patients than predisposing factors and enabling factors.

Research Question 2: What is the relative importance of predisposing factors, enabling factors, and need-for-care factors in accounting for the variability in hospital length of stay among prostate cancer patients?

As mentioned above, the most important predictors of health service use are often need-for-care factors. Previous research has found higher hospital usage in cancer patients with multiple comorbid illnesses, and even when factors such as age and race were found to be influential, comorbidity still had the greatest impact (Shayne, et al., 2013; Legler, Bradley & Carlson, 2011). Hospital length of stay is likely to vary based on the illness level of prostate cancer patients.

Hypothesis 2: Need-for-care factors are more influential predictors of hospital length of stay among prostate cancer patients than predisposing factors and enabling factors.

Research Question 3: To what degree does emergency room use have an effect on hospital length of stay among prostate cancer patients?

Seeking emergency room care may be reflective of the level of illness level or degree to which patients are in need of health services. Previous research has shown that among cancer patients, emergency room visits can often result in hospital admission; even emergency room visits within thirty days have been found to be associated with unplanned hospitalizations (Mayer, et al., 2011; Manzano, et al., 2014). The utilization of emergency room services by prostate cancer patients is likely to have an effect on patterns of inpatient hospitalization.

Hypothesis 3: Emergency room use is an influential predictor of hospital length of stay among prostate cancer patients.

Research Question 4: Do predisposing, enabling, and need-for-care factors show any important interaction effects accounting for the variability in the use of health services in specific subgroups of prostate cancer patients?

While need-for-care factors are most often the strongest predictors of health services utilization, predisposing and enabling factors have of course been important in explaining variations in use. A more comprehensive understanding of such variations can be obtained if there are subgroups characterized by specific influential demographic and social variables. Along with comorbidity, older age and residing in a disadvantaged area have been shown to predict hospitalization patterns among those who have had cancer (Treanor & Donnelly, 2012). When need-for-care factors were found to be the most influential predictors of emergency room service use in Medicare patients, farther assessment of use patterns determined that rural area was highly predictive of emergency room care that was not for life-threatening conditions and could have instead been provided outside of the emergency room (Wolinsky, et al., 2008). In prostate cancer research, interactions between factors such as age, race, and socioeconomic status have been observed (Goovaerts, et al., 2015). Particular social and demographic variables may be predictive of health service use patterns in subgroups of prostate cancer patients in this study.

Hypothesis 4: High users of health services are associated with certain predisposing factors, enabling factors, need-for-care factors, and the interaction effects of these variables.

Research Question 5: To what degree do hospital attributes influence the utilization of health services among prostate cancer patients?

Hospital characteristics may play an important role in the use of health services by prostate cancer patients. Differences in health resource utilization, treatment, and quality of care in prostate cancer patients can be influenced by factors such as hospital location, size, and ownership (Jayadevappa, et al., 2011). According to Parsons, et al. (2010), patients in county hospitals are more apt to undergo surgery due to the fact that the initial care provider in these hospitals is typically a urologist, and these specialists are more likely to recommend surgery; in private care facilities, however, the initial providers tend to be a mix of urologists, radiation oncologists, and medical oncologists (Parsons, et al., 2010, pp.1382-1383). Furthermore, the average hospital stay for cancer patients has been reported to vary in studies that included hospital case volume and teaching facilities (Inman, et al., 2011; Mitchell, et al., 2009).

Hypothesis 5: Hospital attributes are influential predictors on health services utilization by prostate cancer patients.

Chapter Summary

In chapter three, the different approaches that have been used in prostate cancer service utilization research were reviewed. The prevalent frameworks in these studies were broadly categorized as psychological, sociological, and economic approaches. These studies have contributed to what is known about the determinants of health service use for prostate cancer; however, the limitations of using a single perspective have left gaps in the current level of knowledge regarding factors that may contribute to the variations in use. The behavioral model of health services use allows for examination of individual and societal factors as well as the contextual environment to provide a more comprehensive understanding of the important determinants of use. The contributions made by Andersen (1968), Wan and Soifer (1975), and others to integrate individual, societal, and contextual attributes in a model for analyses and the application of specific analytic techniques have enhanced the ability for research to facilitate a more complete understanding of the utilization patterns of individuals and subgroups within the population by determining the relative importance of predictors and their interaction effects, which could be particularly beneficial for policy-related decisions. Although the relevant prostate cancer literature does not include an ample number of studies using this model, this research and other analyses of health services utilization have provided empirical evidence to help guide the selection of predictors. Several hypotheses were developed to address the aims of this study.

CHAPTER THREE: RESEARCH METHODOLOGY

Research Design

A cross-sectional design is used for this study. Medicare claims data for care provided in the inpatient setting are analyzed to determine the predictors of emergency room use and hospital length of stay by prostate cancer patients. Existing differences in the study sample are examined, as the research approach was not experimental. This type of design allows for the examination of patient characteristics and relationships between variables to assess influential factors in the variability of health services utilization. The claims data available is from a single year, therefore it is not possible to conduct a longitudinal analysis to examine utilization patterns over time or determine causal relationships. Inpatient procedures, diagnoses of conditions, types of services used, and basic demographic and geographic information for each patient are included in the claims data. Area-level data sources were linked to the claims data to provide additional information regarding the counties in which patients reside so that important contextual factors influencing the utilization of services could be analyzed as well.

Data Sources

Inpatient Medicare claims data are collected from hospitals and skilled nursing facilities across the U.S. by the Centers for Medicare and Medicaid Services (CMS). The Surveillance, Epidemiology, and End Results (SEER) Program of the National Cancer Institute (NCI) collects cancer incidence and mortality information from registries in 15 states. The SEER data is linked with CMS data to provide detailed information about Medicare beneficiaries with cancer. The linked SEER-Medicare data files are made available by the NCI. The linked data can be useful for addressing research topics and questions across the cancer continuum. SEER-Medicare data includes several Medicare files for types of services, such as hospital, physician, and outpatient, and the Patient Entitlement and Diagnosis Summary File (PEDSF), which contains the detailed cancer-specific information collected by the SEER registries and patient demographic information such as race. Physician and outpatient services are covered by Part B Medicare, while Part A covers hospital services. According to the NIC, 96% of Part A Medicare beneficiaries choose to pay a monthly premium to enroll in Part B (NCI, 2015). Part A Medicare is available for individuals age 65 and older, as well as those who are disabled and/or have end-stage renal disease.

This study uses data from one of the Medicare files included in SEER-Medicare data, the Medicare Provider Analysis Review (MEDPAR) file. The MEDPAR file contains all Medicare Part A hospital stay and skilled nursing facility bills for a single calendar year. Thus, all patients in this dataset have been admitted for inpatient care at least once. There is one summarized record per admission, which contains detailed accommodation and departmental charge data, days of care, entitlement data, basic beneficiary demographic characteristics, diagnosis and surgery information, and use of hospital or skilled nursing facility resources. The MEDPAR File is useful for research involving chronic diseases that may be prevalent in the elderly such as cancer (U.S. Centers for Medicare and Medicaid Services, 2015).

This study also uses the Area Health Resources Files (AHRF) developed by the U.S. Department of Health and Human Services, Health Resources and Services Administration

(HRSA) in order to include valuable information concerning the contextual environment of patients according to the counties in which they reside. The AHRF integrates multiple data sources into a comprehensive set of data offering a broad range of health resources and socioeconomic indicators which impact demand for health care. Key health and demographic data, such as information on health facilities, health professions, measures of resource scarcity, health status, economic activity, health training programs, and socioeconomic and environmental characteristics, for each county in the nation are included in the AHRF (U.S. Department of Health and Human Services, Health Resources and Services Administration, 2015). The data used from this file is based on the 2010 U.S. Census. The geographic codes for counties included in the AHRF data make it possible to link this file to the MEDPAR file.

American Hospital Association (AHA) Survey Data from 2008 is used for this analysis to provide information pertaining to hospital attributes. Through an annual survey of more than 6,300 hospitals in the U.S., the AHA collects facility-level information regarding important characteristics such as organizational structure, inpatient and outpatient utilization, expenses, staffing, and affiliations (American Hospital Association, 2016).

Population and Sample Selection

The claims data available for this research include the population of Medicare enrollees with inpatient records captured in the 2008 MEDPAR file. These records are from a single calendar year, 2007. Given that this study focuses on only the utilization of health services by prostate cancer patients, Medicare enrollees without a diagnosis of prostate cancer are excluded from the analysis. This study does not focus on skilled nursing facility visits. Therefore, records with this type of stay are removed from the dataset. Patients who received inpatient care more than once during the year will have multiple records in the file. For these cases, the record of the most recent admission is included in the dataset used for analysis. These records still include the pertinent information concerning patients given that the MEDPAR file allows for up to ten diagnoses and six procedures using International Classification of Disease, 9th edition, Clinical Modification (ICD-9-CM) codes.

Prostate cancer diagnosis is indicated by the ICD-9-CM diagnosis code 185. The first diagnosis code provided in the MEDPAR file is the primary reason suspected for hospital admission, while the codes in the remaining nine positions can be complications or comorbid conditions associated with the patient's health. In this analysis, prostate cancer patients are identified by the presence of the ICD-9-CM diagnosis code 185 in any of the ten diagnosis fields. All of these records are included in the dataset given that this analysis looks at the length of stay for all-cause hospitalizations, not just those for which prostate cancer was the primary reason for needing inpatient care.

There are 9,309 records for patients with a diagnosis of prostate cancer in the MEDPAR file. Following the consolidation of multiple records for patients and the exclusion of skilled nursing facility stays there are 5,754 individual patient observations. Therefore, the population of patients in the dataset for this study includes 5,754 claims records for Medicare enrollees who have been diagnosed with prostate cancer and hospitalized at least once for any reason during the 2007 calendar year. In this analysis, the hospitalizations from the MEDPAR file are evaluated in terms of the number of days the hospital stay lasted.

Medicare data uses Social Security Administration (SSA) coding system to identify the geographic location of beneficiaries' residences, while the additional data sources with area level factors use Federal Information Processing Standard (FIPS) codes. A SSA and FIPS county code crosswalk file is periodically produced by the Centers for Medicare and Medicaid Services, which allows for Medicare data to be linked with data sources such as the AHRF data. This crosswalk file makes it possible to link the MEDPAR file with the area-level data sources in this study. Ten of the records in the MEDPAR file do not link to the AHRF data based on the county coding information available, leaving 5,744 complete observations for analysis using these variables.

Both the MEDPAR file and AHA Survey data include the Medicare Provider Code for individual facilities. Analysis of hospital variables can only be performed in a subset of the administrative claims data due to the fact that facility information in the hospital dataset match a total of 556 Medicare records.

Measurement of Study Variables

The variables chosen for this study are based on the theoretical framework and existing empirical evidence. The independent variables include individual-level and contextual factors to identify the influential explanatory factors for variations in health services utilization among prostate cancer patients. The individual variables pertain to the characteristics of individual patients, while the contextual variables pertain to county-level characteristics of the geographic area in which the patients live. The hospital variables included in the subset analysis using AHA

Survey data pertain to the facility in which prostate cancer patients received the inpatient care documented in the MEDPAR file. A description of the observed variables included in this study and the sources used to derive their measurements is provided in Table 1.

Dependent Variables

The independent variables categorized as predisposing, enabling, and need-for-care factors in this study are used as predictor variables of the utilization of two types of health services: emergency room and hospital. These services are often included in research concerning utilization, and can be beneficial to understanding prostate cancer care practices, treatment patterns, resource use, and specific patient populations (Seal, et al., 2014; Yong, et al., 2014). Many of the issues that cancer patients have can be addressed during the routine visits for their ongoing care. While there may be instances in which cancer patients' use of emergency room services is necessary, such as for acute issues like fever or respiratory distress, seeking care through the emergency room may also be reflective gaps in care or resource availability (Mayer, et al., 2011, p. 2683; Bryant, et al., 2015, p. 406). Hospitalizations are not only costly, but longer length of hospital stay has been found to be strongly associated with in-hospital mortality in cancer patients (Shayne, et al., 2013). Assessing the factors influencing utilization patterns of emergency room use and hospital length of stay by prostate cancer patients is applicable to understanding and improving the health and delivery of care for these patients, as new information can be used to inform future research efforts.

There are two dependent variables in this analysis: emergency room use and hospital length of stay. The available information from individual patient records in the MEDPAR data file can be used for the two dependent variables because both emergency room and hospital services are covered by Part A Medicare. The dependent variable emergency room use is determined by the presence of charges for emergency room services in the claims record for each patient. This variable is recoded to (0) “no” and (1) “yes.” Thus, not all patient records include emergency room service use.

Hospital service use is measured by the number of days of the hospitalization for each patient based on the most recent admission record in the 2007 calendar year. This dependent variable is the length of stay for all-cause hospitalizations. Since the MEDPAR file consists of only inpatient care claims, all patient records in the dataset include the use of hospital services, with a minimum length of stay of one day.

Independent Variables

The independent variables selected for this study are categorized as predisposing factors, enabling factors, and need-for-care factors based on the theoretical framework, and have been used throughout the relevant literature. There are ten predisposing factors, five enabling factors, and four need-for-care factors. In the data subset analysis including hospital characteristics, there are nine enabling factors. The independent variables are explained in the following sections.

Predisposing Factors

Predisposing factors are demographic and social structure characteristics of the individual and the individual’s social environment. These characteristics exist before care is needed and their presence or absence can be an indicator of the likelihood that people will seek care based on what is known about certain care patterns and behaviors associated with certain characteristics, such as age and previous health services use (Andersen & Newman, 1973, pp. 110-111). Ten variables are used as predisposing factors for this study.

Two of the predisposing variables are from data in the MEDPAR file. These are age and genetic factors. Age represents the number of years listed as the age of each patient in their individual claims record at the time of inpatient care. Individual records from MEDPAR are also used to provide the information regarding genetic factors. This variable is coded as (0) “no” and (1) “yes” based on the presence of selected ICD-9-CM diagnosis codes indicating family and/or personal history of cancer and other diseases. The selected ICD-9-CM codes are listed in Appendix A.

The remaining predisposing factors in this study are based on data from the AHRF. These variables are poverty, race/ethnicity, population age 65 and older, female head of household, median household income, Medicaid eligible population, and uninsured population. These are contextual factors of the counties in which patients live and often used to characterize social structure. Population by race/ethnicity includes separate variables for percentage of the population identifying as Black/ African American, percentage Hispanic/ Latino, and percentage White. The remaining variables are also measured by percentage of the county population.

Enabling Factors

Like predisposing factors, enabling factors are characteristics of the individual or the individual’s community. Enabling factors pertain to the available means or resources needed to utilize health service. These include aspects such as an individual’s source of payment for care, and the number of health care providers in a community. Utilization may be influenced by community-level characteristics such as geographic region and rural-urban “because of local norms concerning how medicine should be practiced or overriding community values which influence the behavior of the individual living in the community” (Andersen & Newman, 1973, pp. 111-112). Additionally, in densely populated urban areas the number of contacts with physicians has been shown to be higher, health resources can be relatively scares in rural areas, and in the poorest sections of urban areas, residents may lack access to such resources (Sundmacher & Busse, 2011, p. 59; Blumenthal & Kagen, 2002). In analysis of physician utilization, urban residence and cost per physician visit were among the predictors found to be influential (Wan & Soifer, 1975). Enabling factors can offer vital information regarding characteristics of the patients, their communities and available resources which may impact their ability to utilize health services.

There are nine independent variables categorized as enabling factors in this study. Four of these variables are used only for a subset analysis of the MEDPAR linked with the AHA survey data. These four variables include hospital size, hospital ownership, hospital cancer program, and hospital resident training. Hospital size is measured by the number of hospital beds at the facility providing care to patient, and is recoded as (1) small <100 beds, (2) medium 100-250 beds, and (3) large >250 beds. Hospital ownership describes the type of organization responsible for establishing policy concerning overall operation of the hospitals. Government-owned, coded as (1), includes State, County, City, City-county, Hospital district or authority, and federal government owned; Non-government, not-for-profit, coded as (2), includes operation by a church or other non-for-profit; and For-profit, investor-owned, coded as (3), includes ownership by individual, partnership, and corporations. Hospital cancer program is measured by whether or not the facility has an American College of Surgeons (ACoS)-approved cancer program. Hospital resident training is measured by whether or not residency training at the facility has been approved by the Accreditation Council for Graduate Medical Education. For both of these variables, “yes” is coded as (1) and “no” coded as (0).

The enabling variable cost measures the amount each patient was responsible to pay for the use inpatient services. Using the individual patient records in the MEDPAR file, this amount is determined by Medicare Part A coinsurance liability and beneficiary inpatient deductible liability. Each year, there is a set inpatient hospital deductible amount that Medicare beneficiaries are responsible to pay during a benefit period, which begins with the first day of inpatient care, and ends after sixty consecutive days without inpatient care. Coinsurance amounts are charged to the patient after sixty days during a benefit period. Coinsurance per day is equivalent to one-fourth of the deductible amount after sixty days, half of the deductible amount after ninety days, and then full costs once lifetime reserve days have been exhausted. Some Medicare beneficiaries receive supplemental coverage to help reduce or eliminate their liability amounts through Medigap plans purchased from private insurance companies, employer retirement health plans, Medicare Advantage plans, or Medicaid benefits for those who qualify based on low income criteria. Cost sharing can affect health services utilization in that patients who have to pay more will reduce their use. The standard cost sharing mechanisms for Medicare beneficiaries may influence decisions to seek or continue care, or types of providers or treatments patients choose (Medicare Payment Advisory Commission, 2012).

Four additional enabling factors used in this study are county-level variables found in the AHRF data. They are: access to physician services, geographic area, rural/urban, and underserved area. Access to physician services is measured by the ratio of physicians per 100,000 of the population in patients' county of residence. This variable is calculated using the 2010 U.S. Census Bureau population estimates and total Non-Federal Primary Care Physician data (M.D.s and D.O.s) for the same year.

Geographic area is based on the U.S. Census Bureau Region in which the patient's county of residence is located. The U.S. Census Bureau identifies these Regions using codes 1 through 4. These codes are (1) Northeast, (2) Midwest, (3) South, and (4) West. In the data subset, U.S. Census Bureau Divisions are used for this variable given that the subset file contains a much smaller number of patient records and they are largely based in the West region. The variable geographic area in the data subset is coded 1 through 9 based on the U.S. Census Bureau Divisions: (1) New England, (2) Middle Atlantic, (3) East North Central, (4) West North Central, (5) South Atlantic, (6) East South Central, (7) West South Central, (8) Mountain, and (9) Pacific.

The Rural/Urban Continuum Codes are metropolitan counties (1-3) and nonmetropolitan counties (4-9). They are defined in the AHRF data as: (1) Counties of metro areas of 1 million population or more; (2) Counties in metro areas of 250,000–1,000,000 population; (3) Counties in metro areas of fewer than 250,000 population; (4) Urban population of 20,000 or more, adjacent to a metro area; (5) Urban population of 20,000 or more, not adjacent to a metro area; (6) Urban population of 2,500-19,999, adjacent to a metro area; (7) Urban population of 2,500-19,999, not adjacent to a metro area; (8) Completely rural or less than 2,500 urban population, adjacent to a metro area; (9) Completely rural or less than 2,500 urban population, not adjacent to a metro area (AHRF, 2014-2015). The same coding is used for this analysis.

Underserved area is measured by the county's designation as a Health Professional Shortage Area (HPSA) for primary care. HPSAs are designated by HRSA using the codes: (0) None of the county designated as a shortage area; (1) The whole county was designated as a shortage area; (2) One or more parts of the county was designated as a shortage area. The same coding is used for this analysis.

For HPSA designation, HRSA defines primary care practitioners as “non-Federal doctors of medicine (M.D.) and doctors of osteopathy (D.O.) providing direct patient care who practice principally in one of the four primary care specialties-general or family practice, general internal medicine, pediatrics, and obstetrics and gynecology. Those physicians engaged solely in administration, research and teaching will be excluded.” HSPA designation for primary care in a geographic area requires that the following criteria are met: 1) Be a rational area for the delivery of primary medical care services, 2) Have a population to full-time-equivalent primary care physician ratio of at least 3,500:1, or have a population to full-time equivalent primary care physician ratio of less than 3,500:1 but greater than 3,000:1 and have unusually high needs for primary care services or insufficient capacity of existing primary care providers, and 3) demonstrate that primary medical professionals in contiguous areas are over utilized, excessively distant, or inaccessible to the population under consideration (AHRF, 2014-2015).

Need-for-Care Factors

Need-for-care factors, often considered to be the most important predictors, represent how individuals perceive their own health, such as functional status, symptoms, magnitude of problems, as well as and the type and level of treatment patients receive once being evaluated by a care provider (Andersen, 1995). In research concerning use of emergency room services and hospitalizations, need-for-care factors have frequently been identified as major predictors (de Boer, Wijker & de Haes, 1997, pg. 111; Wolinsky, et al., 2008, pg. 205). These factors directly pertain to an individual’s illness level and can provide a strong indication of their propensity to utilize health services. Increased disease burden has been shown to lead to greater service utilization in prostate cancer. Research has observed higher use patterns in patients with later stage disease, complications from treatment, greater comorbidity, and poorer functional status (Yong, et al., 2014, pp. 291-296). Additionally, previous health services utilization research for cancer has found increased comorbidity to be an influential predictor of use, and particularly important given that examining comorbidities in cancer patients over the age of 65 can lead to a better understanding of the role that comorbid illnesses have in the utilization of health resources and inform interventions or improvement efforts by highlighting aspects on which attention should focus (Manzano, et al., 2014, p. 3528).

In this study, variables used to determine patients' need for health services are all from individual patient records in the MEDPAR data. Intensive care unit (ICU) indicates time that patients spent receiving this type of care during the hospitalization. This variable is recoded as (1) "yes" if the patient record indicates that ICU care was provided and (2) "no" if the record indicates that patients did spend time in the ICU while hospitalized. The treatment patients received for prostate cancer and complications experienced from these disease management interventions are based on selected ICD-9-CM procedure and diagnosis codes recorded in patient files. Treatment is measured by intervention program of disease management according to selected ICD-9-CM procedure codes for surgery and radiation. This variable is coded as (1) "yes" if the patient record indicates that patients received surgery, radiation, or both, and (0) "no" if records indicate that patients had not received either procedure.

The variable complications is measured by the presence of ICD-9-CM codes for certain conditions and procedures that could potentially be associated with prostate cancer treatment. This variable is coded (1) "yes" if the patient record included any of these diagnoses or procedures, and (0) "no" if none of these diagnoses or procedures were included in the patient records. Appendix A includes the ICD-9-CM codes used for these two variables.

Comorbidity scores are based on the Charlson comorbidity index. The Charlson comorbidity index, initially developed in a cohort of breast cancer patients, includes nineteen medical conditions assigned a weight based on its potential for influencing mortality, and considers both the number conditions and the seriousness of these conditions. The sum of the weighted comorbidities is the index score assigned to patients, thus, a greater burden of comorbid illness is indicated by a higher score. Deyo, et al. adapted the Charlson index for use with inpatient administrative datasets by searching patients' claims for ICD-9-CM diagnostic and procedure codes that correspond to the Charlson comorbid conditions. Patients' outpatient records of course could possibly include important comorbidities that will not be included (Klabunde, Potosky, Legler & Warren, 2000, pp. 1258-1259). This is, however, a valid comorbidity measure that is frequently employed by researchers, and is an appropriate variable for this analysis given that inpatient hospital claims are the only data available and the valuable information can be derived by including Charlson comorbidity index score to study service utilization by prostate cancer patients enrolled in Medicare.

In this analysis, comorbidity index scores are calculated using a SAS macro made available by the NCI to calculate Charlson comorbidity weights from certain ICD-9 codes in MEDPAR file claims (NCI, 2015). Based on the data from patient records in the MEDPAR file, the weights calculated range from 2 through 16. Thus, the variable comorbidity is measured by the calculated comorbidity index scores.

Table 1. Measurement of predictor variables selected for analysis of variations in health services utilization by prostate cancer patients

Category	Study Variable	Description	Source
Health Service	Hospital Length of Stay	Number of days of patient hospital stay; most recent admission for patients with multiple 2007 records	MEDPAR
Health Service	Emergency Room	Patient received ER services, indicated by presence of ER charges in claims data (yes coded as 1, no coded as 0)	MEDPAR
Predisposing	Age	Patient age recorded when inpatient care was received	MEDPAR
Predisposing	Genetic Factors	Personal and/or family history of disease based on selected ICD-9-CM codes for history of cancer and other diseases (yes coded as 1, no coded as 0)	MEDPAR
Predisposing	Female Household	Percentage of families with female head of household in patient county of residence	AHRF
Predisposing	Average Household Income	Median household income (dollar amount) in patient county of residence	AHRF
Predisposing	Medicaid Eligible	Percentage of population eligible for Medicaid in patient county of residence	AHRF
Predisposing	Population 65+	Percentage of population age 65+ in patient county of residence	AHRF
Predisposing	Poverty	Percentage of population below poverty level in patient county of residence	AHRF
Predisposing	Race/ Ethnicity	Percentage of population that is White, Black/African American, and Hispanic/Latino in patient county of residence	AHRF
Predisposing	Uninsured Population	Percentage of population with no health insurance in patient county of residence	AHRF
Enabling	Access to Physician Services	Ratio of physicians per 100,000 of population in patient county of residence	AHRF
Enabling	Cost	Amount patient is responsible to pay for services (Medicare Part A coinsurance liability amount and beneficiary inpatient deductible liability amount)	MEDPAR
Enabling	Geographic Region	Area of the country in which patient county of residence is located based on U.S. Census Bureau Regions (coded as 1 for Northeast, 2 Midwest, 3 South, 4 West)	AHRF
Enabling	Rural/ Urban	Patient county of residence classification based on Rural/Urban Continuum Code (coded 1-9; metropolitan counties are 1-3 and nonmetropolitan counties are 4-9)	AHRF
Enabling	Underserved Area	Health Professional Shortage Area (HPSA) code based on specific criteria and guidelines for primary medical care HPSA designation (none of the county designated coded as 0; whole county designated coded as 1; one or more parts of county designated coded as 2)	AHRF
Enabling	Hospital Size	Total number of hospital beds at facility providing care to patient (<100 beds coded as 1, 100-250 coded as 2, >250 coded as 3; Subset analysis only)	AHA

Category	Study Variable	Description	Source
Enabling	Hospital Ownership	Type of organization responsible for establishing policy concerning overall operation of the hospitals (government, coded as 1; non-government, not-for-profit coded as 2; for-profit, investor-owned coded as 3; Subset analysis only)	AHA
Enabling	Hospital Cancer Program	Cancer program approved by the ACoS at facility providing care (yes coded as 1; no coded as 0; Subset analysis only)	AHA
Enabling	Hospital Resident Training	Residency training approved by Accreditation Council for Graduate Medical Education (yes coded as 1; no coded as 0; Subset analysis only)	AHA
Need	Comorbidity Index Score	Charlson Comorbidity Index Score calculated using macro from the NCI to assign comorbidity weights based on ICD-9-CM procedure and diagnosis codes in claims data	MEDPAR
Need	Complications	Patient experienced complications related to treatment as indicated by the presence of any ICD-9-CM codes for certain conditions and procedures (yes coded as 1, no coded as 0)	MEDPAR
Need	Intensive Care Unit	Patient received care in ICU during hospital stay (yes coded as 1, no coded as 0)	MEDPAR
Need	Treatment	Intervention program of disease management based on ICD-9-CM procedure codes for surgery and radiation (patients have received surgery, radiation, both coded as 1, patients have received neither coded as 0)	MEDPAR

Methods of Data Analysis

Data analysis is performed in two stages, which includes automatic interaction detector (AID) analysis to identify possible subgroups, and regression analysis. Previous research regarding health services utilization has demonstrated that such analytical techniques can be an effective method to identify any interaction between the independent variables, and to examine the relative importance of utilization predictors within subgroups with homogeneous utilization patterns as well as the total sample (Wan & Yates, 1975, pp. 147-148). Applying these methods in this analysis of health services utilization among prostate cancer patients enrolled in Medicare is an appropriate approach that enhances the potential value and usefulness of findings, as more precise information pertaining to the characteristics of individuals and subgroups which make them more or less likely to use certain health services can provide the detail needed to inform the development of policies, programs, and other health care-related plans.

Automatic Interaction Detector Analysis

The first stage of this analysis subdivides prostate cancer patients into clusters with relatively homogeneous service use patterns through AID analysis using the predictive modeling software DTREG. AID analysis involves subdividing the original sample into a number of mutually exclusive subgroups through a series of dichotomous splits with regard to the predictor variables; each observation then becomes a member of exactly one subgroup (Wan, 2002, pp. 47-48). The DTREG software generates predictor trees showing the relative importance of indicators in accounting for variability in the use of health services and the interaction between independent variables. The single-tree models include a node for each split, which contain information regarding the predictor that was used to generate the node and the values of the split point. A textual report for each analysis is also created by the software.

The trees built using DTREG are labeled as classification trees or regression trees based on whether the dependent variable is categorical or continuous. The independent variables can be categorical and continuous. Therefore, the software will generate a classification tree for the dependent variable emergency room use because it is categorical and a regression tree for the dependent variable hospital length of stay because it is continuous. Each of the independent variables will be entered into DTREG once for each of the health service utilization measures, emergency room use and hospital length of stay. The predictor trees generated consist of nodes, which each represent a set of records, or rows, from the dataset. The nodes are referred to as the root node (top node with all of the records from the data), interior nodes (nodes that have child nodes), and terminal nodes (nodes that do not have child nodes). Child nodes are created from dividing records into two groups based the binary split selected by DTREG (Sherrod, 2014, p. 235). The trees constructed through this process of partitioning the dataset into non-overlapping subgroups provide a visual illustration of the importance of independent variables and their interaction effects in explaining variation in the outcome variables.

The independent variables used for this stage of analysis are the social and demographic factors of patient age, race/ethnicity (county population percentage Black/ African American, percentage Hispanic/ Latino, and percentage White), rural/ urban, and underserved area. These are factors commonly employed to distinguish particular needs of communities and individuals. They are selected from the categories of predisposing and enabling factors, and make it possible to determine if there are distinct differences in how need-for-care factors operate within each subgroup in the second stage of analysis.

In order to produce trees with information that is clearer and able to be more easily interpreted, several of the predictor variables are recoded into variables with three categories. Smaller trees are not only easier to understand, but the predictive accuracy for unseen data is greater, as they do not model minor noise in the data in the way that larger trees can (Sherrod, 2014, p. 3.67). The continuous variables, patient age and the three race/ethnicity factors are categorized as follows: Patient age coded as (1) under 75, (2) 75 to 85, and (3) higher than 85; Black/African American population coded as (1) less than 9%, (2) 9% to 13%, and (3) more than 13%; Hispanic/Latino population coded as (1) less than 14%, (2) 14% to 32.0%, and (3) more than 32.0%; and White population coded as (1) less than 50.0%, (2) 50.0% to 75.0%, and (3) more than 75.0%.

The nine codes indicating rural/urban classification of counties are condensed, and coded as (1) rural/urban continuum codes 1-3 (counties in metro areas), (2) rural/urban continuum codes 4-6 (urban population of 20,000 or more and either adjacent or not adjacent to metro areas, and urban population of 2,500-19,999 adjacent to metro areas), and (3) rural/urban continuum codes 7-9 (urban population of 2,500-19,999 and not adjacent to a metro area, and completely rural or less than 2,500 urban population and either adjacent or not adjacent to a metro area). Underserved area remains the same (codes zero to two indicating portion of county designated as Health Professional Shortage Area).

To address the issue of missing values, the DTREG software manual recommends the use of surrogate splitters to classify rows with missing values in the primary splitter as the most accurate method. This is an estimation technique in which the software computes the association between the primary splitter and each alternate predictor as a function of how closely the alternate predictor matches the primary splitter. Surrogate splitters are described as "predictor variables that are not as good at splitting a group as the primary splitter but which yield similar splitting results; they mimic the splits produced by the primary splitter" (Sherrod, 2014, pp. 364-365). This method is used for missing values in the analysis of both emergency room use and hospital length of stay predictor trees.

Regression Analysis

The second stage of this analysis examines the relative contribution of each category of the predictor variables (predisposing, enabling and need-for-care factors) in explaining the total variance in the dependent variables using regression analysis. Multiple regression can be used when there is one continuous dependent variable and two or more independent variables that can be continuous, categorical, or a combination of both. If the dependent variable is categorical, then logistic regression must be used. The hierarchical procedure in regression analysis enables the researcher to decide the order in which blocks of independent variables are entered into the equation. The relative contribution of the variables in each step are assessed, as is the overall model, for predicting the dependent variable (Pallant, 2007, pp. 147-169). The statistical software IBM SPSS Statistics version 23 Premium Grad Pack is used to perform hierarchical binary logistic regression for the dependent categorical variable emergency room use and hierarchical multiple regression for the dependent continuous variable hospital length of stay.

In this study, regression is used to determine the probability of patients utilizing the two types of health services based on specific factors which characterize individual patients and the areas in which they reside. The hierarchical regression procedure makes it possible to examine the influence of each group of independent variables categorized as predisposing, enabling, and need domains, as well as their joint influence. Understanding the extent to which each category of predictor influences the utilization of health services can be particularly useful for research intended to inform policy matters. Ideally, individual illness level, or need-for-care, should be the basis for a distribution of health care that is “equitable” as opposed to social and demographic such as age, race or income. However, realistic public policy efforts aimed at reducing problematic variations in service utilization must consider the extent to which certain factors can actually be altered. Such factors would typically be those categorized as enabling factors (Andersen & Newman, 1973, pp. 117-119). Thus, using the hierarchical technique to observe the amount of variance that each category of predictors explains in the use of health services provides the opportunity to determine which factors are influential, as well as how such information may be applicable to meaningful change efforts.

Regression makes several assumptions about the data. It is important for researchers to be aware of these conditions and check the data set prior to performing either type of regression analysis. Multicollinearity exists when there is high correlation among two or more of the predictors, and can lead to difficulty in understanding the contributions of these variables to account for variation in the dependent variable. Outliers are cases not explained well by the model. These extremely high or low scores in a variable, or cases classified in a category not strongly predicted by the model may also be problematic for interpreting results.

Several additional assumptions are made by multiple regression. These include: 1) normal distribution of residuals about the predicted dependent variable scores (normality), 2) relationship with residuals and predicted dependent variable scores is a straight line (linearity), 3) residual variance is the same for all predicted dependent variable scores (homoscedasticity), and 4) independence of residuals. Logistic regression does not make these assumptions regarding distribution (Pallant, 2007, pp. 149; 169). Procedures included in the SPSS Statistics software are used to check these assumptions for regression analysis. Missing values are addressed using the exclude cases pairwise option in SPSS, which will allow for cases to still be included for analysis if they have the necessary information, and exclude the cases only if the data for a specific analysis is missing (Pallant, 2007, p. 57).

In the hierarchical binary logistic regression models for analysis of emergency room use and the hierarchical multiple regression models for hospital length of stay, variance in the utilization behavior is explained by predisposing factors, enabling factors, and need-for-care factors as individual groups of predictors and the combined effect as categories are added to the model. The final model for hospital length of stay includes the indicators from each category of predictor, as well as the impact of emergency room use to examine variations in utilization by prostate cancer patients. The analysis is performed in each of the subgroups identified through AID analysis in step one, as well as the entire sample to determine the relative influence of the independent variables, interaction effects, and the total variance explained by these factors for the utilization of health services among older males with prostate cancer.

Hierarchical binary logistic regression models for analysis of emergency room use are evaluated using pseudo R Square statistics, goodness of fit test statistics, and odds ratios (OR). Cox & Snell R Square and Nagelkerke R Square values are pseudo R Square statistics used in logistic regression analysis to determine the amount of variance in the dependent variable that can be explained by the model as a whole. To assess the goodness of fit for each model, statistical significance values provided by the Omnibus Test of Model Coefficients and Hosmer and Lemeshow Test are used. These values indicate how well the model fits the data. Statistical significance of model fit and independent variables is indicated by a p-value of 0.05 or less. For the Hosmer and Lemeshow Test, a p-value less than 0.05 indicates a poor model fit.

In logistic regression, the "Exp(B)" value is the odds ratio (OR), which is used to assess the contribution of each predictor variable. The odds ratios represent the likelihood of a patient using the emergency room as the value of the predictor changes. The beta values (β), which are the coefficients that would be used for constructing a regression equation, indicate whether a predictor increases or decreases the likelihood of emergency room use bases on whether the value is positive or negative. By comparing the odds ratios of statically significant variables, it is possible to determine the relative importance of individual predictors in explaining variation in emergency room utilization by prostate cancer patients in this analysis.

Hierarchical multiple regression models in the analysis of hospital length of stay are evaluated using R Square (R^2) values and standardized beta values (β). The F value included in the ANOVA table for the model at each step of the hierarchical multiple regression model is used the assess whether or not the model fit as a whole is statistically significant. As with the logistic regression models, statistical significance of model results and independent variables are indicated by a p-value of 0.05 or less.

The R^2 value indicates how much of the variance in the dependent variable can be explained by the predictor variables. The R^2 change value when each group of predictor variables are entered into the model indicates the amount of additional variance explained by that group of predictors after holding all other factors constant. The R^2 value for the full model indicates the total variance explained by these factors when taken into account together. This makes it possible to determine for each group of predictor variables the amount of variance accounted for predisposing, enabling, and need-for-care factors independently and collectively.

The contribution of each predictor is assessed using standardized beta values (β). Standardized beta coefficients are values that indicate the importance of an independent variable relative to the other independent variables included in the model, whereas the unstandardized coefficient (B) would be used in developing a regression equation. Comparing the standardized beta value (β) of statically significant variables makes it possible to determine the relative importance of individual predictors in explaining variation in the length of hospital stay for prostate cancer patients in this analysis.

Analysis of hospital variables, which are categorized as enabling factors, is performed in a subset of the administrative claims data due to the fact that only a portion of records are able to be matched with the facility information in the hospital dataset. The same methods of analysis that are outlined for the full dataset are the methods used for analysis of emergency room use and hospital length of stay for patient administrative records in the data subset.

Hypothesis Testing and Model Validation

The results derived from the analysis of data are used to test the research hypotheses and validate the overall model of the modified Andersen model developed for this study. AID analysis makes it possible to identify how particular social and demographic factors and interaction effects influence higher or lower health services utilization patterns by patients. Hierarchical regression analysis makes it possible to determine the variance in health services utilization that can be explained by the categories or predictors, as well as the relative influence of individual predictors.

The independent variables are considered to be influential predictors of emergency room use and hospital length of stay if they are statistically significant based on a p-value of 0.05 or lower. The relative importance of predictor variables is determined by the OR values in logistic regression and standardized β values in multiple regression, with higher OR and standardized β values indicating that a predictor is more influential than the other predictors in the model with lower values. For each of the subgroups identified by AID analysis, the importance of predictors and relative influence of factors in the model are evaluated to determine whether the research hypotheses are supported by the results of analysis.

The hierarchical procedure in regression analysis makes it possible to evaluate each category of predictors to determine the amount of variance that predisposing, enabling, and need-for-care factors explain in emergency room use and hospital length of stay by prostate cancer patients. R^2 values are used to report the amount of variance in health services utilization explained by the categories of predictors. As each category of predictors is entered, the model is evaluated according to goodness of fit test statistics and a p-value of 0.05 or less. Based on the statistical significance of model fit and variance explained by the factors included in the model at each step, it is possible to see if the overall modified model for analysis of health services utilization by prostate cancer patients is a valid model for examining emergency room use and hospital length of stay by Medicare enrollees with prostate cancer.

Chapter Summary

This is a nonexperimental study that uses a cross-sectional design. The main data source is the MEDPAR file, which includes inpatient administrative claims data for patients admitted to the hospital in 2007. Data from the AHRF is used to provide information about the geographic areas in which patients reside. AHA Survey Data from 2008 is used for a subset analysis to examine influential hospital attributes. Only MEDPAR patient records that include the ICD-9-CM code for prostate cancer diagnosis are included in this study. The two dependent variables that are used to measure health services utilization are emergency room use and hospital length of stay. The independent variables include ten predisposing factors, five enabling factors, and four need-for-care factors. An additional four enabling factors are used in the data subset analysis to examine the importance of hospital characteristics.

In the first stage of analysis, the predictive modeling software DTREG is used to perform AID analysis with several social and demographic variables for each of the two dependent variables. The sample is subdivided into a number of mutually exclusive subgroups through a series of dichotomous splits with regard to the predictor variables to identify subgroups with similar use patterns. In the second stage of analysis, hierarchical logistic regression is performed for the dependent categorical variable emergency room use and hierarchical multiple regression for the dependent continuous variable hospital length of stay using the statistical software IBM SPSS Statistics version 23 Premium Grad Pack. Regression analysis is performed in each of the subgroups identified through AID analysis and the entire dataset. The purpose of this is to determine the relative importance of the predisposing, enabling, and need-for-care factors in predicting the use of health services, and any important interaction effects. This analysis is also performed using a subset of the data to assess the importance of facility-related variables.

CHAPTER FOUR: RESULTS

This chapter includes descriptive statistics for the full dataset and data subset, results of AID analysis, results of hierarchical binary logistic regression for the analysis of emergency room utilization, results of hierarchical multiple regression for the analysis of hospital length of stay, and results of the data subset analysis including hospital characteristics. Chapter four concludes with hypothesis testing to address the five research questions that this study aims to answer regarding the utilization of health services by prostate cancer patients:

1. What is the relative importance of predisposing factors, enabling factors, and need-for-care factors in accounting for variability in emergency room use among prostate cancer patients?
2. What is the relative importance of predisposing factors, enabling factors, and need-for-care factors in accounting for variability in hospital length of stay among prostate cancer patients?
3. To what degree does emergency room use have an effect on hospital length of stay among prostate cancer patients?
4. Do predisposing, enabling, and need-for-care factors show any important interaction effects accounting for the variability in the use of health services in specific subgroups of prostate cancer patients?
5. To what degree do hospital attributes influence the utilization of health services among prostate cancer patients?

Descriptive Statistics

Table 2 shows descriptive statistics for the variables used in this analysis of variations in utilization of health services by prostate cancer patients. The dataset includes 5,754 patient records, and there are ten missing values for several of the variables from the AHRF data in the full dataset due to mismatched county coding information when the AHRF data and MEDPAR files were merged. As discussed in Chapter 3, missing values were handled using the method of surrogate splitters in DTREG for AID analysis and exclude cases pairwise option in SPSS for regression analysis.

The average age of patients is 77.9 years. Emergency room services were used by 58% of patients, and the average number of days spent in the hospital is 4.8. More than 57% of patients resided in counties identified as being the most urban on the rural/urban continuum code, and 50.5% were from counties that had been wholly designated as an underserved area. Treatment for prostate cancer is recorded in the claims record for 9.1% of patients. The categories for comorbidity index scores 13 through 16 have been collapsed into one category because of the limited number of patient observations (between 0 and 2) in those categories in the full dataset. In the data subset, comorbidity index scores 10 through 16 have been collapsed because there are fewer patient observations in those categories.

Table 2. Descriptive statistics for all variables used in analysis of variations in utilization of health services by prostate cancer patients (N=5,754)

Variable	n	Mean	SD	Range
Age	5,754	77.9	8.0	47-101
Female Head of Household %	5,744	20.0	5.5	6-46.6
Average Household Income	5,744	54,889	13,693	22,335-105,987
Population Medicaid Eligible %	5,744	22.3	9.4	0.2-58.1
Population Age 65+ %	5,744	13.0	3.0	6.5-34.1
Poverty %	5,744	15.0	5.5	3.2-42.2
Uninsured Population %	5,744	17.5	5.2	4.5-37.6
Population Black/ African American%	5,744	12.1	13.3	0-71.3
Population Hispanic/ Latino %	5,744	19.1	17.1	0.4-95.7
Population White %	5,744	68.0	17.0	15.2-98.9
Access to Physicians	5,744	75.3	26.4	0-195.8
Cost	5,754	750.2	618.5	0-22,140
Hospital Length of Stay	5,754	4.8	5.0	1-79

Variable		N	%
Genetic Factors	*No*	5,185	90.1
	Yes	569	9.9
Rural/Urban	*Metro >1 million*	3,311	57.5
	Metro 250,000–1 million	1,159	20.1
	Metro <250,000	429	7.5
	Urban >20,000, Metro adjacent	169	2.9
	Urban >20,000, Not metro adjacent	128	2.2
	Urban 2,500-19,999, Metro adjacent	233	4
	Urban 2,500-19,999, Not metro adjacent	200	3.5
	Rural or < 2,500 urban, Metro adjacent	52	0.9
	Rural or <2,500 urban, Not metro adjacent	63	1.1
	Missing	10	0.2
Underserved Area	*None of county is shortage area*	448	7.8
	Whole county is shortage area	2,921	50.8
	Part of county is shortage area	2,375	41.3
	Missing	10	0.2
Geographic Region	*Northeast*	1,386	24.1
	Midwest	852	14.8
	South	1,085	18.9
	West	2,421	42.1
	Missing	10	0.2
Comorbidity Index Score*	*Score 2*	3,022	52.5
	Score 3	433	7.5
	Score 4	590	10.3
	Score 5	176	3.1
	Score 6	30	0.5
	Score 7	4	0.1

Variable		N	%
	Score 8	1,030	17.9
	Score 9	186	3.2
	Score 10	190	3.3
	Score 11	64	1.1
	Score 12	23	0.4
	Score 13	6	0.1
Complications	*No*	5,288	91.9
	Yes	466	8.1
Intensive Care Unit	*No*	4,542	78.9
	Yes	1,212	21.1
Treatment	*No*	5,228	90.9
	Yes	526	9.1
Emergency Room	*No*	2,419	42
	Yes	3,335	58

*Comorbidity Index Score 13 includes patients with scores 13 through 16

Descriptive statistics for the data subset used in the analysis including hospital factors are shown in Table 3. There are 556 patient records and no missing values. Emergency room services were used by 55.4% of patients in this sample, and the average number of days spent in the hospital is 4.8. The average age of patients is 78.4 years. The data subset does not include any patients from counties identified as being the most rural on the rural/urban continuum code, and 69.2% were from counties identified as being the most urban on the rural/urban continuum code. More than 77% resided in counties that had been wholly designated as an underserved area. Although a smaller measure is used for the geographic area variable (U.S. Census Bureau Divisions rather than Regions), approximately 94% of patients were still based in a single area, the Pacific, which includes Alaska, California, Hawaii, Oregon and Washington. Treatment for prostate cancer is recorded in the claims for 12.1% of patients. Comorbidity index scores 10 through 16 have been collapsed into one category because of the very small number of patient observations (between 0 and 2) in those categories.

Table 3. Descriptive statistics for variables used in analysis of variations in utilization of health services by prostate cancer patients using data subset with hospital variables (N=556)

Variable	Mean	SD	Range
Age	78.4	8.1	47-97
Female Head of Household %	21.1	2.7	12.4-32.5
Average Household Income	5,2813	9,819	29,633-73,678
Population Medicaid Eligible %	33.3	8.0	11.6-58.1
Population Age 65+ %	11.7	2.3	7.9-24.1
Poverty %	17.7	4.5	9.3-34.5
Uninsured Population %	21.8	4.5	13.6-27.2
Population Black/ African American %	7.9	4.8	0.2-54.7
Population Hispanic/ Latino %	38.0	16.0	1-80.4
Population White %	56.4	12.3	23.3-89.3
Cost	737.1	665.9	0-10,912
Access to Physician	70.8	16.4	13.6-98.1
Hospital Length of Stay	4.8	5.2	1.0-60

Variable		N	%
Genetic Factors	*No*	500	89.9
	Yes	56	10.1
Rural/Urban	*Metro >1 million*	385	69.2
	Metro 250,000–1 million	74	13.3
	Metro <250,000	47	8.5
	Urban >20,000, Metro adjacent	10	1.8
	Urban >20,000, Not metro adjacent	14	2.5
	Urban 2,500-19,999, Metro adjacent	15	2.7
	Urban 2,500-19,999, Not metro adjacent	10	1.8
	Rural or < 2,500 urban, Metro adjacent	1	0.2
	Rural or <2,500 urban, Not metro adjacent	0	0
Underserved Area	*None of county is shortage area*	4	0.7
	Whole county is shortage area	429	77.2
	Part of county is shortage area	123	22.1
Geographic Region (Division)	*East South Central*	8	1.4
	West South Central	4	0.7
	Mountain	20	3.6
	Pacific	524	94.2
Hospital Size	*Small (<100 beds)*	219	39.5
	Medium (100-250 beds)	150	27.0
	Large (>250 beds)	186	33.5

Variable		N	%
Hospital Ownership	*Government Owned*	156	28.1
	Non-Government, Not-For-Profit	324	58.3
	Investor Owned, For-Profit	76	13.7
Hospital Cancer Program	*Cancer program not ACOS approved*	338	60.8
	Cancer program ACOS approved	218	39.2
Hospital Resident Training	*Residency program not ACGME approved*	527	94.8
	Residency program ACGME approved	29	5.2
Comorbidity Index Score	*Score 2*	303	54.5
	Score 3	28	5
	Score 4	51	9.2
	Score 5	18	3.2
	Score 6	2	0.4
	Score 7	1	0.2
	Score 8	103	18.5
	Score 9	21	3.8
	Score 10	29	3.5
Complications	*No*	504	90.6
	Yes	52	9.4
Intensive Care Unit	*No*	443	79.8
	Yes	112	20.2
Treatment	*No*	489	87.9
	Yes	67	12.1
Emergency Room	*No*	248	44.6
	Yes	308	55.4

*Comorbidity Index Score 10 includes patients with scores 10 through 14.

Results of Automatic Interaction Detector Analysis

AID analysis was performed using the predictive modeling software DTREG. The six social and demographic variables used for this stage of analysis are: patient age, percentage of population Black/ African American, percentage of population Hispanic/ Latino, percentage of population White, rural/urban, and underserved area. Table 4 shows the characteristics for these independent variables and the two dependent variables.

Table 4. Characteristics, average hospital length of stay and percentage of emergency room utilization by prostate cancer patients for six independent variables in automatic interaction detector analysis

		All Patients (N=5,754*)				Data Subset (N=556)			
Independent Variable	**Category**	**n**	**%**	**Hospital Days**	**ER Use**	**n**	**%**	**Hospital Days**	**ER Use**
Patient Age	1. <75	2,219	38.6	4.77	52.5	182	32.7	4.52	46.7
	2. 75-85	2,504	43.5	4.68	58.3	262	47.1	4.97	54.6
	3. >85	1,031	17.9	4.95	68.9	112	20.1	4.11	71.4
Black/ African American Population (%)	1. <9	2,887	50.2	4.40	55.1	184	33.1	4.10	56.0
	2. 9-13	1,382	24.0	5.12	59.7	362	65.1	5.11	55.2
	3. >13	1,475	25.6	5.10	61.8	10	1.8	6.00	50.0
Hispanic/ Latino Population (%)	1. <14	2,955	51.4	4.70	57.6	50	9.0	4.22	50.0
	2. 14-32	1,441	25.0	4.72	59.1	155	27.9	3.74	53.5
	3. >32	1,348	23.4	4.92	57.4	351	63.1	5.34	57.0
White Population (%)	1. <50	573	10.0	5.30	59.3	70	12.6	3.87	61.4
	2. 50-75	3,267	56.8	4.91	58.8	416	74.8	5.17	55.5
	3. >75	1,904	33.1	4.33	56.0	70	12.6	3.50	48.6
Rural/Urban	1. Urban	4,899	85.1	4.98	60.1	506	91.0	4.98	56.7
	2. Urban Adjacent	530	9.2	4.19	46.8	39	7.0	3.92	43.6
	3. Rural	315	5.5	3.97	43.2	11	2.0	3.45	36.4
Underserved Area	0. No shortage	448	7.8	4.54	57.4	4	0.7	9.50	50.0
	1. All shortage	2,921	50.8	4.68	57.1	429	77.2	4.99	54.5
	2. Part shortage	2,375	41.3	4.88	59.1	123	22.1	3.95	58.5
TOTAL				4.76	58.0			4.79	55.4

*Total number for the dependent variables Hospital Days and Emergency Room Use and the independent variable Patient Age; for the remaining independent variables N=5,744 due to 10 missing.

The number of missing values (ten) for several of the predictor values in the full dataset is relatively small. Missing values are addressed using the surrogate splitters method described in

Chapter 3. These independent variables were entered into DTREG once for emergency room use and then again for hospital length of stay. Through the process of partitioning the dataset into non-overlapping subgroups, two predictor trees were constructed showing the importance of factors and their interaction effects in explaining variation in the dependent variables.

Emergency Room Use

The predictor tree for emergency room utilization by prostate cancer patients is shown in Figure 3. A summary of the terminal nodes is provided in Appendix C. Rural/urban is the most important predictor, and the only variable of importance for the split process out of the six independent variables entered. The two terminal nodes indicate patterns of no emergency room utilization existing in non-urban areas (n = 845, 14.7%), and patterns of emergency room utilization existing in urban areas (n = 4,909, 85.3%). The number in each node corresponding to the numbers in each of the three categories for this variable differs slightly from the descriptive information in Table 2 due to the ten missing values for this variable in the dataset. The node information for classification trees that are produced when the dependent variable is categorical also includes misclassification percent which can be defined as “the percentage of the rows in this node that had target variable categories different from the category that was assigned to the node” (Sherrod, 2014, p. 242). Based on the results, there do not appear to be any important interactions between these variables in predicting emergency room use by prostate cancer patients.

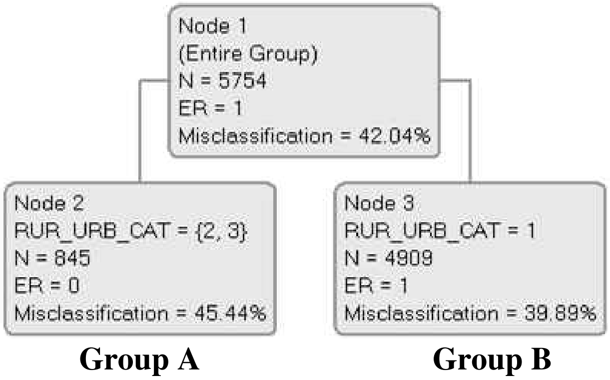

Figure 3. Predictor tree for analysis of emergency room utilization by prostate cancer patients

Hospital Length of Stay

The predictor tree showing the important factors in accounting for variation in hospital length of stay by prostate cancer patients is displayed in Figure 4. Patient age is the only one of the six social and demographic variables that showed no interaction effects in this analysis. There are nine terminal nodes representing subgroups identified as having similar use patterns. Three of the variables, rural/urban, Hispanic/ Latino population, and underserved area are each found in three of the terminal nodes. The percentage of patients found in the rural/ urban terminal nodes is 47.0%, followed by 34.5% and 18.5% in terminal nodes for Hispanic/ Latino population and underserved area respectively. The highest percentage of patients (35%) fall into node 7. Together, nodes 6 and 7 include nearly 47% of patients. In these subgroups, there is an interaction between county characteristics of low Black/ African American population, higher White population, and rural/urban.

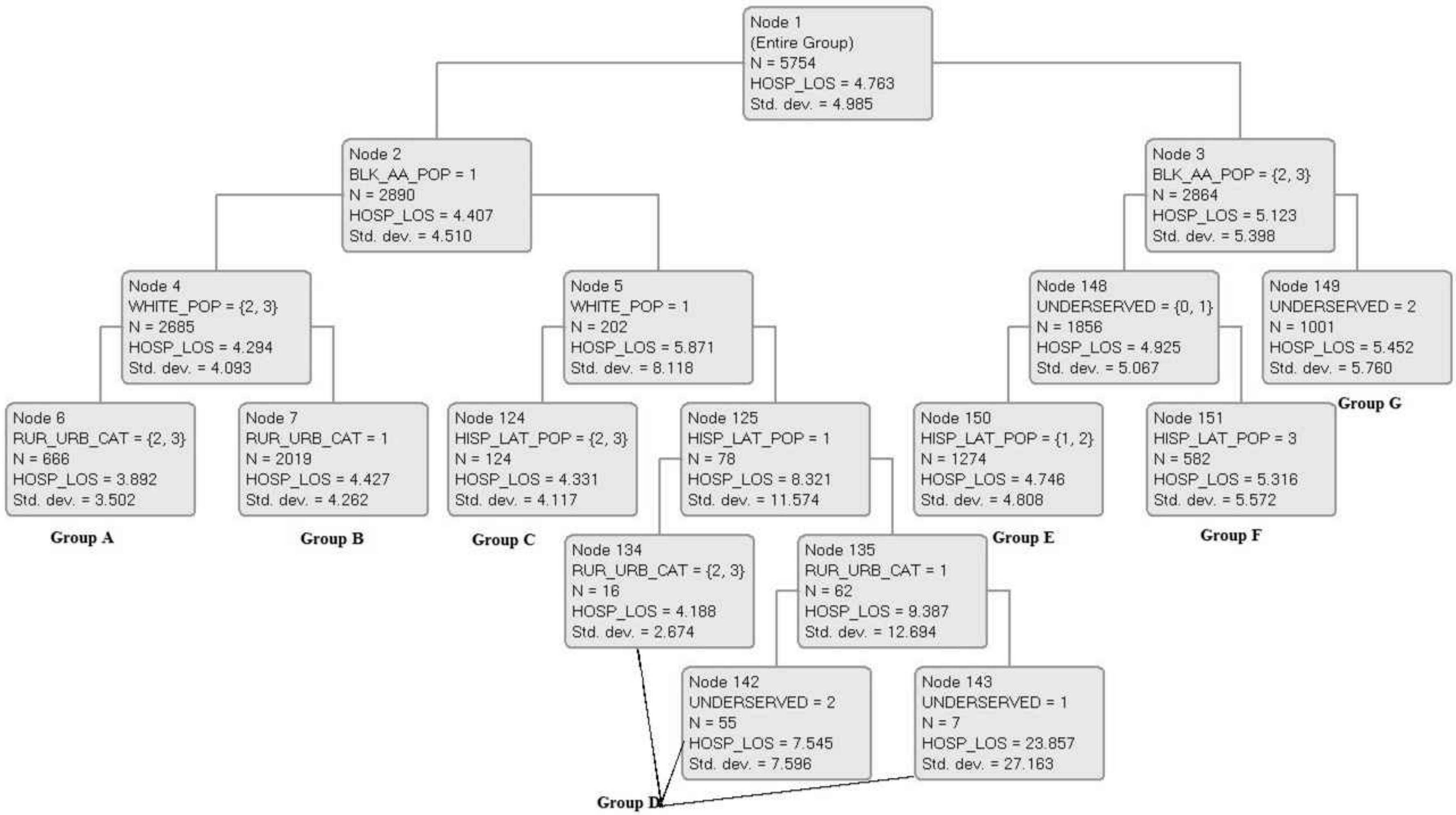

Figure 4. Predictor tree for analysis of hospital length of stay by prostate cancer patients

A summary of the terminal nodes ranked according to the mean number of hospital stay days is included in Appendix C. Underserved areas categorized as either all or part of the county being designated a health professional shortage area are related to longer hospital length of stay. The percentage of patients found in these three nodes (nodes 142, 143, and 149) is 18.5%, most of which (17.4%) are found in node 149. With the exception of nodes 142 and 143, which together account for only about 1% of patients, the average number of days spent in the hospital is greater in subgroups identified by the interactions between higher Black/African American population and underserved area (node 149) and higher Black/ African American population, underserved area, and Hispanic/Latino population (node 151). The mean length of stay is lowest in the subgroup identified by the interaction between low Black/ African American population, higher White population, and non-urban (node 6).

Data Subset

The predictor trees for analysis using the data subset are shown in Figure 5 for emergency room use and Figure 6 for hospital length of stay. A summary of the terminal nodes is included in Appendix C. Patient age is the only variable of importance in the subset analysis of emergency room use. There are three terminal nodes. The terminal node with patients classified as non-users of emergency room services is the subgroup of patients younger than 75 (n = 206, 37.1%). Nearly 63% of patients are classified as users of emergency room services. These are the subgroup of patients age 75-85 (n = 238, 42.8%) and patients older than 85 (n = 112, 20.1%). Percentage of Hispanic/ Latino population is the only variable of importance in the subset analysis of hospital length of stay. There are two terminal nodes, which show patterns of higher average hospital length of stay in counties with more than 32% Hispanic/ Latino population (n =

351, 63.1%) and patterns of lower average hospital length of stay in counties with less than 32% Hispanic/Latino population (n = 205, 36.9%). There are no interaction effects between the variables.

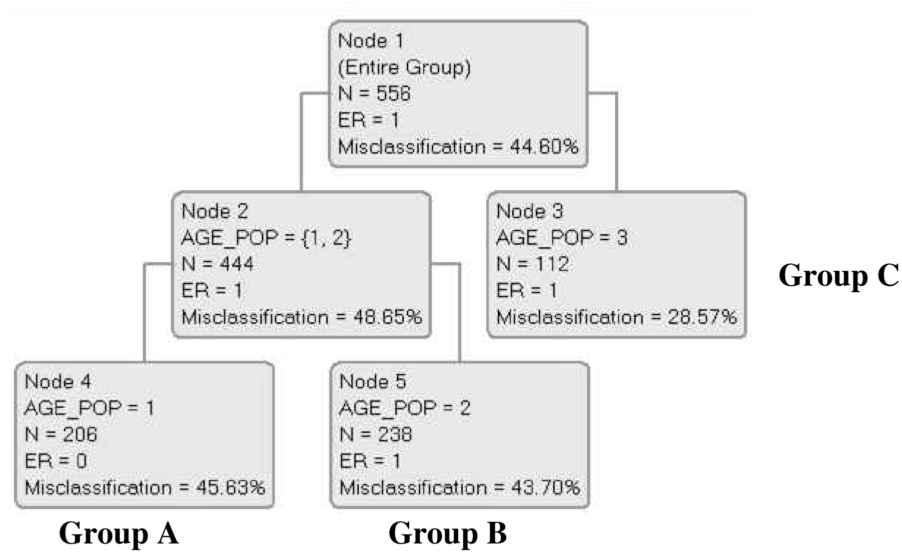

Figure 5 . Predictor tree for analysis of emergency room utilization by prostate cancer patients in data subset

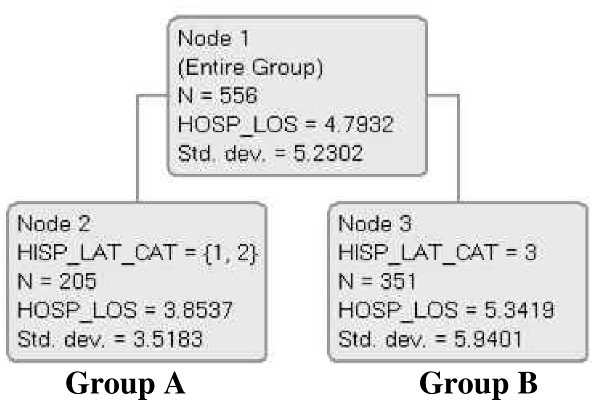

Figure 6. Predictor tree for analysis of hospital length of stay by prostate cancer patients in data subset

Table 5. Description of subgroups used for regression analysis of variations in health services utilization by prostate cancer patients

	N	%	ER Use	Hospital Days
Emergency Room Use				
All Prostate Cancer Patients	5,754	100		
A. Non-Urban County	845	14.7	No	
B. Urban County	4,909	85.3	Yes	
Hospital Length of Stay				
All Prostate Cancer Patients	5,754	100		4.76
A. Black/AA Population <9%, White >75%, Non-urban	666	11.6		3.89
B. Black/AA Population <9%, White >75%, Urban	2,019	35.1		4.43
C. Black/AA Population <9%, White <50%, Hispanic/Latino >14%	124	2.2		4.33
D. Black/AA Population <9%, White <50%, Hispanic/Latino <14%, All/Part Underserved Area	78	1.4		8.32
E. Black/AA Population >9%, All/ None Underserved Area, Hispanic/Latino <32%	1,274	22.2		4.75
F. Black/AA Population >9%, All/ None Underserved Area, Hispanic/Latino >32%	582	10.1		5.32
G. Black/AA Population >9%, Part Underserved Area	1,001	17.4		5.45
Emergency Room Use – Data Subset				
A. Patient Age <75	206	37.1	No	
B. Patient Age 75-85	238	42.8	Yes	
C. Patient Age >85	112	20.1	Yes	
Hospital Length of Stay – Data Subset				
A. Hispanic/Latino Population <32%	205	36.9		3.85
B. Hispanic/Latino Population >32%	351	63.1		5.34

Subgroups for Regression Analysis

Table 5 describes all of the subgroups that have been identified for inclusion in the regression analysis of health services utilization by prostate cancer patients in the full dataset and the data subset including hospital factors based on the influential variables and interaction effects found through AID analysis. Subgroups represent the terminal nodes in each predictor tree. Due to the low number of patients in terminal node 134 (n = 16), node 142 (n = 55) and node 143 (n = 7) in the predictor tree for hospital length of stay by all prostate cancer patients, they have been combined to create subgroup D (n = 78). The new mean number of days spent in the hospital by patients in this subgroup is 8.32, which is the highest mean hospital length of stay out of all subgroups.

Results of Regression Analysis in the Target Subgroups

Assumptions

Preliminary analyses have been conducted to evaluate the assumptions of multicollinearity, normality, linearity, and homoscedasticity. Although the distribution assumptions may not be problematic for larger samples, and logistic regression makes no assumptions about distribution of residuals, two independent variables with a high bivariate correlation and unusual cases considered to be outliers can be problematic for both multiple regression and logistic regression. The values used to determine multicollinearity are correlation of 0.8 or higher, Variance Inflation Factor (VIF) greater than 10, and Tolerance less than 0.10. Correlation tables for the full dataset and data subset are included in Appendix B. There is a correlation of at least 0.8 between the variables poverty and household income (-0.833), poverty and Medicaid eligible (0.8), and population Black/African American and female head of household (0.831). Only the variable female head of household exceeded the VIF and tolerance values (14.24, 0.07). Based on this, the variable female head of household is omitted from the analysis.

In the data subset, there is a correlation of at least 0.8 between poverty and Medicaid eligible population (0.828), average household income and poverty (-0.812), and average household income and underserved area (0.807). The VIF and tolerance values for Medicaid eligible population and average household income are 53.99, 0.019 and 45.89, 0.022 respectively. Additionally, the VIF and tolerance values for percentage of population uninsured were 27.68 and 0.036, and for female head of household are 26.517 and 0.038. These four independent variables have been removed from the analysis using the data subset.

Outliers are not uncommon for larger datasets. Both the full dataset with all prostate cancer patients and the data subset have been evaluated for any extreme outlying or unusual cases that might impact the results. The Casewise Diagnostics table generated by SPSS includes cases with standardized residual values above 3.0 or below -3.0. It would be expected for 1% of cases to fall outside of this range in a normally distributed sample (Pallant, 2007, p. 158). In the full dataset for this analysis, the Casewise Diagnostics table requested (set to outliers outside of 3 standard deviations) included 110 cases, which is 1.9%. The Cook's Distance value, which can be used to assess whether or not the model results would be excessively influenced by these unusual cases based on values greater than 1, is not higher than 0.483 for any of the cases. Additionally, the Casewise List requested in logistic regression does not show any cases that were found for which the model did not fit well. Therefore, no cases have been removed from the dataset. In the data subset, 9 cases, or 1.61%, were included in the Casewise Diagnostics table. The maximum Cook's Distance value is 2.115, indicating that at least on case may have undue influence on the results of the model. This is the only case with a value greater than 1.

After removing this case from the data subset, the Casewise Diagnostics table included 7 cases, or 1.26%, which is now closer to the 1% that would be expected in a normally distributed sample.

Results of Hierarchical Logistic Regression Analysis for Emergency Room Use

Hierarchical binary logistic regression is performed to assess the impact of factors on the likelihood that patients would utilize emergency room services. The model contains ten predisposing factors, five enabling factors, and four need-for-care factors, which is a total of nineteen independent variables. The independent variables that make a unique statistically significant contribution at each step for all groups are reported in this section and identified below in Table 10 following all regression analysis results. Appendix C includes full results for each logistic regression model.

The fit of all models is statistically significant except for the model with only predisposing factors for Emergency Room Group B based on values of the Hosmer and Lemeshow Fit Test, chi-square = 23.708, p = 0.003, indicating that the model with only predisposing factors for patients in urban areas is not able to distinguish between patients who used the emergency room and those who did not. The fit for this model improves when the other categories of predictors are added. All goodness of fit test values and pseudo R square statistics are shown in Table 6.

<u>All Prostate Cancer Patients</u>

Predisposing factors explain between 2.5% (Cox & Snell R Square) and 3.4% (Nagelkerke R Square) of the variance in emergency room use for all prostate cancer patients. The statistically significant variables aree the predisposing factors age, average household income, percentage of county population over age 65, percentage of population with no health insurance, percentage of population that is Black/ African American, percentage of population that is Hispanic/ Latino, and percentage of population that is White.

Prostate cancer patients are more likely to use emergency room services as their age increases ($\beta = 0.028$, OR = 1.029, $p < 0.001$). The likelihood of emergency room use by patients is greater as there are increases in percentage of Black/ African American population ($\beta = 0.018$ OR = 1.019, $p < 0.001$), percentage Hispanic/ Latino ($\beta = 0.009$, OR = 1.009, $p = 0.005$) and percentage White ($\beta = 0.008$, OR = 1.008, $p = 0.006$). Equal likelihood is indicated by county average annual income ($\beta = 0$, OR = 1, $p = 0.005$). Emergency room use is less likely as there are increases in county percentage of individuals over age 65 ($\beta = -0.033$, OR = 0.967, $p = 0.005$) and percentage with no health insurance ($\beta = -0.03$, OR = 0.97, $p = 0.002$).

When enabling factors are added, the amount of variation explained is between 3.7% (Cox & Snell R Square) and 5.0% (Nagelkerke R Square). The statistically significant variables are the predisposing factors age and population below poverty level, and the enabling factors cost, rural/ urban and geographic region. Patients are more likely to use the emergency room as age increases ($\beta = 0.029$, OR = 1.03, $p < 0.001$), and the percentage of individuals living below poverty level in the county increases ($\beta = 0.04$, OR = 1.041, $p = 0.006$). Equal likelihood is indicated by cost ($\beta = 0$, OR = 1, $p = 0.005$). Compared to patients in counties with rural/ urban continuum code 1, emergency room use is less likely by patients in counties with rural/ urban continuum code 3 ($\beta = -0.309$, OR = .734, $p = 0.012$) through code 9 ($\beta = -0.914$, OR = 0.401, $p = 0.002$), with the exception of rural/urban code 5. Patients living in the South ($\beta = -0.361$, OR = 0.697, $p = 0.009$) or West ($\beta = -0.488$, OR = 0.614, $p < 0.001$) regions of the U.S. are less likely to use emergency room services than patients in the Northeast.

The amount of variance explained when need-for-care factors are entered is between 13.1% (Cox & Snell R Square) and 17.6% (Nagelkerke R Square). The statistically significant variables are the predisposing factors age and population below poverty level, the enabling factors rural/ urban and geographic region, and the need-for-care factors comorbidity index score, treatment, and intensive care unit. Patients are more likely to use the emergency room as there are increases in age ($\beta = 0.025$, OR = 1.026, $p < 0.001$) and the percentage of individuals living below poverty level in the county ($\beta = 0.052$, OR = 1.054, $p = 0.001$).

Compared to patients in counties with rural/ urban continuum code 1, considered to be the most urban, emergency room use is less likely by patients in counties with rural/ urban continuum code 3 ($\beta = -0.316$, OR = .729, $p = 0.016$) through code 9 ($\beta = -0.837$, OR = 0.433, $p = 0.006$), with the exception of rural/ urban code 5. Patients living in the Midwest ($\beta = -0.258$, OR = 0.773, $p = 0.038$), South ($\beta = -0.366$, OR = 0.694, $p = 0.012$) or West ($\beta = -0.375$, OR = 0.687, $p = 0.002$) are less likely to use emergency room services than patients in the Northeast.

Patients with more comorbid illnesses are more likely to use emergency room services, with increased likelihood for nearly all comorbidity index scores from score 3 ($\beta = 0.462$, OR = 1.587, $p < 0.001$) to score 12 ($\beta = 1.244$, OR = 3.469, $p = 0.021$) when compared to the lowest score, score 2. Patients receiving care in the intensive care unit are more likely to use emergency room services than patients not receiving this type of care ($\beta = 0.42$, OR = 1.523, $p < 0.001$). Patients receiving treatment for prostate cancer are less likely to use emergency room services than patients who are not receiving treatment ($\beta = -2.225$, OR = 0.108, $p < 0.001$).

Emergency Room Group A (Non-Urban County Residents)

Predisposing factors explain between 2.5% (Cox & Snell R Square) and 3.4% (Nagelkerke R Square) of the variance in emergency room use for Emergency Room Group A. This subgroup includes only patients who reside in non-urban counties and have patterns of less emergency room use. The statistically significant variables are the predisposing factors average household income, percentage of population that is Medicaid eligible, and percentage of White population. Equal likelihood is indicated by county average household income ($\beta = 0$, OR = 1, $p = 0.004$). Patients are more likely to use the emergency room with increases in the percentage of Medicaid eligible population ($\beta = 0.034$, OR = 1.035, $p = 0.021$), and percentage of White population ($\beta = 0.02$, OR = 1.02, $p = 0.019$).

When enabling factors are added, the amount of variation explained is between 5.5% (Cox & Snell R Square) and 7.3% (Nagelkerke R Square). The statistically significant variables are the predisposing factors average household income and percentage of population that is Medicaid eligible, and the enabling factors cost and rural /urban. Patients are more likely to use the emergency room with increases in the percentage of Medicaid eligible individuals in the county ($\beta = 0.038$, OR = 1.039, $p = 0.019$). Equal likelihood is indicated by county average household income ($\beta = 0$, OR = 1, $p = 0.011$) and cost ($\beta = 0$, OR = 1, $p = 0.013$). Compared to patients in counties with rural/ urban continuum code 4, emergency room use is more likely by patients in counties with rural/ urban continuum code 5 ($\beta = 0.61$, OR = 1.841, $p = 0.023$).

The amount of variance explained when need-for-care factors are entered is between 10.6% (Cox & Snell R Square) and 14.1% (Nagelkerke R Square). The statistically significant variables are the predisposing factors average household income and percentage of population

Medicaid eligible, the enabling factor rural/ urban, and the need-for-care factors comorbidity index score and treatment.

Patients are more likely to use the emergency room as there are increases in the percentage of Medicaid eligible individuals in the county ($\beta = 0.036$, OR = 1.037, $p = 0.032$). Equal likelihood is indicated by county average income ($\beta = 0$, OR = 1, $p = 0.022$). Compared to patients in counties with rural/ urban continuum code 4, emergency room use is more likely by patients in counties with rural/ urban continuum code 5 ($\beta = 0.687$, OR = 1.988, $p = 0.015$). Patients with comorbidity index score 10 are more likely ($\beta = 1.526$, OR = 4.599, $p = 0.025$) to use emergency room services compared to the lowest index score. Patients receiving treatment for prostate cancer are less likely to use emergency room services than patients who are not receiving treatment ($\beta = -1.826$, OR = 0.161, $p < 0.001$).

Emergency Room Group B (Urban County Residents)

Predisposing factors explain between 2.4% (Cox & Snell R Square) and 3.3% (Nagelkerke R Square) of the variance in emergency room use for Emergency Room Group B. This subgroup includes only patients who reside in urban counties and have patterns of greater emergency room use. The fit of this model is not statistically significant. The statistically significant variables are the predisposing factors age, county population with no health insurance, percentage of population that is Black/ African American, and percentage of population that is Hispanic/ Latino.

Prostate cancer patients in urban counties are more likely to use emergency room services as age increases ($\beta = 0.035$, OR = 1.036, $p < 0.001$). The likelihood of emergency room use by patients is greater with increases in percentage of county population that is Black/ African

American ($\beta = 0.015$, OR = 1.015, $p < 0.001$) and Hispanic/ Latino ($\beta = 0.012$, OR = 1.012, p = 0.003). Emergency room use is less likely as the percentage of county population with no health insurance increases ($\beta = -0.037$, OR = 0.963, p = 0.001).

When enabling factors are added, the amount of variance explained is between 3.1% (Cox & Snell R Square) and 4.2% (Nagelkerke R Square). The statistically significant variables are the predisposing factors age and poverty, and the enabling factors cost, rural/ urban and geographic region. Patients are more likely to use the emergency room with increases in age ($\beta = 0.035$, OR = 1.036, $p < 0.001$), and the percentage of individuals living below poverty level ($\beta = 0.043$, OR = 1.044, p = 0.021). Equal likelihood is indicated by cost ($\beta = 0$, OR = 1, p = 0.041). Compared to patients in counties with rural/ urban continuum code 1, emergency room use is less likely by patients in counties with rural/ urban continuum code 3 ($\beta = -0.302$, OR = .739, p = 0.019). Patients living in the South ($\beta = -0.432$, OR = 0.655, p = 0.006) or West ($\beta = -0.54$, OR = 0.583, $p < 0.001$) regions of the U.S. are less likely to use the emergency room than in the Northeast.

The amount of variance explained when need-for-care factors are entered is between 13.5% (Cox & Snell R Square) and 18.3% (Nagelkerke R Square). The statistically significant variables are the predisposing factors age and percentage of county below poverty level, the enabling factors rural/ urban and geographic region, and the need-for-care factors comorbidity index score, treatment, and intensive care unit.

Patients are more likely to use the emergency room as there are increases in age ($\beta = 0.031$, OR = 1.032, $p < 0.001$) and the percentage of individuals living below poverty level in the county ($\beta = 0.058$, OR = 1.060, p = 0.003). Compared to patients in counties with rural/ urban continuum code 1, considered to be the most urban, emergency room use is less likely by patients in counties with rural/ urban continuum code 3 (β = -0.309, OR = .734, p = 0.024). Patients living in the South (β = -0.45, OR = 0.637, p = 0.006) or West (β = -0.428, OR = 0.652, p = 0.002) are less likely to use emergency room services than patients in the Northeast.

Patients with more comorbid illnesses are more likely to use emergency room services, with increased likelihood for nearly all comorbidity index scores from score 3 (β = 0.48, OR = 1.616, p < 0.001) to score 12 (β = 1.407, OR = 4.083, p = 0.018) when compared to the lowest index score. Patients receiving care in the intensive care unit are more likely to use emergency room services than patients not receiving this type of care (β = 0.47, OR = 1.60, p < 0.001). Patients who are receiving treatment for prostate cancer are less likely to use emergency room services than patients who are not receiving treatment (β = -2.282, OR = 0.102, p < 0.001).

Table 6. Goodness of fit tests and variance in emergency room utilization by prostate cancer patients explained by predisposing, enabling and need-for-care factors

	Model Goodness of Fit Tests				**Pseudo R^2 Statistics**	
	Omnibus Tests of Model Coefficients		Hosmer & Lemeshow Test		Cox & Snell R Square	Nagelkerke R Square
	Chi-square	Sig.	Chi-square	Sig.		
All Patients						
Predisposing Factors	145.423	0.000	9.704	0.286	0.025	0.034
Predisposing and Enabling Factors	215.802	0.000	14.958	0.060	0.037	0.05
Predisposing, Enabling, and Need Factors	804.648	0.000	7.794	0.454	0.131	0.176
Group A. Non-Urban Areas						
Predisposing Factors	21.611	0.017	5.102	0.747	0.025	0.034
Predisposing and Enabling Factors	47.386	0.001	9.443	0.306	0.055	0.073
Predisposing, Enabling, and Need Factors	94.404	0.000	3.246	0.169	0.106	0.141
Group B. Urban Areas						
Predisposing Factors	119.446	0.000	23.708	0.003	0.024	0.033
Predisposing and Enabling Factors	156.074	0.000	8.793	0.360	0.031	0.042
Predisposing, Enabling, and Need Factors	710.991	0.000	11.617	0.169	0.135	0.183

Results of Hierarchical Multiple Regression Analysis for Hospital Length of Stay

Hierarchical multiple regression is used to evaluate the ability of predisposing factors, enabling factors, need-for-care factors, and emergency room use to predict the length of stay for all-cause hospitalization by prostate cancer patients. The "exclude cases pairwise" option described in Chapter 3 is used to address missing values. For all patients and each of the subgroups, ten predisposing factors are entered into the model at Step 1, five enabling factors are entered at Step 2, four need-for-care factors are entered at Step 3, and emergency room use at Step 4. Table 7 shows the amount of variance in hospital length of stay that is explained by each group of predictors after holding all other factors constant and the total variance that is explained at each step, and whether or not the model is a statistically significantly good fit for the data. The independent variables that make a unique statistically significant contribution at each step for all groups are reported in this section and identified in Table 10. Appendix D includes tables with the coefficients for each model.

<u>All Prostate Cancer Patients</u>

In the group including all patients, predisposing factors alone explain 1.2% of the variance in hospital length of stay, and the model fit is statistically significant, $R^2 = 0.012$, $F(10, 5{,}733) = 7.23$, $p < 0.001$. Genetic factors and percentage of the population that is White are statistically significant predictors, with White population having a higher standardized beta value ($\beta = -0.112$, $p < 0.001$) than genetic factors ($\beta = -0.058$, $p < 0.001$).

Table 7. Variation in hospital length of stay by prostate cancer patients explained by predisposing, enabling and need-for-care factors, and emergency room use

	Predisposing Factors Entered					Enabling Factors Entered					Need Factors Entered					Emergency Room Use Entered				
	R^2	R^2 Change	Sig. F Change	F	Sig.	R^2	R^2 Change	Sig. F Change	F	Sig.	R^2	R^2 Change	Sig. F Change	F	Sig.	R^2	R^2 Change	Sig. F Change	F	Sig.
All Prostate Cancer Patients	0.012	0.012	0.000	7.23	0.000	0.027	0.014	0.000	10.48	0.000	0.061	0.034	0.000	19.43	0.000	0.061	0.001	0.047	18.67	0.000
A) High Concentration White, Non-Urban County Residents	0.022	0.022	0.134	1.50	0.134	0.033	0.010	0.227	1.47	0.111	0.071	0.038	0.000	2.60	0.000	0.071	0.000	0.791	2.47	0.000
B) High Concentration White, Urban County Residents	0.012	0.012	0.008	2.39	0.008	0.039	0.027	0.000	5.42	0.000	0.064	0.025	0.000	7.16	0.000	0.064	0.000	0.534	6.82	0.000
C) High Concentration Hispanic County Residents	0.020	0.020	0.650	0.62	0.650	0.029	0.008	0.316	0.70	0.626	0.108	0.079	0.045	1.53	0.146	0.122	0.014	0.184	1.56	0.126
D) Underserved Area Residents	0.209	0.209	0.052	2.00	0.052	0.242	0.032	0.096	2.14	0.033	0.281	0.039	0.490	1.76	0.660	0.309	0.028	0.121	1.85	0.048
E) High Concentration Black/AA, Low Hispanic County Residents	0.011	0.011	0.187	1.37	0.187	0.038	0.028	0.000	3.35	0.000	0.073	0.035	0.000	5.23	0.000	0.082	0.008	0.001	5.56	0.000
F) High Concentration Black/AA and Hispanic County Residents	0.017	0.017	0.120	1.69	0.120	0.060	0.042	0.000	5.20	0.000	0.099	0.039	0.000	5.69	0.000	0.111	0.012	0.005	5.95	0.000
G) High Concentration Black/AA, Underserved Area Residents	0.018	0.018	0.056	1.80	0.056	0.073	0.056	0.000	5.59	0.000	0.142	0.068	0.000	9.02	0.000	0.146	0.004	0.025	8.84	0.000

When enabling factors are entered, there is a statistically significant change in the amount of variance explained, with enabling factors explaining an additional 1.4% of the variance, R^2 change = 0.014, $p < 0.001$. The model with predisposing and enabling factors together is statistically significant and explains 2.7% of the variance in hospital length of stay by all prostate cancer patients, $R^2 = 0.027$, $F(15, 5{,}728) = 10.48$, $p < 0.001$. The seven statistically significant variables are the predisposing factors genetic factors, percentage of population with no health insurance, and all three of the measures for county population race/ethnicity, and the enabling factors cost and geographic region. Percentage of White population has the highest standardized beta value ($\beta = -0.184$, $p < 0.001$), followed by geographic region ($\beta = -0.132$, $p < 0.001$), Black/ African American population ($\beta = -0.112$, $p < 0.001$), percentage of uninsured population ($\beta = 0.102$, $p < 0.001$), cost ($\beta = 0.084$, $p < 0.001$), Hispanic/ Latino population ($\beta = -0.070$, $p = 0.017$), and genetic factors ($\beta = -0.058$, $p < 0.001$).

When need-for-care factors are entered, an additional 3.4% of the variance is explained after holding predisposing and enabling factors constant. The model with predisposing, enabling, and need-for-care factors together explains 6.1% of the variance in hospital length of stay by all prostate cancer patients. Both the change in variance explained, R^2 change = 0.034, $p < 0.001$, and the model fit with all three categories of predictors, $R^2 = 0.061$, $F(19, 5{,}724) = 19.432$, $p < 0.001$, are statistically significant. The ten statistically significant variables are the predisposing factors genetic factors, percentage of population with no health insurance, and all three of the measures for county population race/ethnicity, the enabling factors cost and geographic region, and the need-for-care factors comorbidity index score, treatment, and intensive care unit.

Percentage of White population has the highest standardized beta value ($\beta = -0.184$, $p < 0.001$), followed by comorbidity index score ($\beta = 0.143$, $p < 0.001$), geographic region ($\beta = -$

0.124, $p < 0.001$), intensive care unit (β = 0.104, $p < 0.001$), Black/ African American population (β = -0.103, p = 0.001), cost (β = 0.102, $p < 0.001$), population with no health insurance (β = 0.097, $p < 0.001$), Hispanic/ Latino population (β = -0.073, p = 0.011), genetic factors (β = -0.051, $p < 0.001$), and treatment (β = -0.038, p = 0.004).

In the final step, emergency room use is added. The additional variance explained after holding predisposing, enabling, and need-for-care factors constant is 0.1%. The final model with all three categories of predictors and emergency room use explains 6.1% of the variance in hospital length of stay by all prostate cancer patients. The change in variance explained, R^2 change = 0.001, p = 0.047, and the final model, $R^2 = 0.061$, $F(20, 5{,}723) = 18.668$, $p < 0.001$, are statistically significant. The eleven significant variables include emergency room use, the predisposing factors genetic factors, population with no health insurance, and all three of the measures for county population race/ethnicity, the enabling factors of cost and geographic region, and the need-for-care factors comorbidity index score, treatment, and intensive care unit.

Percentage of White population has the highest standardized beta value (β = -0.183, $p < 0.001$), followed by comorbidity index score (β = 0.146, $p < 0.001$), geographic region (β = -0.126, $p < 0.001$), intensive care unit (β = 0.106, $p < 0.001$), Black/ African American population (β = -0.103, p = 0.001), cost (β = 0.102, $p < 0.001$), population with no health insurance (β = 0.097, $p < 0.001$), Hispanic/ Latino population (β = -0.073, p = 0.011), genetic factors (β = -0.051, $p < 0.001$), treatment (β = -0.045, p = 0.001), and emergency room use (β = -0.027, p = 0.047).

Hospital Group A (High Concentration White, Non-Urban County Residents)

Hospital Group A includes patients residing in non-urban counties with a high percentage of White population. The mean hospital length of stay for this subgroup (3.89 days) is lower than the mean for all patients (4.76 days). Predisposing factors alone explain 2.2% of the variance in hospital length of stay, and the race variable percentage of the population that is White is statistically significant ($\beta = 0.196$, $p = 0.026$). The model, however, is not statistically significant, $R^2 = 0.022$, $F (10, 655) = 1.5$, $p = 0.134$.

The amount of additional variance explained when enabling factors are entered is 1.0%, and access to physician services is the only statistically significant variable ($\beta = -0.082$, $p = 0.05$). The model with predisposing and enabling factors together explains 3.3% of the variance in hospital length of stay by prostate cancer patients in this subgroup. Neither the change in variation, R^2 change = 0.01, $p = 0.227$, nor the model as a whole, $R^2 = 0.033$, $F (15, 650) = 1.47$, $p = 0.111$ are statistically significant.

When need-for-care factors are entered, an additional 3.8% of the variance is explained after holding predisposing and enabling factors constant. The model with predisposing, enabling, and need-for-care factors together explains 7.1% of the variance in hospital length of stay by prostate cancer patients in Hospital Group A. Both the change in explained variance, R^2 change = 0.038, $p < 0.001$, and the model with all three categories of predictors, $R^2 = 0.071$, $F (19, 646) = 2.6$, $p < 0.001$, are statistically significant. The three statistically significant independent variables are the enabling factor access to physician services and need-for-care factors comorbidity index score and intensive care unit. Intensive care unit has the highest standardized beta value ($\beta = 0.149$, $p < 0.001$), followed by comorbidity index score ($\beta = 0.121$, $p = 0.002$), and access to physician services ($\beta = -0.081$, $p = 0.049$).

There is no additional variance explained when emergency room use is entered into the model. The total variance in hospital length of stay explained by the final model as a whole is 7.1%, and the model fit is statistically significant, $R^2 = 0.071$, $F (20, 645) = 2.47$, $p < 0.001$. The enabling factor access to physician services and the need-for-care factors comorbidity index score and intensive care unit remained the only statistically significant variables, with intensive care unit ($\beta = 0.149$, $p < 0.001$) having a higher standardized beta value than comorbidity index score ($\beta = 0.121$, $p = 0.002$) and access to physician services ($\beta = -0.081$, $p = 0.049$).

<u>Hospital Group B (High Concentration White, Urban County Residents)</u>

Hospital Group B includes patients residing in urban counties with a high percentage of White population. The mean hospital length of stay for this subgroup (4.43 days) is lower than the mean for all patients (4.76 days). Predisposing factors alone explain 1.2% of the variance in hospital length of stay and the model fit is statistically significant, $R^2 = 0.012$, $F (10, 2{,}008) = 2.39$, $p = 0.008$. The statistically significant variables are genetic factors and percentage of the population that is Black/ African American, with percentage Black/ African American population having a higher standardized beta value ($\beta = -0.074$, $p = 0.004$) than genetic factors ($\beta = -0.065$, $p = 0.003$).

When enabling factors are entered, there is a statistically significant change in the amount of variance explained, with enabling factors explaining an additional 2.7% of the variance, R^2 change = 0.027, $p < 0.001$. The model with predisposing and enabling factors together is statistically significant and explains 3.9% of the variation in hospital length of stay by prostate cancer patients in Hospital Group B, $R^2 = 0.039$, $F (15, 2{,}003) = 5.42$, $p < 0.001$. The statistically significant variables are the predisposing factor genetic factors and the enabling factor cost, with cost having a higher standardized beta value (β = -0.152, $p < 0.001$) than genetic factors (β = -0.050, $p = 0.015$).

When need-for-care factors are entered, an additional 2.5% of the variance is explained after holding predisposing and enabling factors constant. The model with predisposing, enabling, and need-for-care factors together explains 6.4% of the variance in hospital length of stay by prostate cancer patients in this subgroup. Both the change in variance explained and the model with all three categories of predictors are statistically significant, R^2 change = 0.025, $p < 0.001$, and $R^2 = 0.064$, $F (19, 1,999) = 7.158$, $p < 0.001$. The five statistically significant variables are the predisposing factor genetic factors, the enabling factor cost, and the need-for-care factors, comorbidity index score, treatment, and intensive care unit. Cost has the highest standardized beta value (β = -0.126, $p < 0.001$), followed by comorbidity index score (β = 0.105, $p < 0.001$), treatment (β = -0.093, $p < 0.001$), genetic factors (β = -0.056, $p = 0.01$), and intensive care unit (β = 0.055, $p = 0.015$).

No additional variance explained by emergency room use when it is added to the model in Step 4. The final model with all three categories of predictors and emergency room use explains 6.4% of the variance in hospital length of stay by prostate cancer patients in Hospital Group B, and is statistically significant, $R^2 = 0.064$, $F (20, 1,998) = 6.817$, $p < 0.001$. The five variables that are statistically significant when need-for-care factors are added to the model remained the significant variables in the final model. Cost has the highest standardized beta value (β = -0.125, $p < 0.001$), followed by comorbidity index score (β = 0.107, $p < 0.001$), treatment (β = -0.097, $p < 0.001$), genetic factors (β = -0.057, $p = 0.009$), and intensive care unit (β = 0.056, $p = 0.013$).

Hospital Group C (High Concentration Hispanic County Residents)

Hospital Group C includes patients residing in counties with a high percentage of Hispanic/ Latino population. The mean hospital length of stay for this subgroup (4.33 days) is lower than the mean for all patients (4.76 days). Predisposing factors alone explain 2% of the variance in hospital length of stay, but the model fit is not statistically significant, $R^2 = 0.02$, $F(4, 119) = 0.619$, $p = 0.650$. None of the variables are statistically significant. When enabling factors are entered, there is not a statistically significant change in variance explained by these factors, R^2 change = 0.008, $p = 0.316$, the fit of the whole model with predisposing and enabling factors, $R^2 = 0.029$, $F(5, 118) = 0.698$, $p = 0.626$, or any of the variables.

Need-for-care factors entered at Step 3 explain an additional 7.9% of the variance in hospital length of stay by prostate cancer patients in Hospital Group C and the total amount of variance explained by the model with predisposing, enabling, and need-for-care factors together is 10.8%. The change in explained variance is statistically significant, R^2 change = 0.079, $p = 0.045$. However, the model with all three categories of predictors is not statistically significant $R^2 = 0.108$, $F(9, 114) = 1.564$, $p = 0.126$. The need-for-care factors comorbidity index score is the only statistically significant variable ($\beta = 0.185$, $p = 0.049$).

The additional variance explained by emergency room use in Step 4 is not statistically significant, R^2 change = 0.014, $p = 0.184$. The final model with all three categories of predictors and emergency room use is also not statistically significant, $R^2 = 0.122$, $F(10, 113) = 1.564$, $p = 0.126$. Again, the only statistically significant variable is comorbidity index score ($\beta = 0.201$, $p = 0.033$).

Hospital Group D (Underserved Area Residents)

Hospital Group D includes patients residing in counties that are all or partially designated as an underserved area. The mean hospital length of stay for this subgroup (8.32 days) is higher than the mean for all patients (4.76 days). Predisposing factors alone explain 20.9% of the variance in hospital length of stay, but the model fit is not statistically significant, $R^2 = 0.209$, $F(9, 68) = 2.001$, $p = 0.052$. Percentage of county population age 65 and older is the only variable that is statistically significant ($\beta = -1.035$, $p = 0.008$).

The additional amount of variance explained by enabling factors at Step 2 is not statistically significant, R^2 change = 0.032, $p = 0.096$. The full model with predisposing and enabling factors explains 24.2% of the variance and is statistically significant, $R^2 = 0.242$, $F(10, 67) = 2.136$, $p = 0.033$. Percentage of county population age 65 and older is still the only statistically significant variable ($\beta = -1.075$, $p = 0.006$).

When need-for-care factors are entered into the model, neither the amount of additional variance explained nor the total variance explained by the model with predisposing, enabling, and need-for-care factors together are statistically significant, R^2 change = 0.039, $p = 0.49$ and $R^2 = 0.281$, $F(14, 63) = 1.76$, $p = 0.066$. Again, the only statistically significant variable is percentage of county population age 65 and older ($\beta = -1.181$, $p = 0.011$).

In the final model for Hospital Group D, the additional variance in hospital length of stay explained by emergency room use after holding all other factors constant is not statistically significant, R^2 change = 0.028, $p = 0.121$). The whole model with all three categories of predictors and emergency room use is statistically significant, $R^2 = 0.309$, $F(15, 62) = 1.846$, $p = 0.048$ and explains 30.9% of the variance in hospital length of stay by prostate cancer patients. The statistically significant variables are the predisposing factor percentage of county population age 65 and older and the enabling factor cost, with percentage of county population age 65 and older ($\beta = -1.181$, $p = 0.005$) having a higher beta value than cost ($\beta = -0.264$, $p = 0.032$).

Hospital Group E (High Concentration Black/ AA, Low Hispanic County Residents)

Hospital Group E includes patients residing in counties with a high percentage of Black/African American population and low Hispanic/ Latino population. The mean hospital length of stay for this subgroup (4.75 days) is only slightly less than the mean for all patients (4.76 days). Predisposing factors explain 1.1% of the variance in hospital length of stay, but the model fit is not statistically significant, $R^2 = 0.011$, F (10, 1,263) = 1.373, $p = 0.187$. The statistically significant variables are the three race/ethnicity factors, percentage of the population that is Black/ African American ($\beta = 0.299$, $p = 0.048$), Hispanic/ Latino ($\beta = 0.136$, $p = 0.029$), and White ($\beta = 0.294$, $p = 0.04$).

When enabling factors are entered, there is a statistically significant change in the amount of variance explained, with enabling factors explaining an additional 2.8% of the variance, R^2 change = 0.028, $p < 0.001$. The model with predisposing and enabling factors together is statistically significant and explains 3.9% of the variance in hospital length of stay by prostate cancer patients in this subgroup, $R^2 = 0.038$, F (15, 1,258) = 3.35, $p < 0.001$. The only statistically significant variable is the enabling factor cost ($\beta = -0.165$, $p < 0.001$).

Need-for-care factors are entered at Step 3, explaining an additional 3.5% of the variance after holding predisposing and enabling factors constant. The model with predisposing, enabling, and need-for-care factors together explains 7.3% of the variance in hospital length of stay by prostate cancer patients in Hospital Group E. The change in variance, R^2 change = 0.035, $p < 0.001$, and the model with all three categories of predictors, $R^2 = 0.073$, F (19, 1,254) = 5.227, p

< 0.001, are statistically significant. The three statistically significant variables are the enabling factor cost, and the need-for-care factors of comorbidity index score, and intensive care unit, with cost having the highest standardized beta value ($\beta = 0.176$, $p < 0.001$), followed by comorbidity index score ($\beta = 0.139$, $p < 0.001$), and intensive care unit ($\beta = 0.110$, $p < 0.001$).

The additional variance explained by emergency room use is 0.8%, and the amount of variance explained by the whole model is 8.2%. Both the change in explained variance and the final model fit are statistically significant, R^2 change = 0.008, $p < 0.001$ and $R^2 = 0.082$, $F(20, 1{,}253) = 5.564$, $p < 0.001$. The five statistically significant variables are the emergency room use, the enabling factor cost, and the need-for-care factors comorbidity index score, treatment, and intensive care unit. Cost has the highest standardized beta value ($\beta = 0.173$, $p < 0.001$), followed by comorbidity index score ($\beta = 0.147$, $p < 0.001$), intensive care unit ($\beta = 0.115$, $p < 0.001$), emergency room use ($\beta = -0.096$, $p = 0.001$), and treatment ($\beta = -0.064$, $p = 0.025$).

Hospital Group F (High Concentration Black/AA and Hispanic County Residents)

Hospital Group F includes patients in counties with a high percentage of Black/ African American and Hispanic/ Latino population. The mean hospital length of stay for this subgroup (5.32 days) is higher than the mean for all patients (4.76 days). Predisposing factors alone explain 1.7% of the variance in hospital length of stay, but the model fit is not statistically significant, $R^2 = 0.017$, $F(6, 575) = 1.69$, $p = 0.12$. The only statistically significant variable is genetic factors ($\beta = -0.099$, $p = 0.017$).

Enabling factors are entered at Step 2, explaining an additional 4.2% of the variance after holding predisposing factors constant. The total amount of variance explained by the model with both categories of predictors is 6%. The change in variance, R^2 change = 0.042, $p < 0.001$, and the whole model, $R^2 = 0.060$, $F(7, 574) = 5.20$, $p < 0.001$, are statistically significant. The statistically significant variables are the predisposing factor genetic factors and the enabling factor cost, with cost ($\beta = 0.206$, $p < 0.001$) having a higher standardized beta value than genetic factors ($\beta = -0.103$, $p = 0.012$).

Need-for-care factors explain an additional 3.9% of the variance in hospital length of stay by prostate cancer patients in this subgroup. The total variance explained by the model as a whole with all three categories of predictors is 9.9%. The change in variance, R^2 change = 0.039, $p < 0.001$, and the model, $R^2 = 0.099$, $F(11, 570) = 5.694$, $p < 0.001$, are both statistically significant. The four statistically significant variables are the predisposing factor genetic factors, the enabling factor cost, and the need-for-care factors comorbidity index score and intensive care unit. Cost has the highest standardized beta value ($\beta = 0.216$, $p < 0.001$), followed by comorbidity index score ($\beta = 0.178$, $p < 0.001$), intensive care unit ($\beta = 0.081$, $p = 0.048$), and genetic factors ($\beta = -0.079$, $p = 0.05$).

In the final step, emergency room use is entered, explaining an additional 1.2% of the variance after holding predisposing, enabling, and need-for-care factors constant. The final model as a whole explains a total of 11.1% of the variance in hospital length of stay by prostate cancer patients in Hospital Group F. Both the change in explained variance and the final model are statistically significant, R^2 change = 0.012, $p = 0.005$ and $R^2 = 0.111$, $F(12, 569) = 5.946$, $p < 0.001$. The four statistically significant variables are emergency room use, the enabling factor cost, and the need-for-care factors comorbidity index score and intensive care unit. Cost has the highest standardized beta value ($\beta = 0.215$, $p < 0.001$), followed by comorbidity index score ($\beta = 0.192$, $p < 0.001$), emergency room use ($\beta = -0.119$, $p = 0.005$) and intensive care unit ($\beta = 0.09$, $p = 0.027$).

Hospital Group G (High Concentration Black/AA, Underserved Area Residents)

Hospital Group G includes patients residing in counties with a high percentage of Black/ African American population and partial designation as an underserved area. The mean hospital length of stay for this subgroup (5.45 days) is higher than the mean for all patients (4.76 days). Predisposing factors explain 1.8% of the variance in hospital length of stay, but the model is not statistically significant, $R^2 = 0.018$, $F(10, 990) = 1.373$, $p = 0.056$. The only statistically significant variable is percentage of population uninsured ($\beta = 0.152$, $p = 0.008$).

Enabling factors are entered at Step 2. There is a statistically significant change in the amount of variance explained, with enabling factors explaining an additional 5.6% of the variance, R^2 change = 0.056, $p < 0.001$. The model with predisposing and enabling factors together is statistically significant and explains 7.3% of the variance in hospital length of stay by prostate cancer patients in Hospital Group G, $R^2 = 0.073$, $F(14, 986) = 5.59$, $p < 0.001$. There are five statistically significant variables, which include the predisposing factors percentage of population with no health insurance, percentage population Black/ African America, and population Hispanic/Latino, and the enabling factors cost and geographic region. Percentage of county population that is uninsured has the highest standardized beta value ($\beta = 0.205$, $p = 0.002$), followed by cost ($\beta = 0.203$, $p < 0.001$), Hispanic/ Latino population (β = 0.-184, $p = 0.019$), Black/ African American population (β = 0.-183, $p = 0.028$), and geographic region (β = 0.-174, $p < 0.001$).

After holding predisposing and enabling factors constant, the need-for-care factors entered at Step 3 explain an additional 6.8% of the variance, R^2 change = 0.068, $p < 0.001$. The total variance explained by all three categories of predictors is 14.2%, $R^2 = 0.142$, $F(18, 982) = 9.010$, $p < 0.001$. The seven independent variables that are statistically significant are the predisposing factors age, percentage of population uninsured and Hispanic/ Latino population, the enabling factors cost and geographic region, and the need-for-care factors comorbidity and intensive care unit. Cost has the highest standardized beta value (β = 0.226, $p < 0.001$), followed by comorbidity index score (β = 0.191, $p < 0.001$), percentage of population uninsured (β = 0.189, p = 0.003), intensive care unit (β = 0.172, $p < 0.001$), percentage of Hispanic/ Latino population (β = -0.172, p = 0.024), geographic region (β = -0.153, p = 0.001), and age (β = 0.06, p = 0.044).

The additional variance explained by emergency room use is 0.4% and the change is statistically significant, R^2 change = 0.004, p = 0.025. The final model is statistically significant and the total amount of variation explained for hospital length of stay by prostate cancer patients in this subgroup is 14.6%, $R^2 = 0.146$, $F (19, 981) = 8.843$, $p < 0.001$. The seven statistically significant variables are emergency room use, the predisposing factors percentage of population uninsured and Hispanic/ Latino population, the enabling factors cost and geographic region, and the need-for-care factors comorbidity and intensive care unit. Cost has the highest standardized beta value (β = 0.228, $p < 0.001$), followed by percentage of population uninsured (β = 0.185, p = 0.003), comorbidity index score (β = 0.182, $p < 0.001$), percentage of Hispanic/ Latino population (β = -0.173, p = 0.022), intensive care unit (β = 0.165, $p < 0.001$), geographic region (β = -0.145, p = 0.001), and emergency room use (β = 0.071, p = 0.025).

Subset Analysis Results of Hierarchical Logistic Regression Analysis for Emergency Room Use

Hierarchical binary logistic regression is performed in a subset of the data for which hospital characteristics were available to assess the impact of factors on the likelihood of prostate cancer patients utilizing emergency room services. This analysis is conducted for all patients, and the subgroups identified through AID analysis: Group A, patients under age 75 (n = 206), Group B, patients age 75 to 85 (n = 237), and Group C, patients over age 85 (n = 112). The model contains seven predisposing factors, nine enabling factors, and four need-for-care factors, which is a total of twenty independent variables. The independent variables that made a unique statistically significant contribution at each step for all groups are reported in this section and identified in Table 10. Appendix E includes tables with the coefficients for each model.

For each of the subgroups, goodness of fit was not statistically significant based on values of the Omnibus Test of Model Coefficients until need-for-care factors were entered in the final step. Goodness of fit test values and pseudo R square statistics for the groups in the subset analysis are reported in this section and shown in Table 8.

<u>All Prostate Cancer Patients</u>

Predisposing factors explain between 4.8% (Cox & Snell R Square) and 6.4% (Nagelkerke R Square) of the variance in emergency room use for all prostate cancer patients. For this model, goodness of fit is statistically significant based on Omnibus Test of Model Coefficients and Hosmer and Lemeshow Test. The statistically significant variables are the predisposing factors age and percentage of county population over age 65. Prostate cancer patients are more likely to use emergency room services as their age increases ($\beta = 0.047$, OR = 1.048, $p < 0.001$). Emergency room use is less likely as there are increases in county percentage of individuals over age 65 ($\beta = -0.144$, OR = 0.866, $p = 0.045$).

When enabling factors are added, the amount of variance explained is between 7.7% (Cox & Snell R Square) and 10.3% (Nagelkerke R Square). For this model, goodness of fit is statistically significant based on Omnibus Test of Model Coefficients and Hosmer and

Lemeshow Test. The statistically significant variables are the predisposing factor age and the enabling factor hospital ownership. Patients are more likely to use the emergency room as age increases ($\beta = 0.049$, OR = 1.05, $p < 0.001$). Compared to patients staying in government-owned hospitals, patients staying in hospitals that are not for profit/ not government-owned are less likely to use emergency room services ($\beta = -0.505$, OR = 0.603, $p = 0.048$).

The amount of variance explained when need-for-care factors are entered is between 21.6% (Cox & Snell R Square) and 29.0% (Nagelkerke R Square). The model fit is statistically significant based on Omnibus Test of Model Coefficients and Hosmer and Lemeshow Test. The four statistically significant variables are the predisposing factor age, the enabling factor hospital ownership, and the need-for-care factors comorbidity index score and treatment.

Patients are more likely to use the emergency room as age increases ($\beta = 0.048$, OR = 1.050, $p < 0.001$). Compared to patients staying in government-owned hospitals, patients staying in hospitals that are not for profit/ not government-owned are less likely to use emergency room services ($\beta = -0.702$, OR = 0.495, $p = 0.014$). The likelihood of emergency room use is greater by patients with the highest comorbidity index score compared to those with the lowest score ($\beta = 1.067$, OR = 2.906, $p = 0.033$). Compared to patients who are no receiving treatment for prostate cancer, patients who are receiving treatment are less likely to use emergency room services ($\beta = -3.132$, OR = 0.044 $p < 0.001$).

Table 8. Goodness of fit tests and variation in emergency room utilization by prostate cancer patients explained by predisposing, enabling and need-for-care factors in subset analysis

	Model Goodness of Fit Tests				Pseudo R^2 Statistics	
	Omnibus Tests of Model Coefficients		Hosmer & Lemeshow Test		Cox & Snell R Square	Nagelkerke R Square
	Chi-square	Sig.	Chi-square	Sig.		
All Prostate Cancer Patients						
Predisposing Factors	27.393	0.000	7.246	0.510	0.048	0.064
Predisposing and Enabling Factors	44.365	0.019	10.31	0.244	0.077	0.103
Predisposing, Enabling, and Need Factors	135.316	0.000	9.089	0.335	0.216	0.29
Group A. Patients Age <75						
Predisposing Factors	5.689	0.577	8.435	0.392	0.027	0.036
Predisposing and Enabling Factors	20.418	0.771	6.652	0.575	0.094	0.126
Predisposing, Enabling, and Need Factors	59.798	0.008	3.828	0.872	0.252	0.337
Group B. Patients Age 75 to 85						
Predisposing Factors	9.521	0.217	4.159	0.843	0.039	0.053
Predisposing and Enabling Factors	26.883	0.415	7.944	0.439	0.107	0.144
Predisposing, Enabling, and Need Factors	85.232	0.000	9.013	0.341	0.302	0.405
Group C. Patients Age >85						
Predisposing Factors	8.854	0.263	7.413	0.493	0.076	0.109
Predisposing and Enabling Factors	37.253	0.055	4.463	0.813	0.283	0.406
Predisposing, Enabling, and Need Factors	52.167	0.031	5.296	0.726	0.372	0.534

Emergency Room Subset Group A (Patients Under Age 75)

Predisposing factors explain between 2.7% (Cox & Snell R Square) and 3.6% (Nagelkerke R Square) of the variance in emergency room use for Emergency Room Subset Group A, patients under the age of 75 with similar patterns of less emergency room use. For this model, goodness of fit is not statistically significant based on values of the Omnibus Test of Model Coefficients. None of the variables are statistically significant.

When enabling factors are added, the amount of variance explained is between 9.4% (Cox & Snell R Square) and 12.6% (Nagelkerke R Square). For this model, goodness of fit is not statistically significant based on values of the Omnibus Test of Model Coefficients. None of the variables are statistically significant.

The amount of variance explained when need-for-care factors are entered is between 25.2% (Cox & Snell R Square) and 33.7% (Nagelkerke R Square). For this model, goodness of fit is statistically significant based on Omnibus Test of Model Coefficients and Hosmer and Lemeshow Test. The need-for-care factor treatment is the only statistically significant variable, indicating that in this subgroup of patients under age 75, patients receiving treatment for prostate cancer are less likely to use emergency room services than patients who are not receiving treatment ($\beta = -3.199$, OR = 0.041, $p < 0.001$).

<u>Emergency Room Subset Group B (Patients Age 75 to 85)</u>

Predisposing factors explain between 3.9% (Cox & Snell R Square) and 5.3% (Nagelkerke R Square) of the variance in emergency room use for Emergency Room Subset Group B, which includes only patients age 75 to 85 who have similar patterns of greater emergency room use. For this model, goodness of fit is not statistically significant based on values of the Omnibus Test of Model Coefficients. Age is the only statistically significant variable, with prostate cancer patients being more likely to use emergency room services as their age increases ($\beta = 0.098$, OR = 1.103, $p = 0.046$).

When enabling factors are added, the amount of variance explained is between 10.7% (Cox & Snell R Square) and 14.4% (Nagelkerke R Square). For this model, goodness of fit is not statistically significant based on values of the Omnibus Test of Model Coefficients. The predisposing factor age is the only statistically significant variable, with prostate cancer patients being more likely to use emergency room services as age increases ($\beta = 0.109$, OR = 1.115, $p = 0.041$).

The amount of variance explained when need-for-care factors are entered is between 30.2% (Cox & Snell R Square) and 40.5% (Nagelkerke R Square). The model fit is statistically significant based on Omnibus Test of Model Coefficients and Hosmer and Lemeshow Test. The enabling factor hospital ownership is the only statistically significant variable. In this subgroup of prostate cancer patients between the age of 75 and 85, those staying in hospitals that are not for profit/ not government owned are less likely to use emergency room services than patients staying in government-owned hospitals ($\beta = -1.042$, OR = 0.353, $p = 0.042$).

Emergency Room Subset Group C (Patients Over Age 85)

Predisposing factors explain between 7.6% (Cox & Snell R Square) and 10.9% (Nagelkerke R Square) of the variance in emergency room use for Emergency Room Subset Group C, which includes only patients over the age of 85 who have similar patterns of greater emergency room use. The model fit is not statistically significant based on values of the Omnibus Test of Model Coefficients. None of the variables are statistically significant.

When enabling factors are added, the amount of variance explained is between 28.3% (Cox & Snell R Square) and 40.6% (Nagelkerke R Square). For this model, goodness of fit is not statistically significant based on values of the Omnibus Test of Model Coefficients. The enabling factors cost and hospital ownership are statistically significant. Patients are less likely to use the emergency room with increases in cost ($\beta = -0.002$, OR = 0.998, $p = 0.021$). Compared to patients staying in government-owned hospitals, patients staying in hospitals that are not for profit/ not government owned are less likely to use emergency room services (β = -1.742, OR = 0.175, p = 0.036).

The amount of variance explained when need-for-care factors are entered is between 37.2% (Cox & Snell R Square) and 53.4% (Nagelkerke R Square). The model fit is statistically significant based on Omnibus Test of Model Coefficients and Hosmer and Lemeshow Test. The enabling factor hospital ownership and the need-for-care factor treatment are statistically significant, indicating that in this subgroup of patients over age 85, patients receiving treatment for prostate cancer are less likely (β = -3.298, OR = 0.037, p = 0.028) to use emergency room services than patients who are not receiving treatment. Compared to patients staying in government-owned hospitals, patients staying in hospitals that are not for profit/ not government owned are less likely to use emergency room services (β = -2.157, OR = 0.116, p = 0.038).

Subset Analysis Results of Hierarchical Multiple Regression Analysis for Hospital Length of Stay

Hierarchical multiple regression is used to evaluate the ability of predisposing factors, enabling factors, need-for-care factors, and emergency room use to predict hospital length of stay by prostate cancer patients in a subset of the data for which hospital characteristics were available. There are no missing values in the data subset (n = 555). The same procedure used in the full dataset is conducted in the subset analysis. For all patients and the subgroups, Hospital Subset Group A (patients in counties with Hispanic/ Latino population <32%, n = 205) and Hospital Subset Group B (patients in counties with Hispanic/ Latino population > 32%, n = 350), seven predisposing factors are entered at Step 1, nine enabling factors entered at Step 2, four need-for-care factors at Step 3, and emergency room use at Step 4. The independent variables that made a unique statistically significant contribution at each step for all groups are reported in this section and identified in Table 10. Appendix F includes tables with the coefficients for each model. The amount of variance in hospital length of stay explained by each group of predictors after holding all other factors constant and total variance explained at each step, and statistical significance of variance change and model fit are reported in this section and shown in Table 9.

Table 9. Variation in hospital length of stay by prostate cancer patients explained by predisposing, enabling and need-for-care factors, and emergency room use in subset analysis

	All Prostate Cancer Patients					A) Low Concentration Hispanic County Residents					B) Hight Concentration Hispanic County Residents				
	R^2	R^2 Change	Sig. F Change	F	Sig.	R^2	R^2 Change	Sig. F Change	F	Sig.	R^2	R^2 Change	Sig. F Change	F	Sig.
Predisposing Factors Entered	0.031	0.031	0.016	2.50	0.016	0.033	0.033	0.462	0.96	0.462	0.014	0.014	0.680	0.69	0.680
Enabling Factors Entered	0.063	0.032	0.035	2.25	0.004	0.182	0.149	0.000	2.61	0.001	0.036	0.022	0.456	0.86	0.615
Need Factors Entered	0.087	0.024	0.007	2.55	0.000	0.235	0.054	0.014	2.83	0.000	0.055	0.018	0.181	1.01	0.448
Emergency Room Use Entered	0.100	0.013	0.005	2.83	0.000	0.242	0.007	0.201	2.79	0.000	0.072	0.017	0.015	1.27	0.194

All Prostate Cancer Patients

In the group including all patients, predisposing factors alone explain 3.1% of the variance in hospital length of stay, and the model fit is statistically significant, $R^2 = 0.031$, $F(7, 547) = 2.501$, $p = 0.016$. Genetic factors and percentage of the population that is Hispanic/ Latino are the only two statistically significant predisposing factors, with percentage Hispanic/

Latino population having a higher standardized beta value (β = -0.191, p = 0.006) than genetic factors (β = -0.087, p = 0.039).

When enabling factors are entered, an additional 3.2% of the variance is explained and the change is statistically significant, R^2 change = 0.032, p = 0.035. The model with predisposing and enabling factors together is statistically significant and explains 6.3% of the variance in hospital length of stay by all prostate cancer patients, $R^2 = 0.063$, F (16, 538) = 2.25, p = 0.004. The four statistically significant variables are the predisposing factor genetic factors, and the enabling factors underserved area, hospital size, and hospital cancer program. Hospital size has the highest standardized beta value (β = 0.192, p = 0.004), followed by underserved area (β = -0.154, p = 0.034), hospital cancer program (β = -0.134, p = 0.026), and genetic factors (β = -0.092, p = 0.029).

When need-for-care factors are entered, an additional 2.4% of the variance is explained after holding predisposing and enabling factors constant. The model with predisposing, enabling, and need-for-care factors together explains 8.7% of the variance in hospital length of stay by all prostate cancer patients. Both the change in explained variance, R^2 change = 0.024, p = 0.007, and the fit of the model with all three categories of predictors, $R^2 = 0.087$, F (20, 534) = 2.545, $p < 0.001$, are statistically significant. The six statistically significant variables are the predisposing factor genetic factors, the enabling factors access to physician services, hospital size and hospital cancer program, and the need-for-care factors comorbidity index score and treatment. Access to physician services has the highest standardized beta value (β = -0.185, p = 0.047), followed by hospital size (β = 0.182, p = 0.006), hospital cancer program (β = -0.139, p = 0.029), treatment (β = -0.107, p = 0.003), comorbidity index score (β = 0.093, p = 0.031) and genetic factors (β = -0.088, p = 0.035).

In the final step, emergency room use is entered into the model. The additional variance explained after holding predisposing, enabling, and need-for-care factors constant is 1.3%. The final model with all three categories of predictors and emergency room use explains 10.0% of the variance in hospital length of stay by all prostate cancer patients. The change in variance explained, R^2 change = 0.013, p = 0.005, and the final model, $R^2 = 0.10$, F (21, 533) = 2.829, $p < 0.001$, are statistically significant. The seven statistically significant variables include emergency room use, the predisposing factor genetic factors, the enabling factors access to physician services, hospital size, and hospital cancer program, and the need-for-care factors comorbidity index score and treatment. Access to physician services has the highest standardized beta value (β = -0.194, p = 0.037), followed by hospital size (β = 0.190, p = 0.004), treatment (β = -0.149, p = 0.001), hospital cancer program (β = -0.141, p = 0.026), emergency room use (β = -0.128, p = 0.005), comorbidity index score (β = 0.107, p = 0.014) and genetic factors (β = -0.092, p = 0.028).

Hospital Subset Group A (Low Concentration Hispanic County Residents)

Hospital Subset Group A includes patients residing in counties with a lower percentage of Hispanic/ Latino population. The mean hospital length of stay for this subgroup (3.85 days) is lower than the mean for all patients (4.79 days). Predisposing factors alone explain 3.3% of the variance in hospital length of stay. The model, however, is not statistically significant, $R^2 = 0.033$, F (7, 197) = 0.96, p = 0.462. None of the variables are statistically significant.

The amount of additional variance explained when enabling factors are entered is 14.9%, and the model with predisposing and enabling factors explains 18.2% of the variance in hospital length of stay by prostate cancer patients in this subgroup. Both the change in explained variance, R^2 change = 0.149, $p < 0.001$, and the model as a whole, $R^2 = 0.182$, $F (16, 188) = 2.61$, $p = 0.001$, are statistically significant. The six statistically significant variables are the predisposing factors percentage of population below poverty level and Black/ African American population, and the enabling factors access to physician services, underserved area, geographic region, and hospital size. Underserved area has the highest standardized beta value ($\beta = -0.553$, $p = 0.001$), followed by geographic region ($\beta = 0.445$, $p = 0.002$), access to physician services ($\beta = -0.415$, $p = 0.003$), Black/ African American population ($\beta = 0.398$, $p = 0.016$), hospital size ($\beta = 0.333$, $p = 0.007$) and percentage of population poverty ($\beta = -0.275$, $p = 0.037$).

When need-for-care factors are entered, an additional 5.4% of the variance is explained after holding predisposing and enabling factors constant. The model with predisposing, enabling, and need-for-care factors explains 23.5% of the variance in hospital length of stay by prostate cancer patients in this subgroup. Both the change in variance explained, R^2 change = 0.054, $p = 0.014$, and the model with all three categories of predictors, $R^2 = 0.235$, $F (20, 184) = 2.832$, $p < 0.001$, are statistically significant. The seven statistically significant variables are the predisposing factor Black/ African American population, the enabling factors access to physicians, rural/ urban, underserved area, geographic region, and hospital size, and the need-for-care factor treatment. Underserved area has the highest standardized beta value ($\beta = -0.531$, $p = 0.002$), followed by geographic region ($\beta = 0.48$, $p = 0.001$), access to physician services ($\beta = -0.429$, $p = 0.002$), Black/ African American population ($\beta = 0.418$, $p = 0.01$), hospital size ($\beta = 0.374$, $p = 0.002$), rural/ urban ($\beta = -0.279$, $p = 0.031$), and treatment ($\beta = -0.222$, $p = 0.002$).

The additional variance explained when emergency room use is entered into the model is 0.7%. The change is not statistically significant. The total variance in hospital length of stay explained by the final model as a whole is 24.2% and the model fit is statistically significant, R^2

= 0.242, F (21, 183) = 2.786, $p < 0.001$. The seven statistically significant variables are the predisposing factor Black/African American population, the enabling factors access to physician services, rural/ urban, underserved area, geographic region, and hospital size, and the need-for-care factor treatment. Underserved area has the highest standardized beta value (β = -0.521, p = 0.002), followed by geographic region (β = 0.492, p = 0.001), access to physician services (β = -0.432, p = 0.001), Black/ African American population (β = 0.427, p = 0.009), hospital size (β = 0.379, p = 0.002), rural/ urban (β = -0.295, p = 0.023), and treatment (β = -0.259, p = 0.001).

Hospital Subset Group B (High Concentration Hispanic County Residents)

Hospital Subset Group B includes patients residing in counties with a higher Hispanic/ Latino population. The mean hospital length of stay for this subgroup (5.34 days) is higher than the mean for all patients (4.79 days). Predisposing factors alone explain 1.4% of the variance in hospital length of stay. The model is not statistically significant. None of the variables are statistically significant.

When enabling factors are entered into the model, the amount of additional variance explained is 2.2%, and the full model with predisposing and enabling factors together explains 3.6% of the variance in hospital length of stay by prostate cancer patients in this subgroup. Neither the change in variance, nor the model as a whole are statistically significant. The enabling factor hospital cancer program is the only statistically significant variable (β = -0.163, p = 0.036).

The amount of additional variance explained when need-for-care factors are entered into the model is 1.8%. The change is not statistically significant, R^2 change = 0.018, p = 0.181. The model with predisposing, enabling, and need-for-care factors together explains 5.5% of the variance. The model is not statistically significant, $R^2 = 0.055$, $F(19, 330) = 1.011$, $p = 0.448$. None of the independent variables are statistically significant.

The additional variance explained when emergency room use is entered into the model after holding predisposing, enabling and need-for-care factors constant is 1.7%, and the change is statistically significant, R^2 change = 0.017, $p = 0.015$. The total variance in hospital length of stay explained by the final model as a whole is 7.2%. The model is not statistically significant, $R^2 = 0.072$, $F(20, 329) = 1.274$, $p = 0.194$. The only statistically significant variable is emergency room use ($\beta = -0.144$, $p = 0.015$).

Table 10 provides a summary of the variables that are statistically significant in the hierarchical regression models including predisposing factors, predisposing and enabling factors, and predisposing, enabling and need-for-care factors. Emergency room use was added in the final models for analysis of hospital length of stay. Each of the groups used for regression analysis are listed across the top row of Table 10. An 'X' in the corresponding row for each predictor indicates that the variable was statistically significant.

Table 10. Statistically significant predictors from regression analysis of emergency room utilization and hospital length of stay by prostate cancer patients

	Emergency Room Use			Hospital Length of Stay								Emergency Room Subset Analysis				Hospital Subset Analysis		
*Group**	**All**	**A**	**B**	**All**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**All**	**A**	**B**	**C**	**All**	**A**	**B**
<u>Model 1. Predisposing Factors</u>																		
Age	X		X									X		X				
Genetic Factors				X		X				X						X		
Average Household Income	X	X																
Medicaid Eligible		X																
Population Age 65+	X							X				X						
Poverty																		
Uninsured Population	X		X								X							
Race/Ethnicity - % Black/AA	X		X			X			X									
Race/Ethnicity - % Hispanic	X		X						X							X		
Race/Ethnicity - % White	X	X		X	X				X									
<u>Model 2. Predisposing & Enabling Factors</u>																		
Age	X		X									X		X				
Genetic Factors				X		X				X						X		
Average Household Income		X																
Medicaid Eligible		X																
Population Age 65+								X										
Poverty	X		X														X	
Uninsured Population				X							X							
Race/Ethnicity - % Black/AA				X							X						X	
Race/Ethnicity - % Hispanic				X							X							
Race/Ethnicity - % White				X														
Cost	X	X	X	X		X			X	X	X		X					
Access to Physicians				X													X	
Rural/ Urban	X	X	X															
Underserved Area																X	X	
Geographic Region	X		X	X							X						X	
Hospital Size																X	X	
Hospital Ownership												X	X					
Hospital Cancer Program																X		X
Hospital Resident Training																		

	Emergency Room Use			Hospital Length of Stay								Emergency Room Subset Analysis				Hospital Subset Analysis		
	All	**A**	**B**	**All**	**A**	**B**	**C †**	**D**	**E**	**F**	**G**	**All**	**A**	**B**	**C**	**All**	**A**	**B**
Model 3. Predisposing, Enabling and Need Factors																		
Age	X		X								X	X						
Genetic Factors				X		X				X						X		
Average Household Income		X																
Medicaid Eligible		X																
Population Age 65+								X										
Poverty	X		X															
Uninsured Population				X							X							
Race/Ethnicity - % Black/AA				X													X	
Race/Ethnicity - % Hispanic				X							X							
Race/Ethnicity - % White				X														
Cost				X		X			X	X	X							
Access to Physicians					X											X	X	
Rural/ Urban	X	X	X														X	
Underserved Area																	X	
Geographic Region	X		X	X							X						X	
Hospital Size																X	X	
Hospital Ownership												X		X	X			
Hospital Cancer Program																X		
Hospital Resident Training																		
Comorbidity Index Score	X	X	X	X	X	X	X		X	X	X	X				X		
Complications																		
Treatment	X	X	X	X		X						X	X		X	X	X	
Intensive Care Unit	X		X	X	X	X			X	X	X							
Model 4. Predisposing, Enabling and Need Factors, and Emergency Room Use																		
Age																		
Genetic Factors				X		X										X		
Average Household Income																		
Medicaid Eligible																		
Population Age 65+								X										
Poverty																		
Uninsured Population				X							X							
Race/Ethnicity - % Black/AA				X													X	
Race/Ethnicity - % Hispanic				X							X							
Race/Ethnicity - % White				X														

	Emergency Room Use			Hospital Length of Stay								Emergency Room Subset Analysis				Hospital Subset Analysis		
	All	**A**	**B**	**All**	**A**	**B**	**C †**	**D**	**E**	**F**	**G**	**All**	**A**	**B**	**C**	**All**	**A**	**B †**
Cost				X		X		X	X	X	X							
Access to Physicians					X											X	X	
Rural/ Urban																	X	
Underserved Area																	X	
Geographic Region				X							X						X	
Hospital Size																X	X	
Hospital Ownership																		
Hospital Cancer Program																X		
Hospital Resident Training																		
Comorbidity Index Score				X	X	X	X		X	X	X					X		
Complications																		
Treatment				X		X			X							X	X	
Intensive Care Unit				X	X	X			X	X	X							
Emergency Room Use				X					X	X	X					X		X

*Refer to analysis results sections for group labels

† Final model fit is not statistically significant

Results of Hypothesis Testing and the Overall Model Validation

Results of the statistical analyses are used to test the five hypotheses developed for this study. Each hypothesis is either rejected (i.e., fail to reject the null hypothesis) or supported (i.e., reject the null hypothesis and fail to reject the corresponding alternative) for each group in both the full dataset and data subset.

H1: Need-for-care factors are more influential predictors of emergency room use among prostate cancer patients than predisposing factors and enabling factors.

The need-for-care factor comorbidity index score has the highest odds ratio in analysis of the group of all prostate cancer patients, both of the subgroups, Emergency Room Group A (Non-Urban County Residents) and Emergency Room Group B (Urban County Residents), and the group of all prostate cancer patients in the data subset. The logistic regression results indicate that patients with higher comorbidity index scores are more likely to use the emergency room that patients with the lowest score. In the group of all patients and Emergency Room Group B (Urban County Residents), the need-for-care factor intensive care unit has the second highest odds ratio.

The need-for-care factor treatment is the only statistically significant variable in the analysis of Emergency Room Subset Group A (Patients Under Age 75). This variable is also among the statistically significant predictors in all emergency room use analysis groups except for Emergency Room Subset Group B (Patients Age 75 to 85). In all groups, the results indicate that the likelihood of emergency room use decreases by patients who are receiving treatment for prostate cancer. The need-for-care factor measuring patient complications is not statistically significant is any of the patient groups analyzed.

Therefore, for all groups in the full dataset, and the group of all patients and Emergency Room Subset Group A (Patients Under Age 75) in the data subset, the findings support to reject the null hypothesis and fail to reject the alternative hypothesis that need-for-care for care factors are more influential predictors of emergency room use by prostate cancer patients than predisposing and enabling factors. For Emergency Room Subset Group B (Patients Age 75 to 85) and Emergency Room Subset Group C (Patients Over Age 85), the findings support to fail to reject the null hypothesis.

H2: Need-for-care factors are more influential predictors of hospital length of stay among prostate cancer patients than predisposing factors and enabling factors.

The need-for-care factor intensive care unit has the highest standardized beta value of all the statistically significant predictors in the hospital length of stay analysis of patients in Hospital Group A (High Concentration White, Non-Urban County Residents). This variable, as well as the need-for-are factor treatment, are statistically significant predictors in approximately half of the groups for which regression analysis has been conducted to study hospital length of stay, but only has the highest standardized beta value in Hospital Group A. The results indicate that having received care in the intensive care unit is associated with increased hospital length of stay, while having received treatment for prostate cancer is associated with decreased hospital length of stay.

Comorbidity index score is a statistically significant predictor of hospital length of stay in more than 85% of the groups included in this analysis. This variable is the only statistically significant predictor in Hospital Group C (High Concentration Hispanic County Residents); however, the overall model fit is not statistically significant. The results indicate that increased comorbidity index score is associated with increased hospital length of stay. The need-for-care factor measuring patient complications is not statistically significant is any of the patient groups analyzed.

Based on these results, for Hospital Group A (High Concentration White, Non-Urban County Residents), the findings support rejecting the null hypothesis and failing to reject the alternative hypothesis that need-for-care factors are more influential predictors of hospital length of stay by prostate cancer patients than predisposing and enabling factors, and failing to reject the null hypothesis for all other groups analyzed.

H3: Emergency room use is an influential predictor of hospital length of stay among prostate cancer patients.

Emergency room use is a statistically significant predictor in the analysis of all patients in both the full dataset and the data subset, as well as Hospital Group E (High Concentration Black/ AA, Low Hispanic County Residents), Hospital Group F (High Concentration Black/AA and Hispanic County Residents), and Hospital Group G (High Concentration Black/ AA, Underserved Area Residents). Emergency room use is the only statistically significant predictor in the analysis of Hospital Subset Group B (High Concentration Hispanic County Residents); however, the overall model fit is not statistically significant. In analysis for Hospital Group G (High Concentration Black/ AA, Underserved Area Residents), the use of emergency room services is associated with increased hospital length of stay; for all other groups, emergency room use is associated with decreased length of stay.

Based on the results showing that emergency room use is a statistically significant predictor, for all patients in both the full dataset and the data subset, and the subgroups Hospital Group E (High Concentration Black/ AA, Low Hispanic County Residents), Hospital Group F (High Concentration Black/AA and Hispanic County Residents), and Hospital Group G (High Concentration Black/ AA, Underserved Area Residents), the findings support rejecting the null hypothesis and failing to reject the alternative hypothesis that emergency room use is an influential predictor of hospital length of stay among prostate cancer patients, and fail to reject the null hypothesis for all other groups.

H4: High users of health services are associated with certain predisposing factors, enabling factors, need-for-care factors, and the interaction effects of particular variables.

Patterns of higher utilization of health services by prostate cancer patients are associated with the interaction effects of several county characteristics, including race/ ethnicity, underserved area, and rural/ urban. AID analysis results show that, compared to mean length of stay for the group of all patients, the mean hospital length of stay is higher among patients in Hospital Group F (High Concentration Black/ AA and Hispanic County Residents) and Hospital Group G (High Concentration Black/ AA, Underserved Area Residents). The interaction between all or part of the county being designated as a health professional shortage area, characterized as urban, and lower percentages of all three race/ ethnicity measures in this study is also shown to be associated with a higher mean hospital length of stay by patients (Hospital Group D).

In evaluation of emergency room use by prostate cancer patients, AID analysis results show patterns of higher use to be associated with patients residing in urban counties in the full dataset (Emergency Room Group B: Non-Urban Residents), and with patient age in the data subset (Emergency Room Subset Group B: Patients Age 75 to 85 and Emergency Room Subset Group C: Patients Over Age 85). Patterns of longer hospital length of stay are associated with a higher Hispanic/ Latino population in counties in the data subset (Hospital Subset Group B). The results of AID analysis do not indicate any interaction effects between predictors in emergency room use in the both the full dataset and subset, or hospital length of stay in the data subset.

Based on these results, the findings support rejecting the null hypothesis for Hospital Group D (Underserved Area Residents), Hospital Group F (High Concentration Black/AA and Hispanic County Residents), Hospital Group G (High Concentration Black/AA, Underserved Area Residents), and Emergency Room Group B (Urban County Residents), Emergency Room Subset Group B (Patients Age 75 to 85), Emergency Room Subset Group C (Patients Over Age 85), and Hospital Subset Group B (High Concentration Hispanic County Residents).

H5: Hospital attributes are influential predictors of health services utilization by prostate cancer patients.

Hospital ownership is a statistically significant predictor in analysis of emergency room use in the subset analysis of the group of all patients, and the two subgroups identified as having similar patterns of higher emergency room use, Emergency Room Subset Group B (Patients Age 75 to 85), and Emergency Room Subset Group C (Patients Over Age 85). For Emergency Room Subset Group C, hospital ownership has the highest odds ratio, and it is the only statistically significant predictor in the final model for Emergency Room Subset Group B. The regression analysis results indicate that, compared to patients receiving care at a government-owned hospital, patients receiving care at a hospital that is non-profit/ non-government-owned are less likely to use emergency room services. Hospital ownership is also a statistically significant predictor of emergency room use for Emergency Room Subset Group A (Patients Under Age 75) in the model containing only predisposing and enabling factors; however, this model is not statistically significant and treatment is the only statistically significant predictor in the final model when need-for-care factors are added to the model.

Hospital size is a statistically significant predictor in analysis of hospital length of stay in analysis of the group of all patients, as well as the subgroup identified as having patterns of shorter hospital length of stay, Hospital Subset Group A (Low Concentration Hispanic County Residents). In the group of all patients, the standardized beta value for hospital size is only slightly less than access to physician services, which has the highest value. For both of these groups, the association shows hospital length of stay increasing as hospital size increases.

Hospital cancer program approved by the ACoS is a statistically significant predictor of hospital length of stay in the group of all patients, with increasing hospital length of stay in facilities that do not have an ACoS approved cancer program. This variable is also a statistically significant predictor of hospital length of stay in the model containing only predisposing and enabling factors for Hospital Subset Group B (High Concentration Hispanic County Residents); however, this model fit is not statistically significant, and this predictor is no longer statistically significant when need-for-care factors are entered into the model. Hospital resident training program is the only one of the four hospital variables that is not shown to be a statistically significant predictor for any of the groups included in this analysis.

Therefore, for all patients and Emergency Room Subset Group B (Patients Age 75 to 85) in the analysis of emergency room use, and all patients and Hospital Subset Group A (Low Concentration Hispanic County Residents) in the analysis of hospital length of stay, the findings support rejecting the null hypothesis and failing to reject the alternative hypothesis that hospital attributes are influential predictors of health services utilization by prostate cancer patients, and failing to reject the null hypothesis for Emergency Room Subset Group A (Patients Under Age 75) and Hospital Subset Group B (High Concentration Hispanic County Residents).

CHAPTER FIVE: DISCUSSION AND CONCLUSIONS

Introduction to Discussion

The purpose of this study was to examine the determinants of health services utilization by prostate cancer patients using administrative claims data for inpatient care. Based on the information available in the Part A Medicare data file, it was possible to study the variability in use of two types of service: emergency room and hospital (measured by length of stay). Outpatient care records and longitudinal data were not available for this analysis, therefore the study did not assess quality differences and the causal relationships among predictors. The theoretical framework used to guide this analysis was Andersen's behavioral model of health services utilization. This framework provided for an integrated approach to exploring the research problem through the inclusion of personal and social characteristics categorized as predisposing, enabling and need-for-care factors. The relative influence of predictors and interaction effects associated with differential use patterns were obtained through statistical analysis. This section includes a summary of hypothesis testing, and discussion of results, contributions and limitations of this research. Recommendations for future research are also provided at the end of this chapter.

Summary of Major Findings: Hypothesis Testing and Model Validation

The results of hypothesis testing are summarized in Table 11. Two types of health services were examined: emergency room use and hospital (use measured by length of stay). Through AID analysis, two subgroups were identified for the study of emergency room use, and seven subgroups were identified for the study of hospital length of stay. A subset of the data was used to examine the influence of hospital attributes. In the subset analysis, there were three subgroups for emergency room use and two subgroups for hospital length of stay. Regression analysis was performed using the full dataset and subset for all patients as well as each of the subgroups. These groups are listed across the top row of Table 11, and an 'X' in the corresponding row for each hypothesis indicates that the hypothesis was supported by results of statistical analysis for the group.

The overall modified model Andersen's behavioral model of health services utilization that was used for this study confirmed that an integrated approach including personal and social factors is useful for analyzing the determinants of health services use by prostate cancer patients enrolled in the Medicare program. The relative importance of these factors varied to some degree based on the characteristics of patient subgroups. While both personal and social factors were statistically significant predictors for most groups, for several groups, the final model included only either characteristics of the individual or social aspects. In addition to understanding the unique contribution of each independent variable in predicting service use, categorizing the predictors as predisposing, enabling, and need-for-care factors provided a framework that made it possible to evaluate how each group of variables influences the variability in emergency room use and length of stay for all-cause hospitalizations by patients with prostate cancer.

Table 11. Results of hypothesis testing for utilization of health services by prostate cancer patients

	Emergency Room			Hospital Length of Stay								Emergency Room Subset				Hospital Length of Stay Subset		
*Group**	**All**	**A**	**B**	**All**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**All**	**A**	**B**	**C**	**All**	**A**	**B**
H1: Need-for-care factors are more influential predictors of emergency room use among prostate cancer patients than predisposing factors and enabling factors.	X	X	X									X	X					
H2: Need-for-care factors are more influential predictors of hospital length of stay among prostate cancer patients than predisposing factors and enabling factors.					X													
H3: Emergency room use is an influential predictor of hospital length of stay among prostate cancer patients.				X					X	X	X					X		
H4: High users of health services are associated with certain predisposing factors, enabling factors, need-for-care factors, and the interaction effects of particular variables.			X					X		X	X			X	X			X
H5: Hospital attributes are influential predictors on health services utilization by prostate cancer patients.												X		X	X	X	X	

**Refer to text in results of analysis and hypothesis testing for group labels*

Implications

Predisposing Factors

Predisposing factors include and demographics and social structure characteristics. Many studies have identified patient age to be an influential determinant of health services utilization by cancer patients (Hagiwara, et al., 2013; Shayne, et al., 2013; Treanor & Donnelly, 2012; Yong, et al., 2014). In this analysis, the predisposing factor of age was statistically significant in more groups than any of the other predisposing factors for analysis of emergency room use. Age was also statistically significant in the model including all three categories of predictors for analysis of hospital length of stay in Hospital Group G, which included patients with similar patterns of longer hospital stays who reside in counties that are considered to be underserved areas and have a high Black/ African American population. The predisposing factor percentage of county population aged 65 and older was the most influential predictor in one of the hospitalization analysis subgroups, with decreased aging population being associated with increased length of stay. This subgroup was identified by the interaction between all three measures of race/ ethnicity and underserved area, and patients in this group were shown to have similar patterns of longer hospital length of stay.

Age and an aging population are considered to be particularly important aspects for cancer-related issues. With increased age comes a greater risk of developing cancer. The health care system will face additional challenges to provide the screenings and care required to meet the needs of these patients, while also managing a population that is aging with more chronic conditions than in the past. Growing demand for resources and the lack of a sufficient supply of medical professionals, particularly in low income areas, could add to the problem of cancer-related health disparities (Rapkin in Elk & Landrin, 2009, pp. 498-499). For prostate cancer patients included in this study, the age of individuals and the population were found to be influential.

Enabling Factors

Enabling factors represent the availability of resources or conditions which make the use of health services possible. In this analysis, enabling factors were influential predictors for many groups. Access to physicians, measured by the ratio of physicians to population, underserved area, and geographic region were among the statistically significant variables with the highest beta value in analysis of hospital length of stay. For analysis of both types of health services, geographic region was statistically significant in the final model including all three categories of predictors for more groups than any other enabling factor (along with cost). The hospital attributes size, type of ownership, and cancer program were also highly influential. Previous studies of prostate cancer and health service use have also identified these factors as being influential. Geographic region has been associated with variations in the type of treatments prostate cancer patients receive, which may reflect the uneven distribution of care providers and specialists across the U.S. (Harlan, et al., 2001; Roberts, et al., 2011). Studies have cited hospital attributes such as case volume and academic teaching status when reporting variations between 1.3 days and 3.8 days for the average length of hospital stay following surgical treatment for prostate cancer using radical prostatectomy (Inman, et al., 2011; Mitchell, et al., 2009).

The enabling factor of cost had the highest standardized beta value in the final models for hospital length of stay analysis for four subgroups, and was one of only two statistically significant predictors in another subgroup. For the subgroups identified as patients with hospitals stays that are shorter than the average length for all patients, increased cost was associated with increased hospital length of stay for Hospital Group E (High Concentration Black/ AA, Low Hispanic County Residents) and decreased length of stay for Hospital Group B (High Concentration White, Urban County Residents). For the subgroups of patients with similar patterns of longer hospital stays increased cost was associated with increased hospital length of stay for Hospital Group F (High Concentration Black/ AA and Hispanic County Residents) and Hospital Group G (High Concentration Black/ AA, Underserved Area Residents), and decreased length of stay for Hospital Group D (Underserved Area Residents). Although it is not possible to determine causality in this analysis, it has been reported that out of pocket costs overall are higher for Medicare patients with cancer compared to those without cancer, and that factors such as being dually eligible for Medicaid or having a supplemental health insurance plan can greatly reduce or eliminate the inpatient care costs for which patients are responsible to pay (American Cancer Society Cancer Action Network, 2012; Medicare Payment Advisory Commission, 2012).

Need-for-Care Factors

Need-for-care factors represent the level of illness that causes an individual to seek care. Many studies have identified need-for-care factors as the most influential predictors of health services utilization, and found factors such as treatment complications, comorbidity and conditions requiring specialized care through the intensive care unit to be particularly influential in cancer patients (Kostakou, et al., 2014; Legler, Bradley & Carlson, 2011; Shayne, et al., 2013; Wolinsky, et al., 2008). The results of this analysis were consistent with the literature in that need-for-care factors were among the statistically significant predictors of health services utilization by prostate cancer patients in all but two of the groups examined. In analysis of emergency room service use, need-for-care factors were not found to make a statistically significant contribution in Emergency Room Subset Group B (Patients Age 75 to 85), nor were these factors statistically significant predictors for Hospital Group D (Underserved Area Residents) in analysis of length of stay for all-cause hospitalization. Need-for-care factors were shown to be the most influential predictors in one-third of the groups in this analysis.

In the final model including all three categories of predictors, the need-for-care factor comorbidity index score was a statistically significant predictor of health services use for twelve of the eighteen groups analyzed in this study; treatment was statistically significant for ten groups, and intensive care unit for eight groups. For emergency room service utilization, comorbidity index score had the highest odds ratio in all three groups of the full dataset and one of the four groups in the subset analysis. The variable treatment had the highest odds ratio for one of the emergency room groups in the subset analysis. Intensive care unit had the highest beta value in one of the subgroups for analysis of hospital length of stay. For all models in which these variables were statistically significant, higher utilization by patients was associated greater comorbidity, receiving care in the intensive care unit, and not receiving treatment for prostate cancer.

While it was not possible to determine the causal relationships among these predictors, these findings do demonstrate the complex disease burden of prostate cancer, and the need for informed care practices and interventions. The importance of understanding the distinct health needs of individuals has been emphasized in other relevant studies, such as those focused on tailored symptom-management education programs for prostate cancer patients, and policies that provide for consideration of disease and individual patient characteristics when determining whether or not patients should be admitted to the intensive care unit (Latini, et al. in Elk & Landrine, 2009; Kostakou, 2014). As treatment options evolve, and new information becomes available regarding the immediate and long term complications and conditions prostate cancer patients may encounter, it is important for relevant practices to be reevaluated or developed in order to meet the needs of these patients.

High Users of Health Services

Several subgroups identified through AID analysis were shown to have similar patterns of higher utilization. Higher emergency room use was found in patients living in counties considered to be the most urban in nature. In the data subset, patients over the age of 85 showed patterns of higher emergency room use, as did patients between the ages of 75 and 85. Prostate cancer patients with patterns of longer hospital length of stay were associated with the interaction effects of several county characteristics, including race/ ethnicity, underserved area, and rural/ urban. Race/ ethnicity was the only factor found to influence homogenous use patterns in the data subset, with a higher mean hospital length of stay in counties with more than 32% Hispanic/ Latino population. The interactions of variables in the subgroups and the predictors that were found to be most influential in each of these groups through regression analysis provide a more in-depth indication personal and social factors associated with the utilization of health services by prostate cancer patients.

Emergency Room Use

Higher use of health services in urban areas as compared to rural areas where there may be fewer resources available has been identified in the literature (Sundmacher & Busse, 2011; Blumenthal & Kagen, 2002). The literature has also identified comorbidity as an influential predictor of emergency room use by cancer patients (Legler, Bradley & Carlson, 2011). In this study, higher of emergency room use patterns were identified in patients living in the most urban counties compared to counties classified as less-urban or rural. The most influential predictor of emergency room utilization for patients in urban counties, as well as those in rural counties and the group of all patients, was comorbidity index score.

As mentioned previously, increasing age has been found to be an important predictor of health services use by cancer patients in numerous studies have (Hagiwara, et al., 2013; Shayne, et al., 2013; Treanor & Donnelly, 2012; Yong, et al., 2014). In this the data subset of this analysis, patterns of increased emergency room were found in patients aged 75 to 85 and the group of patients over age 85. The amount of variance explained in the final logistic regression models for each of these two groups was among the highest out of all groups for both emergency room use and hospital length of stay analysis. The final logistic regression model explained between 30.2% and 40.5% of the variance in emergency room use for the group of patients aged 75 to 85 and between 37.2% and 53.4% of the variance for patients over the age of 85. In both of these groups, the interaction effect of age and hospital attributes is shown, as hospital ownership had the highest odds ratio, with patients receiving care at a non-profit hospital being less likely to use the emergency room than patients receiving care at a government-owned hospital.

Hospital Length of Stay

In addition to meeting specific physician to population ratio criteria, a geographic area must be able to demonstrate that medical professionals are inaccessible to the population, excessively distant, or over utilized in order to be designated as an underserved area (HRSA, 2015). Patients living in poor inner-city communities, patients may lack access to medical care due to unequal distribution of services (Blumenthal & Kagen, 2002). In this study, patterns of longer length of stay for all-cause hospitalizations were identified in urban counties that have been wholly or partially designated as underserved areas. Analysis of this group of patients showed that increased hospital length of stay was associated with decreases in population over the age of 65 and costs.

Several of the other patient groups with relatively homogeneous patterns of longer hospital length of stay were identified by the county characteristics of underserved area and racial/ ethnic minority population. Population characteristics such as socioeconomic status, race, ethnicity, and geographic area often they overlap, which can make it difficult to determine specific disease-related factors and develop effective interventions to address disparities (Brawley in Elk and Landrin, 2011, pp. xxvi-xxix). Analysis of the group of patients with patterns of longer hospital stays in counties with Black/ African American population over 9% and at least one area that has been designated as an underserved area showed that influential predictors associated with hospital length of stay were cost, comorbidity, intensive care unit care, percentage of uninsured population, age, Hispanic/ Latino population, and geographic area.

Additional contextual factors were not among the statistically significant variables associated with length of hospitalization by patients with similar patterns of longer hospital length of stay in counties with Black/ African American population over 9% and Hispanic/ Latino populations over 32%, and that may be considered underserved areas. Analysis of this subgroup of high-service-users showed increased hospital length of stay to be associated with increases in cost, level of comorbidity, intensive care unit care, and decreases in emergency room use.

Contributions

This research made several notable contributions. First, the theoretical framework used in this analysis provided for a detailed understanding of the influence and interaction effects of personal and social factors associated with the use of health services by prostate cancer patients. In previous research, need-for-care factors were often shown to be more influential predictors than predisposing and enabling factors (de Boer, Wijker & de Haes, 1997; Wolinsky, et al., 2008). The results of this analysis were generally consistent with the literature in finding that need-for-care factors were consistently influential predictors of use for most groups of patients. However, for certain groups of patients, social factors were shown to be the strongest predictors. Thus, the integrated approach of the behavioral model of health services utilization to examine predisposing, enabling, and need-for-care factors allowed for a more precise understanding through the inclusion of both individual and societal determinants.

Additionally, the use of a large national administrative claims dataset with patient information, and a national dataset capturing contextual factors with the statistical techniques employed in this analysis made it possible to identify patterns of health services use by individuals and groups. Previous studies have highlighted the importance of considering the contextual environment and potential limitations of data sources that do not capture area-level characteristics (Litaker & Love, 2005; Miller, et al., 2008; Mayer, et al., 2011). In this analysis, a higher level of detail was able to be obtained using a large number of patient records to examine influential predictors and the interaction effects of predictors. Subgroups with both higher and lower propensity for using services add to the current level of understanding and could be applied to efforts aimed at addressing disparities in prostate cancer care and outcomes. While there was still a fair amount of unexplained variance in the final models in this study, particularly in the analysis of hospital length of stay, using the behavioral model of health services utilization and two-stage analytic approach was beneficial for understanding use patterns of health services by Medicare enrollees with prostate cancer.

Furthermore, the literature provides that understanding the specific factors associated with the use of health services by patients enables the development of appropriate interventions to improve care, eliminate unplanned or unnecessary service use, and reduce costs (Bryant, et al., 2015; de Boer, Wijket, & de Haes, 1997; Lang, et al., 2009; Manzano, et al., 2014). In this analysis, there were statistically significant associations between service utilization and individual factors, such as comorbidity, need for intensive care and age, and social factors, such as underserved area designation and high percentages of minority population. These findings offer an indication of prostate cancer patient populations that may be at higher risk for emergency room visits and/or longer hospital length of stay. This information can be applied to future research efforts to help policy makers and cancer care providers in work to address the needs of patients and communities, and to ensure that the health care delivery system is equipped to effectively and efficiently meet these needs.

Study Limitations

There are several potential limitations in this analysis. First, although Medicare claims data provided the opportunity to study a relatively large number of patient records in a broad population, the possibility exists that records include inaccurate or incomplete information due to the coding process of diagnoses and procedures. A number of previous studies using similar data have also cited this potential limitation (Jayadevappa, et al., 2011; Lang, et al., 2009; Yong, et al., 2014). Errors may occur throughout the process of assigning ICD codes, such as miscommunication between patients and clinicians, miscommunication between clinicians and coders, the experience of coders, and quality-control efforts of facilities (O'Mally, et al., 2005). In this analysis, potential problems in the coding process could limit the complete accuracy of information captured for the variables based on ICD-9-CM codes from individual patient records in the MEDPAR data.

A second potential limitation is that this analysis only included Medicare Part A records, thus not making it possible to also take into account care patients received in an outpatient setting. Many of the types of complications that prostate cancer patients may experience, such as urinary and bowel issues, are conditions that would not necessarily require inpatient care. If patients reported these complications during outpatient checkups or visits included in the bundled payment to surgeons for post-surgery routine care, this information would likely not be included in the MEDPAR records. Radiation therapy for prostate cancer is also often provided in an outpatient setting. While this information was present for some patients in the MEDPAR file, it is likely to have been unavailable for all patients who were actually receiving this type of treatment. Outpatient records also could have provided an indication of continuity of care. Cancer patients may be at greater risk for unplanned inpatient service use if follow-up care and illness management are not sufficient, and gaps exist in the coordination of care by primary care physicians, oncologists and other care providers (Manzano, et al., 2014). The availability of data to include outpatient records could improve the accuracy of complication and treatment measures, and allow for a more complete understanding of the care patients received.

Third, the lack of available data pertaining to important information such as stage of cancer, cause of death, utilization from previous years or different settings, race/ ethnicity and other demographic characteristics, cancer specialty, and continuity of care limited the ability to thoroughly examine certain patient and provider characteristics and identify patient response trajectories over time. Including this type of information would provide the opportunity to obtain a greater level of understanding of factors influencing differential use and care patterns of prostate cancer patients, as well as potential causes for observed variations in service use and care quality. This limitation could be addressed in future analyses through the availability of data for multiple years, as longitudinal data would make it possible to assess the care patients received over time and their responses to care. Additional data sources, such as the remaining SEER-Medicare data files that can be linked, could also help to address this limitation. The PEDSF includes information about providers and cancer-specific details from SEER registries, and Medicare Part B claims files capture physician visits and outpatient care.

Finally, because longitudinal data was not available for this analysis, it was not possible to test the model fit for Andersen's initial behavioral model of health services utilization. Andersen's model, shown previously in Figure 1, assumes a sequential relationship among the three categories of predictors, with service use dependent upon predisposing factors first, followed by enabling factors, and then need-for-care factors. According to Andersen and Newman (1973), "the expectations about causal relationships among the predictors can have major implications for attempts at social change" (p. 120). The modified model of Andersen's model developed for this study, shown previously in Figure 2, is not a causal model; it instead assumes that all three categories of predictors are directly related to the utilization of health services by patients with prostate cancer, which allowed for its use with the cross-sectional data that was available. Structural equation modeling is an analytic technique that can be used to "validate the plausibility of a theoretically assumed structure of a set of the study variables," and can be beneficial for research efforts to evaluate factors influencing the use of health services, as well as for determining the "causal processes" of variables (Wan, 2002, p. 85). The use of structural equation modeling to analyze longitudinal data would have allowed for examination of the causal relationships among predisposing, enabling, and need-for-care factors according to the initial Andersen model.

Future Research

Although there were limitations in this study, the results suggest several ways in findings can be applied to benefit future research. The relative importance of predisposing, enabling, and need-for-care factors associated with the utilization of health services by Medicare beneficiaries with prostate cancer provided a better understanding of variance in use patterns by patients and subgroups of patients. This information can be useful for further examinations of the significant determinants and causal relationships among predictors, with the ultimate goal of developing strategies and practices aimed at reducing health disparities in care and outcome to improve the lives of older men faced with disease.

First, additional research is needed to better understand the reasons for emergency room visits and the specific factors associated with emergency room admissions resulting in hospitalization by Medicare beneficiaries with prostate cancer. In this analysis, the association between comorbidity and emergency room use was consistent across all groups in the full dataset, and the group of all patients in the data subset. However, when emergency room use was added in the final models for hospital length of stay analysis, it was not a statistically significant predictor for all patient groups; when it was statistically significant, the relationship was negative, indicating that emergency room visit were associated with shorter hospital length of stay. Results of this analysis also showed that, despite higher emergency room use patterns in urban areas, comorbidity was a significant predictor of use for patients in rural areas, too. This could indicate that patients in rural areas are in need of emergency room services, but lack of access to these facilities.

Emergency room visits by cancer patients have been attributed to numerous factors, including patients with comorbid illnesses having difficulty managing a symptom crisis, problems not being addressed during routine care, hospital discharge before patients have been adequately educated or evaluated, and advanced-stage cancer (Hagiwara, et al., 2013; Inman, et al., 2011; Legler, Bradley & Carlson, 2011; Mayer, et al., 2011). Given what is known about the potential reasons that cancer patients visit the emergency room, it is possible that additional education on how to manage symptoms and prevent worsening conditions, and improvements in the overall quality of care patients receive are needed. A thorough understanding of the structural and process elements of care in relation to patient outcomes could be achieved through future research efforts that include data from the PEDSF and Medicare Part B files, as these sources would provide information concerning prostate cancer stage, disease management, follow-up care practices, and outpatient care patterns.

Second, along with the inclusion of additional data sources, the analysis of longitudinal data would provide the opportunity to delineate the causal relationship among the factors influencing the use of services. In this analysis, variations in the utilization of health services were associated with individual and contextual characteristics. Results showed that receiving cancer treatment was associated with lower likelihood of using the emergency room and shorter length of stay for all-cause hospitalizations. Despite the possible limitations with this variable capturing all treatments to manage prostate cancer in this study, the observed relationship between treatment and service use is relevant given the numerous opinions and recommendations regarding when and which prostate cancer patients should receive treatment. It may be that the patients receiving treatment in this dataset used fewer health services because they were in more frequent contact with medical professionals through outpatient care, and, in-turn, received more advice for managing symptoms and/or acute illnesses. Alternatively, patients receiving treatment could have been sicker, and used fewer of the health services examined in this analysis due to admission to nursing homes or hospice, or death. The analysis of longitudinal data may have resulted in determining how patient care before and after prostate cancer treatment influences the utilization of health services.

Results of this analysis also showed that groups of patients with longer hospital length of stay were identified in counties that are underserved and/or have high racial/ethnic minority populations in this study. According to Brawley (2012), finding interventions to effectively tackle disparities requires adequate categorization of populations, identifying and measuring disparate outcomes, and defining what the causes of disparities are. Socioeconomic status, race, ethnicity, and area of geographic origin are often to categorize populations, and often they overlap, adding to the difficulty of identifying particular causes associated with disease (Brawley in Elk and Landrin, 2012, pp. xxvi-xxix). While the population characteristics of groups of high users of services found in this analysis could be used to inform future research by providing an indication of county attributes upon which to focus efforts, the use of longitudinal data could have made it possible to observe the ways in which differential use patterns were influenced by temporal changes in social and contextual factors. Additional research using longitudinal data would make it possible to better understand the causal relationships between the use of health services and aspects of patient health, care patterns, and societal factors.

Third, future research to better understand the influence of Part A Medicare cost sharing on the use of health services by prostate cancer patients would be beneficial given that cost can be a considerable concern for Medicare patients with cancer. In 2011, the out of pocket expenditures for Medicare beneficiaries was estimated to be approximately 14% of total expenses; for prostate cancer patients, out of pocket expenses were approximately 18% of total expenses, which was the second highest for all cancers after breast cancer (American Cancer Society Cancer Action Network, 2012, pg. 15). The Medicare Payment Advisory Commission has reported on the complexity of using of cost sharing as a tool to reduce unnecessary use of services, and potential financial consequences for patients who need greater care and do not have supplemental coverage (2012).

In this analysis, cost, which included the amounts patients were liable for paying based on deductible or coinsurance, was statistically significant in the final models for five of the eight subgroups in analysis of hospital length of stay. However, for three groups, increased cost was associated with increased hospital length of stay, and for two of these groups, increased cost was associated with decreased hospital length of stay. The amounts for which patients were liable could have been related to a number of factors, such as being dually eligible for Medicaid, whether or not they had a supplemental coverage plan, or previous payment towards the required deductible from prior hospitalization(s) during the Medicare benefit period. The use of data from additional sources and multiple years in future research would provide the opportunity to better understand the costs for which Medicare beneficiaries with prostate cancer were responsible and its relationship to the utilization of health services.

Conclusions

The reduction of disparities in health and healthcare for cancer patients has been, and remains, a major priority by many in the U.S. public health arena. In a health policy brief published by Health Affairs/Robert Wood Johnson Foundation, improvement of the overall health of the population, and improving the overall quality of healthcare and reaching underserved populations were cited as two main focus areas of efforts aimed at reducing health disparities. It states that continued progress in the reduction of disparities necessitates comprehensive quality of care improvements in the U.S. health care system, increased focus on eliminating social factors that can cause poor health, such as poverty, education, and neighborhood characteristics, vigilance in ensuring the viability of safety-net facilities, and additional research, particularly that which will increase the understanding of variations in health outcomes even when care differences are improved (Health Affairs/Robert Wood Johnson Foundation, 2011, pp. 5-6).

Disparities in healthcare are the product of the intricate reciprocal influences of numerous factors and events encountered during the entire healthcare experience, such as those stemming from differences in patients, healthcare providers' actions and decisions, or the design of the healthcare system (Greenberg, Weeks, & Stain, 2008, p. 523). Additional research to examine the causal relationships between genetic, environmental, social, and behavioral factors, and cancer care and survival will continue to enhance the understanding of how to reduce disparities based on the individual/genetic and social/system factors that are most influential for distinct patient groups. Understanding the sources of variation leading to inequalities in the utilization of services can be used to inform such research.

Findings from this study showed that the interactions of personal, social, and health system factors are important to consider when assessing the variability in health service use by prostate cancer patients. Thus, there are no simple answers to explain why differences in the use of health services exist. A “one size fits all” approach to ensure that the utilization of health services for patients with prostate cancer is equitable and appropriate may not be the most efficient or effective approach, as subgroups within the population of patients may have distinct needs. The complex interplay of attributes highlights the importance for there to be some degree of versatility in the development and implementation of policies and interventions aimed at improving care and outcomes for patients with prostate cancer.

The dominance of need-for-care factors as influential predictors in this analysis indicates that the use of emergency room and hospital services by prostate cancer patients was strongly associated with the level of illness. While increased disease burden was predictive of service use for most patients, many of the factors related to the accessibility of services, categorized as enabling factors, were also highly influential for the various patient subgroups. Access to care is often identified as a one of the most influential predictors of disparities. There are a number of spatial and/or non-spatial factors that can affect the ability of individuals and populations to obtain the amount and quality of care needed. Given that these factors contributing to inequities in access can lead to variations in care and treatment patterns, and then differential outcomes for patients, continued efforts to remedy access to care challenges can improve the health and healthcare for individuals and/or patient populations in need of quality health services.

In conclusion, the behavioral model of health services utilization was a useful framework for this research. Examining the importance of categories of predictors and relative influence of both personal and social factors made it possible to identify various factors associated with emergency room use and hospital length of stay by prostate cancer patients enrolled in Medicare. The identification of subgroups with homogeneous use patterns provided a greater level of specification to understanding factors that are more or less influential based on certain social or demographic aspects. The importance of need-for-care factors in this analysis suggests that for most patients with prostate cancer, illness level is highly influential in the use health services. However, enabling factors such as geographic area and access to physician services are also important determinants of use for some patient groups. Future research is needed to enhance the understanding of factors contributing to patients' illness level, and address the specific needs of patients to work towards eliminating disparities in care and outcomes for prostate cancer patients.

APPENDIX A: ICD-9-CM CODES USED FOR VARIABLES

ICD-9-CM Codes Used for Variables

Variable	ICD-9-CM Code	
Genetic Factors	V10.0-V10.9	Personal history of malignant neoplasm
	V12.0-V13.9	Personal history of other diseases
	V15.0-V15.9	Other personal history presenting hazards to health
	V16.0-16.9	Family history of malignant neoplasm
	V17.0-V18.8	Family history of certain other conditions
Complications	288.0	Neutropenia
	457.1	Lymphedema
	556.2	Proctitis - ulcerative (chronic) proctitis
	558.1; 558.9	Gastroenteritis & colitis due to radiation, other & unspecified
	569.2-569.3	Stricture of anus, hemorrhage of rectum & anus
	569.42-569.49	Anal or rectal pain, Proctitis NOS
	593.3-593.4	Stricture or kinking of ureter, other ureteric obstruction
	595.0-595.9	Cystitis
	598.0-598.9	Urethral stricture
	599.8-599.9	Other disorders of urethra & urinary tract other specified & unspecified
	601.0-602.9	Inflammatory diseases of prostate & other disorders of prostate
	606.8-606.9	Infertility due to extratesticular causes, drug therapy, radiation, systemic disease & unspecified
	607.84	Disorders of penis - impotence
	608.8-608.9	Other disorders of male genital organs
	788.30-788.39	Urinary incontinence
	790.93	Nonspecific findings on examination of blood - elevated PSA
	867.0-867.7	Injury to pelvic organs
	909.2-909.5	Late effects of radiation, surgical & medical care complications, adverse effect of drug, medicinal & biological substance
	990.0	Effects of radiation, complication of radiation therapy
	995.2	Unspecified adverse effect of drug, medicinal & biological substance
	997.4-997.5	Complications digestive system & urinary
	998.5	Postoperative infection
	V58.0-V58.1	Encounter for procedures & aftercare - radiotherapy, chemotherapy
	V58.8-V58.89	Encounter for procedures & aftercare - other
	60.81-60.82	Incision or excision of periprostatic tissue
	60.93-60.95	Other operations on prostate: repair of, control postoperative hemorrhage of, transurethral balloon dilation of
Treatment	92.2-92.29	Therapeutic radiology & nuclear medicine
	92.3-92.39	Stereotactic radiosurgery
	60.0-60.69	Operations on prostate & seminal vesicles

APPENDIX B: TABLES OF CORRELATIONS

Table of correlations of variables used in analysis of health services utilization by prostate cancer patients

	Hosp LOS	ER	Age	Female HH	Genetic Factors	Income	Medi-caid	Pop 65+	Black/ AA	Hisp-anic	White	Poverty	Un-insured	Cost	Access	Rur/ Urb	Under-served	Region	Comor-bidity	Comp-lication	ICU	Treat-ment
Hosp LOS	1	0.021	0.009	0.058	-0.059	0.013	0.006	-0.035	0.051	0.022	-0.082	0.002	0.032	0.083	-0.001	-0.042	0.023	-0.033	0.136	-0.005	0.109	-0.064
ER	0.021	1	0.107	0.058	-0.025	0.054	-0.023	-0.063	0.051	0.004	-0.037	-0.021	-0.031	-0.04	0.034	-0.111	0.017	-0.084	0.117	-0.034	0.108	-0.287
Age	0.009	0.107	1	-0.043	0.014	0.029	-0.003	0.017	-0.05	0.012	0.009	-0.028	-0.031	0.004	0.011	-0.002	-0.004	0.017	-0.058	-0.055	-0.013	-0.096
Female HH	0.058	0.058	-0.043	1	-0.035	-0.469	0.534	-0.338	0.831	0.103	-0.649	0.639	0.443	0.008	-0.091	-0.238	-0.033	-0.076	0.006	-0.025	0.003	-0.023
Genetic Factors	-0.059	-0.025	0.014	-0.035	1	0.014	-0.032	0.015	-0.021	-0.008	0.029	-0.03	-0.016	0.01	-0.004	0.012	-0.01	-0.003	-0.031	-0.004	-0.024	0.012
Income	0.013	0.054	0.029	-0.469	0.014	1	-0.596	-0.14	-0.309	0.08	-0.052	-0.833	-0.478	-0.013	0.53	-0.506	0.106	-0.167	-0.006	0.027	0.013	0.002
Medicaid	0.006	-0.023	-0.003	0.534	-0.032	-0.596	1	-0.237	0.175	0.523	-0.441	0.8	0.704	0.008	-0.374	0.122	-0.178	0.498	0.008	-0.03	0.016	0.021
Pop 65+	-0.035	-0.063	0.017	-0.338	0.015	-0.14	-0.237	1	-0.235	-0.405	0.549	-0.163	-0.344	0	-0.065	0.507	-0.003	-0.277	-0.034	-0.007	-0.009	-0.028
Black/ AA	0.051	0.051	-0.05	0.831	-0.021	-0.309	0.175	-0.235	1	-0.257	-0.51	0.408	0.215	0.014	-0.004	-0.182	-0.008	-0.262	-0.013	-0.026	-0.03	-0.045
Hispanic	0.022	0.004	0.012	0.103	-0.008	0.08	0.523	-0.405	-0.257	1	-0.451	0.167	0.594	-0.019	-0.107	-0.292	-0.056	0.459	0.014	0.011	0.075	0.05
White	-0.082	-0.037	0.009	-0.649	0.029	-0.052	-0.441	0.549	-0.51	-0.451	1	-0.289	-0.454	-0.015	-0.127	0.463	-0.019	-0.296	-0.006	0.002	0.001	-0.011
Poverty	0.002	-0.021	-0.028	0.639	-0.03	-0.833	0.8	-0.163	0.408	0.167	-0.289	1	0.653	0.011	-0.416	0.297	-0.119	0.318	0.003	-0.032	-0.006	0.01
Un-insured	0.032	-0.031	-0.031	0.443	-0.016	-0.478	0.704	-0.344	0.215	0.594	-0.454	0.653	1	0	-0.355	-0.005	-0.1	0.537	0	-0.003	0.051	0.018
Cost	0.083	-0.04	0.004	0.008	0.01	-0.013	0.008	0	0.014	-0.019	-0.015	0.011	0	1	0.005	-0.003	0.009	0.023	-0.112	0.008	-0.004	0.054
Access	-0.001	0.034	0.011	-0.091	-0.004	0.53	-0.374	-0.065	-0.004	-0.107	-0.127	-0.416	-0.355	0.005	1	-0.351	0.049	-0.117	-0.007	0.013	-0.039	0.01
Rur/ Urb	-0.042	-0.111	-0.002	-0.238	0.012	-0.506	0.122	0.507	-0.182	-0.292	0.463	0.297	-0.005	-0.003	-0.351	1	-0.075	0.049	-0.011	-0.021	-0.044	-0.014
Under-served	0.023	0.017	-0.004	-0.033	-0.01	0.106	-0.178	-0.003	-0.008	-0.056	-0.019	-0.119	-0.1	0.009	0.049	-0.075	1	-0.053	0.005	0.002	0	0.009
Region	-0.033	-0.084	0.017	-0.076	-0.003	-0.167	0.498	-0.277	-0.262	0.459	-0.296	0.318	0.537	0.023	-0.117	0.049	-0.053	1	0.003	0.002	0.021	0.079
Comor-bidity	0.136	0.117	-0.058	0.006	-0.031	-0.006	0.008	-0.034	-0.013	0.014	-0.006	0.003	0	-0.112	-0.007	-0.011	0.005	0.003	1	-0.038	0	-0.074
Comp-lication	-0.005	-0.034	-0.055	-0.025	-0.004	0.027	-0.03	-0.007	-0.026	0.011	0.002	-0.032	-0.003	0.008	0.013	-0.021	0.002	0.002	-0.038	1	-0.056	0.085
ICU	0.109	0.108	-0.013	0.003	-0.024	0.013	0.016	-0.009	-0.03	0.075	0.001	-0.006	0.051	-0.004	-0.039	-0.044	0	0.021	0	-0.056	1	-0.117
Treat-ment	-0.064	-0.287	-0.096	-0.023	0.012	0.002	0.021	-0.028	-0.045	0.05	-0.011	0.01	0.018	0.054	0.01	-0.014	0.009	0.079	-0.074	0.085	-0.117	1

Table of correlations of variables used in analysis of health services utilization by prostate cancer patients in subset analysis including hospital factors

	Hosp LOS	ER	Age	Female HH	Genetic Factors	Income	Medi-caid	Pop 65+	Black/ AA	Hisp-anic	White	Poverty	Un-insured	Cost	Access	Rur/ Urb	Under-served	Region	Size	Owner-ship	Cancer Prog	Train-ing	Comor-bidity	Comp-lication	ICU	Treat-ment
Hosp LOS	1	-0.038	0.027	0.099	-0.091	-0.01	0.078	-0.078	0.057	0.126	-0.088	0.031	0.131	-0.061	-0.063	-0.078	-0.1	-0.026	0.089	0.03	-0.005	0.017	0.126	0.02	0.072	-0.139
ER	-0.038	1	0.185	0.029	-0.049	0.03	0.016	-0.112	0.019	0.062	-0.069	0.038	-0.002	-0.062	0.008	-0.077	0.034	0.016	0.035	-0.058	0.022	-0.018	0.145	-0.06	0.044	-0.358
Age	0.027	0.185	1	0.041	-0.035	0.021	0.016	-0.042	0.025	0.035	-0.06	-0.003	0.059	0.025	0.027	-0.057	-0.005	-0.01	0.031	0.007	-0.009	0.023	-0.089	-0.159	-0.033	-0.135
Female HH	0.099	0.029	0.041	1	0.013	-0.357	0.751	-0.63	0.383	0.652	-0.62	0.596	0.688	-0.023	-0.174	-0.266	-0.489	-0.128	-0.051	0.036	-0.122	-0.168	0.082	-0.005	-0.018	-0.037
Genetic	-0.091	-0.049	-0.035	0.013	1	-0.01	-0.011	0.025	0.047	-0.047	0.008	-0.003	-0.01	0.005	0.026	0.009	-0.014	-0.032	-0.012	0.068	0	0.029	-0.012	0.036	-0.049	0.023
Income	-0.01	0.03	0.021	-0.357	-0.01	1	-0.693	-0.158	0.322	-0.218	-0.415	-0.812	-0.471	-0.001	0.768	-0.607	0.808	0.225	0.215	0.111	0.215	0.331	-0.01	-0.011	0.063	-0.011
Medi-caid	0.078	0.016	0.016	0.751	-0.011	-0.693	1	-0.42	-0.238	0.708	-0.2	0.829	0.795	0.006	-0.52	0.052	-0.775	0.156	-0.125	0.019	-0.141	-0.276	0.078	-0.019	-0.038	0.012
Pop 65+	-0.078	-0.112	-0.042	-0.63	0.025	-0.158	-0.42	1	-0.264	-0.663	0.756	-0.246	-0.368	-0.018	-0.06	0.571	0.042	-0.201	-0.037	-0.055	0.013	0.033	-0.099	0.016	-0.001	-0.003
Black/	0.057	0.019	0.025	0.383	0.047	0.322	-0.238	-0.264	1	-0.096	-0.572	-0.152	-0.071	-0.027	0.353	-0.277	0.306	-0.61	0.099	0.04	0.026	0.092	0.039	0.022	-0.016	-0.065
Hispanic	0.126	0.062	0.035	0.652	-0.047	-0.218	0.708	-0.663	-0.096	1	-0.497	0.439	0.753	-0.035	-0.407	-0.387	-0.5	0.315	0.021	0.003	-0.02	-0.128	0.073	-0.055	0.065	-0.015
White	-0.088	-0.069	-0.06	-0.62	0.008	-0.415	-0.2	0.756	-0.572	-0.497	1	0.006	-0.296	-0.006	-0.362	0.644	-0.17	-0.12	-0.09	-0.07	-0.011	-0.006	-0.089	0.033	-0.009	0.04
Poverty	0.031	0.038	-0.003	0.596	-0.003	-0.812	0.829	-0.246	-0.152	0.439	0.006	1	0.449	0.007	-0.612	0.309	-0.661	-0.13	-0.18	-0.124	-0.177	-0.288	0.064	-0.032	-0.122	0.046
Un-insured	0.131	-0.002	0.059	0.688	-0.01	-0.471	0.795	-0.368	-0.071	0.753	-0.296	0.449	1	-0.026	-0.416	-0.208	-0.782	0.093	0.013	0.085	-0.055	-0.243	0.065	-0.004	0.063	-0.055
Cost	-0.061	-0.062	0.025	-0.023	0.005	-0.001	0.006	-0.018	-0.027	-0.035	-0.006	0.007	-0.026	1	0.026	0.026	0.006	0.041	-0.002	0.042	-0.011	-0.048	-0.157	0.064	-0.01	0.134
Access	-0.063	0.008	0.027	-0.174	0.026	0.768	-0.52	-0.06	0.353	-0.407	-0.362	-0.612	-0.416	0.026	1	-0.47	0.662	0.149	0.158	0.117	0.125	0.201	-0.005	0.011	0	-0.008
Rur/ Urb	-0.078	-0.077	-0.057	-0.266	0.009	-0.607	0.052	0.571	-0.277	-0.387	0.644	0.309	-0.208	0.026	-0.47	1	-0.236	-0.297	-0.206	-0.101	-0.15	-0.103	-0.016	0.008	-0.051	0.017
Under-served	-0.1	0.034	-0.005	-0.489	-0.014	0.808	-0.775	0.042	0.306	-0.5	-0.17	-0.661	-0.782	0.006	0.662	-0.236	1	0.046	0.109	0.009	0.14	0.261	-0.041	-0.046	0	0.008
Region	-0.026	0.016	-0.01	-0.128	-0.032	0.225	0.156	-0.201	-0.61	0.315	-0.12	-0.13	0.093	0.041	0.149	-0.297	0.046	1	-0.054	0.044	0.018	-0.021	-0.019	-0.037	0.044	0.055
Size	0.089	0.035	0.031	-0.051	-0.012	0.215	-0.125	-0.037	0.099	0.021	-0.09	-0.18	0.013	-0.002	0.158	-0.206	0.109	-0.054	1	0.145	0.732	0.273	0.048	0.03	0.056	-0.007
Owner-	0.03	-0.058	0.007	0.036	0.068	0.111	0.019	-0.055	0.04	0.003	-0.07	-0.124	0.085	0.042	0.117	-0.101	0.009	0.044	0.145	1	-0.025	0.055	0.033	-0.053	0.017	0.024
Cancer Prog	-0.005	0.022	-0.009	-0.122	0	0.215	-0.141	0.013	0.026	-0.02	-0.011	-0.177	-0.055	-0.011	0.125	-0.15	0.14	0.018	0.732	-0.025	1	0.275	0.04	0.02	0.009	0.008
Training	0.017	-0.018	0.023	-0.168	0.029	0.331	-0.276	0.033	0.092	-0.128	-0.006	-0.288	-0.243	-0.048	0.201	-0.103	0.261	-0.021	0.273	0.055	0.275	1	0.051	0.036	0.003	0.012
Comor-bidity	0.126	0.145	-0.089	0.082	-0.012	-0.01	0.078	-0.099	0.039	0.073	-0.089	0.064	0.065	-0.157	-0.005	-0.016	-0.041	-0.019	0.048	0.033	0.04	0.051	1	-0.048	0.034	-0.151
Comp-lication	0.02	-0.06	-0.159	-0.005	0.036	-0.011	-0.019	0.016	0.022	-0.055	0.033	-0.032	-0.004	0.064	0.011	0.008	-0.046	-0.037	0.03	-0.053	0.02	0.036	-0.048	1	-0.023	0.071
ICU	0.072	0.044	-0.033	-0.018	-0.049	0.063	-0.038	-0.001	-0.016	0.065	-0.009	-0.122	0.063	-0.01	0	-0.051	0	0.044	0.056	0.017	0.009	0.003	0.034	-0.023	1	-0.159
Treat-ment	-0.139	-0.358	-0.135	-0.037	0.023	-0.011	0.012	-0.003	-0.065	-0.015	0.04	0.046	-0.055	0.134	-0.008	0.017	0.008	0.055	-0.007	0.024	0.008	0.012	-0.151	0.071	-0.159	1

APPENDIX C: SUMMARY OF PREDICTOR TREE TERMINAL NODES

Terminal nodes summary of social and demographic variables in predicting emergency room use and ranking of mean hospital length of stay by prostate cancer patients

		Node by Node		Cumulative Nodes			
Node	**Variable**	**n**	**%**	**n**	**%**	**ER Use**	**Hospital Days**
Emergency Room							
2	Rural/ Urban 2, 3 (Urban adjacent & Rural)	845	14.7	845	14.7	No	
3	Rural/ Urban 1 (Urban)	4,909	85.3	5,754	100	Yes	
Hospital Length of Stay							
6	Rural/Urban 2, 3 (Urban adjacent & Rural)	666	11.6	666	11.6		3.9
134	Rural/Urban 2, 3 (Urban adjacent & Rural)	16	0.3	682	11.9		4.2
124	Hispanic/ Latino 2, 3 (> 14)	124	2.2	806	14.0		4.3
7	Rural/Urban 1 (Urban)	2,019	35.1	2,825	49.2		4.4
150	Hispanic/ Latino 1, 2 (< 32)	1,274	22.2	4,099	71.4		4.7
151	Hispanic/ Latino 3 (> 32)	582	10.1	4,681	81.5		5.3
149	Underserved 2 (Part shortage area)	1,001	17.4	5,682	98.9		5.5
142	Underserved 2 (Part shortage area)	55	1.0	5,737	99.9		7.5
143	Underserved 1 (All shortage area)	7	0.1	5,754	100		23.9

Terminal node summary of social and demographic variables in predicting emergency room utilization and hospital length of stay by prostate cancer patients in data subset

Node	**Variable**	**n**	**%**	**ER Use**	**Hospital Days**
Emergency Room					
4	Age 1 (<75)	206	37.1	No	
3	Age 3 (>85)	112	20.1	Yes	
5	Age 2 (75-85)	238	42.8	Yes	
Hospital Length of Stay					
2	Hispanic/Latino Population 1, 2 (<32%)	205	36.9		3.9
3	Hispanic/Latino Population 3 (>32%)	351	63.1		5.3

APPENDIX D: LOGISTIC REGRESSION RESULTS

Hierarchical logistic regression analysis for emergency room utilization by all prostate cancer patients (n = 5754)

All Patients						
1. Predisposing Factors						
	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.028	0.003	0.000	1.029	1.022	1.036
Genetic Factors	-0.167	0.090	0.063	0.846	0.709	1.009
Average Household Income	0.000	0.000	0.005	1.000	1.000	1.000
Medicaid Eligible	-0.002	0.007	0.734	0.998	0.985	1.011
Population Age 65+	-0.033	0.012	0.005	0.967	0.945	0.990
Poverty	0.025	0.014	0.079	1.025	0.997	1.054
Uninsured Population	-0.030	0.010	0.002	0.970	0.952	0.989
Race/Ethnicity - % Black/ AA	0.018	0.004	0.000	1.019	1.011	1.026
Race/Ethnicity - % Hispanic	0.009	0.003	0.005	1.009	1.003	1.016
Race/Ethnicity - % White	0.008	0.003	0.006	1.008	1.002	1.014
Constant	-2.944	0.693	0.000	0.053		
2. Predisposing and Enabling Factors						
	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.029	0.003	0.000	1.030	1.023	1.037
Genetic Factors	-0.155	0.091	0.088	0.856	0.717	1.023
Average Household Income	0.000	0.000	0.163	1.000	1.000	1.000
Medicaid Eligible	0.002	0.007	0.784	1.002	0.988	1.016
Population Age 65+	-0.022	0.013	0.097	0.978	0.952	1.004
Poverty	0.040	0.015	0.006	1.041	1.011	1.071
Uninsured Population	-0.005	0.013	0.685	0.995	0.970	1.020
Race/Ethnicity - % Black/ AA	0.000	0.005	0.950	1.000	0.990	1.010
Race/Ethnicity - % Hispanic	-0.002	0.004	0.641	0.998	0.990	1.006
Race/Ethnicity - % White	0.003	0.004	0.388	1.003	0.996	1.010
Cost	0.000	0.000	0.005	1.000	1.000	1.000
Access to Physicians	-0.001	0.001	0.599	0.999	0.997	1.002
Rural/Urban 1			0.000			
Rural/Urban 2	-0.059	0.081	0.463	0.942	0.804	1.104
Rural/Urban 3	-0.309	0.123	0.012	0.734	0.577	0.935
Rural/Urban 4	-0.487	0.180	0.007	0.615	0.432	0.874
Rural/Urban 5	-0.211	0.206	0.305	0.810	0.541	1.212
Rural/Urban 6	-0.766	0.170	0.000	0.465	0.333	0.648
Rural/Urban 7	-0.779	0.188	0.000	0.459	0.317	0.664
Rural/Urban 8	-0.695	0.311	0.025	0.499	0.271	0.918
Rural/Urban 9	-0.914	0.294	0.002	0.401	0.225	0.713
Underserved Area - No			0.652			
Underserved Area - All	-0.066	0.121	0.589	0.937	0.738	1.188
Underserved Area - Part	-0.006	0.113	0.957	0.994	0.796	1.241
Geographic Region-Northeast			0.000			
Geographic Region-Midwest	-0.208	0.118	0.077	0.812	0.645	1.023
Geographic Region-South	-0.361	0.138	0.009	0.697	0.531	0.914

	B	S.E.	Sig.	OR	95% CI for OR Lower	Upper
Geographic Region-West	-0.488	0.112	0.000	0.614	0.493	0.765
Constant	-2.176	0.779	0.005	0.114		

3. Predisposing, Enabling and Need Factors

	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.025	0.004	0.000	1.026	1.018	1.033
Genetic Factors	-0.092	0.096	0.335	0.912	0.756	1.100
Average Household Income	0.000	0.000	0.182	1.000	1.000	1.000
Medicaid Eligible	-0.002	0.008	0.771	0.998	0.983	1.013
Population Age 65+	-0.026	0.014	0.068	0.975	0.948	1.002
Poverty	0.052	0.015	0.001	1.054	1.022	1.086
Uninsured Population	-0.017	0.014	0.215	0.983	0.958	1.010
Race/Ethnicity - % Black/ AA	0.001	0.005	0.819	1.001	0.991	1.012
Race/Ethnicity - % Hispanic	0.000	0.004	0.911	1.000	0.991	1.008
Race/Ethnicity - % White	0.004	0.004	0.230	1.004	0.997	1.012
Cost	0.000	0.000	0.299	1.000	1.000	1.000
Access to Physicians	0.000	0.001	0.951	1.000	0.997	1.003
Rural/Urban 1			0.000			
Rural/Urban 2	-0.078	0.086	0.361	0.925	0.782	1.094
Rural/Urban 3	-0.316	0.131	0.016	0.729	0.565	0.942
Rural/Urban 4	-0.557	0.187	0.003	0.573	0.397	0.826
Rural/Urban 5	-0.178	0.219	0.415	0.837	0.545	1.284
Rural/Urban 6	-0.776	0.177	0.000	0.460	0.325	0.651
Rural/Urban 7	-0.845	0.195	0.000	0.429	0.293	0.629
Rural/Urban 8	-0.673	0.320	0.035	0.510	0.272	0.955
Rural/Urban 9	-0.837	0.304	0.006	0.433	0.239	0.786
Underserved Area - No			0.880			
Underserved Area - All	-0.003	0.126	0.978	0.997	0.778	1.277
Underserved Area - Part	0.030	0.117	0.801	1.030	0.818	1.297
Geographic Region-Northeast			0.007			
Geographic Region-Midwest	-0.258	0.124	0.038	0.773	0.606	0.985
Geographic Region-South	-0.366	0.145	0.012	0.694	0.522	0.922
Geographic Region-West	-0.375	0.119	0.002	0.687	0.545	0.867
Comorbidity Index Score 2			0.000			
Comorbidity Index Score 3	0.462	0.113	0.000	1.587	1.272	1.980
Comorbidity Index Score 4	0.468	0.100	0.000	1.597	1.313	1.942
Comorbidity Index Score 5	0.461	0.173	0.008	1.586	1.130	2.225
Comorbidity Index Score 6	0.734	0.444	0.098	2.084	0.872	4.979
Comorbidity Index Score 7	0.662	1.162	0.569	1.939	0.199	18.909
Comorbidity Index Score 8	0.492	0.080	0.000	1.635	1.399	1.911
Comorbidity Index Score 9	0.966	0.181	0.000	2.628	1.843	3.748
Comorbidity Index Score 10	0.572	0.167	0.001	1.773	1.277	2.461
Comorbidity Index Score 11	0.408	0.277	0.141	1.504	0.873	2.590
Comorbidity Index Score 12	1.244	0.538	0.021	3.469	1.209	9.958
Comorbidity Index Score 13	0.572	0.878	0.515	1.771	0.317	9.897
Complications	0.021	0.107	0.843	1.021	0.828	1.261
Treatment	-2.225	0.135	0.000	0.108	0.083	0.141
Intensive Care Unit	0.420	0.073	0.000	1.523	1.320	1.756
Constant	-2.236	0.826	0.007	0.107		

Hierarchical logistic regression analysis for emergency room utilization by prostate cancer patients in Group A (n = 845)

Emergency Room Group A						
1. Predisposing Factors						
	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	-0.004	0.009	0.638	0.996	0.979	1.013
Genetic Factors	-0.015	0.232	0.949	0.985	0.625	1.553
Average Household Income	0.000	0.000	0.004	1.000	1.000	1.000
Medicaid Eligible	0.034	0.015	0.021	1.035	1.005	1.065
Population Age 65+	-0.025	0.026	0.328	0.975	0.927	1.026
Poverty	0.023	0.029	0.438	1.023	0.966	1.084
Uninsured Population	0.027	0.023	0.233	1.027	0.983	1.074
Race/Ethnicity - % Black/ AA	0.015	0.009	0.110	1.015	0.997	1.034
Race/Ethnicity - % Hispanic	0.001	0.007	0.835	1.001	0.988	1.015
Race/Ethnicity - % White	0.020	0.008	0.019	1.020	1.003	1.037
Constant	-5.186	1.989	0.009	0.006		
2. Predisposing and Enabling Factors						
	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.000	0.009	0.983	1.000	0.983	1.018
Genetic Factors	0.000	0.236	0.999	1.000	0.630	1.587
Average Household Income	0.000	0.000	0.011	1.000	1.000	1.000
Medicaid Eligible	0.038	0.016	0.019	1.039	1.006	1.072
Population Age 65+	0.026	0.031	0.405	1.026	0.966	1.090
Poverty	0.014	0.033	0.669	1.014	0.951	1.081
Uninsured Population	0.028	0.035	0.419	1.028	0.961	1.101
Race/Ethnicity - % Black/ AA	0.009	0.011	0.404	1.009	0.987	1.032
Race/Ethnicity - % Hispanic	0.004	0.008	0.626	1.004	0.989	1.019
Race/Ethnicity - % White	0.014	0.009	0.137	1.014	0.996	1.033
Cost	0.000	0.000	0.013	1.000	0.999	1.000
Access to Physicians	-0.003	0.003	0.391	0.997	0.990	1.004
Rural/Urban 4			0.047			
Rural/Urban 5	0.610	0.269	0.023	1.841	1.086	3.121
Rural/Urban 6	-0.238	0.239	0.320	0.788	0.493	1.260
Rural/Urban 7	-0.076	0.253	0.764	0.927	0.565	1.520
Rural/Urban 8	-0.200	0.371	0.590	0.819	0.396	1.694
Rural/Urban 9	-0.363	0.350	0.300	0.696	0.350	1.382
Underserved Area - No			0.299			
Underserved Area - All	-0.379	0.258	0.142	0.685	0.413	1.135
Underserved Area - Part	-0.181	0.240	0.452	0.834	0.521	1.337
Geographic Region-Northeast			0.152			

Geographic Region-Midwest	-0.611	0.616	0.321	0.543	0.162	1.814
Geographic Region-South	-0.024	0.696	0.972	0.976	0.249	3.819
Geographic Region-West	-0.599	0.619	0.333	0.549	0.163	1.847
Constant	-5.024	2.559	0.050	0.007		

3. Predisposing, Enabling and Need Factors

	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	-0.002	0.009	0.816	0.998	0.979	1.017
Genetic Factors	0.042	0.245	0.863	1.043	0.646	1.686
Average Household Income	0.000	0.000	0.022	1.000	1.000	1.000
Medicaid Eligible	0.036	0.017	0.032	1.037	1.003	1.071
Population Age 65+	0.027	0.032	0.406	1.027	0.964	1.095
Poverty	0.018	0.034	0.588	1.019	0.953	1.089
Uninsured Population	0.019	0.036	0.593	1.020	0.949	1.095
Race/Ethnicity - % Black/ AA	0.012	0.012	0.303	1.012	0.989	1.036
Race/Ethnicity - % Hispanic	0.008	0.008	0.313	1.008	0.992	1.025
Race/Ethnicity - % White	0.018	0.01	0.074	1.018	0.998	1.038
Cost	0.000	0.000	0.067	1.000	0.999	1.000
Access to Physicians	-0.003	0.004	0.448	0.997	0.99	1.004
Rural/Urban 4			0.038			
Rural/Urban 5	0.687	0.283	0.015	1.988	1.141	3.464
Rural/Urban 6	-0.202	0.247	0.414	0.817	0.503	1.326
Rural/Urban 7	-0.118	0.262	0.653	0.889	0.532	1.485
Rural/Urban 8	-0.153	0.38	0.688	0.858	0.408	1.808
Rural/Urban 9	-0.325	0.363	0.370	0.722	0.355	1.471
Underserved Area - No			0.411			
Underserved Area - All	-0.351	0.266	0.186	0.704	0.418	1.185
Underserved Area - Part	-0.213	0.249	0.392	0.808	0.496	1.316
Geographic Region-Northeast			0.180			
Geographic Region-Midwest	-0.629	0.625	0.314	0.533	0.157	1.815
Geographic Region-South	0.034	0.708	0.962	1.035	0.258	4.149
Geographic Region-West	-0.484	0.632	0.444	0.616	0.179	2.126
Comorbidity Index Score 2			0.452			
Comorbidity Index Score 3	0.5	0.295	0.090	1.648	0.925	2.937
Comorbidity Index Score 4	0.231	0.243	0.342	1.260	0.782	2.031
Comorbidity Index Score 5	-0.029	0.436	0.948	0.972	0.414	2.283
Comorbidity Index Score 6	1.339	1.291	0.300	3.814	0.304	47.854
Comorbidity Index Score 9	0.306	0.204	0.134	1.358	0.91	2.026
Comorbidity Index Score 10	1.526	0.681	0.025	4.599	1.211	17.464
Comorbidity Index Score 11	0.077	0.444	0.863	1.080	0.452	2.58
Comorbidity Index Score 12	0.32	0.685	0.640	1.378	0.36	5.27
Comorbidity Index Score 13	0.288	1.452	0.843	1.333	0.077	22.975
Complications	-0.215	0.312	0.491	0.806	0.437	1.487
Treatment	-1.826	0.384	0.000	0.161	0.076	0.342
Intensive Care Unit	-0.003	0.191	0.986	0.997	0.685	1.451
Constant	-5.158	2.675	0.054	0.006		

Hierarchical logistic regression analysis for emergency room utilization by prostate cancer patients in Group B (n = 4909)

Emergency Room Group B						
1. Predisposing Factors						
	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.035	0.004	0.000	1.036	1.028	1.043
Genetic Factors	-0.181	0.098	0.065	0.834	0.688	1.011
Average Household Income	0.000	0.000	0.450	1.000	1.000	1.000
Medicaid Eligible	-0.013	0.008	0.096	0.987	0.971	1.002
Population Age 65+	-0.002	0.015	0.889	0.998	0.970	1.027
Poverty	0.032	0.018	0.077	1.032	0.997	1.069
Uninsured Population	-0.037	0.011	0.001	0.963	0.943	0.984
Race/Ethnicity - % Black/ AA	0.015	0.004	0.000	1.015	1.007	1.024
Race/Ethnicity - % Hispanic	0.012	0.004	0.003	1.012	1.004	1.020
Race/Ethnicity - % White	0.006	0.003	0.093	1.006	0.999	1.012
Constant	-2.847	0.801	0.000	0.058		
2. Predisposing and Enabling Factors						
	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.035	0.004	0.000	1.036	1.028	1.043
Genetic Factors	-0.169	0.099	0.087	0.845	0.696	1.025
Average Household Income	0.000	0.000	0.508	1.000	1.000	1.000
Medicaid Eligible	-0.005	0.009	0.548	0.995	0.978	1.012
Population Age 65+	-0.022	0.016	0.167	0.978	0.948	1.009
Poverty	0.043	0.019	0.021	1.044	1.007	1.083
Uninsured Population	-0.006	0.015	0.675	0.994	0.965	1.023
Race/Ethnicity - % Black/ AA	-0.004	0.006	0.469	0.996	0.984	1.008
Race/Ethnicity - % Hispanic	-0.001	0.005	0.840	0.999	0.989	1.009
Race/Ethnicity - % White	-0.001	0.004	0.789	0.999	0.991	1.007
Cost	0.000	0.000	0.041	1.000	1.000	1.000
Access to Physicians	-0.001	0.002	0.573	0.999	0.996	1.002
Rural/Urban 1			0.064			
Rural/Urban 2	-0.057	0.083	0.493	0.945	0.803	1.112
Rural/Urban 3	-0.302	0.129	0.019	0.739	0.574	0.952
Underserved Area - No			0.717			
Underserved Area - All	-0.018	0.141	0.898	0.982	0.746	1.294
Underserved Area - Part	0.041	0.131	0.754	1.042	0.806	1.346
Geographic Region-Northeast			0.000			
Geographic Region-Midwest	-0.082	0.140	0.559	0.922	0.701	1.212
Geographic Region-South	-0.423	0.153	0.006	0.655	0.485	0.885
Geographic Region-West	-0.540	0.130	0.000	0.583	0.451	0.752
Constant	-2.024	0.864	0.019	0.132		
3. Predisposing, Enabling and Need Factors						
	B	S.E.	Sig.	OR	95% CI for OR	

					Lower	Upper
Age	0.031	0.004	0.000	1.032	1.024	1.040
Genetic Factors	-0.104	0.105	0.322	0.901	0.734	1.107
Average Household Income	0.000	0.000	0.503	1.000	1.000	1.000
Medicaid Eligible	-0.010	0.009	0.303	0.990	0.972	1.009
Population Age 65+	-0.027	0.017	0.110	0.973	0.941	1.006
Poverty	0.058	0.020	0.003	1.060	1.020	1.102
Uninsured Population	-0.018	0.016	0.253	0.982	0.953	1.013
Race/Ethnicity - % Black/ AA	-0.003	0.006	0.634	0.997	0.984	1.010
Race/Ethnicity - % Hispanic	0.000	0.005	0.968	1.000	0.989	1.010
Race/Ethnicity - % White	0.000	0.004	0.962	1.000	0.992	1.008
Cost	0.000	0.000	0.799	1.000	1.000	1.000
Access to Physicians	0.000	0.002	0.951	1.000	0.997	1.003
Rural/Urban 1			0.079			
Rural/Urban 2	-0.071	0.088	0.418	0.931	0.783	1.107
Rural/Urban 3	-0.309	0.137	0.024	0.734	0.561	0.960
Underserved Area - No			0.756			
Underserved Area - All	0.037	0.147	0.803	1.037	0.777	1.384
Underserved Area - Part	0.080	0.137	0.558	1.083	0.829	1.416
Geographic Region-Northeast			0.003			
Geographic Region-Midwest	-0.148	0.148	0.318	0.863	0.646	1.153
Geographic Region-South	-0.450	0.162	0.006	0.637	0.464	0.876
Geographic Region-West	-0.428	0.139	0.002	0.652	0.496	0.855
Comorbidity Index Score 2			0.000			
Comorbidity Index Score 3	0.480	0.123	0.000	1.616	1.269	2.057
Comorbidity Index Score 4	0.507	0.111	0.000	1.660	1.336	2.064
Comorbidity Index Score 5	0.608	0.196	0.002	1.837	1.251	2.696
Comorbidity Index Score 6	0.628	0.466	0.178	1.873	0.751	4.669
Comorbidity Index Score 8	0.516	0.087	0.000	1.675	1.412	1.987
Comorbidity Index Score 9	0.935	0.189	0.000	2.547	1.757	3.692
Comorbidity Index Score 10	0.656	0.183	0.000	1.927	1.345	2.760
Comorbidity Index Score 11	0.405	0.302	0.180	1.499	0.830	2.707
Comorbidity Index Score 12	1.407	0.594	0.018	4.083	1.273	13.092
Comorbidity Index Score 13	0.622	0.885	0.482	1.863	0.329	10.550
Complications	0.055	0.115	0.631	1.057	0.843	1.325
Treatment	-2.282	0.145	0.000	0.102	0.077	0.136
Intensive Care Unit	0.470	0.080	0.000	1.600	1.368	1.871
Constant	-2.106	0.922	0.022	0.122		

APPENDIX E: MULTIPLE REGRESSION RESULTS

Hierarchical multiple regression analysis for hospital length of stay by all prostate cancer patients (n=5754)

All Patients				
1. Predisposing Factors				
	B	SE	Beta	Sig.
(Constant)	7.996	1.665		0.000
Age	0.007	0.008	0.011	0.386
Genetic Factors	-0.976	0.219	-0.058	0.000
Average Household Income	0.000	0.000	-0.046	0.151
Medicaid Eligible	-0.027	0.016	-0.050	0.104
Population Age 65+	0.015	0.028	0.009	0.590
Poverty	-0.047	0.034	-0.051	0.172
Uninsured Population	0.034	0.023	0.036	0.139
Race/Ethnicity - % Black/AA	0.000	0.009	0.001	0.982
Race/Ethnicity - % Hispanic	-0.002	0.008	-0.008	0.756
Race/Ethnicity - % White	-0.033	0.007	-0.112	0.000
2. Predisposing and Enabling Factors				
	B	SE	Beta	Sig.
(Constant)	10.536	1.767		0.000
Age	0.007	0.008	0.012	0.364
Genetic Factors	-0.970	0.218	-0.058	0.000
Average Household Income	0.000	0.000	-0.050	0.134
Medicaid Eligible	-0.018	0.017	-0.035	0.267
Population Age 65+	-0.028	0.031	-0.017	0.356
Poverty	-0.037	0.035	-0.040	0.293
Uninsured Population	0.098	0.025	0.102	0.000
Race/Ethnicity - % Black/AA	-0.042	0.011	-0.112	0.000
Race/Ethnicity - % Hispanic	-0.020	0.009	-0.070	0.017
Race/Ethnicity - % White	-0.054	0.008	-0.184	0.000
Cost	0.001	0.000	0.084	0.000
Access to Physicians	-0.003	0.003	-0.015	0.353
Rural/Urban	0.015	0.054	0.005	0.788
Underserved Area	0.088	0.109	0.011	0.420
Geographic Region	-0.538	0.085	-0.132	0.000
3. Predisposing, Enabling and Need Factors				
	B	SE	Beta	Sig.
(Constant)	8.356	1.754		0.000
Age	0.011	0.008	0.018	0.163
Genetic Factors	-0.848	0.214	-0.051	0.000
Average Household Income	0	0	-0.042	0.205
Medicaid Eligible	-0.018	0.016	-0.033	0.281
Population Age 65+	-0.021	0.03	-0.013	0.481
Poverty	-0.032	0.034	-0.035	0.355
Uninsured Population	0.093	0.025	0.097	0.000

	B	SE	Beta	Sig.
Race/Ethnicity - % Black/AA	-0.039	0.011	-0.103	0.001
Race/Ethnicity - % Hispanic	-0.021	0.008	-0.073	0.011
Race/Ethnicity - % White	-0.054	0.008	-0.184	0.000
Cost	0.001	0	0.102	0.000
Access to Physicians	-0.002	0.003	-0.01	0.535
Rural/Urban	0.036	0.054	0.013	0.498
Underserved Area	0.085	0.107	0.011	0.426
Geographic Region	-0.508	0.084	-0.124	0.000
Comorbidity Index Score	0.253	0.023	0.143	0.000
Complications	0.147	0.236	0.008	0.532
Treatment	-0.661	0.227	-0.038	0.004
Intensive Care Unit	1.276	0.159	0.104	0.000

4. Predisposing, Enabling and Need Factors, and Emergency Room Use

	B	SE	Beta	Sig.
(Constant)	8.376	1.754		0.000
Age	0.013	0.008	0.021	0.115
Genetic Factors	-0.855	0.214	-0.051	0.000
Average Household Income	0	0	-0.04	0.221
Medicaid Eligible	-0.018	0.016	-0.033	0.279
Population Age 65+	-0.023	0.03	-0.014	0.449
Poverty	-0.029	0.034	-0.031	0.402
Uninsured Population	0.091	0.025	0.096	0.000
Race/Ethnicity - % Black/AA	-0.039	0.011	-0.103	0.001
Race/Ethnicity - % Hispanic	-0.021	0.008	-0.073	0.011
Race/Ethnicity - % White	-0.054	0.008	-0.183	0.000
Cost	0.001	0	0.102	0.000
Access to Physicians	-0.002	0.003	-0.01	0.535
Rural/Urban	0.028	0.054	0.01	0.597
Underserved Area	0.088	0.107	0.011	0.412
Geographic Region	-0.516	0.084	-0.126	0.000
Comorbidity Index Score	0.258	0.023	0.146	0.000
Complications	0.148	0.236	0.008	0.531
Treatment	-0.783	0.235	-0.045	0.001
Intensive Care Unit	1.302	0.16	0.106	0.000
Emergency Room	-0.275	0.138	-0.027	0.047

Hierarchical multiple regression analysis for hospital length of stay by prostate cancer patients in Group A (n=666)

Hospital Group A				
1. Predisposing Factors				
	B	SE	Beta	Sig.
(Constant)	-6.612	5.123		0.197
Age	0.003	0.017	0.007	0.864
Genetic Factors	-0.819	0.442	-0.072	0.064
Average Household Income	0.000	0.000	0.033	0.687
Medicaid Eligible	-0.009	0.035	-0.024	0.796
Population Age 65+	0.047	0.049	0.046	0.332
Poverty	0.033	0.066	0.059	0.621
Uninsured Population	0.036	0.050	0.050	0.465
Race/Ethnicity - % Black/AA	0.066	0.105	0.029	0.534
Race/Ethnicity - % Hispanic	0.025	0.017	0.103	0.159
Race/Ethnicity - % White	0.085	0.038	0.196	0.026
2. Predisposing and Enabling Factors				
	B	SE	Beta	Sig.
(Constant)	-5.839	5.324		0.273
Age	0.003	0.017	0.008	0.843
Genetic Factors	-0.790	0.443	-0.070	0.075
Average Household Income	0.000	0.000	0.069	0.440
Medicaid Eligible	-0.010	0.036	-0.026	0.783
Population Age 65+	0.076	0.052	0.073	0.144
Poverty	0.048	0.068	0.086	0.481
Uninsured Population	0.033	0.062	0.045	0.594
Race/Ethnicity - % Black/AA	0.085	0.109	0.038	0.438
Race/Ethnicity - % Hispanic	0.020	0.018	0.085	0.267
Race/Ethnicity - % White	0.070	0.043	0.160	0.105
Cost	0.000	0.000	-0.021	0.600
Access to Physicians	-0.011	0.006	-0.082	0.050
Rural/Urban	-0.005	0.109	-0.002	0.966
Underserved Area	0.297	0.194	0.062	0.127
Geographic Region	-0.056	0.284	-0.015	0.843
3. Predisposing, Enabling and Need Factors				
	B	SE	Beta	Sig.
(Constant)	-6.72	5.261		0.202
Age	0.007	0.017	0.015	0.695
Genetic Factors	-0.749	0.435	-0.066	0.086
Average Household Income	0	0	0.051	0.560
Medicaid Eligible	-0.017	0.035	-0.045	0.631
Population Age 65+	0.081	0.051	0.078	0.114
Poverty	0.052	0.067	0.093	0.435
Uninsured Population	0.023	0.061	0.032	0.706

	B	SE	Beta	Sig.
Race/Ethnicity - % Black/AA	0.059	0.108	0.026	0.582
Race/Ethnicity - % Hispanic	0.02	0.018	0.084	0.267
Race/Ethnicity - % White	0.07	0.042	0.161	0.099
Cost	0	0	0.013	0.746
Access to Physicians	-0.011	0.006	-0.081	0.049
Rural/Urban	-0.018	0.108	-0.008	0.869
Underserved Area	0.319	0.192	0.066	0.098
Geographic Region	-0.014	0.28	-0.004	0.961
Comorbidity Index Score	0.156	0.051	0.121	0.002
Complications	-0.075	0.539	-0.005	0.890
Treatment	-0.737	0.478	-0.06	0.124
Intensive Care Unit	1.351	0.352	0.149	0.000
4. Predisposing, Enabling, and Need Factors, and Emergency Room Use				
	B	SE	Beta	Sig.
(Constant)	-6.846	5.287		0.196
Age	0.007	0.017	0.015	0.693
Genetic Factors	-0.75	0.436	-0.066	0.086
Average Household Income	0	0	0.054	0.542
Medicaid Eligible	-0.016	0.035	-0.042	0.649
Population Age 65+	0.081	0.051	0.078	0.114
Poverty	0.052	0.067	0.094	0.433
Uninsured Population	0.024	0.062	0.033	0.695
Race/Ethnicity - % Black/AA	0.061	0.108	0.027	0.571
Race/Ethnicity - % Hispanic	0.02	0.018	0.085	0.262
Race/Ethnicity - % White	0.071	0.043	0.163	0.096
Cost	0	0	0.013	0.751
Access to Physicians	-0.011	0.006	-0.081	0.049
Rural/Urban	-0.019	0.108	-0.008	0.860
Underserved Area	0.32	0.193	0.066	0.097
Geographic Region	-0.015	0.28	-0.004	0.958
Comorbidity Index Score	0.157	0.051	0.121	0.002
Complications	-0.074	0.54	-0.005	0.890
Treatment	-0.762	0.488	-0.062	0.119
Intensive Care Unit	1.351	0.353	0.149	0.000
Emergency Room	-0.074	0.279	-0.011	0.791

Hierarchical multiple regression analysis for hospital length of stay by prostate cancer patients in Group B (n=2019)

Hospital Group B				
1. Predisposing Factors				
	B	SE	Beta	Sig.
(Constant)	2.584	3.118		0.407
Age	-0.009	0.012	-0.016	0.460
Genetic Factors	-0.917	0.312	-0.065	0.003
Household Income	0.000	0.000	0.020	0.721
Medicaid Eligible	0.004	0.029	0.008	0.896
Population Age 65+	0.043	0.038	0.030	0.267
Poverty	-0.018	0.064	-0.021	0.781
Uninsured Population	-0.023	0.047	-0.025	0.626
Race/Ethnicity - % Black/AA	0.141	0.049	0.074	0.004
Race/Ethnicity - % Hispanic	0.022	0.013	0.090	0.088
Race/Ethnicity - % White	0.016	0.017	0.049	0.352
2. Predisposing and Enabling Factors				
	B	SE	Beta	Sig.
(Constant)	6.097	3.604		0.091
Age	-0.007	0.012	-0.013	0.553
Genetic Factors	-0.884	0.309	-0.063	0.004
Household Income	0.000	0.000	-0.009	0.895
Medicaid Eligible	0.002	0.030	0.005	0.942
Population Age 65+	0.005	0.044	0.003	0.913
Poverty	-0.048	0.067	-0.057	0.469
Uninsured Population	0.024	0.053	0.026	0.649
Race/Ethnicity - % Black/AA	0.118	0.060	0.062	0.051
Race/Ethnicity - % Hispanic	0.013	0.013	0.052	0.335
Race/Ethnicity - % White	-0.003	0.019	-0.009	0.884
Cost	-0.001	0.000	-0.152	0.000
Access to Physicians	0.003	0.005	0.019	0.550
Rural/Urban	0.291	0.200	0.049	0.146
Underserved Area	-0.002	0.149	0.000	0.989
Geographic Region	-0.268	0.148	-0.080	0.070
3. Predisposing, Enabling and Need Factors				
	B	SE	Beta	Sig.
(Constant)	4.755	3.592		0.186
Age	-0.009	0.012	-0.017	0.447
Genetic Factors	-0.789	0.306	-0.056	0.010
Household Income	0	0	0.006	0.926
Medicaid Eligible	0.002	0.03	0.005	0.935
Population Age 65+	0.006	0.043	0.005	0.881
Poverty	-0.037	0.066	-0.043	0.576
Uninsured Population	0.02	0.052	0.022	0.700

	B	SE	Beta	Sig.
Race/Ethnicity - % Black/AA	0.111	0.06	0.059	0.062
Race/Ethnicity - % Hispanic	0.012	0.013	0.05	0.357
Race/Ethnicity - % White	-0.002	0.019	-0.006	0.924
Cost	-0.001	0	-0.126	0.000
Access to Physicians	0.004	0.005	0.023	0.461
Rural/Urban	0.307	0.198	0.052	0.121
Underserved Area	-0.002	0.147	0	0.987
Geographic Region	-0.227	0.147	-0.068	0.122
Comorbidity Index Score	0.155	0.033	0.105	0.000
Complications	0.219	0.336	0.014	0.515
Treatment	-1.273	0.309	-0.093	0.000
Intensive Care Unit	0.555	0.227	0.055	0.015

4. Predisposing, Enabling and Need Factors, and Emergency Room Use

	B	SE	Beta	Sig.
(Constant)	4.672	3.595		0.194
Age	-0.008	0.012	-0.015	0.503
Genetic Factors	-0.795	0.306	-0.057	0.009
Household Income	0	0	0.008	0.905
Medicaid Eligible	0.003	0.03	0.006	0.929
Population Age 65+	0.006	0.043	0.004	0.894
Poverty	-0.035	0.066	-0.041	0.593
Uninsured Population	0.02	0.052	0.022	0.703
Race/Ethnicity - % Black/AA	0.113	0.06	0.06	0.058
Race/Ethnicity - % Hispanic	0.012	0.013	0.05	0.354
Race/Ethnicity - % White	-0.001	0.019	-0.004	0.942
Cost	-0.001	0	-0.125	0.000
Access to Physicians	0.004	0.005	0.022	0.475
Rural/Urban	0.305	0.198	0.051	0.125
Underserved Area	0	0.147	0	0.998
Geographic Region	-0.229	0.147	-0.069	0.119
Comorbidity Index Score	0.157	0.033	0.107	0.000
Complications	0.223	0.336	0.015	0.508
Treatment	-1.334	0.325	-0.097	0.000
Intensive Care Unit	0.569	0.228	0.056	0.013
Emergency Room	-0.127	0.204	-0.015	0.534

Hierarchical multiple regression analysis for hospital length of stay by prostate cancer patients in Group C (n=124)

Hospital Group C				
1. Predisposing Factors				
	B	SE	Beta	Sig.
(Constant)	-5.671	16.857		0.737
Age	-0.055	0.046	-0.110	0.233
Genetic Factors	0.343	1.324	0.024	0.796
Medicaid Eligible	0.035	0.166	0.019	0.832
Race/Ethnicity - % White	0.284	0.327	0.080	0.386
2. Predisposing and Enabling Factors				
	B	SE	Beta	Sig.
(Constant)	-3.419	17.004		0.841
Age	-0.056	0.046	-0.113	0.222
Genetic Factors	0.107	1.345	0.007	0.937
Medicaid Eligible	0.036	0.166	0.020	0.831
Race/Ethnicity - % White	0.258	0.328	0.072	0.433
Cost	-0.001	0.001	-0.093	0.316
3. Predisposing, Enabling and Need Factors				
	B	SE	Beta	Sig.
(Constant)	-11.118	16.845		0.511
Age	-0.045	0.047	-0.091	0.338
Genetic Factors	-0.349	1.336	-0.024	0.795
Medicaid Eligible	0.079	0.163	0.043	0.631
Race/Ethnicity - % White	0.355	0.324	0.1	0.275
Cost	-0.001	0.001	-0.085	0.351
Comorbidity Index Score	0.285	0.143	0.185	0.049
Complications	0.491	1.251	0.035	0.695
Treatment	-1.463	1.186	-0.116	0.220
Intensive Care Unit	1.512	0.973	0.14	0.123
4. Predisposing, Enabling and Need Factors, and Emergency Room Use				
	B	SE	Beta	Sig.
(Constant)	-11.552	16.791		0.493
Age	-0.051	0.047	-0.102	0.281
Genetic Factors	-0.104	1.344	-0.007	0.939
Medicaid Eligible	0.064	0.163	0.035	0.697
Race/Ethnicity - % White	0.391	0.324	0.11	0.230
Cost	-0.001	0.001	-0.072	0.428
Comorbidity Index Score	0.31	0.144	0.201	0.033
Complications	0.555	1.247	0.04	0.657
Treatment	-2.174	1.296	-0.172	0.096
Intensive Care Unit	1.633	0.974	0.151	0.096
Emergency Room	-1.145	0.857	-0.135	0.184

Hierarchical multiple regression analysis for hospital length of stay by prostate cancer patients in Group D (n=78)

Hospital Group D				
1. Predisposing Factors				
	B	SE	Beta	Sig.
(Constant)	51.244	66.526		0.444
Age	0.181	0.157	0.134	0.252
Genetic Factors	1.162	5.819	0.022	0.842
Medicaid Eligible	3.625	2.290	2.527	0.118
Population Age 65+	-10.276	3.775	-1.035	0.008
Poverty	-6.448	3.705	-3.327	0.086
Uninsured Population	0.076	1.389	0.034	0.957
Race/Ethnicity - % Black/AA	13.663	12.843	0.808	0.291
Race/Ethnicity - % Hispanic	2.810	1.938	0.385	0.152
Race/Ethnicity - % White	2.022	1.247	1.135	0.110
2. Predisposing and Enabling Factors				
	B	SE	Beta	Sig.
(Constant)	92.153	69.960		0.192
Age	0.130	0.158	0.096	0.412
Genetic Factors	2.455	5.792	0.047	0.673
Medicaid Eligible	2.907	2.299	2.026	0.211
Population Age 65+	-10.672	3.732	-1.075	0.006
Poverty	-5.182	3.732	-2.673	0.170
Uninsured Population	-0.586	1.425	-0.266	0.683
Race/Ethnicity - % Black/AA	9.181	12.946	0.543	0.481
Race/Ethnicity - % Hispanic	2.515	1.920	0.344	0.195
Race/Ethnicity - % White	1.570	1.259	0.881	0.217
Cost	-0.007	0.004	-0.198	0.096
3. Predisposing, Enabling and Need Factors				
	B	SE	Beta	Sig.
(Constant)	84.71	70.851		0.236
Age	0.22	0.167	0.163	0.192
Genetic Factors	2.279	6.014	0.043	0.706
Medicaid Eligible	2.495	2.373	1.739	0.297
Population Age 65+	-10.433	3.996	-1.051	0.011
Poverty	-4.278	3.829	-2.207	0.268
Uninsured Population	-0.826	1.46	-0.375	0.574
Race/Ethnicity - % Black/AA	9.219	13.771	0.545	0.506
Race/Ethnicity - % Hispanic	2.2	2.055	0.301	0.288
Race/Ethnicity - % White	1.432	1.337	0.804	0.288
Cost	-0.008	0.004	-0.23	0.059
Comorbidity Index Score	0.446	0.452	0.114	0.327
Complications	4.044	3.943	0.122	0.309
Treatment	5.29	4.587	0.139	0.253

	B	SE	Beta	Sig.
Intensive Care Unit	1.816	4.294	0.048	0.674
4. Predisposing, Enabling and Need Factors, and Emergency Room Use				
	B	SE	Beta	Sig.
(Constant)	65.388	71.112		0.361
Age	0.253	0.166	0.187	0.134
Genetic Factors	1.579	5.962	0.03	0.792
Medicaid Eligible	3.324	2.404	2.317	0.172
Population Age 65+	-11.724	4.035	-1.181	0.005
Poverty	-5.404	3.853	-2.788	0.166
Uninsured Population	-0.809	1.444	-0.367	0.577
Race/Ethnicity - % Black/AA	15.928	14.267	0.941	0.269
Race/Ethnicity - % Hispanic	3.225	2.134	0.441	0.136
Race/Ethnicity - % White	2.098	1.388	1.177	0.136
Cost	-0.009	0.004	-0.264	0.032
Comorbidity Index Score	0.506	0.448	0.13	0.263
Complications	4.42	3.905	0.133	0.262
Treatment	4.46	4.565	0.117	0.332
Intensive Care Unit	1.264	4.259	0.033	0.768
Emergency Room	-4.362	2.777	-0.188	0.121

Hierarchical multiple regression analysis for hospital length of stay by prostate cancer patients in Group E (n=1274)

Hospital Group E				
1. Predisposing Factors				
	B	SE	Beta	Sig.
(Constant)	-7.315	5.902		0.215
Age	0.006	0.017	0.010	0.729
Genetic Factors	-0.605	0.452	-0.038	0.180
Household Income	0.000	0.000	0.038	0.645
Medicaid Eligible	-0.061	0.042	-0.104	0.150
Population Age 65+	-0.059	0.105	-0.022	0.574
Poverty	0.089	0.080	0.114	0.268
Uninsured Population	0.084	0.049	0.081	0.090
Race/Ethnicity - % Black/AA	0.097	0.049	0.299	0.048
Race/Ethnicity - % Hispanic	0.105	0.048	0.136	0.029
Race/Ethnicity - % White	0.107	0.052	0.294	0.040
2. Predisposing and Enabling Factors				
	B	SE	Beta	Sig.
(Constant)	-11.530	9.120		0.206
Age	0.009	0.017	0.014	0.615
Genetic Factors	-0.628	0.447	-0.039	0.160

	B	SE	Beta	Sig.
Household Income	0.000	0.000	0.054	0.551
Medicaid Eligible	-0.072	0.049	-0.122	0.142
Population Age 65+	-0.032	0.117	-0.012	0.782
Poverty	0.105	0.087	0.133	0.230
Uninsured Population	0.037	0.086	0.036	0.665
Race/Ethnicity - % Black/AA	0.129	0.071	0.399	0.068
Race/Ethnicity - % Hispanic	0.129	0.067	0.166	0.056
Race/Ethnicity - % White	0.136	0.073	0.373	0.062
Cost	0.001	0.000	0.165	0.000
Access to Physicians	-0.001	0.007	-0.009	0.844
Rural/Urban	-0.035	0.134	-0.011	0.796
Underserved Area	0.012	0.583	0.001	0.983
Geographic Region	0.306	0.418	0.057	0.464
3. Predisposing, Enabling and Need Factors				
	B	SE	Beta	Sig.
(Constant)	-11.617	9.005		0.197
Age	0.008	0.017	0.013	0.638
Genetic Factors	-0.623	0.441	-0.039	0.157
Household Income	0	0	0.07	0.438
Medicaid Eligible	-0.056	0.048	-0.095	0.245
Population Age 65+	-0.059	0.116	-0.022	0.610
Poverty	0.084	0.086	0.107	0.329
Uninsured Population	0.033	0.084	0.032	0.695
Race/Ethnicity - % Black/AA	0.121	0.069	0.375	0.081
Race/Ethnicity - % Hispanic	0.114	0.066	0.147	0.085
Race/Ethnicity - % White	0.123	0.072	0.338	0.087
Cost	0.001	0	0.176	0.000
Access to Physicians	-0.001	0.007	-0.007	0.872
Rural/Urban	0.024	0.132	0.007	0.857
Underserved Area	0.185	0.574	0.011	0.748
Geographic Region	0.254	0.411	0.047	0.537
Comorbidity Index Score	0.238	0.047	0.139	0.000
Complications	0.6	0.5	0.033	0.230
Treatment	-0.733	0.518	-0.039	0.157
Intensive Care Unit	1.404	0.352	0.11	0.000
4. Predisposing, Enabling, and Need Factors, and Emergency Room Use				
	B	SE	Beta	Sig.
(Constant)	-9.585	8.99		0.287
Age	0.012	0.017	0.019	0.483
Genetic Factors	-0.657	0.439	-0.041	0.134
Household Income	0	0	0.056	0.531
Medicaid Eligible	-0.056	0.048	-0.095	0.242
Population Age 65+	-0.07	0.115	-0.027	0.542
Poverty	0.084	0.085	0.107	0.327
Uninsured Population	0.04	0.084	0.038	0.635
Race/Ethnicity - % Black/AA	0.106	0.069	0.328	0.127

Race/Ethnicity - % Hispanic	0.101	0.066	0.13	0.126
Race/Ethnicity - % White	0.112	0.072	0.306	0.120
Cost	0.001	0	0.173	0.000
Access to Physicians	-0.001	0.007	-0.005	0.914
Rural/Urban	0.001	0.132	0	0.996
Underserved Area	0.181	0.572	0.011	0.752
Geographic Region	0.16	0.411	0.03	0.698
Comorbidity Index Score	0.251	0.047	0.147	0.000
Complications	0.517	0.498	0.028	0.300
Treatment	-1.202	0.535	-0.064	0.025
Intensive Care Unit	1.468	0.351	0.115	0.000
Emergency Room	-0.953	0.285	-0.096	0.001

Hierarchical multiple regression analysis for hospital length of stay by prostate cancer patients in Group F (n=582)

Hospital Group F				
1. Predisposing Factors				
	B	SE	Beta	Sig.
(Constant)	-34.246	148.367		0.818
Age	0.017	0.029	0.024	0.556
Genetic Factors	-1.938	0.811	-0.099	0.017
Household Income	0.001	0.002	0.088	0.799
Poverty	1.286	3.571	0.126	0.719
Race/Ethnicity - % Hispanic	-0.084	0.556	-0.014	0.879
Race/Ethnicity - % White	-0.172	0.123	-0.070	0.163
2. Predisposing and Enabling Factors				
	B	SE	Beta	Sig.
(Constant)	-36.262	145.267		0.803
Age	0.014	0.029	0.019	0.637
Genetic Factors	-2.012	0.794	-0.103	0.012
Household Income	0.001	0.002	0.086	0.800
Poverty	1.303	3.497	0.128	0.709
Race/Ethnicity - % Hispanic	-0.032	0.545	-0.005	0.953
Race/Ethnicity - % White	-0.193	0.121	-0.079	0.110
Cost	0.002	0.000	0.206	0.000
3. Predisposing, Enabling and Need Factors				
	B	SE	Beta	Sig.
(Constant)	10.278	143.012		0.943
Age	0.031	0.029	0.043	0.293
Genetic Factors	-1.548	0.787	-0.079	0.050
Household Income	0	0.002	-0.033	0.920

	B	SE	Beta	Sig.
Poverty	0.172	3.442	0.017	0.960
Race/Ethnicity - % Hispanic	0.136	0.536	0.022	0.800
Race/Ethnicity - % White	-0.177	0.119	-0.072	0.136
Cost	0.002	0	0.216	0.000
Comorbidity Index Score	0.346	0.079	0.178	0.000
Complications	0.24	0.848	0.011	0.777
Treatment	-0.579	0.762	-0.031	0.447
Intensive Care Unit	1.034	0.522	0.081	0.048
4. Predisposing, Enabling and Need Factors, and Emergency Room Use				
	B	SE	Beta	Sig.
(Constant)	42.485	142.606		0.766
Age	0.045	0.029	0.063	0.128
Genetic Factors	-1.391	0.784	-0.071	0.077
Household Income	-0.001	0.002	-0.112	0.737
Poverty	-0.639	3.434	-0.063	0.852
Race/Ethnicity - % Hispanic	0.245	0.534	0.04	0.647
Race/Ethnicity - % White	-0.142	0.119	-0.058	0.232
Cost	0.002	0	0.215	0.000
Comorbidity Index Score	0.372	0.079	0.192	0.000
Complications	0.167	0.843	0.008	0.843
Treatment	-1.099	0.78	-0.059	0.159
Intensive Care Unit	1.154	0.521	0.09	0.027
Emergency Room	-1.334	0.473	-0.119	0.005

Hierarchical multiple regression analysis for hospital length of stay by prostate cancer patients in Group G (n=1001)

Hospital Group G				
1. Predisposing Factors				
	B	SE	Beta	Sig.
(Constant)	-5.806	7.214		0.421
Age	0.032	0.023	0.043	0.171
Genetic Factors	-1.116	0.622	-0.057	0.073
Average Household Income	0.000	0.000	0.116	0.329
Medicaid Eligible	0.027	0.057	0.028	0.636
Population Age 65+	-0.120	0.103	-0.045	0.245
Poverty	0.031	0.123	0.026	0.802
Uninsured Population	0.212	0.080	0.152	0.008
Race/Ethnicity - % Black/AA	0.003	0.032	0.006	0.928
Race/Ethnicity - % Hispanic	-0.007	0.027	-0.015	0.781
Race/Ethnicity - % White	0.044	0.035	0.093	0.213
2. Predisposing and Enabling Factors				
	B	SE	Beta	Sig.

	B	SE	Beta	Sig.
(Constant)	-1.807	8.458		0.831
Age	0.035	0.023	0.048	0.118
Genetic Factors	-1.004	0.606	-0.051	0.098
Household Income	0.000	0.000	0.177	0.203
Medicaid Eligible	0.020	0.063	0.021	0.751
Population Age 65+	-0.124	0.104	-0.047	0.237
Poverty	0.169	0.156	0.143	0.280
Uninsured Population	0.286	0.091	0.205	0.002
Race/Ethnicity - % Black/AA	-0.084	0.038	-0.183	0.028
Race/Ethnicity - % Hispanic	-0.091	0.039	-0.184	0.019
Race/Ethnicity - % White	-0.022	0.040	-0.045	0.591
Cost	0.002	0.000	0.203	0.000
Access to Physicians	-0.014	0.014	-0.045	0.319
Rural/Urban	-0.079	0.296	-0.016	0.789
Geographic Region	-0.861	0.231	-0.174	0.000
3. Predisposing, Enabling and Need Factors				
	B	SE	Beta	Sig.
(Constant)	-5.64	8.182		0.491
Age	0.044	0.022	0.06	0.044
Genetic Factors	-0.682	0.586	-0.035	0.245
Household Income	0	0	0.187	0.164
Medicaid Eligible	-0.008	0.061	-0.008	0.893
Population Age 65+	-0.095	0.101	-0.036	0.347
Poverty	0.215	0.151	0.183	0.154
Uninsured Population	0.263	0.088	0.189	0.003
Race/Ethnicity - % Black/AA	-0.069	0.037	-0.149	0.064
Race/Ethnicity - % Hispanic	-0.084	0.037	-0.172	0.024
Race/Ethnicity - % White	-0.017	0.039	-0.037	0.654
Cost	0.002	0	0.226	0.000
Access to Physicians	-0.018	0.014	-0.059	0.177
Rural/Urban	-0.123	0.286	-0.024	0.667
Geographic Region	-0.756	0.225	-0.153	0.001
Comorbidity Index Score	0.399	0.063	0.191	0.000
Complications	-0.676	0.622	-0.033	0.278
Treatment	0.636	0.655	0.029	0.332
Intensive Care Unit	2.328	0.409	0.172	0.000
4. Predisposing, Enabling and Need Factors, and Emergency Room Use				
	B	SE	Beta	Sig.
(Constant)	-5.321	8.166		0.515
Age	0.04	0.022	0.054	0.072
Genetic Factors	-0.656	0.585	-0.033	0.263
Household Income	0	0	0.183	0.173
Medicaid Eligible	-0.014	0.061	-0.015	0.815
Population Age 65+	-0.099	0.101	-0.037	0.328
Poverty	0.214	0.15	0.182	0.156
Uninsured Population	0.257	0.088	0.185	0.003

Race/Ethnicity - % Black/AA	-0.067	0.037	-0.146	0.071
Race/Ethnicity - % Hispanic	-0.085	0.037	-0.173	0.022
Race/Ethnicity - % White	-0.017	0.039	-0.037	0.652
Cost	0.002	0	0.228	0.000
Access to Physicians	-0.02	0.014	-0.065	0.137
Rural/Urban	-0.107	0.286	-0.021	0.707
Geographic Region	-0.718	0.225	-0.145	0.001
Comorbidity Index Score	0.38	0.063	0.182	0.000
Complications	-0.738	0.621	-0.036	0.235
Treatment	1.014	0.675	0.047	0.133
Intensive Care Unit	2.235	0.411	0.165	0.000
Emergency Room	0.844	0.377	0.071	0.025

APPENDIX F: SUBSET ANALYSIS LOGISTIC REGRESSION RESULTS

Hierarchical logistic regression analysis for emergency room utilization by all prostate cancer patients in subset analysis (n = 555)

All Patients						
1. Predisposing Factors						
	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.047	0.011	0.000	1.048	1.025	1.071
Genetic Factors	-0.283	0.29	0.329	0.753	0.427	1.33
Population Age 65+	-0.144	0.072	0.045	0.866	0.752	0.997
Poverty	0.008	0.023	0.747	1.008	0.962	1.055
Race/Ethnicity - % Black/AA	-0.002	0.026	0.946	0.998	0.948	1.051
Race/Ethnicity - % Hispanic	-0.005	0.009	0.579	0.995	0.977	1.013
Race/Ethnicity - % White	0.007	0.015	0.664	1.007	0.977	1.037
Constant	-2.008	1.452	0.167	0.134		
2. Predisposing and Enabling Factors						
	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.049	0.011	0.000	1.05	1.027	1.074
Genetic Factors	-0.188	0.299	0.528	0.828	0.461	1.487
Population Age 65+	-0.121	0.113	0.284	0.886	0.709	1.106
Poverty	-0.017	0.073	0.813	0.983	0.852	1.134
Race/Ethnicity - % Black/AA	0.001	0.059	0.985	1.001	0.891	1.124
Race/Ethnicity - % Hispanic	-0.007	0.019	0.706	0.993	0.957	1.03
Race/Ethnicity - % White	0.003	0.032	0.930	1.003	0.942	1.068
Cost	0.00	0.00	0.094	1.00	0.999	1.00
Access to Physicians	-0.008	0.018	0.664	0.992	0.957	1.028
Rural/ Urban 1			0.972			
Rural/ Urban 2	0.511	0.681	0.454	1.666	0.438	6.335
Rural/ Urban 3	0.275	0.685	0.689	1.316	0.343	5.042
Rural/ Urban 4	0.052	1.141	0.964	1.053	0.112	9.861
Rural/ Urban 5	-0.066	0.819	0.936	0.936	0.188	4.665
Rural/ Urban 6	-0.584	1.18	0.620	0.558	0.055	5.627
Rural/ Urban 7	-0.463	0.982	0.637	0.629	0.092	4.315
Rural/ Urban 8	-20.363	40192.97	1.000	0.00	0.00	.
Underserved Area - No			0.836			
Underserved Area -All	-0.404	1.552	0.795	0.668	0.032	13.992
Underserved Area - Part	-0.074	1.565	0.962	0.929	0.043	19.956
Geographic Area-E S Central			0.543			
Geographic Area-W S Central	1.497	1.683	0.374	4.47	0.165	120.917
Geographic Area-Mountain	0.372	1.725	0.829	1.45	0.049	42.633
Geographic Area-Pacific	1.025	1.697	0.546	2.786	0.1	77.472
Hospital Size-Small			0.255			
Hospital Size-Medium	0.039	0.275	0.888	1.039	0.607	1.78
Hospital Size-Large	0.471	0.345	0.173	1.602	0.814	3.153

Hospital Type-Government			0.140			
Hospital Type-Non Profit	-0.505	0.256	0.048	0.603	0.366	0.996
Hospital Type-For Profit	-0.276	0.329	0.400	0.759	0.398	1.444
Hospital Cancer Program	-0.018	0.283	0.949	0.982	0.564	1.708
Hospital Resident Training	-0.491	0.449	0.275	0.612	0.254	1.477
Constant	-1.477	4.908	0.764	0.228		

3. Predisposing, Enabling and Need Factors

	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.048	0.013	0.000	1.050	1.023	1.076
Genetic Factors	-0.135	0.329	0.680	0.873	0.458	1.664
Population Age 65+	-0.184	0.12	0.123	0.832	0.658	1.051
Poverty	0.028	0.081	0.725	1.029	0.878	1.205
Race/Ethnicity - % Black/AA	0.007	0.062	0.906	1.007	0.893	1.137
Race/Ethnicity - % Hispanic	-0.011	0.02	0.592	0.989	0.951	1.029
Race/Ethnicity - % White	0.02	0.034	0.563	1.020	0.954	1.09
Cost	0	0	0.856	1.000	1.000	1.000
Access to Physicians	-0.006	0.019	0.766	0.994	0.958	1.032
Rural/ Urban 1			0.957			
Rural/ Urban 2	0.431	0.752	0.566	1.539	0.353	6.712
Rural/ Urban 3	0.285	0.754	0.705	1.330	0.304	5.826
Rural/ Urban 4	-0.052	1.211	0.966	0.950	0.089	10.187
Rural/ Urban 5	-0.28	0.92	0.761	0.756	0.124	4.588
Rural/ Urban 6	-0.589	1.213	0.627	0.555	0.051	5.974
Rural/ Urban 7	-0.72	1.119	0.520	0.487	0.054	4.360
Rural/ Urban 8	-20.931	40192.97	1.000	0.000	0.000	.
Underserved Area - No			0.616			
Underserved Area -All	-0.253	1.553	0.871	0.776	0.037	16.303
Underserved Area - Part	0.373	1.573	0.813	1.452	0.067	31.691
Geographic Area-E S Central			0.467			
Geographic Area-W S Central	1.305	1.73	0.450	3.689	0.124	109.458
Geographic Area-Mountain	0.731	1.782	0.682	2.077	0.063	68.212
Geographic Area-Pacific	1.553	1.751	0.375	4.727	0.153	146.316
Hospital Size-Small			0.176			
Hospital Size-Medium	0.053	0.303	0.862	1.054	0.582	1.91
Hospital Size-Large	0.574	0.375	0.127	1.775	0.85	3.704
Hospital Type-Government			0.047			
Hospital Type-Non Profit	-0.702	0.285	0.014	0.495	0.283	0.866
Hospital Type-For Profit	-0.401	0.368	0.276	0.670	0.326	1.377
Hospital Cancer Program	0.045	0.307	0.884	1.046	0.573	1.907
Hospital Resident Training	-0.462	0.486	0.342	0.630	0.243	1.634
Comorbidity Index Score 2			0.374			
Comorbidity Index Score 3	0.34	0.446	0.446	1.405	0.586	3.371
Comorbidity Index Score 4	0.43	0.353	0.222	1.538	0.770	3.069
Comorbidity Index Score 5	0.681	0.591	0.249	1.977	0.620	6.297
Comorbidity Index Score 6	-0.151	1.477	0.918	0.860	0.048	15.555

Comorbidity Index Score 7	-21.767	40192.97	1.000	0.000	0.000	.
Comorbidity Index Score 8	0.432	0.268	0.108	1.540	0.910	2.605
Comorbidity Index Score 9	0.803	0.569	0.158	2.233	0.732	6.811
Comorbidity Index Score 10	1.067	0.5	0.033	2.906	1.092	7.739
Complications	-0.06	0.35	0.864	0.942	0.474	1.872
Treatment	-3.132	0.502	0.000	0.044	0.016	0.117
Intensive Care Unit	0.02	0.242	0.935	1.020	0.634	1.640
Constant	-3.333	5.151	0.518	0.036		

Hierarchical logistic regression analysis for emergency room utilization by prostate cancer patients in Group A in subset analysis (n = 206)

Emergency Room Subset Group A						
1. Predisposing Factors						
	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.076	0.085	0.373	1.079	0.913	1.275
Genetic Factors	-0.91	0.788	0.248	0.402	0.086	1.886
Population Age 65+	0.002	0.152	0.988	1.002	0.744	1.351
Poverty	0.116	0.08	0.150	1.123	0.959	1.314
Race/Ethnicity - % Black/AA	0.261	0.169	0.123	1.298	0.932	1.806
Race/Ethnicity - % Hispanic	0.014	0.019	0.448	1.014	0.978	1.053
Race/Ethnicity - % White	0.051	0.043	0.238	1.053	0.967	1.146
Constant	-13.216	9.443	0.162	0		
2. Predisposing and Enabling Factors						
	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.097	0.105	0.354	1.102	0.897	1.355
Genetic Factors	-0.944	0.945	0.318	0.389	0.061	2.479
Population Age 65+	-13.711	3744.722	0.997	0.00	0.00	.
Poverty	15.113	1970.433	0.994	3661154.987	0.00	.
Race/Ethnicity - % Black/AA	31.325	3760.155	0.993	4.01879E+13	0.00	.
Race/Ethnicity - % Hispanic	-0.759	338.08	0.998	0.468	0.00	2.79E+287
Race/Ethnicity - % White	9.371	1297.91	0.994	11737.722	0.00	.
Cost	-0.002	0.001	0.021	0.998	0.997	1.00
Access to Physicians	-2.595	613.821	0.997	0.075	0	.
Rural/ Urban 1			1.000			
Rural/ Urban 2	-114.67	15388.092	0.994	0.00	0.00	.
Rural/ Urban 3	-84.73	13574.242	0.995	0.00	0.00	.
Rural/ Urban 4	-91.22	24445.615	0.997	0.00	0.00	.

Rural/ Urban 5	-49.459	6800.114	0.994	0.00	0.00	.
Rural/ Urban 6	12.24	30099.12	1.000	206867.234	0.00	.
Rural/ Urban 7	225.722	50497.53	0.996	1.07E+98	0.00	.
Underserved Area - No	63.012	8808.757	0.994	2.32122E+27	0.00	.
Geographic Area-E S Central			1.000			
Geographic Area-W S Central	230.875	144110.367	0.999	1.85E+100	0.00	.
Geographic Area-Mountain	589.519	155726.251	0.997	1.06E+256	0.00	.
Geographic Area-Pacific	478.452	147888.143	0.997	6.15E+207	0.00	.
Hospital Size-Small			0.181			
Hospital Size-Medium	0.125	0.77	0.871	1.134	0.251	5.128
Hospital Size-Large	1.794	1.211	0.138	6.016	0.56	64.608
Hospital Type-Government			0.106			
Hospital Type-Non Profit	-1.742	0.83	0.036	0.175	0.034	0.891
Hospital Type-For Profit	-0.861	0.911	0.345	0.423	0.071	2.521
Hospital Cancer Program	-0.608	0.856	0.477	0.544	0.102	2.913
Hospital Resident Training	17.645	3055.407	0.995	46025655.52	0.00	.
Constant	-1125.045	200654.291	0.996	0		

3. Predisposing, Enabling and Need Factors

	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.002	0.038	0.959	1.002	0.93	1.08
Genetic Factors	-0.414	0.577	0.473	0.661	0.213	2.048
Population Age 65+	0.087	0.257	0.736	1.09	0.659	1.805
Poverty	0.194	0.271	0.474	1.214	0.714	2.064
Race/Ethnicity - % Black/AA	0.68	0.631	0.281	1.974	0.573	6.8
Race/Ethnicity - % Hispanic	0.013	0.061	0.832	1.013	0.899	1.142
Race/Ethnicity - % White	0.155	0.195	0.427	1.167	0.797	1.71
Cost	0.000	0.000	0.904	1.000	0.999	1.001
Access to Physicians	-0.072	0.058	0.215	0.93	0.83	1.043
Rural/ Urban 1			0.92			
Rural/ Urban 2	-0.302	1.621	0.852	0.739	0.031	17.724
Rural/ Urban 3	-1.653	1.912	0.387	0.191	0.005	8.120
Rural/ Urban 4	-2.349	2.782	0.398	0.095	0.000	22.273
Rural/ Urban 5	1.696	1.55	0.274	5.452	0.261	113.78
Rural/ Urban 6	-2.076	2.684	0.439	0.125	0.001	24.184
Rural/ Urban 7	-21.694	24776.67	0.999	0.000	0.000	.
Underserved Area - No			0.519			
Geographic Area-E S Central			0.369			
Geographic Area-W S Central						
Geographic Area-Mountain	-30.78	40192.97	0.999	0.000	0.000	.
Geographic Area-Pacific	-1.904	1.349	0.158	0.149	0.011	2.095
Hospital Size-Small			0.59			
Hospital Size-Medium	0.244	0.605	0.687	1.276	0.390	4.173
Hospital Size-Large	0.657	0.692	0.343	1.929	0.496	7.491

Hospital Type-Government			0.555			
Hospital Type-Non Profit	-0.552	0.523	0.291	0.576	0.206	1.606
Hospital Type-For Profit	-0.613	0.755	0.416	0.542	0.123	2.377
Hospital Cancer Program	0.365	0.561	0.516	1.440	0.479	4.327
Hospital Resident Training	-0.389	0.875	0.656	0.678	0.122	3.763
Comorbidity Index Score 2			0.572			
Comorbidity Index Score 3	0.041	0.619	0.947	1.042	0.310	3.501
Comorbidity Index Score 4	-0.964	0.734	0.189	0.382	0.091	1.608
Comorbidity Index Score 5	0.523	1.01	0.605	1.687	0.233	12.226
Comorbidity Index Score 6	-21.41	40192.97	1	0.000	0.000	.
Comorbidity Index Score 8	0.063	0.438	0.885	1.065	0.451	2.515
Comorbidity Index Score 9	0.043	0.993	0.965	1.044	0.149	7.314
Comorbidity Index Score 10	1.227	0.714	0.086	3.411	0.842	13.819
Complications	0.176	0.498	0.724	1.192	0.449	3.164
Treatment	-3.199	0.807	0	0.041	0.008	0.198
Intensive Care Unit	0.031	0.421	0.941	1.032	0.452	2.354
Constant	-25.262	32.898	0.443	0.000		

Hierarchical logistic regression analysis for emergency room utilization by prostate cancer patients in Group B in subset analysis (n = 238)

Emergency Room Subset Group B						
1. Predisposing Factors						
	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.098	0.049	0.046	1.103	1.002	1.215
Genetic Factors	0.018	0.433	0.967	1.018	0.435	2.38
Population Age 65+	-0.161	0.119	0.174	0.851	0.675	1.074
Poverty	0.057	0.039	0.143	1.059	0.981	1.142
Race/Ethnicity - % Black/AA	-0.034	0.041	0.406	0.967	0.892	1.047
Race/Ethnicity - % Hispanic	-0.028	0.016	0.087	0.973	0.943	1.004
Race/Ethnicity - % White	-0.007	0.027	0.788	0.993	0.942	1.046
Constant	-5.088	4.387	0.246	0.006		
2. Predisposing and Enabling Factors						
	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.109	0.053	0.041	1.115	1.005	1.237
Genetic Factors	0.203	0.475	0.670	1.225	0.483	3.107
Population Age 65+	-0.357	0.258	0.167	0.7	0.422	1.161
Poverty	-0.068	0.211	0.748	0.934	0.618	1.413
Race/Ethnicity - % Black/AA	0.207	0.439	0.637	1.23	0.521	2.906

Race/Ethnicity - % Hispanic	-0.007	0.044	0.868	0.993	0.911	1.082
Race/Ethnicity - % White	0.08	0.13	0.536	1.084	0.84	1.397
Cost	0.00	0.00	0.361	1.00	0.999	1.00
Access to Physicians	0.015	0.03	0.614	1.015	0.957	1.078
Rural/ Urban 1			0.950			
Rural/ Urban 2	1.619	1.606	0.313	5.05	0.217	117.51
Rural/ Urban 3	1.156	1.453	0.427	3.176	0.184	54.821
Rural/ Urban 4	23.067	40192.97	1.000	1041535597	0.00	.
Rural/ Urban 5	-0.564	1.457	0.699	0.569	0.033	9.899
Rural/ Urban 6	0.232	2.162	0.915	1.261	0.018	87.224
Rural/ Urban 7	0.327	1.717	0.849	1.386	0.048	40.127
Underserved Area - No			0.947			
Underserved Area -All	-2.847	56842.541	1.000	0.058	0.00	.
Underserved Area - Part	-3.33	56842.541	1.000	0.036	0.00	.
Geographic Area-E S Central			1.000			
Geographic Area-W S Central	45.537	46229.393	0.999	5.97403E+19	0.00	.
Geographic Area-Mountain	29.32	22839.878	0.999	5.4152E+12	0.00	.
Geographic Area-Pacific	29.365	22839.878	0.999	5.66478E+12	0.00	.
Hospital Size-Small			0.454			
Hospital Size-Medium	0.217	0.447	0.627	1.242	0.517	2.983
Hospital Size-Large	0.695	0.587	0.236	2.004	0.635	6.331
Hospital Type-Government			0.219			
Hospital Type-Non Profit	-0.624	0.434	0.151	0.536	0.229	1.255
Hospital Type-For Profit	0.072	0.511	0.888	1.074	0.395	2.925
Hospital Cancer Program	-0.136	0.443	0.759	0.873	0.366	2.081
Hospital Resident Training	-1.269	0.747	0.089	0.281	0.065	1.214
Constant	-36.459	61259.267	1.000	0.00		

3. Predisposing, Enabling and Need Factors

	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.097	0.063	0.124	1.102	0.974	1.246
Genetic Factors	0.537	0.589	0.362	1.711	0.539	5.431
Population Age 65+	-0.568	0.312	0.068	0.566	0.307	1.043
Poverty	0.009	0.29	0.977	1.009	0.571	1.78
Race/Ethnicity - % Black/AA	0.189	0.575	0.743	1.208	0.391	3.731
Race/Ethnicity - % Hispanic	0.001	0.054	0.98	1.001	0.902	1.112
Race/Ethnicity - % White	0.120	0.178	0.499	1.128	0.796	1.597
Cost	0.000	0.000	0.655	1.000	0.999	1.000
Access to Physicians	0.038	0.037	0.31	1.038	0.965	1.117
Rural/ Urban 1			0.963			
Rural/ Urban 2	1.229	2.059	0.551	3.417	0.06	193.234
Rural/ Urban 3	1.068	1.827	0.559	2.909	0.081	104.415
Rural/ Urban 4	23.471	40192.97	1	1.6E+10	0	.
Rural/ Urban 5	-1.389	1.921	0.47	0.249	0.006	10.773
Rural/ Urban 6	1.245	2.418	0.607	3.473	0.03	397.388
Rural/ Urban 7	-0.014	2.318	0.995	0.986	0.01	92.64

	B	S.E.	Sig.	OR	Lower	Upper
Underserved Area - No			0.989			
Underserved Area -All	-3.263	56841.76	1	0.038	0.000	.
Underserved Area - Part	-2.967	56841.76	1	0.051	0.000	.
Geographic Area-E S Central			0.977			
Geographic Area-W S Central	45.239	46352.12	0.999	4.4E+19	0.000	.
Geographic Area-Mountain	29.158	23086.97	0.999	4.6E+12	0.000	.
Geographic Area-Pacific	28.361	23086.97	0.999	2.1E+12	0.000	.
Hospital Size-Small			0.272			
Hospital Size-Medium	0.465	0.541	0.39	1.592	0.552	4.598
Hospital Size-Large	1.112	0.702	0.113	3.04	0.769	12.027
Hospital Type-Government			0.102			
Hospital Type-Non Profit	-1.042	0.513	0.042	0.353	0.129	0.964
Hospital Type-For Profit	-0.271	0.602	0.653	0.763	0.234	2.484
Hospital Cancer Program	-0.301	0.517	0.56	0.74	0.268	2.039
Hospital Resident Training	-0.906	0.84	0.281	0.404	0.078	2.095
Comorbidity Index Score 2			0.733			
Comorbidity Index Score 3	1.287	1.066	0.227	3.623	0.449	29.253
Comorbidity Index Score 4	1.091	0.63	0.083	2.976	0.866	10.229
Comorbidity Index Score 5	20.999	21607.38	0.999	1.3E+09	0	.
Comorbidity Index Score 6	21.788	40192.97	1	2.9E+09	0	.
Comorbidity Index Score 8	0.272	0.451	0.547	1.312	0.542	3.174
Comorbidity Index Score 9	0.205	0.838	0.807	1.227	0.237	6.345
Comorbidity Index Score 10	0.612	0.763	0.422	1.845	0.414	8.223
Complications	-0.337	0.679	0.620	0.714	0.189	2.705
Treatment	-22.239	7461.696	0.998	0.000	0.000	.
Intensive Care Unit	0.147	0.415	0.724	1.158	0.513	2.611
Constant	-37.059	61351.737	1.000	0.000		

Hierarchical logistic regression analysis for emergency room utilization by prostate cancer patients in Group C in subset analysis (n = 112)

Emergency Room Subset Group C						
1. Predisposing Factors						
	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	-0.01	0.032	0.750	0.99	0.931	1.053
Genetic Factors	-0.359	0.476	0.451	0.699	0.275	1.776
Population Age 65+	-0.152	0.13	0.244	0.859	0.666	1.109
Poverty	-0.039	0.043	0.360	0.962	0.885	1.046
Race/Ethnicity - % Black/AA	-0.034	0.063	0.582	0.966	0.855	1.092
Race/Ethnicity - % Hispanic	-0.002	0.015	0.906	0.998	0.968	1.029
Race/Ethnicity - % White	-0.004	0.028	0.882	0.996	0.942	1.053

	B	S.E.	Sig.	OR	95% CI for OR	
Constant	3.6	3.097	0.245	36.596		

2. Predisposing and Enabling Factors

	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	-0.005	0.035	0.884	0.995	0.929	1.065
Genetic Factors	-0.39	0.523	0.456	0.677	0.243	1.888
Population Age 65+	0.098	0.247	0.692	1.103	0.68	1.789
Poverty	0.065	0.242	0.789	1.067	0.664	1.713
Race/Ethnicity - % Black/AA	0.284	0.579	0.624	1.328	0.427	4.133
Race/Ethnicity - % Hispanic	0.009	0.057	0.876	1.009	0.902	1.129
Race/Ethnicity - % White	0.041	0.18	0.819	1.042	0.732	1.484
Cost	0.00	0.00	0.188	1.00	0.999	1.00
Access to Physicians	-0.047	0.054	0.386	0.954	0.857	1.061
Rural/ Urban 1			0.906			
Rural/ Urban 2	-0.054	1.427	0.970	0.948	0.058	15.531
Rural/ Urban 3	-0.959	1.747	0.583	0.383	0.012	11.767
Rural/ Urban 4	-0.785	2.563	0.759	0.456	0.003	69.227
Rural/ Urban 5	2.00	1.448	0.167	7.387	0.432	126.206
Rural/ Urban 6	-1.627	2.54	0.522	0.197	0.001	28.531
Rural/ Urban 7	-20.949	28319.02	0.999	0.00	0.00	.
Rural/ Urban 8	-28.739	40192.97	0.999	0.00	0.00	.
Underserved Area - No			0.640			
Underserved Area -All	3.533	10.455	0.735	34.231	0.00	271301398
Underserved Area - Part	4.868	11.6	0.675	130.076	0.00	9.72684E+1
Geographic Area-E S Central			0.841			
Geographic Area-W S Central	-26.653	40192.97	0.999	0.00	0.00	.
Geographic Area-Pacific	-0.704	1.198	0.557	0.494	0.047	5.176
Hospital Size-Small			0.724			
Hospital Size-Medium	-0.031	0.509	0.951	0.969	0.358	2.626
Hospital Size-Large	0.323	0.588	0.583	1.382	0.436	4.379
Hospital Type-Government			0.729			
Hospital Type-Non Profit	-0.201	0.441	0.648	0.818	0.345	1.94
Hospital Type-For Profit	-0.494	0.623	0.428	0.61	0.18	2.072
Hospital Cancer Program	0.448	0.488	0.358	1.565	0.602	4.074
Hospital Resident Training	-0.209	0.806	0.795	0.811	0.167	3.939
Constant	-6.957	30.25	0.818	0.001		

3. Predisposing, Enabling and Need Factors

	B	S.E.	Sig.	OR	95% CI for OR	
					Lower	Upper
Age	0.157	0.129	0.225	1.17	0.908	1.507
Genetic Factors	-0.883	1.09	0.418	0.414	0.049	3.505
Population Age 65+	-14.539	3867.844	0.997	0.000	0.000	.
Poverty	15.163	2048.802	0.994	3846676.88	0.000	.
Race/Ethnicity - % Black/AA	31.415	3902.396	0.994	4.3999E+13	0.000	.
Race/Ethnicity - % Hispanic	-0.727	350.063	0.998	0.483	0.000	5.E+297
Race/Ethnicity - % White	9.521	1341.597	0.994	13643.8	0.000	.

Cost	-0.001	0.001	0.166	0.999	0.997	1.001
Access to Physicians	-2.492	637.669	0.997	0.083	0.000	.
Rural/ Urban 1			1.000			
Rural/ Urban 2	-114.286	15983.12	0.994	0.000	0.000	.
Rural/ Urban 3	-81.991	14154.48	0.995	0.000	0.000	.
Rural/ Urban 4	-85.336	25452.51	0.997	0.000	0.000	.
Rural/ Urban 5	-51.885	7040.902	0.994	0.000	0.000	.
Rural/ Urban 6	18.593	31193.19	1.000	118846630	0.000	.
Rural/ Urban 7	228.494	51136.8	0.996	1.71E+99	0.000	.
Rural/ Urban 8						
Underserved Area - No	62.303	9172.969	0.995	1.1424E+27	0.000	.
Underserved Area -All						
Underserved Area - Part						
Geographic Area-E S Central			1.000			
Geographic Area-W S Central	232.332	118347.8	0.998	7.95E+100	0.000	.
Geographic Area-Pacific	596.384	133570.9	0.996	1.02E+259	0.000	.
Hospital Size-Small	480.865	123768.6	0.997	6.87E+208	0.000	.
Hospital Size-Medium			0.167			
Hospital Size-Large	0.33	0.948	0.728	1.391	0.217	8.912
Hospital Type-Government	2.254	1.446	0.119	9.525	0.56	162.015
Hospital Type-Non Profit			0.114			
Hospital Type-For Profit	-2.157	1.037	0.038	0.116	0.015	0.884
Hospital Cancer Program	-0.924	1.022	0.366	0.397	0.054	2.939
Hospital Resident Training	-0.067	0.935	0.942	0.935	0.150	5.837
Comorbidity Index Score 2	16.99	3185.209	0.996	23913395.6	0.000	.
Comorbidity Index Score 3			0.966			
Comorbidity Index Score 4	0.019	1.54	0.990	1.019	0.05	20.843
Comorbidity Index Score 5	1.378	1.205	0.253	3.967	0.374	42.106
Comorbidity Index Score 6	-0.159	1.077	0.883	0.853	0.103	7.037
Comorbidity Index Score 8	-18.4	40192.97	1.000	0.000	0.000	.
Comorbidity Index Score 9	0.796	0.988	0.420	2.217	0.32	15.374
Comorbidity Index Score 10	17.286	40192.97	1.000	32158943	0.000	.
Complications	0.33	1.89	0.861	1.391	0.034	56.516
Treatment	-3.298	1.499	0.028	0.037	0.002	0.698
Intensive Care Unit	0.211	0.847	0.804	1.235	0.235	6.499
Constant	-1142.71	187269.2	0.995	0.000		

APPENDIX G: SUBSET ANALYSIS MULTIPLE REGRESSION RESULTS

Hierarchical multiple regression analysis for hospital length of stay by all prostate cancer patients in subset analysis (n=555)

All Patients				
1. Predisposing Factors				
	B	SE	Beta	Sig.
(Constant)	-0.344	3.245		0.916
Age	0.010	0.024	0.018	0.670
Genetic Factors	-1.358	0.656	-0.087	0.039
Population Age 65+	0.099	0.155	0.049	0.522
Poverty	-0.026	0.052	-0.025	0.614
Race/Ethnicity - % Black/AA	0.104	0.059	0.107	0.081
Race/Ethnicity - % Hispanic	0.056	0.020	0.191	0.006
Race/Ethnicity - % White	0.013	0.033	0.034	0.703
2. Predisposing and Enabling Factors				
	B	SE	Beta	Sig.
(Constant)	-0.359	10.560		0.973
Age	0.007	0.024	0.012	0.778
Genetic Factors	-1.431	0.654	-0.092	0.029
Population Age 65+	0.058	0.166	0.029	0.725
Poverty	-0.056	0.074	-0.054	0.451
Race/Ethnicity - % Black/AA	0.137	0.093	0.142	0.138
Race/Ethnicity - % Hispanic	-0.024	0.034	-0.083	0.474
Race/Ethnicity - % White	-0.020	0.045	-0.051	0.663
Cost	-0.001	0.000	-0.055	0.195
Access to Physician	-0.052	0.027	-0.181	0.055
Rural/Urban	-0.358	0.263	-0.107	0.173
Underserved Area	-1.681	0.793	-0.154	0.034
Geographic Region	1.268	0.869	0.117	0.145
Hospital Size	1.052	0.362	0.192	0.004
Hospital Type	-0.128	0.329	-0.017	0.699
Hospital Cancer Program	-1.366	0.614	-0.143	0.026
Hospital Resident Training	0.638	0.961	0.030	0.507
3. Predisposing, Enabling and Need Factors				
	B	SE	Beta	Sig.
(Constant)	-2.794	10.512		0.79
Age	0.007	0.025	0.012	0.778
Genetic Factors	-1.372	0.649	-0.088	0.035
Population Age 65+	0.085	0.165	0.042	0.608
Poverty	-0.028	0.075	-0.027	0.706
Race/Ethnicity - % Black/AA	0.135	0.092	0.139	0.143
Race/Ethnicity - % Hispanic	-0.025	0.034	-0.085	0.464
Race/Ethnicity - % White	-0.014	0.044	-0.037	0.754
Cost	0.000	0.000	-0.027	0.522
Access to Physician	-0.053	0.027	-0.185	0.047

	B	SE	Beta	Sig.
Rural/Urban	-0.420	0.261	-0.125	0.108
Underserved Area	-1.407	0.795	-0.129	0.077
Geographic Region	1.313	0.863	0.121	0.129
Hospital Size	0.998	0.360	0.182	0.006
Hospital Type	-0.054	0.332	-0.007	0.872
Hospital Cancer Program	-1.330	0.609	-0.139	0.029
Hospital Resident Training	0.587	0.955	0.028	0.539
Comorbidity Index Score	0.154	0.071	0.093	0.031
Complications	0.483	0.688	0.03	0.483
Treatment	-1.530	0.625	-0.107	0.015
Intensive Care Unit	0.401	0.501	0.034	0.424

4. Predisposing, Enabling and Need Factors, and Emergency Room Use

	B	SE	Beta	Sig.
(Constant)	-4.626	10.466		0.659
Age	0.018	0.025	0.031	0.473
Genetic Factors	-1.424	0.645	-0.092	0.028
Population Age 65+	0.056	0.165	0.027	0.735
Poverty	-0.010	0.075	-0.01	0.891
Race/Ethnicity - % Black/AA	0.143	0.091	0.148	0.117
Race/Ethnicity - % Hispanic	-0.027	0.034	-0.094	0.419
Race/Ethnicity - % White	-0.007	0.044	-0.018	0.878
Cost	0.000	0.000	-0.028	0.507
Access to Physician	-0.055	0.027	-0.194	0.037
Rural/Urban	-0.469	0.260	-0.14	0.072
Underserved Area	-1.237	0.793	-0.113	0.119
Geographic Region	1.467	0.859	0.135	0.088
Hospital Size	1.044	0.358	0.19	0.004
Hospital Type	-0.111	0.330	-0.015	0.736
Hospital Cancer Program	-1.356	0.605	-0.141	0.026
Hospital Resident Training	0.504	0.949	0.024	0.596
Comorbidity Index Score	0.176	0.071	0.107	0.014
Complications	0.478	0.684	0.03	0.485
Treatment	-2.142	0.658	-0.149	0.001
Intensive Care Unit	0.405	0.498	0.035	0.417
Emergency Room	-1.206	0.430	-0.128	0.005

Hierarchical multiple regression analysis for hospital length of stay by all prostate cancer patients in Group A in subset analysis (n=205)

Hospital Subset Group A				
1. Predisposing Factors				
	B	SE	Beta	Sig.
(Constant)	1.975	4.064		0.627
Age	-0.002	0.029	-0.005	0.948
Genetic Factors	-1.327	0.791	-0.119	0.095
Population Age 65+	0.040	0.137	0.032	0.771
Poverty	-0.038	0.062	-0.050	0.545
Race/Ethnicity - % Black/AA	0.089	0.050	0.192	0.076
Race/Ethnicity - % Hispanic	0.016	0.057	0.029	0.785
Race/Ethnicity - % White	0.018	0.030	0.091	0.542
2. Predisposing and Enabling Factors				
	B	SE	Beta	Sig.
(Constant)	2.918	9.358		0.756
Age	0.005	0.028	0.012	0.862
Genetic Factors	-1.210	0.753	-0.109	0.110
Population Age 65+	-0.016	0.143	-0.013	0.911
Poverty	-0.210	0.100	-0.275	0.037
Race/Ethnicity - % Black/AA	0.184	0.076	0.398	0.016
Race/Ethnicity - % Hispanic	-0.116	0.067	-0.220	0.083
Race/Ethnicity - % White	-0.059	0.038	-0.294	0.126
Cost	-0.001	0.001	-0.084	0.215
Access to Physician	-0.077	0.025	-0.415	0.003
Rural/Urban	-0.440	0.235	-0.242	0.063
Underserved Area	-3.652	1.113	-0.553	0.001
Geographic Region	2.326	0.752	0.445	0.002
Hospital Size	1.352	0.492	0.333	0.007
Hospital Type	-0.520	0.401	-0.094	0.196
Hospital Cancer Program	-0.605	0.864	-0.084	0.485
Hospital Resident Training	0.261	0.881	0.023	0.767
3. Predisposing, Enabling and Need Factors				
	B	SE	Beta	Sig.
(Constant)	0.004	9.219		1
Age	-0.009	0.028	-0.023	0.741
Genetic Factors	-1.283	0.738	-0.115	0.084
Population Age 65+	0.005	0.141	0.004	0.974
Poverty	-0.171	0.099	-0.224	0.086
Race/Ethnicity - % Black/AA	0.194	0.075	0.418	0.01
Race/Ethnicity - % Hispanic	-0.105	0.066	-0.198	0.116
Race/Ethnicity - % White	-0.050	0.038	-0.249	0.187
Cost	0.000	0.001	-0.033	0.634
Access to Physician	-0.080	0.025	-0.429	0.002

	B	SE	Beta	Sig.
Rural/Urban	-0.507	0.233	-0.279	0.031
Underserved Area	-3.509	1.120	-0.531	0.002
Geographic Region	2.511	0.747	0.48	0.001
Hospital Size	1.518	0.491	0.374	0.002
Hospital Type	-0.353	0.396	-0.064	0.374
Hospital Cancer Program	-0.941	0.851	-0.131	0.271
Hospital Resident Training	0.406	0.872	0.036	0.642
Comorbidity Index Score	0.057	0.090	0.044	0.525
Complications	0.025	0.792	0.002	0.975
Treatment	-2.309	0.723	-0.222	0.002
Intensive Care Unit	0.549	0.629	0.059	0.384

4. Predisposing, Enabling and Need Factors, and Emergency Room Use

	B	SE	Beta	Sig.
(Constant)	-0.778	9.223		0.933
Age	-0.005	0.028	-0.013	0.852
Genetic Factors	-1.377	0.741	-0.124	0.065
Population Age 65+	-0.003	0.141	-0.002	0.983
Poverty	-0.165	0.099	-0.217	0.096
Race/Ethnicity - % Black/AA	0.198	0.075	0.427	0.009
Race/Ethnicity - % Hispanic	-0.104	0.066	-0.197	0.117
Race/Ethnicity - % White	-0.046	0.038	-0.231	0.221
Cost	0.000	0.001	-0.034	0.618
Access to Physician	-0.080	0.025	-0.432	0.001
Rural/Urban	-0.538	0.234	-0.295	0.023
Underserved Area	-3.444	1.119	-0.521	0.002
Geographic Region	2.576	0.747	0.492	0.001
Hospital Size	1.539	0.490	0.379	0.002
Hospital Type	-0.354	0.395	-0.064	0.372
Hospital Cancer Program	-0.997	0.851	-0.139	0.243
Hospital Resident Training	0.342	0.872	0.03	0.696
Comorbidity Index Score	0.078	0.091	0.06	0.393
Complications	0.071	0.792	0.006	0.929
Treatment	-2.693	0.781	-0.259	0.001
Intensive Care Unit	0.513	0.628	0.055	0.415
Emergency Room	-0.672	0.524	-0.095	0.201

Hierarchical multiple regression analysis for hospital length of stay by all prostate cancer patients in Group B in subset analysis (n=350)

Hospital Subset Group B				
1. Predisposing Factors				
	B	SE	Beta	Sig.
(Constant)	-13.461	27.247		0.622
Age	0.011	0.036	0.016	0.769
Genetic Factors	-1.436	0.957	-0.081	0.134
Population Age 65+	0.303	0.441	0.049	0.492
Poverty	0.095	0.202	0.062	0.640
Race/Ethnicity - % Black/AA	0.615	0.847	0.212	0.468
Race/Ethnicity - % Hispanic	0.057	0.072	0.066	0.431
Race/Ethnicity - % White	0.102	0.266	0.080	0.701
2. Predisposing and Enabling Factors				
	B	SE	Beta	Sig.
(Constant)	-21.147	58.286		0.717
Age	0.004	0.036	0.007	0.903
Genetic Factors	-1.437	0.969	-0.081	0.139
Population Age 65+	2.391	1.501	0.388	0.112
Poverty	0.811	0.501	0.529	0.106
Race/Ethnicity - % Black/AA	1.538	1.759	0.532	0.383
Race/Ethnicity - % Hispanic	-0.227	0.299	-0.262	0.447
Race/Ethnicity - % White	0.040	0.422	0.031	0.925
Cost	0.000	0.001	-0.032	0.559
Access to Physician	-0.468	0.389	-1.057	0.230
Rural/Urban	-5.057	5.564	-0.742	0.364
Underserved Area	18.806	15.383	0.194	0.222
Hospital Size	0.734	0.497	0.119	0.141
Hospital Type	0.177	0.490	0.022	0.718
Hospital Cancer Program	-1.735	0.826	-0.163	0.036
Hospital Resident Training	0.211	2.044	0.006	0.918
3. Predisposing, Enabling and Need Factors				
	B	SE	Beta	Sig.
(Constant)	-24.075	58.143		0.679
Age	0.012	0.038	0.019	0.742
Genetic Factors	-1.328	0.973	-0.075	0.173
Population Age 65+	2.488	1.500	0.404	0.098
Poverty	0.862	0.501	0.562	0.086
Race/Ethnicity - % Black/AA	1.601	1.756	0.553	0.363
Race/Ethnicity - % Hispanic	-0.230	0.299	-0.264	0.443
Race/Ethnicity - % White	0.028	0.422	0.022	0.947
Cost	0.000	0.001	-0.01	0.851
Access to Physician	-0.480	0.389	-1.084	0.218
Rural/Urban	-5.085	5.553	-0.746	0.36

	B	SE	Beta	Sig.
Underserved Area	19.148	15.334	0.197	0.213
Hospital Size	0.649	0.502	0.106	0.197
Hospital Type	0.252	0.500	0.03	0.615
Hospital Cancer Program	-1.614	0.827	-0.152	0.052
Hospital Resident Training	0.194	2.043	0.005	0.925
Comorbidity Index Score	0.176	0.100	0.098	0.08
Complications	0.379	1.029	0.021	0.713
Treatment	-0.962	0.930	-0.059	0.302
Intensive Care Unit	0.648	0.714	0.052	0.365

4. Predisposing, Enabling and Need Factors, and Emergency Room Use

	B	SE	Beta	Sig.
(Constant)	-28.197	57.733		0.626
Age	0.029	0.038	0.043	0.451
Genetic Factors	-1.291	0.966	-0.073	0.182
Population Age 65+	2.388	1.490	0.388	0.11
Poverty	0.899	0.498	0.587	0.072
Race/Ethnicity - % Black/AA	1.765	1.744	0.61	0.312
Race/Ethnicity - % Hispanic	-0.215	0.296	-0.248	0.468
Race/Ethnicity - % White	0.065	0.419	0.051	0.876
Cost	0.000	0.001	-0.01	0.851
Access to Physician	-0.470	0.386	-1.062	0.224
Rural/Urban	-4.840	5.513	-0.71	0.381
Underserved Area	18.344	15.223	0.189	0.229
Hospital Size	0.721	0.499	0.117	0.15
Hospital Type	0.149	0.498	0.018	0.766
Hospital Cancer Program	-1.604	0.821	-0.151	0.052
Hospital Resident Training	0.039	2.029	0.001	0.985
Comorbidity Index Score	0.195	0.100	0.109	0.052
Complications	0.291	1.022	0.016	0.776
Treatment	-1.696	0.970	-0.104	0.081
Intensive Care Unit	0.705	0.709	0.056	0.321
Emergency Room	-1.506	0.615	-0.144	0.015

APPENDIX H: IRB APPROVAL

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901, 407-882-2012 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

From : **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To : **Roberta L. McKee**

Date : **July 01, 2016**

Dear Researcher:

On 07/01/2016, the IRB determined that the following proposed activity is not human research as defined by DHHS regulations at 45 CFR 46 or FDA regulations at 21 CFR 50/56:

Type of Review:	Not Human Research Determination
Project Title:	Variations in the Utilization of Health Services by Patients with Prostate Cancer
Investigator:	Roberta L McKee
IRB ID:	SBE-16-12368
Funding Agency:	
Grant Title:	
Research ID:	N/A

University of Central Florida IRB review and approval is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are to be made and there are questions about whether these activities are research involving human subjects, please contact the IRB office to discuss the proposed changes.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Joanne Muratori

Signature applied by Joanne Muratori on 07/01/2016 09:08:30 AM EDT

IRB Manager

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