THE COST OF DYING ON MEDICARE:

AN ANALYSIS OF EXPENDITURE DATA

A Dissertation

by

DONALD REED HOUSE, JR.

Submitted to the Office of Graduate Studies at
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2005

Major Subject: Economics

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Chair of Committee,	Thomas Saving
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ABSTRACT

The Cost of Dying on Medicare:

An Analysis of Expenditure Data. (August 2005)

Donald Reed House, Jr., B.S., Texas A&M University

Chair of Advisory Committee: Dr. Thomas Saving

Roughly one third of Medicare expenditures are made on behalf of beneficiaries in their terminal year, though only five percent of the Medicare-covered population dies annually. Per-capita spending on decedents is as much as six times the level of spending on survivors. The demographic, technological and political trends that will determine the future path of spending on terminal-year beneficiaries have important implications for the fiscal well-being of the Medicare program, and by extension, the American taxpayer. Coming to an understanding of the moving parts that will control the path of the cost of dying on Medicare is vital for careful consideration of Medicare's future, and for any discussions about further reform of the program. Analysis of expenditures in the terminal year must be made while keeping in mind the fact that major expenditures are often made in surviving years. The spike in spending in the terminal period rightly focuses attention to expenditures near death, but also we should proceed in its analysis keeping in mind that it is not the only spell of elevated medical spending for a typical individual. Given those cautions, however, the cost of dying on Medicare stands as an important area of economic inquiry and policy consideration. As total Medicare expenditures top a quarter trillion dollars, the third of that spending which covers treatments in beneficiaries' terminal years ought to be understood more fully than it is currently.

DEDICATION

For my father.

ACKNOWLEDGMENTS

This work would not have been possible without the direction and support of Dr. Thomas R. Saving, though his assistance and support of the author began far before this project was conceived. His leadership was integral to getting me to the point where I could begin the research contained herein, and has been as central in its actual progress. His care and support of me and my family has made our lives significantly better than they could otherwise have been. While I have been far more trouble to him than I am comfortable remembering or acknowledging, it was not from a dearth of respect or a lack of awareness of the contribution that he has made in my life. His patience and ambition for me together made this possible, and I am grateful for both.

I want to thank Dr. Michael E. Workman for his aid, enthusiasm and support. While the topics covered in this thesis are not his normal area, he has been a real asset academically and personally. His willingness to work so closely with me with material out of his traditional element has been kind, generous, and significantly helpful.

Dr. Finis Welch and Dr. Donald Deere gave me the tools and understanding I depended on in this research and their role in its execution has been indispensable. The examples of careful thought and analysis that they have provided me in the classes I took from them set the bar high for what qualifies to me as successful research. Fear of the penetrating questions that I expected from them motivated me to more fully understand my own work than I otherwise would have. Whether or not this work meets the standards I learned from them is not a question I can answer. I am grateful to them both.

Dr. Timothy Gronberg has always been kind and generous to me. One regret I have about the research herein is that I failed to sufficiently seek out the help of Dr. Gronberg. His example as a scholar and his patience and good will convince me that this would have been a better work had I taken better care to involve him more fully in the research. I thank him for his help, support and patience.

Christy Essix, Tyffanne Rowan, and Barbara Fisher deserve and have my deep gratitude. Their aid in getting me through these past few years has been a true kindness to me and to my family.

Finally, I want to thank my family. My father, Dr. Donald R. House, Sr., completed his dissertation in economics at Texas A&M roughly thirty-two years before I am now finishing mine. Without that example, not to mention the incredible support I have been the beneficiary of, I would certainly not be here today. My mother's support has been vital throughout, from believing in me from the beginning to baking refreshments for the defense. Lastly, I want to acknowledge my wife's role in all this. She gave me the reason to start this journey and the strength to see it to the end. In her own way, she worked as hard as I did on this research. In her heart, she believes it's her dissertation too; it is in mine as well.

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CHAPTER I

INTRODUCTION

Roughly one third of annual Medicare expenditures are made on behalf of beneficiaries in their terminal year, though only five percent of the Medicare-covered population dies annually. Per-capita spending on decedents is as much as six times the level of spending on survivors. The demographic, technological and political trends that determine the path of spending on terminal-year beneficiaries have important implications for the fiscal well-being of the Medicare program and, by extension, the American taxpayer. Understanding the parts that will control the path of the costs of dying on Medicare is vital for careful consideration of Medicare's future, and for any discussions on further reform of the program.

Because Medicare covers recipients through death, the program can expect to make expenditures for every enrollee related to his or her death. Given current life expectancies, 92% of all American decedents who die after the age of 65 have some of their death related expenditures covered by the program. Expenditures for beneficiaries in their terminal year stand out as a subject for investigation in part, because there is almost always a significant increase in expenditure at that time. If one averages the expenditure paths of a death-cohort together and examines the mean profile, the sole period of significantly elevated spending occurs at or near death. Death is related to high levels of spending for a death-cohort for the

This dissertation follows the style of the *American Economic Review*.

simple reason that it is the only event where the spending of the entire cohort “stacks.” All other major events in representative individuals’ medical histories are distributed prior to death, and thus average out, losing salience. An unknown, but no doubt significant, portion of intensive medical procedures are done with the expectation that the person will survive and recover. Analysis of expenditures in the terminal year must be made while keeping in mind that major expenditures are often made in surviving years. The spike in spending in the terminal period rightly focuses attention to expenditures near death, but we should proceed in analysis keeping in mind that is not the only spike in typical spending.

Concerns over the cost of dying on Medicare and the quality of end of life care those expenditures secure is not new. Probably the most familiar effort to control costs for beneficiaries in their terminal year was the provision in the Tax Equity and Fiscal Responsibility Act of 1982 for a Medicare hospice benefit. The program was intended to reduce Medicare costs by providing a means for elderly individuals with terminal illnesses to spend their final days receiving palliative care in a lower-cost hospice facility or at home with the aid of home-health personnel. A further discussion of the hospice benefit will come later, but it serves as an illustration of the level of attention drawn by terminal period medical costs.

One aspect of terminal year spending that has conceptual bearing on the economics of terminal period benefits is considering the counterfactual to all but palliative efforts. If one pauses to consider the “but for” scenario if the expenditures were withheld, the outcome would not be expected to be much different. There is a sense in which expenditures around

the time of death that are not purely palliative in nature are wasted, at least ex post, as they obviously failed to extend the life of the beneficiary. This impression fails to consider the uncertainty under which medical care for the elderly is provided. Many of the procedures which necessitate Medicare expenditures are provided in an attempt to extend life, as standard treatments for morbidities not distinctly related to death. Most people who receive expensive care survive (W.A. Knaus, et al.. 1993). It is a different matter to discuss the cost-effectiveness of extending life than it is to address expenditures in the terminal year, and policy makers must tread carefully around these matters. However, there is evidence that Medicare expenditures on end of life care are not being spent in a manner that maximizes beneficiaries' quality of life near death. This paper will address some of that evidence and the history of those concerns.

The cost of dying on Medicare is an important area of economic inquiry and policy consideration. As total Medicare expenditures top a quarter trillion dollars, the third of that which covers treatments in beneficiaries' terminal years should be understood more fully. One must consider the intensive dimensions of Medicare usage in the terminal year, controlled by medical standards, technological advances, increases in health and longevity, and reimbursement policy as well as the extensive dimensions driven primarily by demographic and generational population changes. Demographic changes will steer the solvency of the program but a better handle is needed on the individual experience. This work will focus on the health drivers of terminal period expenditures at the individual level.

Health and death are necessarily related, and an analysis of death which ignores health would be severely limited in its application.

At the level of an individual's experience on Medicare, several factors contribute to shaping the path of their expenditures. A beneficiary's initial health on entering the program and their health habits while on the program will have enormous consequences for their expected Medicare expenditures. Expenditure paths can reasonably be expected to be sensitive to medical technological advances. As technology advances, the standards of care for specific health conditions change. The ability of medical science to allow the elderly to survive into more advanced ages impacts the bottom line of the Medicare program in a number of dimensions, both positively and negatively. A key determinate of the cost of the terminal year of a given beneficiary to Medicare is their age at death. Older people die less expensively, but there are maintenance costs associated with getting a beneficiary to an advanced age. The net effect on expenditure paths is ambiguous. For example, if many more beneficiaries survived into extreme old age death-related expenses would be dramatically reduced as a matter of economic interest. The expenditures related to getting that number of beneficiaries to advanced ages would no doubt attract our attention, however. As medical science pushes forward and people survive to older ages, the consequences for Medicare could be significant.

The dimensions of a typical individual's experience on Medicare that are primarily concerned to this present work are as follows:

- Health at age
- Probability of disease onset at age
- Standard of care at age of disease
- Effectiveness of care toward improving health and extending longevity
- Impact of health on expenditures
- Impact of longevity on expenditures
- “Death experience”
- Impact of alternatives in palliative care on death related expenditures
- Impact of care on quality of life

Outline

The remainder of the current chapter will cover many relevant features of the Medicare program and give an overview of several of the analytical issues investigated in this work.

The second chapter will provide a discussion of the relevant literature. Medicare is politically significant and an economic issue in this country and as such has already attracted a huge amount of analysis. As medical, economic and political situations have changed, different concerns take priority in emphasis, but there seems to be no single dimension of the program or its future not addressed somewhere. As economic and econometric science has advanced, our ability to glean important relationships in the path of Medicare spending has increased. The second chapter will attempt to establish the foundation in the literature on

which the current analysis builds.

Chapter III will present the data used to estimate the empirical models to be discussed in the fourth chapter. It is customary to precede a discussion of the data with an outline of the models, but a reverse order is more appealing in this case. The structure of the models (and the contribution of this work) is, to a great degree, controlled by the data used. Because the data is the star, it gets higher billing.

As mentioned, Chapter IV will contain the empirical models estimated using the data discussed in Chapter III. There are three areas of focus on which the models will seek to provide insight. They are the persistence of Medicare reimbursed expenditures and terminal period expenditures by specific disease under the ICD-9 disease categorization; the impact of utilizing quarterly versus annual data in estimating expenditure persistence; and the relationship between total spending and disease-specific expenditures across disease categories. The results of the models for each disease will be presented and briefly discussed.

The fifth chapter will present a consideration of further steps for the research and the challenges they present.

Issues for Analysis

The specific study of the composition of death-related expenditures made by Medicare on the behalf of individuals for medical services has been fairly limited in the past few years. There was a significant level of interest around the time of the institution of

hospice benefits in 1983, but the focus has moved away from specifically death-related expenditures. As befits analysis that is concerned with the overall viability of the program, most recent work that includes death-related expenditures have as their focus the entire expenditure profile, if not simply the expected total lifetime expenditures, e. g. James D. Lubitz, et al.. (2003). From a policy standpoint, it is the total "bill" the government can expect to receive that is the primary issue. One limitation of studies directed at lifetime expenditures is that they cannot directly incorporate the impact on expenditures from changes in the standards of care for people at various stages of their lives and in specific health circumstances. Strengthening that aspect of analysis, and focusing specifically on the most expensive period of a beneficiaries' career on Medicare is an important goal which this work seeks to further explore. The data available to utilize the investigational approach pursued in this work is limited in time, so the primary goal of this research is to investigate and establish the existent relationships between Medicare beneficiaries' medical expenditures during the period proceeding their terminal quarter and the expenditures related to their death. The first step in developing policies that could contribute to control the cost of dying on Medicare is to establish a way of predicting those costs under the current policy. The question investigated in this work is: To what degree and under what circumstances can Medicare-reimbursed death related expenditures be predicted by a beneficiary's medical experiences while enrolled in the program?

To answer this question, a series of econometric models of varying and generally increasing econometric complexity will be estimated. One goal of the modeling strategy is

to discover the most efficient level at which to model Medicare expenditures to predict death-related expenditures. The models will be estimated using individual data that cover an eight year span of Medicare reimbursement histories, which include specific diagnoses, treatments and levels of expenditure.

One weakness of the data used compared to other studies is that little is known about the individuals other than their medical histories. The self-reported health and ADL and IADL disability levels which make up a large part of the information in related studies are not available here. Their absence constrains the questions that can directly address, but do not limit the achievement of the goal of this work. One consequence in lacking such information is the difficulty it causes in linking this investigation with others that have made use of them. Lubitz, et al.. (2003), for example, exclusively used disability scores as the measure of health state in predicting total Medicare expenditures. With no bridge between that study and this one, it is difficult to single out the cause of disparities in predictions.

Background

> *To die of old age is a death rare, extraordinary, and singular and so much less natural than others. It is the last and extremist kind of dying ... a privilege rarely seen.* - Montaigne, 1575

Death from old age is entirely different in nature and frequency now than it was in the 16th century. Even since the beginning of the last century, life expectancy has gone from 50 years to over 75. The death rate in 1900 was around 1720 per 100,000 population. It was

half that in 1990. Adjusting for age, the death rate has fallen by 63% in the past fifty years. The typical American can now expect to live a long life and die at an advanced age, historically speaking.

The radical changes in life expectancy have, to a large degree, come from medical advances against communicable diseases. In 1900, respiratory, infectious, parasitic, and gastrointestinal diseases and disorders accounted for about 40% of all deaths in the US. Today the number is much lower. For example, tuberculosis caused 11% of all deaths a century ago. Today it represents a fraction of a percent. With fewer deaths from communicable diseases, disorders associated with old age have become more common as causes of death. Heart disease now kills more than three times the rate it did 100 years ago. The implication of medical successes against the killers of prior history is that people are now living to an advanced age. A woman surviving until age 75 can expect almost twelve more years of life, while a man in the same circumstance is expected to live almost ten additional years. The typical decedent, then, is far older than has historically been common. The change in life expectancy has also changed the nature of death. Today, the typical decedent is quite elderly and death frequently comes when they succumb to a chronic illness which they battled for some period prior to death.

The changing nature of death is also evident when one considers where people die. Less than 50 percent of deaths (49.6%) occurred in hospitals or institutions in 1949. U.S. mortality statistics for 1992 indicate that the proportion of people who pass away in hospitals or institutions had risen to 74 percent. The increased rate of death in hospitals as

opposed to death at home reflects the changed nature of death in recent history. In addition, many more people experience disability prior to death. Death comes later and slower than it used to.

A large part of the costs of the typical later, slower deaths in America are borne by the Medicare program. Over 60 percent of all costs of enrolled decedents in their final year are covered by Medicare. A significant portion of Medicare-enrolled decedents are also covered by Medicaid; especially those decedents who spend their final days in a nursing home or other institution. Medicare enrollees who die in the hospital incur roughly twice the costs of those who die at home, and death in a hospital setting is much more typical than in the recent past. Table 1-1 from Marilyn J. Field and Christine K. Cassel (1997) makes clear

TABLE 1.1- A CENTURY OF CHANGE

A Century of Change		
	1900	2000
Life Expectancy	47 years	75 years
Usual place of death	home	hospital
Most medical expenses	paid by family	paid by Medicare
Disability before death	usually not much	2 years on average
Source: Field and Cassel, eds *Approaching Death: Improving Care at the End of Life*, IOM (1997)		

the triumph of modern medicine over many forms of disease has vastly improved the active life expectancy of Americans. In doing so, it has changed the nature of death experienced by the average American.

Many in the medical community are concerned that the American medical society in general and the Medicare program in specific have adopted attitudes and polices which harm the quality of life people experience near death. It is argued that we as a society have been so intent on saving and extending life that we are ill equipped to provide care and support to those people nearing death. Daniel Callahan decried the unwillingness to let nature take its course resulting in a needlessly cruel and entirely impersonal death "in a technologic cocoon." A study of medical professionals indicated that at least half feel they have at some time delivered burdensome and useless medical procedures against their own conscience (M.Z. Solomon et al., 1993). The RAND corporation issued a white paper in 2003 entitled *Living Well at the End of Life: Adapting Heath Care to Serious Chronic Illness in Old Age.* In it, authors Joanne Lynn and David Adamson are highly critical of the medical communities approach to the dying.

Chronically ill elderly people and families living through the end of life of a family member deserve a better system than the one currently available. They depend on the health care system to serve their needs and certainly not to add to the burden of their or a loved one's final days.

The Medicare program has a hard time with terminally ill Americans. Despite the provision in 1983 (eighteen years after the program began) of hospice benefits under

Medicare, the program is still seen as inadequately handling beneficiaries near the end of their lives. In a report from the Medicare Payment Advisory Commission produced in 1998,

> *There is widespread agreement that the quality of care provided at the end of life is poor. Many studies have found that people do not get the care they want and that many suffer from high levels of pain due to miscommunication. Studies also suggest that current payment policies fail to provide adequate incentives for the provision of palliative care.*

The hospice benefit was intended to both care for the dying and hopefully limit death-related expenditures. In 1982, Senator Dole and Congressman Pannetta led a bipartisan effort to pass the Medicare Hospice Benefit. That was the culmination of burgeoning interests in developing alternatives to what was seen as the inhuman fate of the critically ill and elderly in modern acute care hospitals. Leaders in the Hospice movement in America drew inspiration from Dame Cicely Saunders in England who founded St. Christopher's Hospice in 1964, the first in the modern era. As the Medicare Hospice Benefit has been instituted, beneficiaries are eligible to enroll in a Hospice program when, in the judgment of their physician, they can expect death within the next six months. Enrollees who survive that time period must be recertified at regular intervals by their physician. By enrolling in a Hospice program, Medicare beneficiaries waive their access to other Medicare services.

Because of the structure of Hospice regulation, the program has attracted a subset of the dying population because of its characteristics. Hospice patients are

typically characterized as cancer patients given fewer than six months to live by their physicians, and in need of substantial ameliorative services while beyond the reach of life-saving measures.

Ordinarily, the failure to provide quality end-of-life care is blamed on the necessary orientation of the medical community for aggressively attacking acute illness with the intention to cure it. Most physicians are not trained to accept the coming of death, but fight it with all the means at their disposal. A related problem which surfaces in assigning critically ill patients to Hospice is the high level of uncertainty under which care is provided for chronic illnesses. This will be addressed in greater detail in the next chapter, but it is reasonable to assume that it is very difficult for doctors or patients to sign away their access to curative care if there is any hope remaining for extending the life of the patient.

Despite these concerns, Hospice has been reasonably successful at controlling costs for those critically ill persons who enroll in it. Estimates in some studies suggest that every dollar spent on the Hospice program can save up to $1.52 in Part A and Part B benefits. This and similar estimates will be addressed in the next chapter.

One remaining concern about the Hospice benefit and a general criticism of the medical system that can lead to poor end of life care is the discontinuity in services provided by having to formally enroll in a Hospice program to receive palliative care. Medicare hospice structure and other cost control measures that are

part of Medicare regulation are seen as impediments to quality end of life care because they cause care to be provided in manners contrary to the medical and personal realities at hand. The administrative requirements of the Medicare program often require choices to be made about the care a terminally ill patient receives at times and in conditions which are non-optimal. Patients often must remain in acute care hospitals and often receive invasive procedures which degrade quality of life with a low probability of extending longevity. One alternative can be to "give up" and enroll in Hospice and forgo further curative treatments.

The first step in matching treatments to patterns of disease and demise is to understand those patterns in the diseases and disorders which most significantly affect Medicare beneficiaries. Present work represents an effort to understand the trajectories of death inherent in modern "killer diseases" and econometrically model the path of those expenditures.

Technical Points

It will be useful as this work continues to understand how Medicare pays for claims, no matter what type of care. Allowables are set specifically according to type of product or service and are categorized by acute or long-term care, by outpatient or inpatient services, but there is a general formula that is used as the basis for all types of services. In the typical Fee-For-Service (FFS) program which most Medicare beneficiaries use, providers' reimbursement or payment from Medicare are based on predetermined rates and are not

affected by the provider's costs or posted fee schedule. These providers have agreed to accept as payment in full, minus the patient's cost sharing liability, the determined payment amounts that Medicare has set. Medicare policy makers determine these amounts by researching national base payment rates or conversion factors based on national average historical costs. There is an adjustment formula to reflect regional price levels, normally based on the local hospital wage index. Other adjustments can be factored in for unusual patient characteristics, unusual treatment, atypical market areas, or because policymakers wish to encourage certain activities, such as the need for medical professionals in a rural community.

Many technical aspects of the Medicare program and the history of its analysis intrude on the discussion of the cost of dying on Medicare. Some will be directly addressed, but others need to be acknowledged and answered. For example, the total unfunded liability of the Medicare program is forecasted to be $23.3 trillion, while the addition of Medicare Part D has raised the unfunded liability by an additional estimated $16.6 trillion. If the plan continues unchanged into the future and future generations participate in the program on the same terms as current generations, the total Medicare debt rises to $61.6 trillion. It is beyond the scope of this work to remain sufficiently general such that certain measurement problems are resolved without notice.

First among the challenges of analyzing medical care over time is the measure of price, and to separate that from quantity. Those forces which influence the prices paid by Medicare for the various standard procedures directly influence Medicare expenditures.

Work by Joseph Newhouse (2001) has made clear that we have a poor handle on real price and quantity changes within medicine. The Medicare program controls the prices they pay for medical services, supplies, and equipment through a complicated process of base price ceilings with geographic adjustments along with erratic yearly percentage adjustments across expenditure categories. While it is beyond the scope of this work to tackle the problems inherent in medical price adjustments, it is necessary to keep them in mind as the analysis proceeds. Changes in reimbursement levels or reimbursement formulas can be expected to have significant effects, obviously on per-unit expenditures, but also on utilization levels. A rapid increase in the level of utilization of specific benefits could either reflect the evolution of best medical practices, or a change in the reimbursement formula that encourages the marketing and distribution of a product covered. One can currently see many advertisements on television for powered wheelchairs and scooters, and respiratory equipment and supplies covered by Medicare. Such publicity can be expected to increase the use of the products advertised independent of standards of care or best practices in the medical establishment.

Conclusion

The work outlined thus far represents an effort to address some key elements of the experience of beneficiaries of the Medicare program and the impact of their health problems on Medicare finances. The data used to address the questions is vast and a bit unwieldy. The potential for insight into the relationships between health and expenditures that will shape

the future of Medicare is hard to overstate. The present work is intended as a first cut to consolidate some facts, develop insights into some basic relationships, reveal similarities and differences among diseases that may have bearing on financing decisions, and to highlight anomalous or interesting elements in the data. The results generated at this stage are in the main descriptive and risk becoming quite tedious. The work serves primarily to inform and motivate more targeted work within specific diseases or disease categories. By developing and implementing a standard template through which to assess the relationship between diseases and expenditures over time, the work has the potential to reveal as much when it works well at getting at the relationships as when it does not. The structure of the approach is useful, not because it perfectly defines or identifies at the distinct features of each disease (it does not), but because it processes an immense problem and an equally immense data resource and reveals many areas ripe for a closer look. The promise of the present project is in what it makes possible more than in what is accomplished in the following pages.

CHAPTER II

LITERATURE REVIEW

End-of-life medical care for Medicare beneficiaries has long been an area recognized as ripe for re-evaluation and reform. There is a sense that significant waste and unnecessary suffering are hallmarks of the dying process caused in part by the regulations and economic incentives built into the Medicare program. The Medicare program seems to have been designed to care for seniors with acute illnesses, and has significant trouble addressing chronic and/or terminal conditions through its standard reimbursement formula. The institution of the Hospice benefit in 1982 was aimed at addressing this difficulty, but there is evidence the Hospice benefit is doing a poor job addressing the situation. The challenges that Medicare faces in funding high quality end-of-life care for beneficiaries has generated a significant level of scholarly interest and discussion. The following chapter presents a survey of the literature(s) which provide a foundation for the present work.

A discussion and organization of the literature relevant to the cost of dying on Medicare has to contend with the fact that the subject is the confluence of several branches of literature that have developed in various fields of inquiry and with widely varying emphases. The foundational question of this study of the determinates of terminal period Medicare expenditures, and the focus of the following review will remain on those issues addressed in the literature which have the most significant bearing on the question. It is very

difficult, however, not to go somewhat a field if an interpretable picture is to be presented. The cost of dying on Medicare depends on the costs associated with the services determined to be necessary to care for individuals with often significant health challenges. Decisions over the target quality of care and the evolution of effective treatments are central to the level of expenditures generated during the terminal period. As such, the literature which addresses standards of care and treatment is directly related to the question herein approached. The following literature review is intended to discuss and organize the relevant literature to a degree which facilitates a deeper understanding of the forces at work which impact the cost of dying on Medicare, and at the same time avoid excessive entanglement in the real and important questions which remain imperfectly answered in each branch of the literature. Given that the intent of the review that follows is to walk a fine line between insights into pertinent issues and overwhelming confusion from the many directions the review must take to accomplish its goal, it will become a bit wobbly in places. The findings in the literature are organized by topic, and the relevance to the present question addressed within each topic.

Disease Specific Studies

To understand what death on Medicare means, one must understand the patterns of demise that lead to a death for which Medicare is financially responsible. As technologies in medicine advance, the way in which we die and from which ailments we die have changed. One attempt of outlining the patterns of demise is RAND's White Paper. In it the authors

outlined three patterns of functional decline differentiated by the diseases from which people ultimately die. The first of the three patterns is a short period of evident decline, typical of most types of cancer. This pattern shows an ability to be comfortable for most of the duration of the illness and then as the disease worsens, the pattern shows a rapid decline. This is the pattern for which Hospice as we know it is most commonly used and where it seems most appropriate. This first pattern is how one-fifth of Medicare claims are categorized.

The second pattern, which represents 20% of the Medicare claims, is described as one that shows "long-term limitations" that include "intermittent exacerbations and sudden dying." These circumstances are typical of organ system failure. Patients seen following this pattern live relatively longer with their ailment, and are only moderately limited by the disease. If the disease is managed well, a patient can live comfortably for an extended period and only dies, somewhat suddenly, after a series of complications from which the body could no longer rebound.

The third is a pattern of prolonged dwindling, typical of dementia or Alzheimer's disease, a disabling stroke, or general frailty. This pattern makes up 40% of Medicare claims. The last 20% of Medicare deaths are categorized as completely unexpected and sudden deaths or are simply not yet able to be categorized.

To further breakdown our question, Mark C. McClellan, et al. (2000) took specific disease codes and looked specifically at expenditures at those times, focusing on home health and use of Hospice services. McClellan uses four types of illnesses to see how a death

by this disease is foreseen and managed. The first disease is an AMI or acute myocardial infarction, more commonly known as a heart attack. Heart attacks are usually quite unexpected and do not allow much time to plan for palliative care. It is no surprise that AMI sufferers are not typical Hospice care users and are not likely to die at home with Hospice care. The second ailment McClellan uses is the hemorrhagic stroke. This is again an acute ailment that leaves little time for proactive measures in palliative care. The place of death and circumstance of care statistics for the stroke victims are very similar to those if the AMI sufferers.

In contrast, the third disease pattern is for lung cancer. Lung cancer is often used as the prototypical terminal illness. Prognoses are more accurate, and there is often at least 3 to 6 months of time to offer palliative care. The time of death is therefore more predictable, and lung cancer patients are very common users of Hospice care. Lung cancer deaths in a hospital have come down from 52% to 36% in the last fifteen years. In 1988, 2 % of lung cancer deaths occurred at home with Hospice care, whereas in 1995 that number was up to 30%. The last disease McClellan used for his research was COPD or chronic obstructive pulmonary disease. This is a type of chronic respiratory illness such as serious asthma, bronchitis, and emphysema. It is also a good example of long term chronic and terminal disease like ling cancer, but one that is substantially less painful and more easily managed. With the use of certain durable medical goods and regular doctor visits, a COPD patient is able to maintain relative comfort without feeling the need for serious intervention like Hospice, unlike cancer sufferers. From 1988 to 1995, COPD deaths in hospitals hovered

consistently just above 35%. COPD patients reached out to Hospice care at 1% in 1988 and that number rose to only 10% in 1995.

Looking at the issue from another prospective, Jay Bhattacharya, et al. (1996) looks to demographic group and specific disease expenditure patterns to estimate life expectancy curves. The Bhattacharya paper further gleans meaning from the Medicare claims files as a basis for analyses of patterns of a cause-specific demise. They note that the Medicare claims form is not the most accurate in explanation of cause of death as having a more comprehensive description for each claimant in hand, but that it is more thorough and accurate than the limited death certificate data that has been used in previous population-based studies.

This paper wishes to dive somewhere in between RAND and McClellan by looking at patterns of demise by disease code using both studies. At the same time, we will borrow much of the structure of Bhattacharya's analysis to investigate the issues at hand.

Parallel Research

Since Medicare is such an important political topic and has such an influence on America's governmental budget, it is natural that a significant part of the literature on Medicare focuses on estimating total program liabilities. This literature has as its focus forecasting the impact on Medicare's bottom line from demographic, technological, and policy changes. As a result, several facts and methodologies have been developed which have a bearing on the present question. Chief among these is the treatment of increasing

longevity on expected total lifetime Medicare expenditures for individuals. Most studies in the branch of the literature focus on the individual only to better understand impacts on entire cohort expenditures and then total program liabilities. Nevertheless, several of their findings are important and relevant to the present work.

An example is Tim Miller's research on increasing longevity and Medicare expenditures (2000). His theme is to argue for the use of expected time until death rather than age as health state variables in official Medicare funding projections. He argues conclusively that in a world of improving health and increasing longevity, use of age as a predictor of expenditure will necessarily bias expenditure forecasts upward. As the health of people in their seventieth year improves, estimates of the cost of care required for them should fall. Depending on age as a predictor will mask improvements in health at age for a considerable period. Miller argues that since expenditures are more closely related to health than age and the linkage between age and health has weakened. Age has become an inefficient proxy for health state. He recommends the use of life expectancy in its place for Medicare predictions. The present research seeks to offer an alternative but follows in the spirit of Miller's argument.

The pertinent findings in Miller (2000) that help provide context for the research that follows include the following:

- Decline in age specific mortality lead to decline in age specific costs because declining mortality reduces the proportion of high cost users.
- Average medical costs rise both with age and with time until death, primarily

because time until death is generally related to age.

- Medical technological advances serve to de-link age and time until death.
- Death related expenditures fall with age, because fewer invasive procedures are recommended for the oldest old.

With a similar goal, Lubitz, et al. (2003) issued a much publicized study in the New England Journal of Medicine which surprisingly found increases in the life expectancy of the elderly had a neutral effect on total lifetime Medicare expenditures. Lubitz's work stands as different as one can get in approach as the study here, while still seeking to answer some of the same questions. Lubitz sets up a first order Markov chain transition matrix across disability states based on longitudinal reports of individual's ADL, IADL, and Naki Disability scores. Through this he treats health state as entirely embodied in current disability level. The methodology employed follows Sarah B. Laditka and Douglas A.Wolf (1998). They find that individuals who remain free of disability into advanced old age put less of a burden than beneficiaries who spend many fewer years on the program but live with disability during the period. They find a seventy-year-old who has no functional limitation can expect 14.3 more years of life and will cost the Medicare program roughly $136,000. In contrast, a seventy-year-old with at least one ADL limitation is expected to live 11.6 years with expenditures of approximately $145, 000. Thus the consequence of improving health at age will offset the added anticipated costs of increasing longevity.

What Are Expenditures Buying?

One of the strongest criticisms of end of life care in America and of Medicare program's treatment of the dying come not from a unwillingness to spend sufficient resources to ease suffering at the end of life, but the misuse and misapplication of effort and resources in ways that can even cause further suffering for beneficiaries facing the end of life. Concern over the quality of life of people near death and of the "quality" of death arose significantly in this country in the last seventies. Congress instituted the hospice benefit under Medicare in 1983 to provide some alternative sources of care near death. For reasons addressed below, Hospice may have been an incomplete solution and if anything concern over the quality of end of life care had increased since its inception.

The magnitude of the problem was made clear through two studies funded by the Robert Wood Johnson Foundation in the 1990s. The Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatment (SUPPORT) collected data from patients in teaching hospitals from 1989 to 1994 to understand their care, treatment, preferences, and patterns of decision-making among critically ill patients. The study focused on hospital admitted patients suffering from nine specific disease categories: acute respiratory failure, COPD, congestive heart failure, liver disease, coma, colon cancer, lung cancer, multiple organ system failure with malignancy, and multiple organ system failure with sepsis. The data used covered roughly five thousand patients over a five year period.

The project aimed at collecting data useful in answering a host of important questions related to dying. Most salient of these for the present research is the investigators

interest in the ability of physicians to accurately anticipate the time of a patient's death. Addressing concerns about care of the dying demands a strong ability to distinguish the dying from those people who are likely to survive. The SUPPORT study indicates that physicians are particularly poor at judging (or at least expressing) when a person with a serious chronic illness has "crossed the line." If one looks at a death cohort of people the day before they pass away, on average they would be given a 17% chance of living another two months. A week prior to death, they would be given a 50% of surviving two months. As investigator Joanne Lynn (2003) points out, the inability to distinguish probable decedents from probable survivors calls into to question the use of the term end-of-life care, at least from any sort of prospective approach. A separate but equally important outcome of the study has been a better understanding of the preferences of terminally ill people about their deaths and care near the end of life. How the services provided match the preferences of the dying gets at the question of what the Medicare program is really buying for its expenditures on behalf of the dying.

The SUPPORT study indicates that the medical community is doing a particularly poor job in providing care that matches terminal ill patient's preferences. The investigators suggest that primary reason for this important failure is the reluctance of physicians to "admit failure" by shifting a patient's care to a palliative approach and abandoning hopefully curative interventions.

A recent study in the *Journal of General Internal Medicine* (Amy Sullivan, Michael Lakoma, and Susan Block 2003) used a telephone survey of roughly 1500 medical students

to investigate their attitudes towards and training related to patient death. More than 40% of respondents reported that dying patients were not considered good teaching cases and that quality of life concerns for dying patients was not considered a core competency. Fewer than 18% had received any formal training concerning end-of-life care. Nearly half felt unprepared to manage their own feelings about patients' deaths or help bereaved families. Virtually every serious investigation into end-of-life care done within the medical community has come away making strong recommendations for revamping the education and training medical students receive for dealing with terminally ill patients. In the past few years, efforts have been made to train physicians in palliative care procedures and to encourage rational and quality-of-life focused care decisions (E.H. Wagner et al., 2001).

In addition to the typical doctor's reluctance to discuss death, the SUPPORT study found significant evidence of ignorance of the patients references regarding end-of-life care. Fewer than 50% of physicians were aware of patient's unwillingness to submit to invasive procedure with a low probability of success.

The medical literature is equally critical of America's health care system in its almost exclusive focus on acute care. The Institute of Medicine's Committee on Care at the End of Life make an issue of the fact that health insurers often restrict care to people with ongoing medical problems or terminal illnesses out of fear that they will disproportionately attract sicker that average people. Carol F. Capello, Diane E. Meier, and Christine K. Cassel (1998) find that while a large percentage of deaths occur in hospitals, hospitals are not explicitly reimbursed for providing palliative care provided there. As will be discussed in

Chapter III, Medicare reimbursements make use of specific codes for treatments. There is a diagnostic code under Medicare that identifies patients receiving inpatient palliative care at an acute care facility, but there is no reimbursement associated with the code, and it is not surprising that the code is rarely used (Christine K. Cassel and Bruce C. Vladeck, 1996).

To further question what Medicare is getting for the expenditures the program makes on behalf of beneficiaries, studies have made use of regional differences in Medicare usage rates among the critically ill. One such investigation by Elliott S. Fisher, et al. (2003) found that despite usage rates that can vary as much as 60%, there was little difference in mortality rates, in changes to functional status, or in reported patient satisfaction levels. Jon Skinner and John E. Wennberg (1998) similarly found no evidence that increased per capita spending in the last six months of life lowered mortality rates.

Proportions of Total Medicare Spending in Terminal Year

One question that serves to give an impression of the magnitude of the issue is the proportion of total Medicare spending which is accounted for by medical care provided to beneficiaries in their final years of life. The first notable inquiry came in 1984 by James Lubitz and Ronald Prihoda in Health Care Financing Review. Making use of cross-sectional data about the Medicare expenditures made on the 1978 death cohort during the cohorts final two years, the authors found that the total expenditures on decedents represented roughly 28% of total Medicare expenditures while the group studied accounted for only 6% of the beneficiaries of the program in that year.

Lubitz and Prihoda's estimates were partially confirmed by S. H. Long, et al. (1984) work in the same year which specifically considered beneficiaries who died of cancer. Other concurrent studies include N. McCall and one by W. D. Spector and V. Mor, both papers from 1984. Essentially the same question was addressed more recently using a panel of decedents from the year 1993-1998. Christopher Hogan, et al. (2001) used data similar to that employed in the present research to estimate the proportion of Medicare expenditures going to decedents in their final year in *Health Affairs* in 2001. They determine that 27.4% of all expenditures were associated with the care of the 5% of the beneficiary population which were in their terminal year. It seems the proportion has held up over the past twenty years. Studies which arrived at similar estimates include G. L. Gaumer and J. Stavins (1992), and James D. Lubitz & Gerald F. Riley (1993).

Hospice

The U.S. Congress instituted a Hospice benefit for Medicare beneficiaries in 1983. The intent of the benefit was to provide a funding mechanism through which terminally ill patients could face their final days in their own homes or in specialized institutions free of invasive medial care. As the consistency of the estimates across time shows, the Hospice benefit has done little to reduce the proportion of Medicare expenditures associated with services for the dying. Concerning absolute expenditures in hospice those studies which have tried to establish direct cost savings have been troubled by methodological issues. It is known that Medicare Hospice rates reflect historic patterns of treatment, such as the

population of those beneficiaries dying of cancer in the early 80s, a matter which affects not just the Hospice issue but all Medicare expenditures. H.A. Huskamp, et al. (2001) suggest several ways in which this program can be updated to better reflect technological advances in the treatment of prototypical terminal illnesses like cancer, and the usefulness of Hospice care for other disease patterns.

Reduction in that proportion was not the only significant intent of the program, however. A major intent of providing hospice services to the terminally ill was to improve the quality of life of the dying. The Medicare hospice benefit came out of the rise in interest in hospice services generally. There was substantial concern that not only was the Medicare program spending a significant level of funds on the dying, but also that the services it was purchasing were not entirely appropriate.

One final area of the literature relevant to contribution the present work is aimed at making is that on persistence. The question addressed can be roughly expressed as the following: What does a high level of expenditure in one period predict for the next period? Are there high-cost and low-cost individuals? The answer is particularly important to discussion of alternatives to Medicare funding and the practicality of private insurance replacing or augmenting Medicare. Andrew Rettenmaier and Zijun Wang's work of 2002 and 2003 represent the apex of technical precision and brute econometric force being brought to bear on the subject. The present work has a bit easier a time than do those authors in that medical expenditures in the run-up to death are strongly increasing across most diseases. As people near death, their medical expenses rise each quarter. The problem that

plagues the persistence literature of many periods with zero costs and the econometric challenges that result are less of a problem near death.

The literature presented above serves as a foundation for the work which will unfold in the following two chapters. The data and methods used hereafter are distinct from any of the papers sighted, but they together establish the motivation for the work and inform the decisions made explicitly and behind the scenes that allow for the results obtained. The existing literature on Medicare comprises a breadth and depth that serve to indicate the importance and complexity of the subject for the taxpayer, the researcher and the beneficiary of the Medicare program. The work to be presented in the next two chapters does not promise to either or extend or contract the complexity of the issues or the literature, but hopes to contribute to a clearer understanding of the existing relationships between health, finances, and diseases under the present system.

CHAPTER III

DATA

The data used to estimate the models in this work come from the 5% Sample Standard Analytical Files from the Centers for Medicare and Medicaid Services. The Standard Analytical Files are a set of annual files covering the Medicare reimbursements made at the individual level. They consist of complete Medicare claims information of a 5% sample of Medicare enrollees determined by using the last digits of the Social Security Number or equivalent Railroad Retirement Board number. The seven files which comprise the information relevant to this work are broken down by class of Medicare expenditure. Durable medical equipment, home health services, skilled nursing facilities, inpatient services, outpatient services, and hospice services are itemized in distinct files. Claims for physician services are held in the carrier file. Finally, the denominator file contains demographic information about the beneficiary including age, race, gender, Medicare enrollment history and zip code. These files are linked together through the use of non-identifiable beneficiary numbers. The information in the data comes from billing records for individuals. The records include the principle diagnosis code which motivated the claim (ICD-9 classification), secondary supporting codes, the level of expenditure, and a host of supportive information. The files are publicly available, but are subject to stringent use restrictions which include proscriptions on merging in outside data. Some work has

been done with the data by groups not constrained by usage restrictions (inside CMS, for example), so some things are known about the sample that are not legally reproducible here.

It is common for the Standard Analytical files to be used in cross section. Each year of observation contains roughly two million individuals. Each individual is assigned a unique identifier (hic hereafter). The hospice file for a given year, for example, contains hospice claims data for each person who had any covered treatment in a hospice setting. A full record of any individual's Medicare expenditure in a year requires that each of the seven files for that be merged together. Each claim record contains the hic, information of the disease code requiring treatment, the treatment administered, unique codes for the hospital or medical professional administering the treatment, supplemental disease codes in cases of multiple causes or co-morbidity, and the level of claim in dollars with the necessary information about geographic adjustments in allowables. Across two million individuals and seven files, it is easy to see why computational limitations quickly become relevant, and thus why cross-sectional analysis is the usual choice of researchers.

One special feature of the data used herein is the fact that it contains eight years of data on the sample of individuals, provided they lived throughout the window. The data covers the time period from the first quarter of 1994 to the final quarter of 2001. For modeling tractability, the current data set has been collapsed into quarters. Thus, it entails thirty-two quarters worth of full claims information on a 5% sample of the Medicare population.

It is important to note what is not in the data. The files contain all the billing information for procedures covered by Medicare. Thus, those medical services not covered

under Medicare which are administered to the population in our data set are entirely missing. The fact that significant portions of medical expenditures are absent, significantly limits the interpretation that can be taken from the data. For example, little can be said about pharmaceuticals and institutional care. This stands in contrast to survey data such as the National Long-Term Care Survey, the standard venue in which to investigate the questions here explored. One key areas of information that are not in this data but that are foundational for most of the literature in the area are disability scores. In prior literature, disability scores such as IADL and NAGI have formed the basic (health state) variables. One novel aspect of the present research is the attempt to define health state on the basis of prior medical expenditures, both generally and in-disease.

It should be emphasized that to whatever degree the present effort proves acceptable, the resulting measures are likely far weaker than disability measures, for example, for quality of life inquiries. Perhaps however, it may prove more relevant for budget impact analysis. Thus, the data used in the present study is quite different than the data used in the existing literature, both in its content and its potential use. It is hoped that this work will prove complementary to those studies based on survey data. Also, to make a virtue of necessity, it is interesting to consider how this essentially administrative data can be more easily monitored than the standard survey data. Claims information is necessarily messier than survey data, but it is free, it is available and it is current.

The subset of the data used to estimate the model outlined in the next chapter is more limited than the 5% sample. It consists of the decedents among a 10% sample of the 5% sample of Medicare enrollees. The reason for working with a subset rather than the entire

available sample is simple computational constraints. The models in the next chapter are estimated using machines which are fairly powerful by the current desktop standards, but no more observations could be used than are currently in the subset. A similar study done three years ago was limited to a sample 20% the size of the one used here for the same reasons.

Comparison of Data to Earlier Studies

The primary concern about data that has been as "processed" as this has been the degree to which it is representative of the population it is intending to describe. For that purpose, what follows are a series of tables containing descriptive statistics of the sample along with those of comparable studies.

As is evident Table 3-1 above, samples are not identical. The differences are not necessarily intuitive. The Hogan sample is smaller and covers an earlier period. The perception that people are dying at older ages coupled with the fact that the present sample encompasses Hogan's time frame plus three later years makes the age distribution differences a concern.

TABLE 3-1-SUMMARY STATISTICS OF DECEDENTS

Demographic Characteristics	**Hogan** *Survivors*	*Decedents*		**House** *Decedents*
Average Age in Years	70.6	78.3	*	78.5
Percent Under 65	17	7	*	6
Percent 65 to 74	47	26		31
Percent 75 to 84	27	37	*	34
Percent 85 and older	9	29	*	29
Percent Female	57	53		53.69
Percent race non-Caucasian	14	13	*	13
Percent with Some HMO Enrollment in Year	13	10	*	7.25

Source : Analysis of Medicare enrollment data for a 0.1 percent sample of beneficiaries, 1994 through 1998
Taken from Hogan : Table 3-3: Demographics of Decedents vs. Survivors, Pooled Annual Rates 1994 through 1998
*Signifies statistically significant difference between decedents and survivors, p. <.05, two-tailed t-test

Cause of Death Determination

One set of variables generated from the raw information in the claims files concerned the cause of death. The data used in the present study contained no official cause of death of the sort that would appear on a death certificate. The cause of death used in the analysis in the next chapter is generated by a simple algorithm from the medical claims files. The following Table (3-2) from D. Hoyert, et al. (1999) shows the distribution of the leading causes of death in persons age 65 and older in 1997.

TABLE 3-2: LEADING CAUSES OF DEATH FOR PERSONS AGE 65 AND OLDER, 1997

Rank	Disease (ICD-9 code range)	Decedents	Rate per 100,000	Percent of Decedents
	All causes	1,728,872	5,074	100%
1	Diseases of heart (390-398, 402,404-429)	606,913	1781	35%
2	Malignant neoplasms (140-208)	382913	1124	22%
3	Cerebrovascular diseases (430-438)	140,366	412	8%
4	Chronic obstructive pulmonary diseases (490-496)	94411	277	5%
5	Pneumonia and influenza (480-487)	77,561	228	4%
6	Diabetes mellitus (250)	47289	139	3%
7	Accidents and adverse effects E800-E949)	31,386	92	2%
8	Alzheimer's disease (331.0)	22154	65	1%
9	Nephritis, nephrotic syndrome, Nephrosis (580-589)	21,787	64	1%
10	Septicemia (038)	18079	53	1%
	All other causes (Residual)	286,013	839	17%

Source: Taken from Hoyert et al.. 1999, Table 8

The current study focuses on a group of disease categories which together account for over 80% of all causes of death on official death certificates for the beneficiary population. Beneficiaries, for whom the plurality of expenditures in their last year of life were attributed to a single disease category in the list, are designated to have died from that disease. Those decedents for whom no single disease accounts for more than 50% of their expenditures are designated in the "other" category. Also, decedents whose primary disease is not one of the ones on which the study focuses are included in the "other" category. The procedure described has significant drawbacks when it comes to interpreting results, but it is common in the literature. The adopted procedure already hits the limit of computational power available, and all sensible refinements of it considered to date would require even more power. At present, it seems best to explicitly identify the limitations of the adopted procedure and await refinements and expansions in future work.

The majority of elderly decedents suffer from several chronic conditions at the time of death. The records used in this study have a primary ICD-9 code assigned to each procedure, but up to three secondary codes may also be assigned to any treatment. For many conditions, the procedure adopted yields a plausible and straight-forward assignment of cause of death. Treatments of terminal cancer, for example, are concentrated and specific. The same is true of kidney disease, for example. Other conditions, however, are associated with significant levels of varied complications. Treatments specifically motivated by complications may well cloud the picture of the primary cause of death for a beneficiary. If the cost of treating a complication were to exceed the cost of treating the underlying cause of death, the decedent would be presumed to have died of the co-morbidity, and not the

disease which truly caused death. Heart disease and diabetes are commonly co-morbid. A beneficiary may be equally likely to die of one or the other according to the adopted procedure.

Competing Risk Determination

The adopted methodology has the inherent weakness that the assigned cause of death may have cost only slightly more than another, possibly the "real" cause of death. There have been extensive investigations on the impact of various medical technological advances and general medical scientific advances on the rate at which people die of various diseases. The standard data used in such studies is the Census Bureau's Multiple Cause of Death Mortality files from 1970, 1980, 1990 and 2000. Much of the refinement that has taken place in that literature has involved overcoming the competing risk problem. The basic difficulty in that data is that all that is available to researchers is cause of death and age at death. Since everyone eventually dies of something, the prevention of a death by cancer will "cause" a death by something else. If longevity is increased, it is difficult in that setting to assign which field of progress is responsible. Various innovative ways have been developed to put bounds on the impact of life-extending interventions. The methodology adopted here has the same conceptual problem as the mortality files, but the sin is perhaps worse because much more information is available. One potential avenue of refining the present method would be to consider ratios of expenditure and denote those individuals where the cause of death is not as clear because competing causes were near the same level. For the present, the interpretation of the results should be considered with the understanding that the

competing-causes problem has been left uncorrected. It is believed that the problem should weaken the results sought in the modeling section. Thus, the decision to use the methodology adopted should come at the cost of efficiency and precision, but the results should not be biased as a result of the problem.

To further emphasize the gravity of this reservation, it is useful to consider evidence on the prevalence of chronic conditions among the elderly. A study of 1999 Medicare beneficiaries suggested that 82% had one or more chronic conditions and 65% had multiple chronic conditions (Jennifer Wolff, Barbara Starfield and Gerard Anderson, 2002). Treatment for such conditions as diabetes, heart disease and the care needed after a stroke are all quite expensive, but may well not be the cause of death for many people. The adopted procedure will however pick up any of these as the cause of death for the purposes of the analysis rather than the medically valid one.

Selection of Causes of Death

What follows is a detailed analysis of the death-related expenditure profiles for several diseases under Medicare. There are potentially 3,492 specific disease codes by which someone could conceivably die. The analysis focuses on 34 disease codes grouped into 25 “diseases”. The reasoning behind the selection of diseases is rather straightforward. The primary motivation was to capture those diseases from which the majority of Medicare recipients die. Heart disease, common cancers, and strokes are obvious choices. In addition, several diseases that are considered of interest to CMS, CDC or (possibly) the Census Bureau have been included because they feature in popular statistical reports on changes in

the rate of death. Finally, one disease code, hip fracture, was included because it was convenient and relevant to a particular subset of spending that will feature prominently in future work. Due to the constraints of processing power, the diseases reported are not complete representations of the true mortality of those diseases. Many diseases can be categorized under several ICD-9 codes. By definition, heart disease consists of ICD-9 codes 410-414. Of these, the most common codes assigned for morbidity are 401, 402, 410, and 414. It is only these that are included in this analysis. Thus, the disease categories are not complete but are intended to be representative and capture the majority of decedents.

Death-related Expenditure Profiles

Heart Disease (ICD-9 codes 401,402,410,414)

Heart Failure (ICD-9 code 428)

Breast Cancer (ICD-9 code 174)

Skin Cancer (ICD-9 code 172)

Cancer of the Larynx (ICD-9 code 161)

Cervical Cancer (ICD-9 code 180)

Prostate Cancer (ICD-9 code 185)

Bladder Cancer (ICD-9 code 188)

Lung Cancer (ICD-9 code 162)

Colorectal Cancer (ICD-9 codes 153-154)

Leukemia (ICD-9 codes 204-205)

Non-Hodgkin's Lymphoma (ICD-9 code 202)

Cerebrovascular Disease (ICD-9 codes 436-443)

Stroke (ICD-9 codes 431-432)

COPD (ICD-9 codes 490-491, 492, 494, 496)

Pneumonia (ICD-9 codes 480-487)

Diabetes Mellitus (ICD-9 code 250)

Alzheimer's disease (ICD-9 code 331)

Kidney Failure (ICD-9 codes 580, 582, 583, 585, 590, 592)

Septicemia (ICD-9 code 38)

Parkinson's disease (ICD-9 code 332)

Multiple Sclerosis (ICD-9 code 340)

Muscular Dystrophy (ICD-9 code 359)

Hip Fracture (ICD-9 code 820)

Other

One significant omission from the list is the general section for frailty. While frailty is a recognized medical condition from which significant numbers of elderly persons die, it is rarely, if ever, used for Medicare billing. The reason for this is the fact that the Medicare system has not implemented any payment for procedures motivated exclusively by frailty.

Heart Disease (ICD-9 codes 401,402,410,414)

Heart disease is the leading cause of hospitalization among the elderly. In 1996, acute myocardial infarction or AMI accounted was the cause of hospitalization of 394,850 Medicare beneficiaries. Medicare spent nearly $3.6 billion, or about $9,780 per discharge. Heart disease is composed of a few significantly different medical conditions. Chronic hypertensive disease (ICD-9 401) is a manageable long-term chronic condition that can be associated with ongoing medical costs. Acute myocardial infarction (ICD-9 code 410), on the other hand, is probably the most common example of an acute condition that causes rapid death. Combining these two conditions which have inherently very different expenditure profiles, is an unfortunate consequence of the way the data was available. An early opportunity for future investigation will be to parse out these particular codes to get a clearer picture of this costly disease. The pattern of total expenditures and those expenditures specific to heart disease are illustrated in Figure 3.1 and listed in Table 3.3. In addition, the difference between the total and in-disease expenditures is provided to serve as an illustration of out of disease spending.

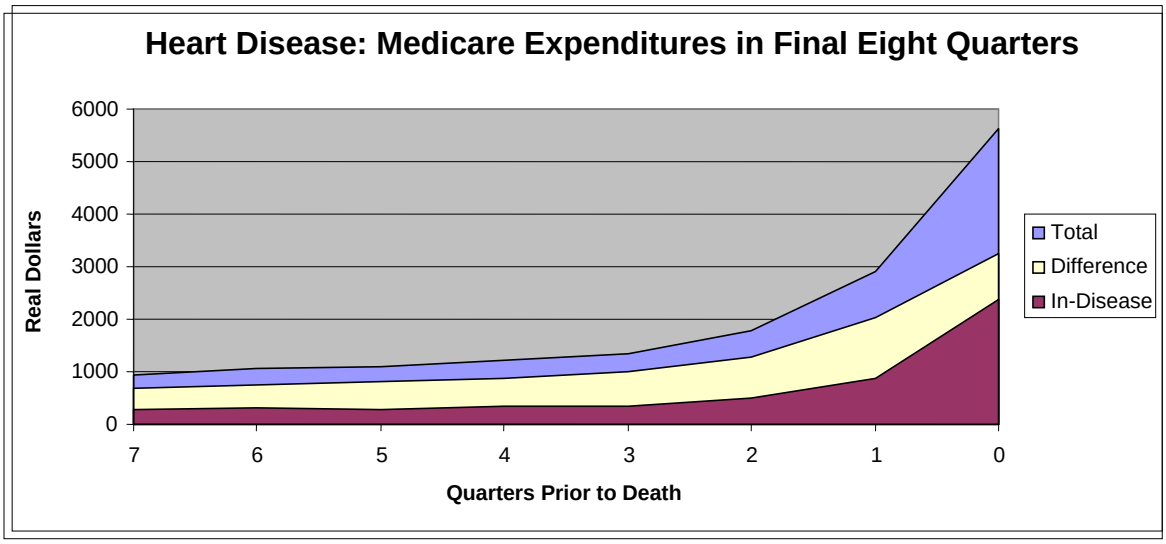

FIGURE 3.1. HEART DISEASE: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.3-HEART DISEASE: SUMMARY STATISTICS

Quarter prior to death	**Total**	**Disease Specific**	**Observations**
7	951.4927	279.3621	7006
6	1066.415	303.4583	7093
5	1083.861	286.399	7067
4	1207.184	344.376	7146
3	1341.537	355.6126	7207
2	1776.156	500.9474	7253
1	2915.603	879.7377	7394
0	5637.623	2376.977	7658
Male	47.87		
Black	9.26		
Hispanic	0.8		
Age at death	78.16949		

Heart Failure (ICD-9 code 428)

Heart failure is listed as the reason for more than 700,000 hospitalizations among Medicare recipients every year, and is linked with high rates of mortality and morbidity. For patients over 65 years of age, there is no disease more commonly noted as cause for hospitalization. It is estimated that national annual It is a common disease in the older population, accounting for more hospital admissions than any other diagnosis in patients over the age of 65. Estimates of Medical expenditures paid out for the treatment of heart failure in the United States range from $10 billion to $40 billion. The pattern of total expenditures and those expenditures specific to heart failure are illustrated in Figure 3.2 and listed in Table 3.4.

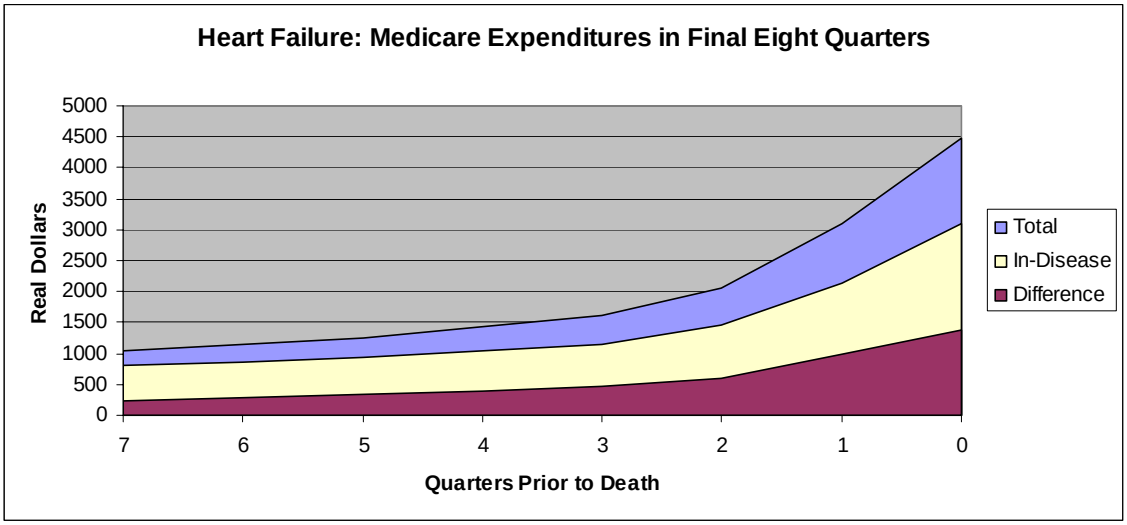

FIGURE 3.2. HEART FAILURE: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.4- HEART FAILURE: SUMMARY STATISTICS

Quarter prior to death		**Total**	**Disease Specific**	**Observations**
	7	1036.519	241.3204	7982
	6	1137.897	278.9559	7993
	5	1252.406	326.7693	8031
	4	1435.035	389.5881	8092
	3	1613.112	465.7726	8160
	2	2055.903	590.2862	8226
	1	3110.718	985.9734	8467
	0	4479.006	1389.854	8543
Male		43.27		
Black		9.51		
Hispanic		0.82		
Age at death		79.85465		Heart F

Breast Cancer (ICD-9 code 174)

It is estimated that almost 75 percent of all breast cancers are found in women over the age of 50. Conditional on having reached the age of 60, a woman has a 1 in 13 chance of developing breast cancer before age 79. Between 1996 and 2000, 96% of breast cancer deaths occurred in women aged 40 and older (*SEER Cancer Statistics*). The pattern of total expenditures and those expenditures specific to breast cancer are illustrated in Figure 3.3 and listed in Table 3.5.

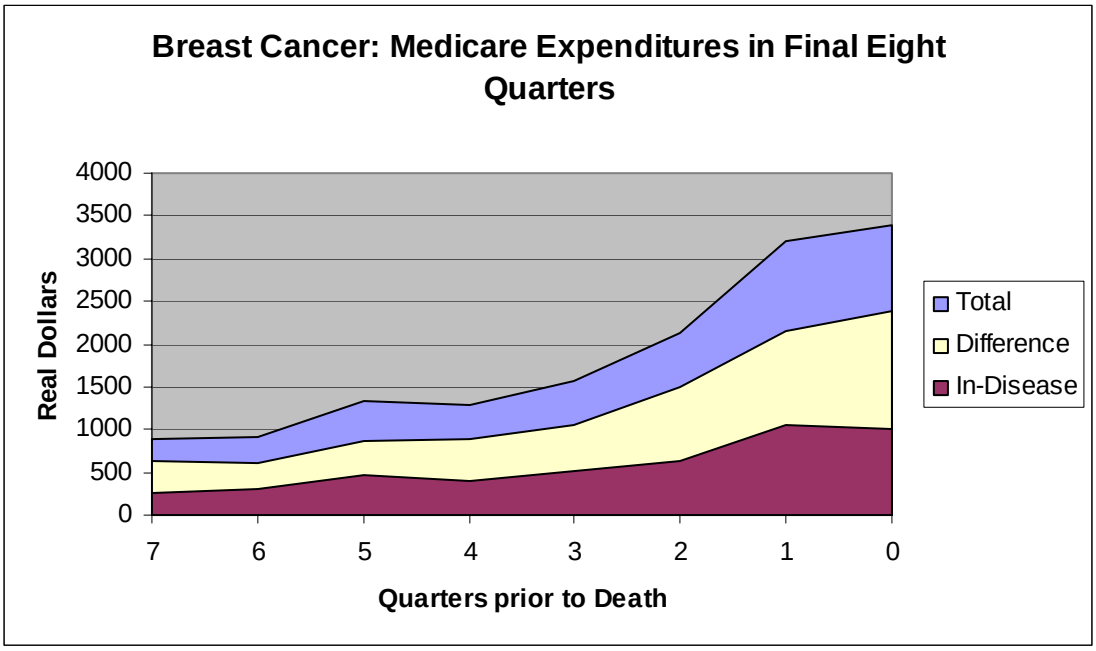

FIGURE 3.3. BREAST CANCER: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.5-BREAST CANCER: SUMMARY STATISTICS

Quarter prior to death		**Total**	**Disease Specific**	**Observations**
	7	877.2484	246.0202	801
	6	916.7862	311.01	805
	5	1333.195	467.2803	835
	4	1278.143	397.7901	836
	3	1574.421	524.7276	855
	2	2119.177	631.6492	868
	1	3211.752	1057.458	917
	0	3398.279	1016.284	930
Male		0.93		
Black		10.31		
Hispanic		0.42		
Age at death		75.28874		Breast

Skin Cancer (ICD-9 code 172)

Over one-half of all cancers diagnosed in 2002 were categorized under the broad heading of skin cancer (American Cancer Society, *Cancer Facts & Figures*, 2002). It has been estimated that roughly half of all Americans who live beyond age 65 will develop skin cancer at least once. The heading of skin cancer includes both the generally non life-threatening non-melanoma conditions (i.e. basal cell carcinoma and squamous cell carcinoma) and the more serious melanoma version that can quickly metastasize. Melanoma accounts for about 4% of skin cancer cases, but it causes about 79% of skin cancer deaths (American Cancer Society, *Overview of Skin Cancer*). The pattern of total expenditures and those expenditures specific to skin cancer are illustrated in Figure 3.4 and listed in Table 3.6.

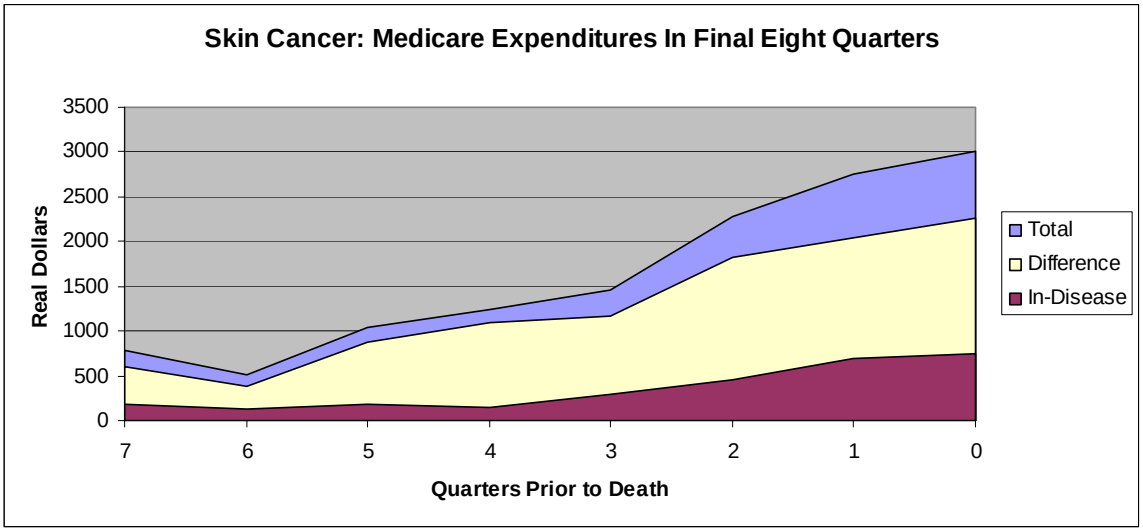

FIGURE 3.4. SKIN CANCER: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.6-SKIN CANCER: SUMMARY STATISTICS

Quarter prior to death		Total	Disease Specific	Observations
	7	786.8785	181.0224	105
	6	514.0691	133.5749	112
	5	1044.231	174.3489	112
	4	1241.635	148.1614	115
	3	1453.553	289.0154	114
	2	2276.613	455.0162	120
	1	2748.598	698.8285	127
	0	3003.966	752.3239	131
Male		64.93		
Black		0.75		
Hispanic		0		
Age at death		75.39179		skin

Cancer of the Larynx (ICD-9 code161)

Laryngeal cancer or cancer of the larynx is primarily a disease that affects persons over age 55. It is a disease often occurring in tobacco users and heavy drinkers. The American Cancer Society estimates that 9,880 new cases of laryngeal cancer (7,920 in men and 1,960 in women) will be diagnosed, and 3,770 people (2,960 men and 810 women) will die from the disease in the United States in 2005. There are approximately 2,500 cases of "hypopharyngeal" cancer are diagnosed each year. The pattern of total expenditures and those expenditures specific to cancer of the larynx are illustrated in Figure 3.5 and listed in Table 3.7.

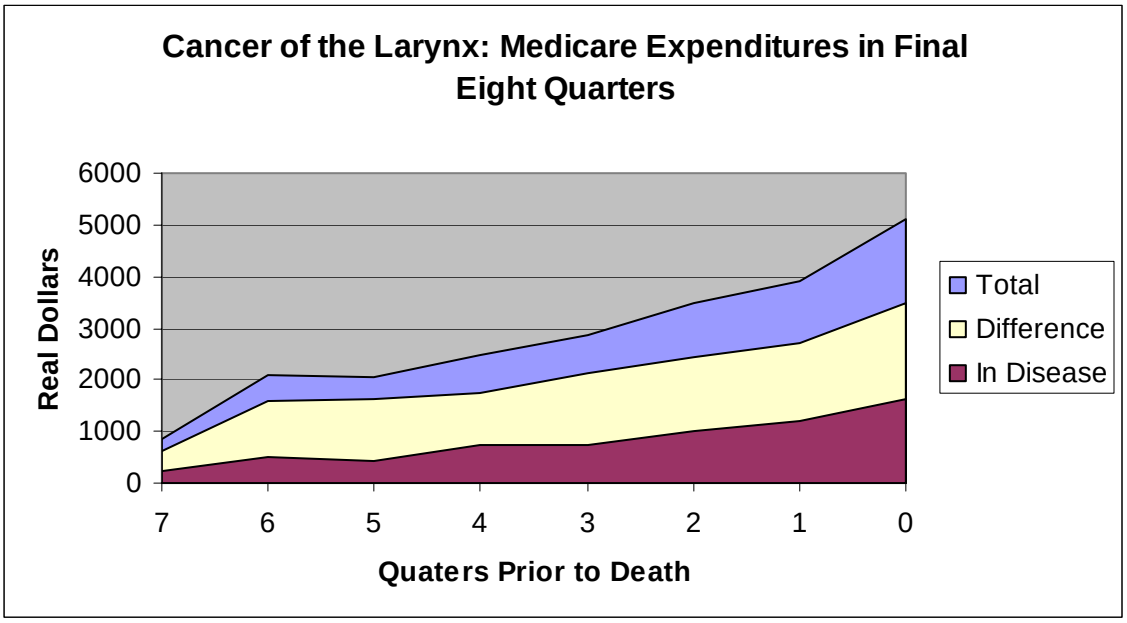

FIGURE 3.5. CANCER OF THE LARYNX: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.7-CANCER OF THE LARYNX: SUMMARY STATISTICS

Quarters Prior to Death	Total	Disease Specific	Observations
7	854.6842	233.1253	108
6	2089.813	495.0283	113
5	2047.804	425.4714	112
4	2475.038	721.9085	110
3	2856.756	736.7877	112
2	3465.025	1020.419	120
1	3908.873	1184.609	125
0	5126.641	1641.788	130
Male	84.85%		
Black	13.74%		
Hispanic	1.53%		
Mean Age at Death	71.94		

Cervical Cancer (ICD-9 code 180)

Women over the age of 65 have a cervical cancer incidence rate of 16.8 per 100,000, contrasted against 7.4 for women younger than 65. This age group also accounts for forty-one percent of cervical cancer deaths in the United States as they have a cervical cancer mortality rate that is nearly three times greater than for women younger than 65 (National Cancer Institute Cancer Statistics Branch and NIH Consensus Panel 1996). The pattern of total expenditures and those expenditures specific to cervical cancer are illustrated in Figure 3.6 and listed in Table 3.8.

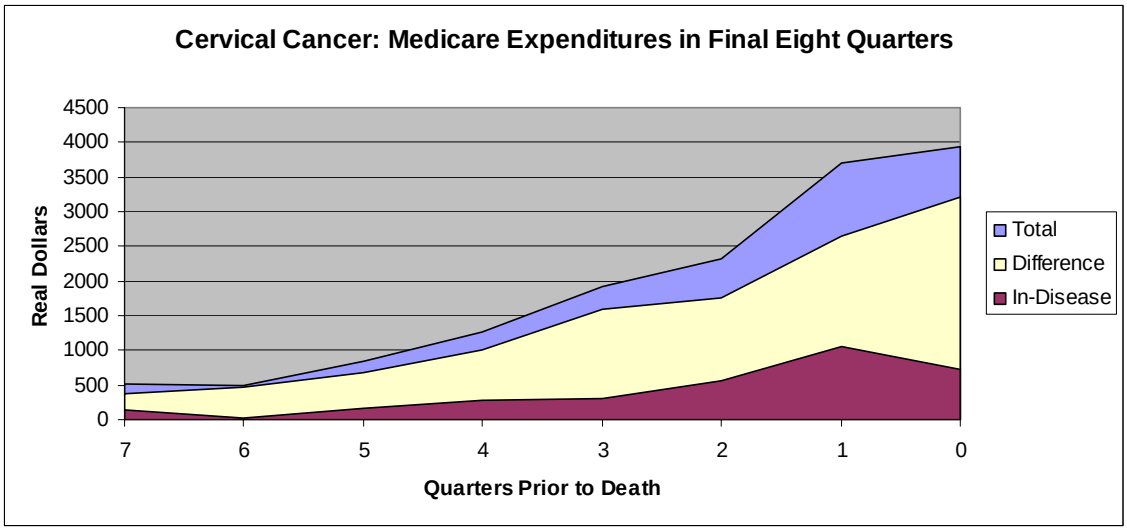

FIGURE 3.6. CERVICAL CANCER: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.8-CERVICAL CANCER: SUMMARY STATISTICS

Quarter prior to death	Total	Disease Specific	Observations
7	505.8303	132.1593	66
6	496.214	25.97666	66
5	852.4665	171.2725	62
4	1267.511	270.0361	67
3	1920.335	315.124	70
2	2317.213	553.3955	74
1	3704.867	1053.112	85
0	3935.283	719.8556	89
Male	3.3		
Black	13.33		
Hispanic	2.22		
Mean Age at Death	73.95604		Cervical

Prostate Cancer (ICD-9 code 185)

In 2003, prostate cancer accounted for more than a quarter of the cancer cases in men and 11% of the deaths. Men over the age of 60 have a 1 in 7 chance of developing prostate cancer. The average age at diagnosis is 72 years of age, so many patients with prostate cancer, especially those whose disease does not spread, may die of other illnesses or mere frailty without ever having suffered significantly from their cancer (American Cancer Society, *Cancer Facts and Figures 1998*). The pattern of total expenditures and those expenditures specific to prostate cancer are illustrated in Figure 3.7 and listed in Table 3.9.

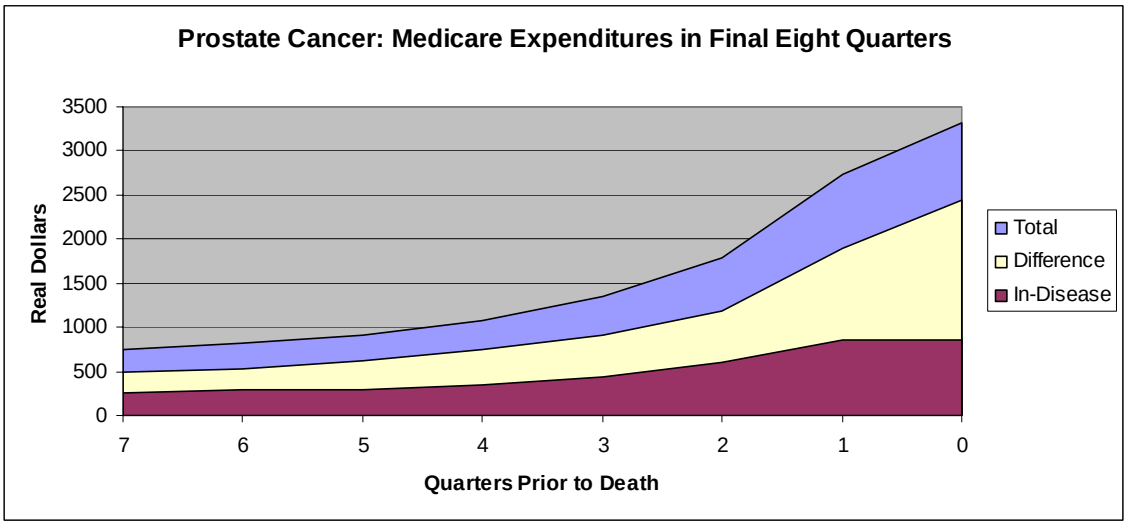

FIGURE 3.7. PROSTATE CANCER: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.9-PROSTATE CANCER: SUMMARY STATISTICS

Quarter prior to death		Total	Disease Specific	Observations
	7	748.7248	252.8714	1212
	6	829.4112	294.0032	1216
	5	917.683	293.3112	1223
	4	1081.395	339.2733	1240
	3	1355.522	444.3537	1258
	2	1790.12	599.8556	1280
	1	2743.175	850.1349	1322
	0	3311.276	865.747	1345
Male		99.86		
Black		13.4		
Hispanic		0.86		
Mean Age at Death		78.91566		Prostate

Bladder Cancer (ICD-9 code 188)

Bladder cancer is the development of tumors inside the transitional cell lining of the urinary tract. It is estimated by the American Cancer Society that in 2004 there were 60,240 new cases of Bladder Cancer and that from those 12,710 deaths occurred. Bladder cancer is 2 to 3 times more common in men and those persons 70 and older have 2 to 3 times greater incidence of developing the disease than those aged 55–69 and 15 to 20 times more often than those aged 30–54 *(*Urology Channel Website, 2004). The pattern of total expenditures and those expenditures specific to bladder cancer are illustrated in Figure 3.8 and listed in Table 3.10.

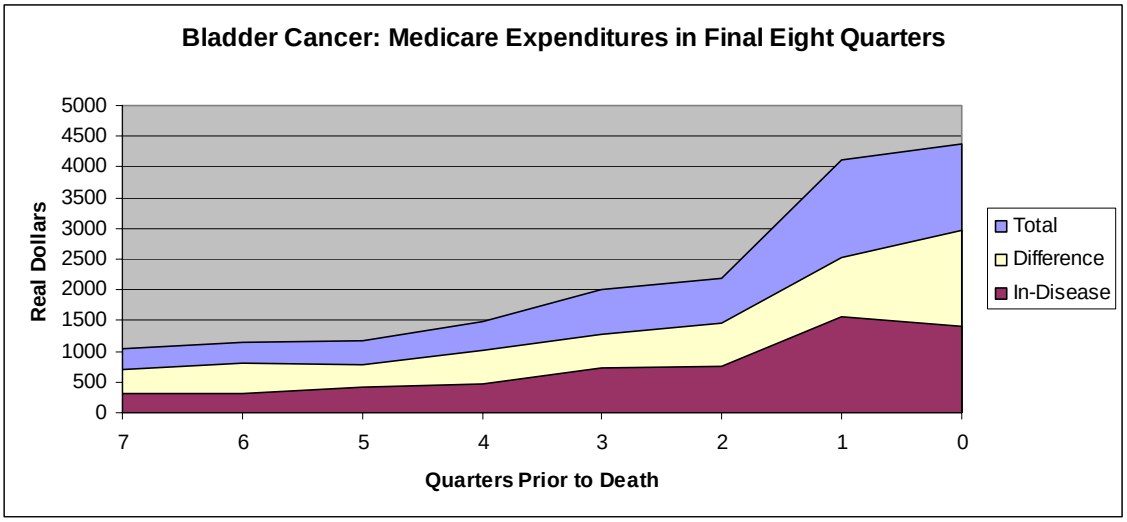

FIGURE 3.8. BLADDER CANCER: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.10-BLADDER CANCER: SUMMARY STATISTICS

Quarter prior to death	**Total**	**Disease Specific**	**Observations**
7	1033.082	320.8533	414
6	1141.168	323.853	421
5	1175.858	407.5471	428
4	1494.566	469.5311	438
3	2000.183	724.8035	444
2	2192.207	746.2583	454
1	4102.955	1574.352	475
0	4379.005	1404.624	481
Male	68.74		
Black	5.65		
Hispanic	0.6		
Mean Age at Death	78.7014		Bladder

Lung Cancer (ICD-9 code 162)

The American Cancer Society estimates that there will be 172,570 new cases of lung cancer in 2005, accounting for approximately 13% of cancers detected this year. Of those there will be 163,510 deaths. Lung cancer is consistently the leading cause of cancer-related deaths among both men and women. Men aged 60 to 79 have a 1 in 17 chance of developing the disease, whereas women in the same age range face a 1 in 26 chance of having lung cancer (American Cancer Society, *Cancer Facts and Figures, 2005*). The pattern of total expenditures and those expenditures specific to lung cancer are illustrated in Figure 3.9 and listed in Table 3.11.

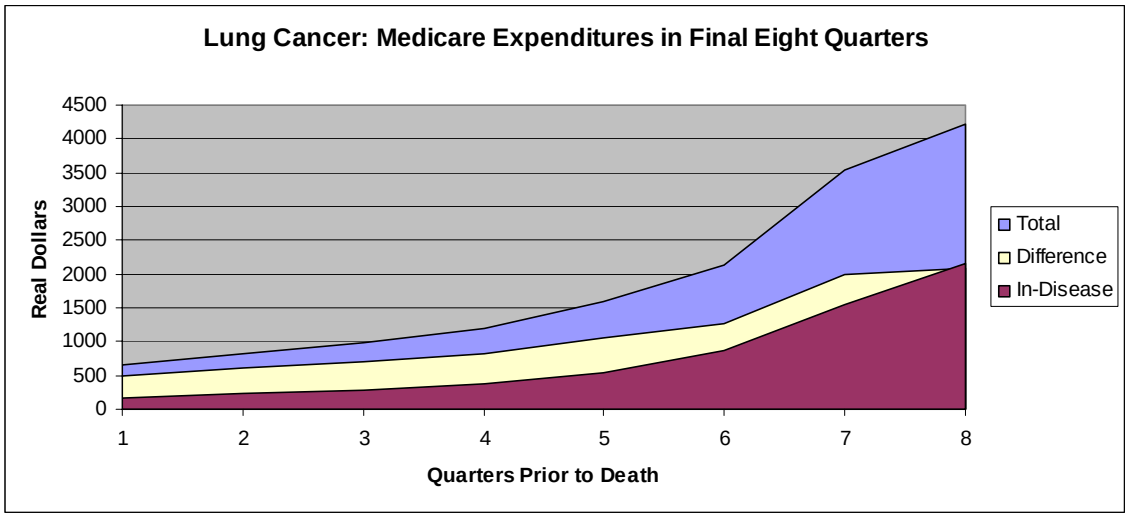

FIGURE 3.9. LUNG CANCER: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.11-LUNG CANCER: SUMMARY STATISTICS

Quarters Prior to Death		**Total**	**Disease Specific**	**Observations**
	7	645.7616	164.5728	2792
	6	831.6551	227.6184	2837
	5	984.1343	289.9235	2877
	4	1194.429	363.8389	2903
	3	1595.704	534.2246	2990
	2	2126.567	860.5966	3185
	1	3537.425	1547.575	3438
	0	4230.202	2154.693	3633
Male		59.42		
Black		8.9		
Hispanic		0.3		
Mean Age at Death		74.0033		lung

Colorectal Cancer (ICD-9 codes 153-154)

In 2005, it is estimated that Americans will face almost 145,000 new cases of colorectal cancer, with about 56,290 deaths from the disease, accounting for 10% of the cancer-related deaths this year. The biggest risk factor with this disease is simply age, as 90% of the cases diagnosed are those found in patients over the age of 50 (American Cancer Society, *Cancer Facts and Figures, 2005*). The pattern of total expenditures and those expenditures specific to colorectal cancer are illustrated in Figure 3.10 and listed in Table 3.12.

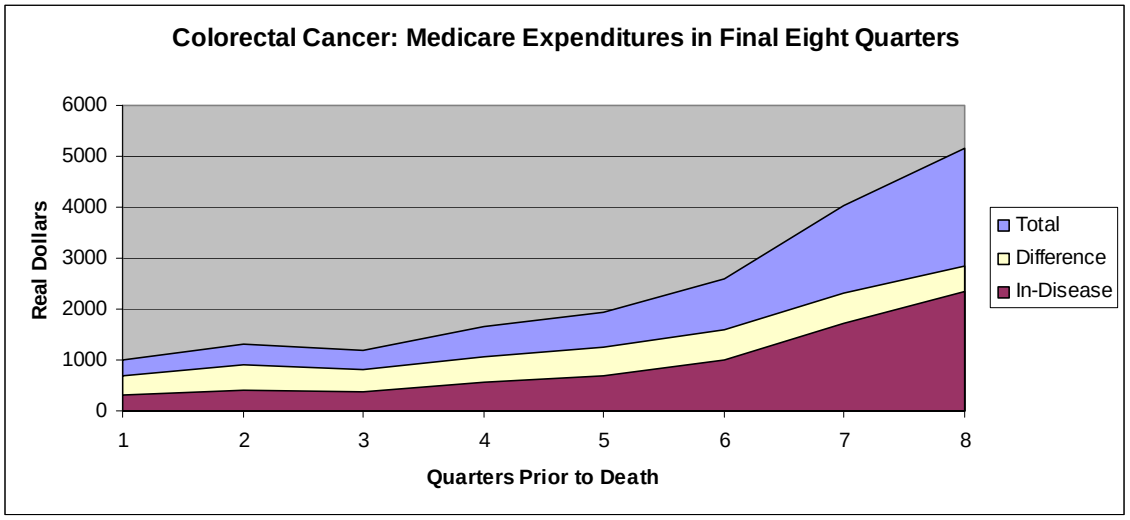

FIGURE 3.10. COLORECTAL CANCER: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.12-COLORECTAL CANCER: SUMMARY STATISTICS

Quarter prior to death	**Total**	**Disease Specific**	**Observations**
7	998.7629	326.1158	1536
6	1318.251	415.7167	1541
5	1201.579	387.9865	1570
4	1651.881	574.394	1613
3	1926.45	676.6422	1631
2	2583.112	997.1344	1698
1	4038.49	1732.164	1807
0	5161.01	2330.305	1877
Male	46.37		
Black	8.88		
Hispanic	1.05		
Age at death	77.34333		colo

Leukemia (ICD-9 codes 204-205)

Leukemia is a malignant disease or a cancer of the bone marrow and blood. It is characterized by the unrestrained accumulation of blood cells (Leukemia and Lymphoma Society, *Leukemia, Lymphoma, Myeloma, Facts 2004*, In Press). The American Cancer Society projects there will be 34,810 new cases of leukemia in 2005 and from that, 22,570 deaths. Leukemia is often thought to be a primarily childhood disease, but it is in fact ten times more likely to be diagnosed in adults. The pattern of total expenditures and those expenditures specific to leukemia are illustrated in Figure 3.11 and listed in Table 3.13.

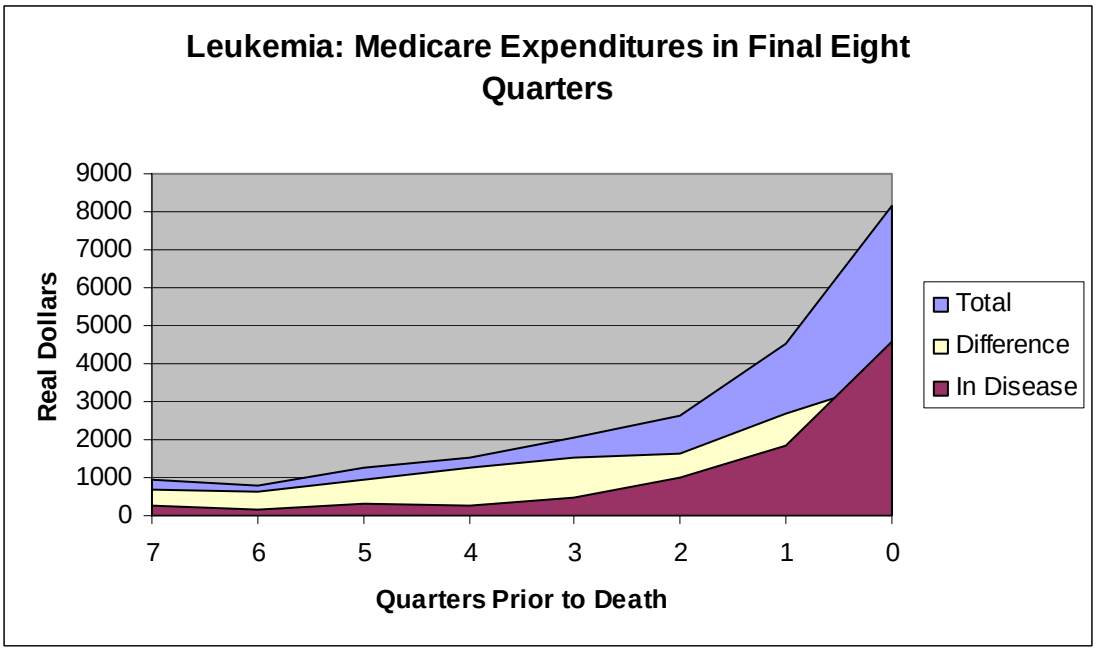

FIGURE 3.11. LEUKEMIA: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.13-LEUKEMIA: SUMMARY STATISTICS

Quarter prior to death		Total	Disease Specific	Observations
	7	966.4444	256.8718	344
	6	794.4889	157.6479	354
	5	1283.782	330.7558	356
	4	1508.1	240.9146	365
	3	2026.317	499.0542	379
	2	2625.835	983.2448	377
	1	4528.256	1836.537	399
	0	8159.386	4554.312	412
Male		58.95		
Black		7.67		
Hispanic		0.48		
Age at death		75.5358		Leuk

Non-Hodgkin's Lymphoma (ICD-9 code 202)

Non-Hodgkin's Lymphoma is cancer of the lymph nodes, and it is a cancer that is unpredictable and one easily spreads beyond the lymphatic system. Non-Hodgkin's Lymphoma will account for 8% of new cancer diagnoses in 2005 or 56,390 cases. Of these, Non-Hodgkin's Lymphoma is expected to claim the lives of 19,200 Americans. A little more than 1% of Americans between the ages of 60 and 79 will develop the cancer. One year survival rate is 77% and the five year survival rates is 59% (American Cancer Society, *Cancer Facts and Figures, 2005*). The pattern of total expenditures and those expenditures specific to non-Hodgkin's lymphoma are illustrated in Figure 3.12 and listed in Table 3.14.

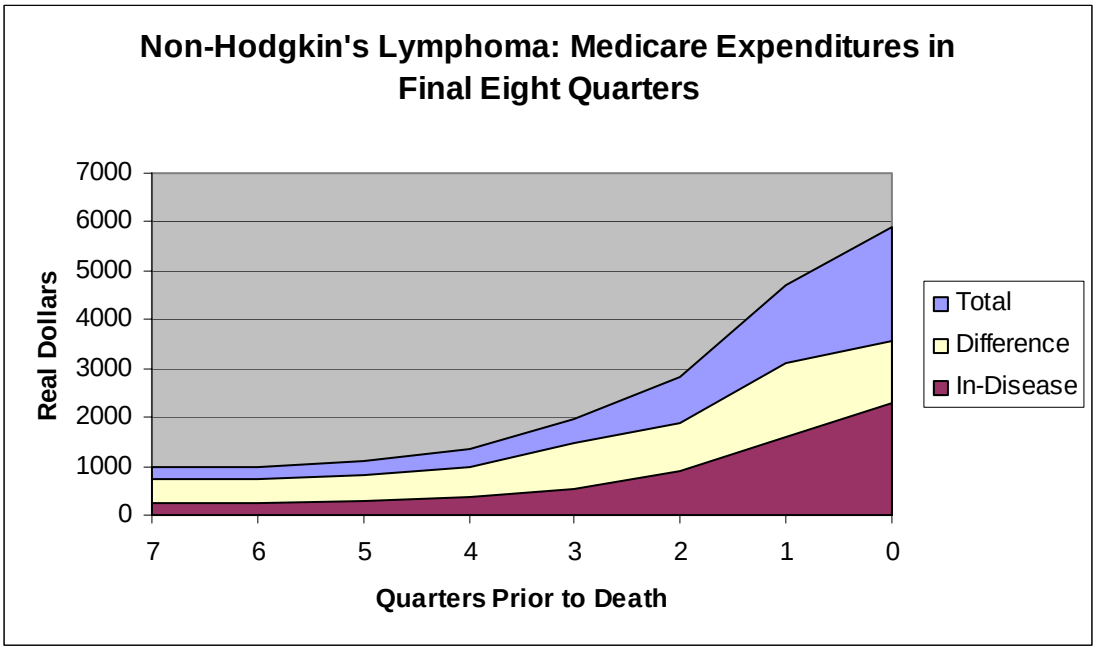

FIGURE 3.12. NON-HOGKIN'S LYMPHOMA: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.14-NON-HOGKIN'S LYMPHOMA: SUMMARY STATISTICS

Quarter prior to death		**Total**	**Disease Specific**	**Observations**
	7	988.8598	236.493	519
	6	966.6587	237.884	523
	5	1107.328	301.1254	526
	4	1364.971	365.8223	536
	3	1979.254	517.7737	549
	2	2807.915	916.0848	565
	1	4719.498	1594.711	602
	0	5877.8	2298.997	621
Male		49.6		
Black		5.44		
Hispanic		0.16		
Mean Age at Death		74.85063		Non Hopkins

Cerebrovascular Disease (ICD-9 codes 436-443)

This category of disease is “ill-defined” as cerebrovascular disease that may or may not be acute and does not include an intracranial or intra-cerebral hemorrhage, commonly known as a stroke, but does include an aneurysm or the bulging of a blood vessel wall. Cerebrovascular disease is much more life-threatening in patients over the age of 70. The pattern of total expenditures and those expenditures specific to cerebrovascular disease are illustrated in Figure 3.13 and listed in Table 3.15.

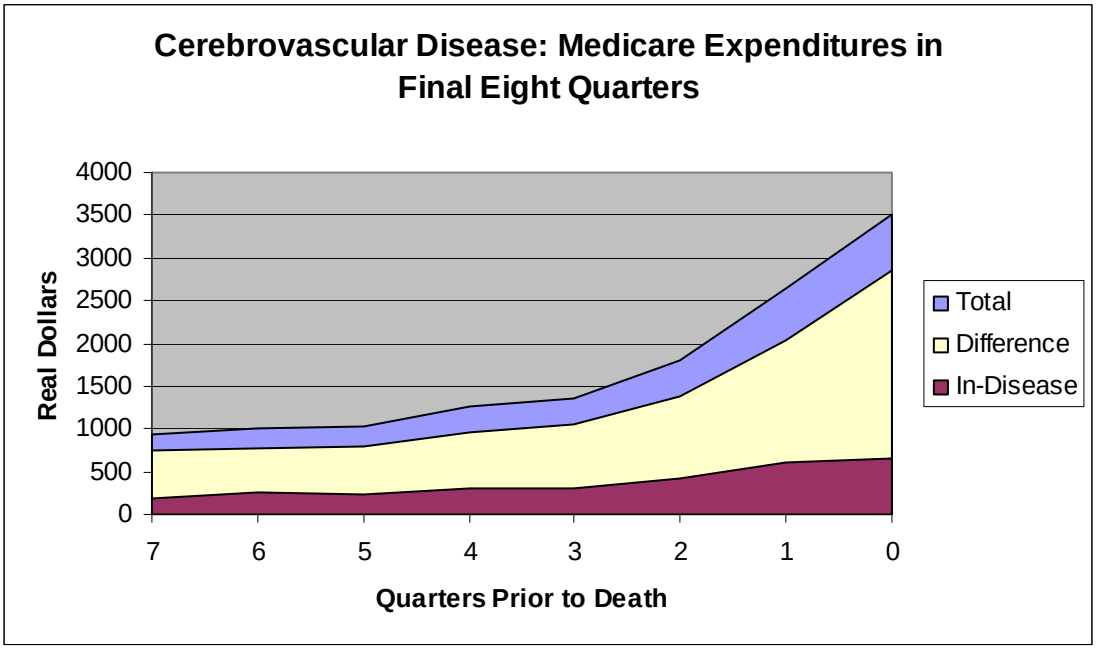

FIGURE 3.13. CEREBROVASCULAR DISEASE: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.15-CEREBROVASCULAR DISEASE: SUMMARY STATISTICS

Quarter prior to death		Total	Disease Specific	Observations
	7	946.6813	196.4355	4861
	6	1015.734	250.0618	4893
	5	1027.689	242.8582	4917
	4	1251.504	295.4154	4915
	3	1358.954	295.4213	4927
	2	1807.41	419.4126	4995
	1	2640.459	606.0752	5201
	0	3512.287	647.6719	5295
Male		39.03		
Black		11.16		
Hispanic		0.66		
Age at death		80.52686		cere

Stroke (ICD-9 codes 431-432)

A stroke is when a blood vessel in the brain is blocked or is made narrower, reducing the blood flow in that vessel significantly. A stroke encompasses the damage done to the brain when this vessel is blocked or bursts. It was estimated that three-quarters of a million Americans would suffer a stroke in 2004, and of those, 160,000 would die. It is said to be the third leading cause of death in the US. Sixty-two percent of people who suffer a stroke in any given year are over the age of 65 (The Internet Stroke Center). The pattern of total expenditures and those expenditures specific to stroke are illustrated in Figure 3.14 and listed in Table 3.16.

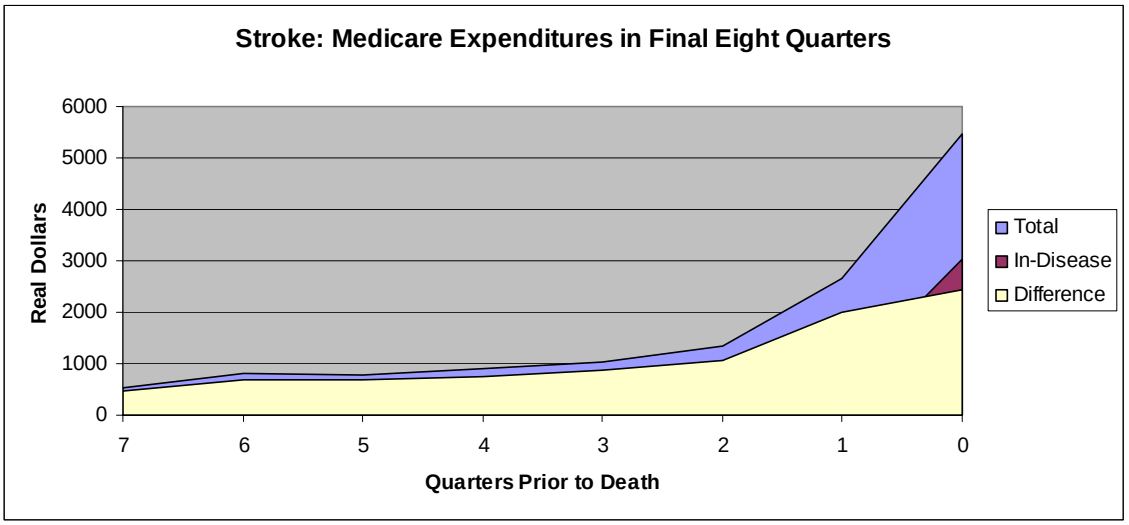

FIGURE 3.14. STROKE: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.16-STROKE: SUMMARY STATISTICS

Quarter prior to death		Total	Disease Specific	Observations
	7	537.0868	68.17584	798
	6	808.5765	129.2901	788
	5	767.147	67.68327	798
	4	911.4004	166.667	813
	3	1031.52	149.9741	810
	2	1333.275	260.3714	827
	1	2656.37	645.7846	855
	0	5473.204	3033.411	983
Male		46.64		
Black		11.34		
Hispanic		0.91		
Age at death		78.48571		Stroke

COPD (ICD-9 codes 490-492, 494, 496)

Chronic Obstructive Pulmonary Disease or COPD includes two conditions. The first is chronic bronchitis, which is the inflammation and subsequent scarring of the airway structure. Emphysema is the enlargement and degradation of the air sacs within the lungs which are called the alveoli. Almost 90% of the cases of COPD occur as a result of smoking, as a smoker has a tenfold risk to acquiring the disease as does as a non-smoker (JAMA web site, *Information on COPD,* 2004). COPD is the fourth leading cause of death for persons aged of 65 to 84, claiming the lives 120,000 American in 2002 (National Center for Health Statistics, *Report of Final Mortality Statistics,* 2002). Females are now twice as likely to be diagnosed with COPD as males. Quality of life diminishes significantly as the disease worsens, and a patient can require mechanical respiratory assistance. The pattern of total expenditures and those expenditures specific to COPD are illustrated in Figure 3.15 and listed in Table 3.17.

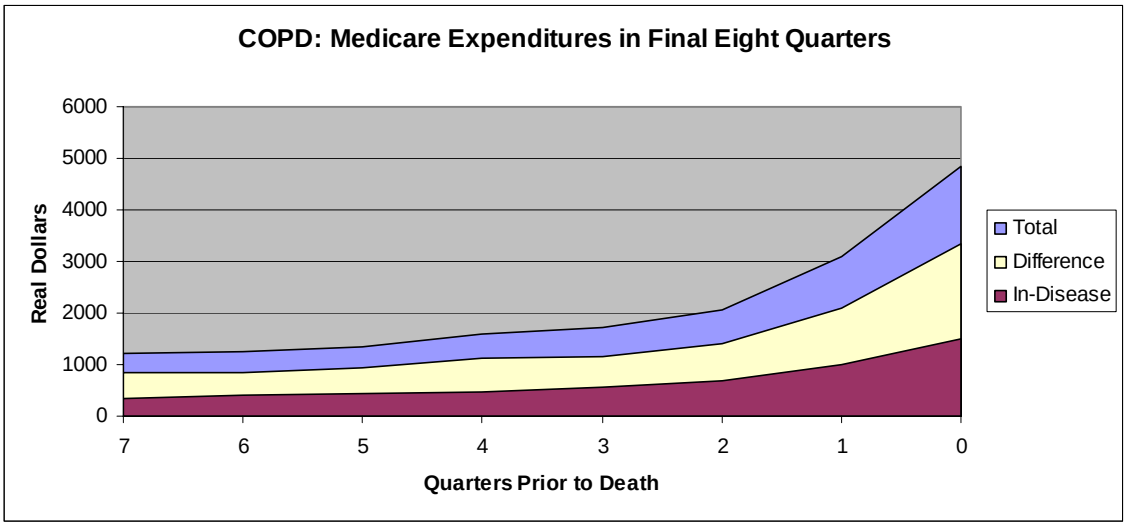

FIGURE 3.15. COPD: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.17-COPD: SUMMARY STATISTICS

Quarter prior to death		**Total**	**Disease Specific**	**Observations**
	7	1217.557	359.0775	4470
	6	1248.877	393.1828	4531
	5	1350.321	424.5832	4545
	4	1606.012	472.7045	4567
	3	1708.227	548.0693	4607
	2	2068.93	677.9129	4682
	1	3104.336	1001.868	4791
	0	4850.652	1491.567	4847
Male		51.91		
Black		5.96		
Hispanic		0.75		
Age at death		75.44517		COPD

Pneumonia (ICD-9 codes 480-487)

In 2002, pneumonia claimed the lives of almost 60,000 Americans over the age of 65. The elderly, who have weakened cough and gag reflexes and decreased immune ability, have much lower survival rates, especially those with other conditions (National Center for Health Statistics, 2002). The pattern of total expenditures and those expenditures specific to pneumonia are illustrated in Figure 3.16 and listed in Table 3.18.

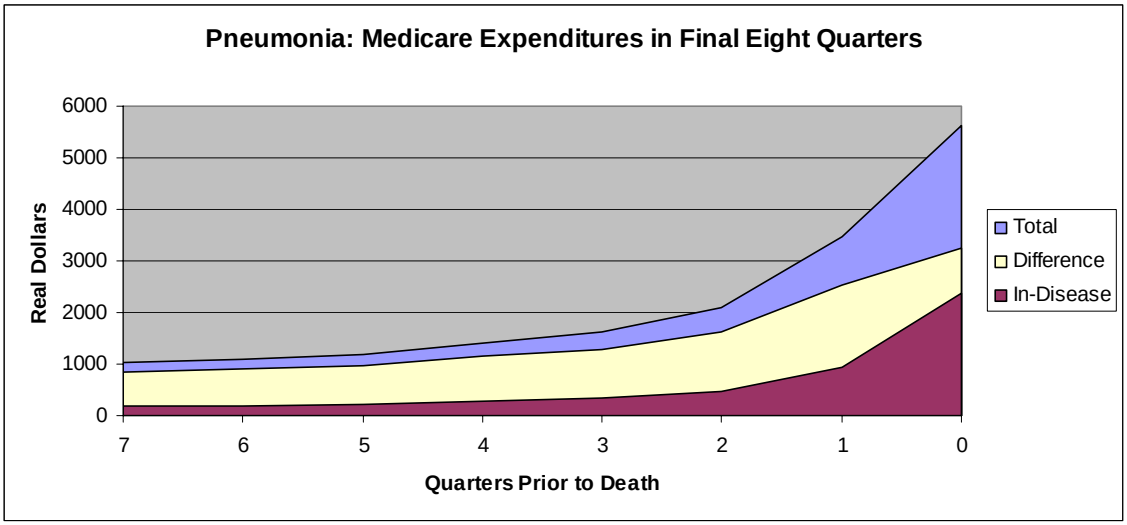

FIGURE 3.16. PNEUMONIA: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.18-PNEUMONIA: SUMMARY STATISTICS

Quarter prior to death		**Total**	**Disease Specific**	**Observations**
	7	1018.034	175.9555	6090
	6	1105.655	198.3878	6024
	5	1185.596	216.0888	6090
	4	1416.359	274.7908	6128
	3	1637.202	346.4828	6178
	2	2107.628	470.1097	6275
	1	3465.062	927.2706	6507
	0	5628.785	2372.38	6697
Male		50.25		
Black		9.09		
Hispanic		0.88		
Age at death		80.16489		pneu

Diabetes Mellitus (ICD-9 codes 250)

Diabetes mellitus is one of the more expensive causes of morbidity and mortality in older Americans. In 1997, the condition accounted for 2.3 million hospital admissions, 14 millions hospital days, and 70 million nursing home days with specific medical expenditures estimated at $44 million. More than half a million new cases are diagnosed each year. Over 10% of people over the age of 65 have clinical diabetes. This condition increases an older adult's likelihood of having myocardial infarction, stroke and kidney failure *(*Lebovitz, H.E., 1997). The pattern of total expenditures and those expenditures specific to diabetes mellitus are illustrated in Figure 3.17 and listed in Table 3.19.

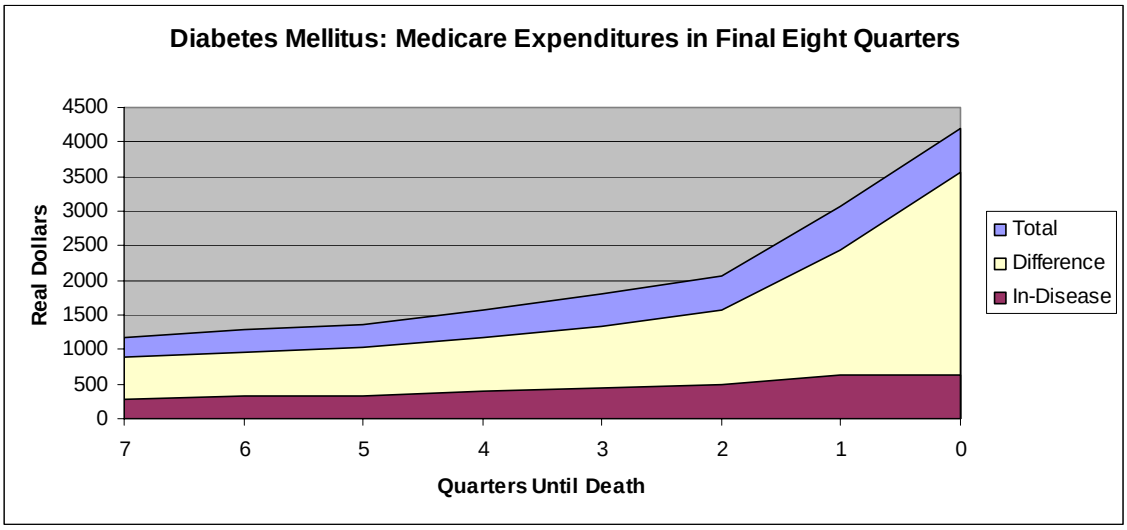

FIGURE 3.17. DIABETES MELLITUS: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.19-DIABETES MELLITUS: SUMMARY STATISTICS

Quarter prior to death	Total	Disease Specific	Observations
7	1164.872	277.0593	3446
6	1295.349	328.3004	3466
5	1347.708	317.8169	3467
4	1565.188	397.7791	3491
3	1796.613	450.9656	3506
2	2073.745	492.184	3558
1	3070.086	641.2895	3611
0	4192.373	638.2264	3593
Male	44.86		
Black	15.66		
Hispanic	1.59		
Mean Age at Death	75.12347		diabetes

Alzheimer's Disease (ICD-9 code 331)

It is estimated that 4.5 million people in the US have Alzheimer's disease and the number is expected to grow significantly (L.E. Hebert, et al. 2003). Medicare spent $31.9 billion on Alzheimer's disease in 2000 (Lewin Group, 2001). A person suffering from Alzheimer's disease is expected to live an average of eight years from the diagnosis, but can live more than twenty. Patients with the disease have half the survival rates as there unaffected counterparts, and that survival rate is also changed by age at onset and the severity of other medical conditions (E.B. Larson, et al. 2004). The pattern of total expenditures and those expenditures specific to Alzheimer's disease are illustrated in Figure 3.18 and listed in Table 3.20.

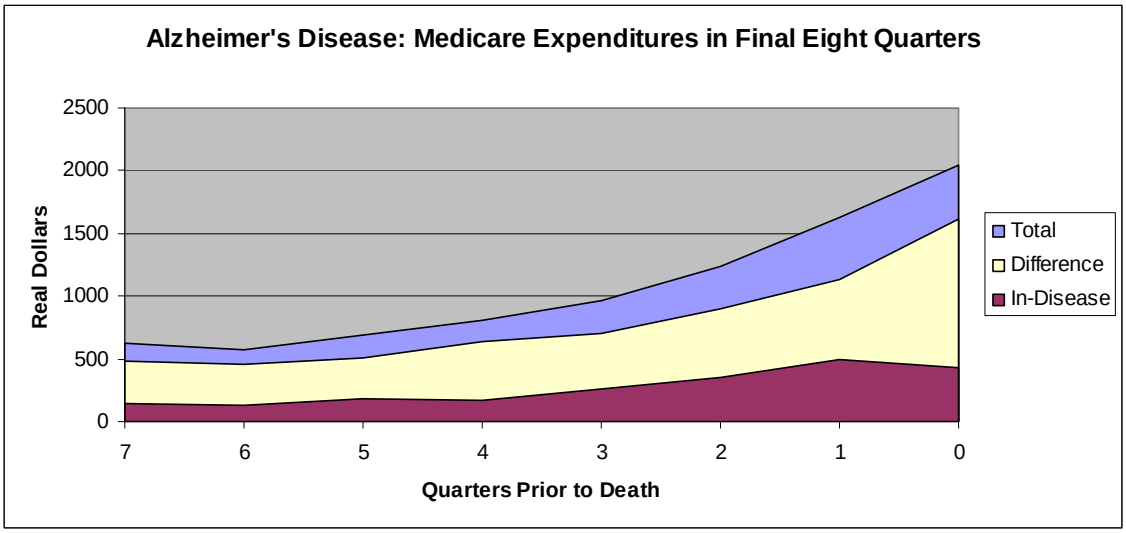

FIGURE 3.18. ALZHEIMER'S DISEASE: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.20-ALZHEIMER'S DISEASE: SUMMARY STATISTICS

Quarter prior to death		Total	Disease Specific	Observations
	7	621.5586	145.5056	1239
	6	576.8116	127.3169	1249
	5	693.1146	182.6369	1252
	4	809.1196	174.4844	1269
	3	960.3822	257.0144	1301
	2	1241.72	349.0617	1315
	1	1625.684	493.1615	1349
	0	2043.651	432.0051	1341
Male		35.01		
Black		6.58		
Hispanic		0.64		
Age at death		81.65196		alz

Kidney Failure (ICD-9 codes 580, 582, 583, 585, 590, 592)

The 1999 U.S. Renal Data System Annual Report, produced by the National Institute of Diabetes and Digestive and Kidney Diseases, showed that the number of Americans with kidney failure is increasing by 6% each year, with the US leading the word in number of new diagnoses per million population. 79,000 Americans suffered End Stage Renal Disease or total kidney failure in 1997. These patients require kidney dialysis or transplants of the organ to survive the disease. Sixty-two percent of the new cases reported in 1997 were patients aged 60 or more. The pattern of total expenditures and those expenditures specific to kidney failure are illustrated in Figure 3.19 and listed in Table 3.21.

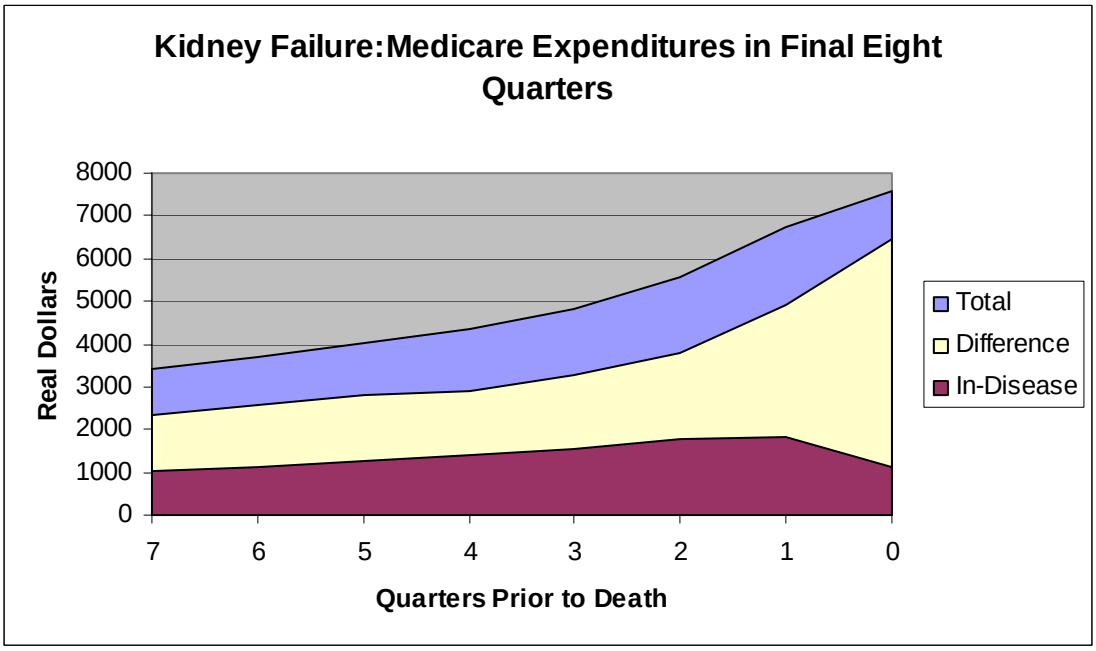

FIGURE 3.19. KIDNEY FAILURE: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.21-KIDNEY FAILURE: SUMMARY STATISTICS

Quarter prior to death		**Total**	**Disease Specific**	**Observations**
	7	3406.887	1044.46	1832
	6	3697.979	1132.208	1848
	5	4035.811	1244.213	1883
	4	4339.213	1426.178	1903
	3	4823.353	1565.086	1927
	2	5549.128	1763.32	1958
	1	6749.506	1846.772	1992
	0	7576.899	1133.665	2002
Male		52.11		
Black		25.05		
Hispanic		2.08		
Age at death		68.7358		Kidney

Septicemia (ICD-9 code 38)

Septicemia is infection or poisoning of the blood and is often associated with severe disease. The infection can begin in the lungs, urinary tract, or abdomen and can lead to septic shock and sometimes death. Septic shock has a survival rate of slightly more than 50%, depending on the organs of the body involved. People over the age of 65 are at particular risk of developing septicemia and subsequently dying from it. During the last decade, there was a considerable, unexplained increase in the rate of elderly US who were hospitalized for septicemia, according to William B. Baine, M.D., of the Agency for Healthcare Research and Quality. Dr. Baine and his colleagues used Medicare claims data for hospital discharges from 1991 through 1998 to study over 75,000 hospitalizations for septicemia in patients aged 65 or older.

From 1991 through 1997, the diagnosis codes for “unspecified septicemia" increased 108 percent annually, and those for pneumococcal septicemia increased 310 percent. These increases exceeded the growth of the elderly Medicare population. In this period the morbidity associated with the disease hit males and African-American patients the hardest. The pattern of total expenditures and those expenditures specific to septicemia are illustrated in Figure 3.20 and listed in Table 3.22.

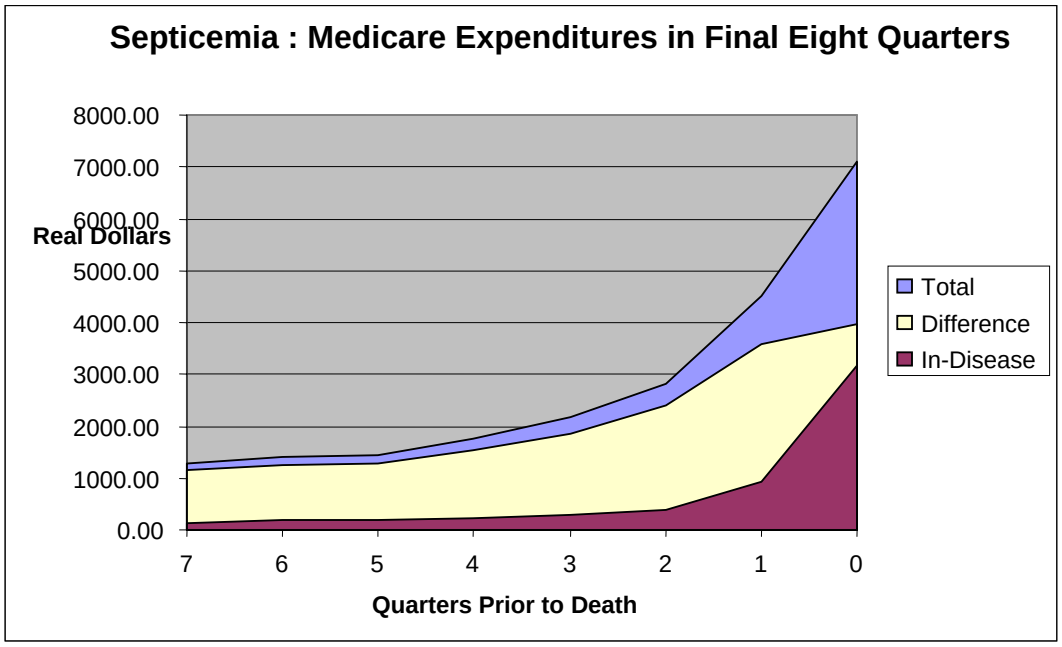

FIGURE 3.20. SEPTICEMIA: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.22-SEPTICEMIA: SUMMARY STATISTICS

Quarter Prior to Death	Total	Disease Specific	Observations
7	1285.47	128.1493	2481
6	1422.53	177.7643	2482
5	1455.66	177.5688	2490
4	1754.52	234.4857	2522
3	2172.74	301.3311	2538
2	2805.66	392.0569	2596
1	4501.33	924.2728	2686
0	7112.48	3152.251	2819
Male	43.02%		
Black	14.69%		
Hispanic	1.10%		
Mean Age at Death	78.34		sept

Parkinson's Disease (ICD-9 code 332)

Parkinson's disease is a chronic, progressive, and disabling neurological disorder of which 85% of cases are diagnosed in persons over the age of 60, with the average age of onset at 57. In its later stages, it can be completely debilitating and cause some dementia. It is very common for older Parkinson's disease sufferers to also suffer arthritis, broken bones, and diabetes. They are much more likely to use home-health care or skilled nursing facilities *(Medicare Costs and Resource Use for Parkinson's Disease).* In the United States, it is estimated that 1.5 million Americans suffer from the disease and that 60,000 new cases are diagnosed each year. Parkinson's disease can be difficult to diagnose and is usually a disease that is managed with therapy and pharmaceuticals, rather than being treated and/or cured (National Parkinson's Foundation, 2004). The pattern of total expenditures and those

expenditures specific to Parkinson's disease are illustrated in Figure 3.21 and listed in Table 3.23.

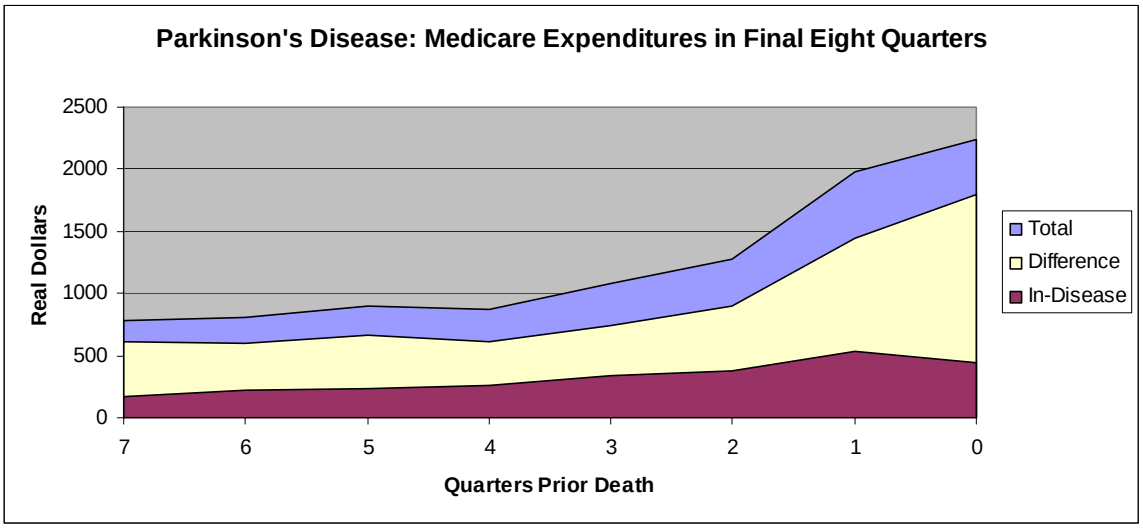

FIGURE 3.21. PARKINSON'S DISEASE: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.23-PARKINSON'S DISEASE: SUMMARY STATISTICS

Quarter prior to death		Total	Disease Specific	Observations
	7	779.4796	171.8542	697
	6	808.8793	215.6443	702
	5	899.385	234.7422	700
	4	876.6993	265.4056	693
	3	1078.253	340.7946	701
	2	1273.631	377.9488	709
	1	1977.545	536.1833	705
	0	2234.313	440.3613	689
Male		53.54		
Black		4.01		
Hispanic		0.4		
Age at death		79.41286		park

Multiple Sclerosis (ICD-9 code 340)

Multiple Sclerosis is an autoimmune disease affecting the central nervous system that is usually diagnosed between the ages of 20 and 50. It is a disruption or scarring on the myelin, the protective cover for the nerve fibers in the brain and spinal cord. It currently afflicts between 350,000 and 500,000 Americans. Only 10% of new diagnoses are made after age 65. It is two to three times more common in women than in men. The disease can be manageable at first, but as the patient ages the periods of remission decrease and the severity of the disability increases. Today, due to advancements in treatment options, this incurable disease still allows a patient a normal life expectancy pattern minus seven years (The Multiple Sclerosis Foundation, 2005). The pattern of total expenditures and those expenditures specific to multiple sclerosis are illustrated in Figure 3.22 and listed in Table 3.24.

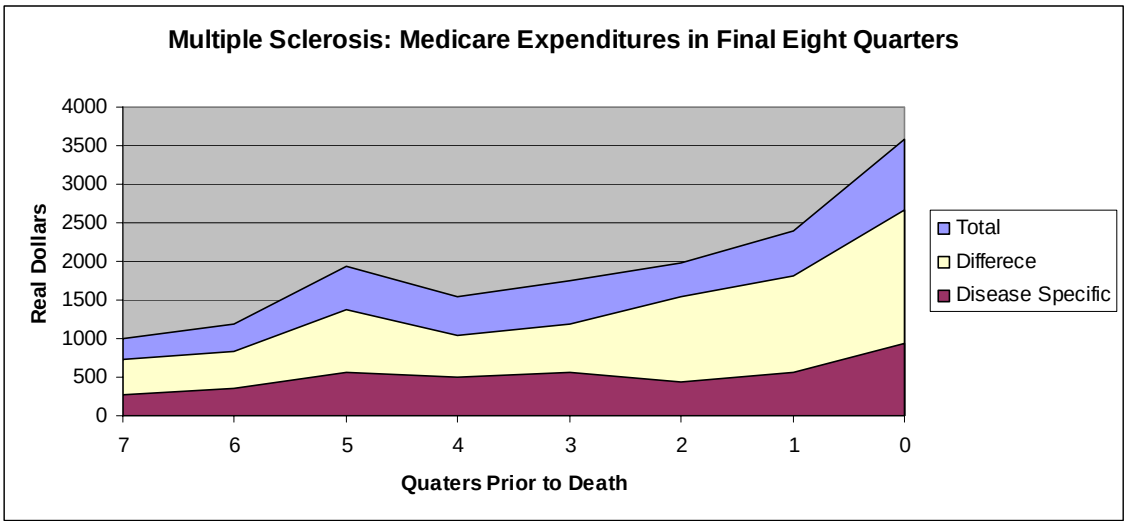

FIGURE 3.22. MULTIPLE SCLEROSIS: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.24-MULTIPLE SCLEROSIS: SUMMARY STATISTICS

Quarter prior to death		Total	Disease Specific	Observations
	7	1003.102	268.5977	109
	6	1196.927	353.8864	107
	5	1928.254	562.2959	101
	4	1533.269	499.4747	106
	3	1753.946	559.8756	110
	2	1978.666	445.1169	106
	1	2386.529	570.5417	112
	0	3592.196	933.9864	110
Male		37.29		
Black		5.22		
Hispanic		1.74		
Age at death		63.03457		MS

Muscular Dystrophy (ICD-9 code 359)

Muscular dystrophy is a group of nine genetic, degenerative conditions that affect voluntary muscle control, although they are combined into one three-digit ICD-9 code and this work did not attempt to distinguish one from another. The nine types of muscular dystrophy have onset at different ages, from birth to late adulthood. The majority of people affected by Muscular Dystrophy die before reaching the Medicare population age. Specific variants more commonly affect individuals who could reach advanced age. Of particular interest to this research is the condition known as Distal Muscular Dystrophy which has an onset at 40 to 60 years of age or Amyotrophic Lateral Sclerosis (ALS) (Also known as Lou Gehrig's Disease) which usually affects adults. As medical advance enables more of these people to reach older ages, the diagnosis will become more and more relevant to this research (*Muscular Dystrophy Association website 2005)*. The pattern of total expenditures

and those expenditures specific to muscular dystrophy are illustrated in Figure 3.23 and listed in Table 3.25.

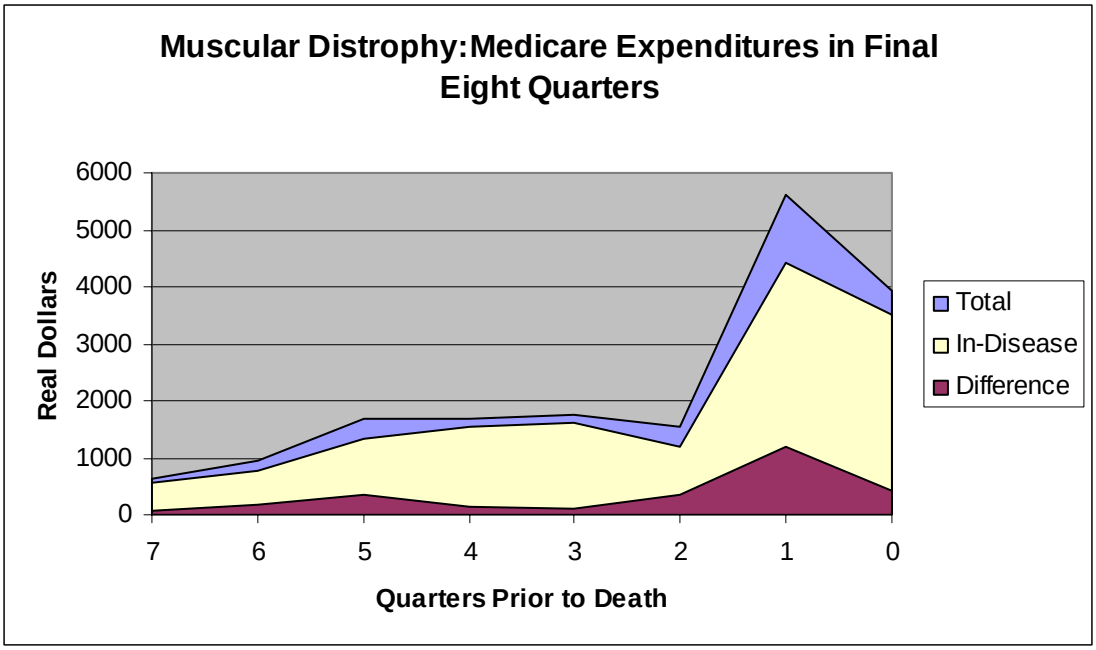

FIGURE 3.23. MUSCULAR DYSTROPHY: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.25-MUSCULAR DYSTROPHY: SUMMARY STATISTICS

Quarter prior to death		Total	Disease Specific	Observations
	7	642.5296	73.9473	34
	6	956.0851	180.2558	36
	5	1697.59	355.0531	37
	4	1681.079	144.2947	37
	3	1740.884	116.1376	38
	2	1554.309	345.6022	37
	1	5617.672	1208.91	35
	0	3927.507	413.1758	40
Male		66.67		
Black		2.22		
Hispanic		0		
Age at death		64.34028		MD

Hip Fracture (ICD-9 code 820)

Over one-third of older Americans age 65 or older fall each year and of those who fall, 20% to 30% suffer moderate to severe injuries such as hip fractures that reduce mobility and independence, and increase the risk of premature death (M.C. Hornbrook 1994; J.M. Hausdorff 2001; D.A. Sterling 2001). Among people ages 75 years and older, those who fall are nearly five times more likely to be placed in a long-term care facility for a stay of a year or more (I.P. Donald 1999). Women sustain about 80% of all hip fractures (J.A. Stevens 2000). In 1999 in the United States, hip fractures resulted in approximately 338,000 hospital admissions (J.R. Popovic, 2001). The pattern of total expenditures and those expenditures specific to hip fracture are illustrated in Figure 3.24 and listed in Table 3.26.

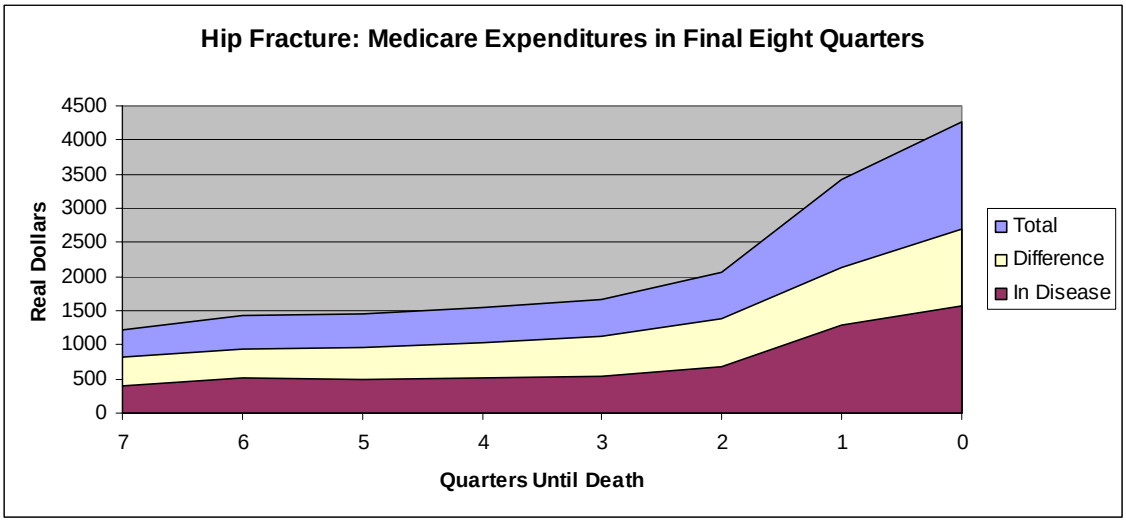

FIGURE 3.24. HIP FRACTURE: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.26-HIP FRACTURE: SUMMARY STATISTICS

Quarter prior to death	**Total**	**Disease Specific**	**Observations**
7	1227.312	403.2396	2544
6	1438.221	504.56	2568
5	1454.075	489.5794	2595
4	1557.56	523.9802	2609
3	1663.717	545.5047	2617
2	2055.197	678.7576	2660
1	3418.373	1286.431	2721
0	4272.15	1570.752	2758
Male	27.56		
Black	3.65		
Hispanic	0.35		
Age at death	83.28434		hip

Other

Other consists of all ICD-9 codes net of the ones included above. This was constructed by subtracting out expenditures for the codes above from an independent measure of total expenditures. It is quite possible that some of the included spending was motivated by one the conditions above but that that condition was listed as a secondary diagnostic code for the covered procedure. This category is not intended to be ripe for interpretation but to serve as a catch-all and perhaps a baseline or "average" profile. The pattern of total expenditures and those expenditures specific to other diseases are illustrated in Figure 3.25 and listed in Table 3.27.

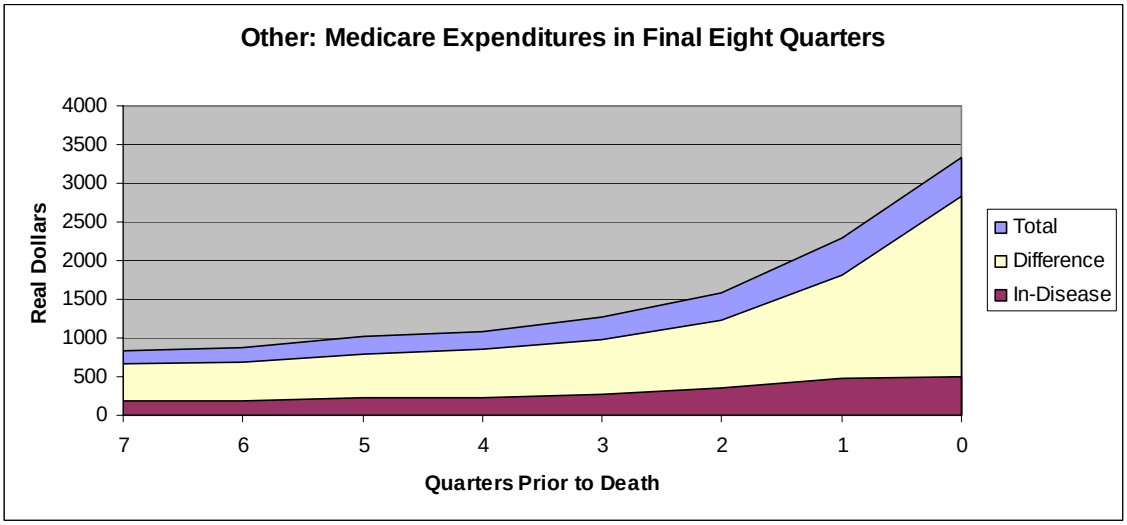

FIGURE 3.25. OTHER: MEDICARE EXPENDITURES IN FINAL EIGHT QUARTERS

TABLE 3.27-OTHER: SUMMARY STATISTICS

Quarter prior to death		Total	Disease Specific	Observations
	7	841.5765	177.1004	8440
	6	869.681	182.8368	8462
	5	1015.42	222.2659	8393
	4	1088.44	231.9564	8443
	3	1261.917	276.1524	8403
	2	1582.648	363.2562	8519
	1	2297.092	487.8175	8775
	0	3338.786	495.6446	9055
Male		40.48		
Black		9.99		
Hispanic		0.83		
Age at death		78.09937		other

The descriptive statistics on each disease represents the first contribution of the present work. Only by stacking decedents on their time of death and then considering the expenditures path that got them to that point can useful analysis of the cost of dying begin. The patterns of expenditures for most diseases are quite similar in that they represent a person going from relatively good health up until their dying day. The levels prior to death are in effect averaged across the experiences of all the decedents of each disease. No one individual's experience is likely to conform to the pattern presented. They serve as an illustration of the path of expenditures both in disease and in total to give a visual impression of the cost of dying. What can be observed from each is the relationship between in disease spending and in total spending and the changes in that relationship as death approaches.

The underlying relationship between health and expenditure that these graphs and tables being to present are the subject of the econometric models in the chapters that follows. It is an open question whether the primary contribution of this work will come merely from the compilation of these statistics or from what econometric relationships can be revealed with the adopted procedure. Taken together the statistics presented here and in the models developed in the next chapter serve as a reference for future targeted investigations on specific diseases or disease categories.

CHAPTER IV

RESULTS

The design of the models undertaken in this work is intended to investigate several aspects of the costs of dying on Medicare. This section will be made up of three sets of models. The goal of each model is to predict terminal period Medicare expenditures from expenditures made in prior periods. The models are designed to identify patterns that could potentially inform decisions about changes to the structure of Medicare repayment systems. The idea is that the models range from purely descriptive analyses of the data to specifications intended to establish whether or not the data can be used to forecast impending costs. It is hoped that these models can serve as a foundation for future work targeted at designing a repayment system that can efficiently provide ameliorative benefits as seniors enter their terminal periods. While the primary goal is simply to describe and further an understanding of the disease-specific cost profiles, the models are designed with particular forecasting thresholds in mind. The logic of the progression is directed at determining the level of detail which yields the most useful relationships.

The primary focus of the modeling in the work that follows is to establish the relationship between the path of expenditures leading up to death and the expenditures of the terminal period. This is done at two levels. One set of models seeks to explain the

disease-specific expenditures, while the other focuses on the entire set of terminal period expenditures. While it is to be hoped that many models will reflect a tight and dependable relationship on which policy measures could be based, lack of a statistically significant relationship can be equally informative.

The initial descriptive model estimated for each disease focuses simply on the pattern of in-disease expenditure in the four quarters prior to the terminal period. It is intended to focus on the period of time for which hospice services are presently available. Co-variates for each model include an indicator variable for sex, for race (black), as well as a discreet age variable assessed at the time of death. It has been generally found that these demographic factors are strongly significant and they serve to ground the model in the prior literature. It is anticipated that the relationship between spending in these periods and the expenses in the terminal period will reflect the characteristic nature of the disease analyzed. For example, a disease such as septicemia is expected to show a strong relationship in the final period, but little earlier than that. Chronic conditions such as diabetes are expected to be associated with a high level of persistence through out the terminal year.

The second set of models focus on in-disease spending in the final year averaged across four quarters prior to death. Its unique characteristic is that it includes counts of specific treatments motivated by the disease which is ultimately estimated to cause death. Again, age at death, race and sex are included as co-variates. This specification is intended to investigate the relationship between major (expensive) interventions and total

expenditure versus the potential alternative of more frequent, less invasive procedures. It is naively expected that number of procedures will enter negatively in a model of terminal period expenditure after total in-disease expenditures are controlled.

The final model looks at total Medicare expenditures rather than disease-specific expenditures. A comparison of this set of models to the other sets will serve to suggest the relevance of the specific in-disease expenditure criterion used in the above models. It is expected that many diseases that ultimately cause the death of beneficiaries represent only the last straw in a long period of declining health. It is hoped the distinction between this set of models and the first set will differentiate diseases in an important manner. Given the fact that frailty is so poorly documented and many seniors lives with significant chronic illnesses for years prior to death, it is useful to distinguish between diseases that commonly "kill off" the frail, and those diseases which cause the death of people who otherwise have few claims. If it is the case that for a disease, total spending is a far more powerful predictor than in-disease spending that would argue that the disease in question could be associated with chronic poor health and that further specific study of its related expenditures would be of little use. If instead the in-disease spending is the primary driver of terminal period expenditures, it would seem to suggest that a stronger and clear picture can be defined.

For each disease the three models described above are estimated in the following manner. The model of quarterly expenditure levels and the model of yearly averages with treatment counts are estimated with three distinct specifications. The need for the three

specifications comes from the nature of the death disease variables generated. In estimating the relationship between the pattern of expenditure prior to death and terminal period expenditure for colon cancer, the relevant population would of course be those people who die of colon cancer. Given the construction of the variables, it is unfortunately the case that many people who die at the time they do because they have colon cancer may well actually be flagged as having died of heart failure, stroke, or septicemia, etc. So many people who do not "die" of colon cancer will have positive levels of expenditure for colon cancer treatments (whether they survived it or not). In addition, the majority of individuals in the sample will have no expenditures for colon cancer in any particular quarter prior to death. Thus, there are two problems with estimating the model. The first problem is a muddy dependant variable and the second is a great many zeros in the independent variables. The approach adopted to address these problems is to include three estimates of each model, OLS on the whole population, Tobit, and OLS only on decedents of the disease analyzed. The third model uses total expenditures as a dependent variable. The initial model in that set is common for all diseases and is presented first. Within each disease, a Tobit model focusing on the expenditures in that disease and an OLS model on the decedents of that disease will be included.

The initial treatment is a simple OLS regression predicting terminal period expenditures using all persons in the sample. The OLS specification is not expected to be dependable due to the complication of a non-normal distribution in the independent

variables. It is likely that few men in the sample will have treatments for cervical cancer, for example. The fact that each disease will affect only a small segment of the sample generates a significant left-censoring of the expenditure distribution. OLS is included primarily as a baseline estimate.

Tobit analysis is intended to address the left-censoring problem. In most circumstances, this is probably the preferred estimator. It has the property of correcting for the zero problem. A partial concern remains, however. It is possible for many diseases that small positive expenditures exist for people from testing, mislabeling, data errors or other reasons. It is also true that many people have net negative expenditures on their Medicare claims for particular diseases. These represent rebates to correct for prior billing errors. It is a bit too strong to say that censoring exists at any expenditure level, because there are observations across the range, positive and negative. It is a drawback of the adopted approach that a blanket treatment for all diseases makes correcting for the problem unworkable at this level. In future work, diseases should be considered independently and the modeling procedure tailored to their particular characteristics. The intended contribution of the adopted methodology depends on a consistent approach across diseases, however. That said, the Tobit results are probably the most dependable but not without their problems.

A third set of estimates is a simple OLS on only those individuals who are flagged as having died of the disease in question. While this is likely to take care of the left-censoring problem in itself, it eliminates those people who have had positive levels of expenditure for

the disease, but are not listed as having died from it. As such, the conclusions drawn from the models must be very limited in application. It is certainly possible that a disease commonly co-morbid with other diseases with similar expenditure levels would suffer from such analysis. If it is largely a coin toss whether the decedent is classified as having died of a heart attack or a stroke, eliminating the expenditure profile of those who die of a heart attack from an understanding of the expenditure progression of victims of strokes will render the analysis biased and ineffective.

Estimation Results

The following pages present and describe the results of the models outlined above in order of their prevalence in the data as a cause of death. Given that many of the diseases have similar patterns of demise, in many cases emphasis will be placed on the differences between patterns rather than repeating the similarities. The focus of the analysis will be in comparing the results of the differing specifications to get a sense of the expenditure patterns within the disease and their correspondence to non-expenditure factors.

One element at issues is the usefulness of adopted procedure for disaggregating expenditures into disease specific spending. For comparison, the first results presented cover total Medicare spending. The dependant variable in the initial model is total terminal period expenditures. The model seeks to explain variation in total terminal period expenditures with the path of total expenditures in the seven quarters prior, along with covariates. The results are assumed to be unique on their own, as no similar quarter-based modeling has been found in the existing literature.

The results in Table 4.1 confirm the general findings in the literature as well as the impression made by a casual inspection of the descriptive statistics. Total spending follows an upward trend up to the terminal period. Age at death is strongly negative. Increased age at death lowers terminal expenditures. Men incur higher levels of Medicare expenditure after controlling for age than women, and blacks have higher expenditures than whites.

Full Sample

TABLE 4.1-FULL SAMPLE HISTORY OF TOTAL SPENDING

	Coeff	Std. Err
Total Spending t-1	**0.166**	0.0068
Total Spending t-2	-0.01	0.0092
Total Spending t-3	**0.211**	0.011
Total Spending t-4	**0.348**	0.0117
Total Spending t-5	0.258	0.13
Total Spending t-6	**0.0341**	0.0127
Total Spending t-7	0.0209	0.0126
Age at Death	**-61.65**	3.37
Black	**1323.2**	123.5
Male	**264.1**	73
Cons	**8713**	285.4
Observations	62,829	
R^2	0.0385	

Heart Disease

TABLE 4.2- HEART DISEASE: IN DISEASE EXPENDITURES IN YEAR OF DEATH

Heart disease	**OLS**		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.076**	0.007	**0.279**	0.018	**-0.04**	0.019
t-2	**0.029**	0.001	**0.169**	0.025	**-0.085**	0.027
t-3	**0.052**	0.015	**0.306**	0.038	**-0.13**	0.041
t-4	0.016	0.014	**0.192**	0.035	**-0.15**	0.038
Age	**-5.65**	0.951	2.26	2.95	**-59.1**	7.3
Black	-24.33	35.15	**267.16**	105.7	32.9	250.6
Male	6.13	21.37	-22.52	65.38	-111.7	147.9
Cons	**794.74**	77.63	**-5144.7**	244.71	**7233.1**	598.4
Observations	58603		58603		7961	
Uncensored Obs (Tobit)			14459			
R^2	0.0032		0.0013		0.013	
LL			-162306			

TABLE 4.3-HEART DISEASE: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

Average In Disease Spending in Final Yr **Heart disease**	**OLS**		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.0162**	0.0033	**0.143**	0.0089	**-0.084**	0.014
Count Mean	**-9.87**	1.28	**-45.15**	3.96	**-69.38**	8.98
Age Death	**-8.58**	1.03	**-9.57**	3.2	**-86.82**	7.96
Black	-26.99	35.14	**265.68**	105.82	-24.86	249.52
Male	-6.99	21.43	-82.36	65.7	232.28	148.01
Cons	**1181.96**	92.78	**-3563.2**	290.18	**10518.73**	713.84
Observations	58676		58676		7961	
Uncensored Obs (Tobit)			14459			
R^2	0.0019		0.0011		0.0214	
LL			-162364			

As shown in Table 4.2, more than one-third of the individuals in the sample had positive expenditures for heart disease as defined in this work during their final year of life, while only half as many are flagged as having died from it. The OLS model on all decedents finds a strong relationship between the in-disease expenditures leading up to death and the expenditures in the final period. The period four quarters prior to death is the only one without statistical significance. The Tobit model is similar in results but with much stronger statistical significance. Relative to many of the diseases that will be considered, the Tobit model for heart disease covers many more uncensored observations and thus has much more

foundation for the estimates. The OLS models run only on decedents of heart disease shows quite a different pattern. Contrary to the increasing pattern of expenditures found in the straight OLS and in the Tobit, it finds a negative relationship between past spending and terminal spending. This pattern would seem to suggest that individuals with a history of severe heart disease expire without significant medical interventions in the last quarter relative to individuals suffering from other conditions. This is reinforced by looking at the profile of individuals in the decedent regression. On average they are older and more likely to be male than the sample in the Tobit and OLS models.

The results of the model as shown in Table 4.3 for persistence in heart disease confirm the observation that those individuals that experience a high level of expenditure tend to persist at that high level. The model finds that in the entire population, a high level of heart disease related expenditures in the year prior to the year of death is associated with increased expenditure in the terminal period. The Tobit specification finds largely the same result. It would have been surprising to see this model contradict the model above in Tobit-OLS correspondence. OLS on decedents lends credence to the argument above that people with “terminal” heart disease may receive less invasive procedures in their last quarter. As with other models, the OLS on decedents specification is an exception to that finding, with decedents form heart diseases having lower terminal period costs. It is

interesting to find that a reduction in the number of treatments for heart disease in quarters prior to the terminal period results in lower terminal period expenditures. This could simply be an indication that some individuals in the sample receive fewer medical services throughout their demise, and thus have lower costs. It would be plausible to suspect, however, that those receiving fewer treatments early on might need more invasive treatments later. The evidence suggests the prior explanation may carry more weight as regards heart disease.

In Table 4.4, the OLS specification finds a pattern for heart disease that is similar to that aggregated total spending, but the relationship is significantly weaker. By casual inspection, it seems logical that many people who die due to heart disease in later years may well have a long history of medical expenditures leading up to the terminal period. For individuals who are very frail in later life, heart disease may well cause their death when few interventions are recommended. Getting them to that point, though, could likely have required a significant level of total medical expenditures in prior years.

TABLE 4.4-HEART DISEASE: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.235**	0.028	**0.192**	0.02
Total Spending t-2	-0.047	0.040	**-0.064**	0.026
Total Spending t-3	0.068	0.049	-0.034	0.038
Total Spending t-4	**0.11**	0.051	-0.0084	0.039
Total Spending t-5	-0.06	0.051	**-0.018**	0.042
Total Spending t-6	0.023	0.054	0.05	0.036
Total Spending t-7	0.019	0.013	0.032	0.041
Age Death	**-53**	3.5	**-96.09**	12.28
Black	**1348.9**	128.82	400.07	424.52
Male	**315.37**	75.82	122.49	242.95
Cons	**7767.33**	296.88	**12601.92**	1027.2
Observations	42581		5241	
Uncensored Obs (Tobit)	40648			
R^2	0.0018		0.0434	
LL	-422917			

Heart Failure

TABLE 4.5-HEART FAILURE: IN DISEASE EXPENDITURES IN YEAR OF DEATH

Heart Failure 428						
	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.15**	0.006	**0.42**	0.013	0.017	0.0172
t-2	**0.09**	0.0083	**0.29**	0.02	-0.04	0.025
t-3	**0.12**	0.01	**0.36**	0.023	-0.04	0.03
t-4	**0.084**	0.009	**0.244**	0.02	-0.012	0.03
Age	-0.21	0.52	**17.63**	1.53	**-28.24**	4.29
Black	-7.92	19.09	**-117.2**	55.87	122.48	151.93
Male	15.74	11.60	-28.33	33.47	179.37	91.55
Cons	**197.46**	42.13	**-3887**	127.8	3734.25	359.88
Observations	58603		58603		6781	
Uncensored Obs (Tobit)			15685			
R^2	0.0267		0.0081		0.0089	
LL			-164227			

As shown in Table 4.5, heart failure exhibits an expenditure pattern similar to that of heart disease. People who passed away from heart failure were a bit older than average, more likely to be white and less likely to be male. The sample used in the Tobit was one year older than the total sample on average, and those flagged as decedents were one year older still. The OLS model shows a steadily increasing level of expenditure to the terminal period. Interestingly, none of the demographic covariates are found to have statistical significance. The Tobit model, in contrast, finds a steeper expenditure slope as well as some strong results

for the age and racial indicator variables. The age at death coefficient is strongly negative. The OLS model run only on decedents of heart failure shows little of interest other than a strong negative effect from age at death.

TABLE 4.6-HEART FAILURE: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

Average In Disease Spending in Final Yr
Heart Failure
428

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure						
Mean	**0.056**	0.0023	**0.21**	0.0055	**-0.018**	0.0085
Count Mean	**-5.97**	0.7	**-17.53**	2.05	**-44.19**	5.46
Age at Death	**-1.60**	0.56	**14.54**	1.68	**-44.43**	4.66
Black	-9.39	19.23	**-125.45**	56.56	85.81	151.32
Male	11.20	11.73	-30.27	34.01	97.89	91.51
Cons	**417.76**	50.75	**-3367.1**	153.65	**5749.58**	427.59
Observations	58676		58676		6781	
Uncensored Obs (Tobit)			15685			
R^2	0.0109		0.0047		0.0191	
LL			-164809			

The results of the expenditure mean model shown in Table 4.6 require some consideration. There is a strong indication that patients who receive more treatments experience lower levels of terminal period expenditure. In all other respects, there is contradiction between the findings. OLS and Tobit models find a positive relationship between pre-terminal and terminal expenditures, while the OLS on decedents model finds

the opposite. The most plausible reason for the disparity is the difference in mean age in the samples. The decedents group was the oldest, and the strong age at death result indicates that older people receive less expensive treatments in their terminal year. If the pattern extends back to prior periods, a group of older heart failure patients would have lower expenditures both in the terminal and pre-terminal periods.

TABLE 4.7-HEART FAILURE: HISTORY OF TOTAL SPENDING

History of total spending 428				
	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.179**	0.019	**0.151**	0.019
Total Spending t-2	0.02	0.02	-0.014	0.027
Total Spending t-3	0.03	0.034	**0.077**	0.032
Total Spending t-4	0.047	0.035	**0.102**	0.031
Total Spending t-5	-0.022	0.037	-0.005	0.036
Total Spending t-6	0.026	0.036	-0.013	0.034
Total Spending t-7	0.019	0.013	-0.014	0.035
Age at Death	**-52.99**	3.5	**-76.43**	9.54
Black	**1348.9**	128.3	591.3	331.95
Male	**315.37**	75.82	196.34	195.04
Cons	**7767.33**	296.88	**9995.1**	822.11
Observations	42581		5241	
Uncensored Obs (Tobit)	40648			
R^2	0.0018		0.0434	
LL	-422917			

The path of total spending shown in Table 4.7 for heart failure patients is entirely similar to that of the full sample. There are no contradictions between the Tobit and OLS on

decedents model, though the decedents model is considerably better at explaining variations in terminal period expenditures.

Breast Cancer

TABLE 4.8-BREAST CANCER: IN DISEASE EXPENDITURES IN YEAR OF DEATH

174	**OLS**		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.379**	0.004	**1.236**	0.048	**0.242**	0.035
t-2	**0.068**	0.008	**0.513**	0.088	-0.035	0.067
t-3	**0.084**	0.008	**0.348**	0.095	0.051	0.074
t-4	0.007	0.009	**0.458**	0.096	-0.105	0.072
Age	**-0.277**	0.085	**-18.735**	2.758	-0.506	4.869
Black	2.249	3.168	-81.884	103.327	236.069	178.557
Male	**-18.817**	1.930	**-2905.832**	166.287	-108.980	560.175
Cons	**39.900**	6.968	**-2872.166**	228.574	**812.508**	379.086
Observations	60214		60214		960	
Uncensored Obs (Tobit)			1195			
R^2	0.1907		0.1096		0.0552	
LL			13691.353			

Breast cancer, as shown in Table 4.8, exhibits a significant upward trend in in-disease expenditures to the terminal period. The path increases steeply in the period just prior to the terminal period. All three specifications concur in the relationship existing and generally agree in the slope of the path. The OLS model on decedents finds little, presumably due to the very low number of decedents. It is probable that given the large

difference in strength between the Tobit and the OLS on decedents models that breast cancer is present for many individuals who are flagged as having died of something else. It is unclear at this point what diseases are commonly co-morbid with breast cancer. Further research using the present data may well be warranted on the topic.

TABLE 4.9-BREAST CANCER: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

Average In Disease Spending in Final Yr	**OLS**		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.046**	0.001	**0.288**	0.014	0.001	0.009
Count Mean	**-1.114**	0.124	**-60.906**	4.533	**-15.253**	6.647
Age Death	-0.770	0.101	**-46.670**	3.447	-6.946	5.392
Black	2.139	3.460	-87.068	118.265	282.436	182.511
Male	**-33.022**	2.111	**-3982.717**	209.687	-295.165	572.320
Cons	**116.223**	9.083	-482.486	287.071	**1713.594**	454.707
Observations	60265		60265		960	
Uncensored Obs (Tobit)			1195			
R^2	0.0335		0.0689		0.0089	
LL			-14318.018			

As is the case with the quarterly observations as shown in Table 4.9, the annual means predict that higher than average expenditures prior to the terminal period predict higher than average terminal expenditures in the terminal disease. The OLS on the full sample and the Tobit model find particularly strong indications of the relationship. The OLS on decedents specification finds no significant relationship between pre-terminal expenditures and terminal expenditures. In contrast to the pattern found in heart disease, the decedents from breast cancer are younger than the general sample. The age at death variable is weak among decedents, most likely a result of the age distribution. Treatment counts are strongly negative in all specifications. Race shows little relation to terminal period expenditures. The strength of the sex indicator variable is most likely not important for policy consideration. Less than one percent of breast cancer patients in the sample were men.

TABLE 4.10-BREAST CANCER: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.196**	0.04	0.22	0.049
Total Spending t-2	0.042	0.07	-0.102	0.07
Total Spending t-3	-0.075	0.093	-0.09	0.9
Total Spending t-4	-0.0005	0.098	0.014	0.1
Total Spending t-5	0.004	0.105	-0.003	0.046
Total Spending t-6	0.111	0.124	-0.023	0.107
Total Spending t-7	-.0293	0.112	-0.056	0.097
Age Death	**-48.28**	14.46	-50.37	17.9
Black	**1344.98**	534.44	-197.44	613.62
Male	**-1073.31**	394.67	2203.1	2098
Cons	**6638.88**	1244.34	7001.781	1461.09
Observations	42581		657	
Uncensored Obs (Tobit)	40648			
R^2	0.0018		0.0461	
LL	-422916.71			

The history of total spending, as distinct from in-disease spending, has no clear relationship with total terminal period expenditures, as shown in Table 4.10. The common findings on age at death, sex, and race continue here.

Skin Cancer

TABLE 4.11-SKIN CANCER: IN DISEASE EXPENDITURES IN YEAR OF DEATH

172	**OLS**		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.341**	0.003	**1.378**	0.121	**0.258**	0.075
t-2	**0.015**	0.005	**0.749**	0.175	-0.114	0.113
t-3	**0.313**	0.006	**1.128**	0.218	0.250	0.131
t-4	**0.492**	0.010	**2.152**	0.310	0.305	0.184
Age	0.023	0.020	-0.445	3.734	**13.088**	7.682
Black	-0.209	0.742	-378.848	183.933	**3175.887**	976.289
Male	0.745	0.450	366.204	88.117	105.821	180.166
Cons	-1.139	1.628	-4534.614	412.479	-572.665	625.626
Observations	60214		60214		134	
Uncensored Obs (Tobit)			195			
R^2	0.2983		0.1057		0.2077	
LL			-2489.7857			

As evidenced by the paucity of observations in the OLS on decedents model as shown in Table 4.11, very few individuals were flagged as having died from skin cancer in the sample. The strength of the results in the OLS model indicate that positive levels of skin cancer-related spending are highly predictive of higher terminal period expenditures. Skin cancer decedents are younger than is average for the total sample, significantly less likely to be black, and more likely to be male. Fully 65% of skin cancer decedents are men. The expenditure path leading up to the terminal period is consistent and well-defined. None of the demographic variables were found to have a significant impact on terminal year

expenditures. The OLS and the Tobit models exhibit strong results for the expenditure path while the OLS on decedent model does not. This is probably because if the fact that there are so few decedents from skin cancer in the sample.

TABLE 4.12-SKIN CANCER: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

Average In Disease Spending in Final Yr Skin Cancer 172	**OLS**		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.105**	0.002	**1.176**	0.109	-0.008	0.047
Count Mean	**-0.106**	0.031	**-29.000**	6.654	-15.918	10.444
Age Death	-0.041	0.025	**-15.480**	5.052	4.829	8.507
Black	-1.381	0.869	**-743.143**	262.175	**2888.013**	1037.648
Male	**1.140**	0.529	**507.493**	117.545	124.237	188.420
Cons	**6.152**	2.280	**-4636.632**	532.044	506.035	721.707
Observations	60265		60265		134	
Uncensored Obs (Tobit)			195			
R^2	0.0352		0.0429		0.094	
LL			-2664.7578			

As shown in Table 4.12, early average expenditures are confirmed to have a strong positive influence on terminal in disease expenditure for skin cancer. The OLS and Tobit models agree while the OLS on decedents model is inconclusive. Treatment counts are found to be a strongly negative predictor of terminal period expenditures. The Tobit finds

age at death to be significantly negative in its effect though both OLS models find no significance. The Tobit is unique in finding that blacks have lower terminal period expenditures for skin cancer. Men appear to incur higher costs.

TABLE 4.13-SKIN CANCER: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	.01	.13	-.11	.123
Total Spending t-2	.22	.16	.079	.093
Total Spending t-3	.15	.18	.295	.189
Total Spending t-4	-.19	.19	.024	.14
Total Spending t-5	-.04	.19	.93	.116
Total Spending t-6	**.62**	.29	-.17	.278
Total Spending t-7	-.19	.33	-.083	.19
Age Death	-16.5	22.3	1.77	31.7
Black	**3362.8**	855.4	**7916**	3072.7
Male	271.6	503.	-824.3	702.8
Cons	2525.9	2032	2980.8	2609.8
Observations	604		82	
Uncensored Obs (Tobit)	556			
R^2	.0029		.17	
LL	-5643.1			

Past observations of total Medicare expenditures have little predictive power for terminal period expenditures among skin cancer patients. In contradiction to the above model shown in Table 4.13, both the Tobit and OLS on decedents find that blacks with positive expenditures for skin cancer treatments have significantly higher terminal period

expenditures.

Cancer of the Larynx

TABLE 4.14-CANCER OF THE LARYNX: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.302**	0.005	**1.619**	0.183	0.166	0.113
t-2	**-0.059**	0.005	**0.638**	0.163	-0.129	0.107
t-3	**0.129**	0.006	**1.274**	0.213	-0.010	0.134
t-4	-0.001	0.006	**1.032**	0.237	-0.175	0.137
Age	-0.098	0.071	**-47.491**	14.150	-1.049	36.184
Black	0.340	2.646	760.131	474.730	-423.002	1031.475
Male	**5.811**	1.606	**2838.139**	438.868	1629.775	971.110
Cons	7.865	5.808	**-14851.310**	1505.290	476.911	2695.546
Observations	60214		60214		131	
Uncensored Obs (Tobit)			155			
R^2	0.06		0.712		0.0035	
LL			-2225.5909			

Cancer of the larynx is typified by an unusual expenditure path relative to other cancers. The OLS model as shown in Table 4.14 reveals a significant negative impact on terminal period expenditure from expenditures two quarter prior to death. The quarter immediately prior to death is found to be strongly positive. Men are found to have higher levels of expenditures and they make up almost 85 % of the population. Decedents are

almost four years younger than the general sample, and significantly more likely to be black. There is no indication that race or age at death significantly changes the level of terminal period expenditures.

TABLE 4.15-CANCER OF THE LARYNX: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.042**	0.002	**1.167**	0.114	-0.085	0.071
Count Mean	**-0.202**	0.097	**-102.637**	22.100	4.041	43.404
Age Death	**-0.175**	0.079	**-72.260**	15.864	-4.127	40.400
Black	1.273	2.720	**1192.875**	492.370	-561.450	1031.985
Male	**6.378**	1.656	**3144.114**	480.464	1401.511	977.063
Cons	**16.985**	7.137	**-13062.260**	1615.893	1027.836	3299.880
Observations	60265		60265		131	
Uncensored Obs (Tobit)			155			
R^2	0.0059		0.0614		0.0319	
LL			-2249.0396			

Yearly average expenditures indicate higher levels of expenditure toward laryngeal cancer are associated with higher terminal period expenditures. This is consistent across the OLS and Tobit models, though the OLS model on decedents is inconclusive in this regard (as well as in all other things). Looking at Table 4.15, higher number of treatments for the disease led to lower terminal expenditures while age at death is also strongly negative. Blacks are found to have higher expenditures in the Tobit and men are found to have more

expenditures in both models.

TABLE 4.16-CANCER OF THE LARYNX: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**.37**	.12	.285	.166
Total Spending t-2	-.04	.15	-.28	.22
Total Spending t-3	-0.54	.245	-.095	.21
Total Spending t-4	.068	.163	-.058	.16
Total Spending t-5	.28	.242	.106	.20
Total Spending t-6	-.14	.158	-.18	.17
Total Spending t-7	.30	.242	.18	.40
Age Death	-28.82	26.01	-14.3	100.23
Black	**3042**.	935.4	-357.3	3309.5
Male	1000.9	579.7	3218.11	2313.3
Cons	3347.8	2368.9	3025.5	7343
Observations	582		84	
Uncensored Obs (Tobit)	534			
R^2	.0036		.078	
LL	-5482.18			

The history of total spending shown in Table 4.16 suggests little about terminal period expenditures for laryngeal cancer. High costs one quarter prior to the terminal period positively influence terminal period expenditures. Blacks are found to have higher expenditures than whites. Little else can be deduced.

Cervical Cancer

The results for the in disease expenditure path as shown in Table 4.17 are a bit of a puzzle. In general they suggest a strong level of persistence in treatment costs. The models are particularly strong relative to other cancers. The anomaly that stands out is the coefficient on expenditures in the OLS model three quarters prior to death. It suggests a statistically significant inverse relationship between expenditures in that period for cervical cancer and terminal expenses. This is opposed to the rest of the path and to the findings of the Tobit model. It is likely best not to speculate as to the cause of the unusual finding at this time. It may well prove interesting in future work. There is considerable evidence that men who die from cervical cancer do so cheaply. It is most likely the result of data error.

TABLE 4.17-CERVICAL CANCER: IN DISEASE EXPENDITURES IN YEAR OF DEATH

180	**OLS**		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.114**	0.003	**0.873**	0.136	0.046	0.066
t-2	**0.323**	0.004	0.300	0.165	**0.360**	0.090
t-3	**-0.060**	0.005	**0.702**	0.237	-0.176	0.164
t-4	**0.228**	0.006	**0.691**	0.244	0.207	0.144
Age	-0.008	0.019	**-15.715**	6.395	2.258	8.429
Black	1.312	0.699	383.849	208.058	492.171	364.549
Male	**-1.168**	0.424	**-2115.235**	409.187	647.616	672.670
Cons	1.770	1.535	**-4809.839**	647.258	195.827	641.581
Observations	60214		60214		90	
Uncensored Obs (Tobit)			98			
R^2	0.333		0.107		0.3356	
LL			-1327.7623			

TABLE 4.18-CERVICAL CANCER: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

Average In Disease Spending in Final Yr 180						
	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.03**	0.001	**0.36**	0.07	0.03	0.07
Count Mean	-0.09	0.30	**-51.37**	12.51	8.95	17.45
Age Death	**-0.08**	0.02	**-39.22**	9.05	-3.74	10.91
Black	0.92	0.85	**415.54**	277.54	328.04	422.31
Male	**-2.41**	0.52	**-3190.50**	584.14	411.58	810.63
Cons	**9.98**	2.24	**-4336.92**	834.11	818.76	919.67
Observations	60265		60265		90	
Uncensored Obs (Tobit)			98			
R^2	0.0077		0.0544		0.0208	
LL			-1406.0242			

Yearly averages indicate high level of persistence in cervical cancer expenditure. The findings, shown in Table 4.18, also demonstrate that a higher number of treatments results in lower levels of expenditure. Age at death enters in a strongly negative fashion. The results on race are inconclusive.

TABLE 4.19-CERVICAL CANCER: HISTORY OF TOTAL SPENDING

History of total spending 180				
	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**.358**	.14	.204	.143
Total Spending t-2	.052	.19	-.101	.178
Total Spending t-3	-.100	.27	-.056	.193
Total Spending t-4	.15	.42	-.088	.263
Total Spending t-5	.31	.64	-.66	.519
Total Spending t-6	-.04	.44	-.200	.435
Total Spending t-7	-.32	.58	.106	.599
Age Death	-31.3	23.62	**-99.14**	44.1
Black	**3145.6**	854.4	1579.9	1485.1
Male	-65.63	548.6	-1181.1	3543.1
Cons	3900.6	2146.1	**11796**	3608.4
Observations	559		47	
Uncensored Obs (Tobit)	511			
R^2	.0032		.27	
LL	-5206.7			

As is the case with most cancers, history of total spending, as shown in Table 4.19, suggests little about terminal period expenditures. The OLS on decedents model seems to control well for the level of expenditure in terms of R-squared. It is most likely the result of little variance in those terminal expenditures.

Prostate Cancer

TABLE 4.20-PROSTATE CANCER: IN DISEASE EXPENDITURES IN YEAR OF DEATH

185	**OLS**		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.462**	0.005	**1.329**	0.045	**0.344**	0.037
t-2	**0.118**	0.007	**0.384**	0.056	0.068	0.047
t-3	**0.075**	0.008	**0.428**	0.064	-0.007	0.053
t-4	**-0.027**	0.009	**0.521**	0.072	**-0.142**	0.065
Age	**0.195**	0.094	**26.351**	2.448	-9.413	4.757
Black	**19.110**	3.479	**510.179**	72.165	**340.712**	121.347
Male	**22.612**	2.128	**3362.047**	184.621	71.501	1089.553
Cons	**-17.386**	7.637	**-8762.328**	312.682	1215.620	1148.277
Observations	60324		60214		1396	
Uncensored Obs (Tobit)			1744			
R^2	0.2169		0.1243		0.0914	
LL			-18929.956			

The path of expenditures for prostate cancer, as shown in Table 4.20, becomes significantly positive at least nine months prior to the terminal period. The specifications contradict each other in sign, though not in significance of costs a year prior. The typical age at death from prostate cancer is roughly a year older than the sample average and patients are more likely to be black. Blacks are found to have higher costs. The older a prostate cancer patient is the fewer and less costly are the treatments they receive.

TABLE 4.21-PROSTATE CANCER: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

Average In Disease Spending in Final Yr 185	**OLS**		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.069**	0.001	**0.479**	0.015	-0.002	0.012
Count Mean	**-0.783**	0.137	**-29.096**	3.486	**-13.209**	5.589
Age Death	0.164	0.112	**25.074**	3.067	**-18.237**	5.563
Black	**23.313**	3.830	**629.435**	84.920	**358.218**	126.283
Male	**36.786**	2.355	**4175.175**	224.110	398.005	1133.564
Cons	-3.702	10.060	**-9650.175**	392.850	2048.035	1222.417
Observations	60265		60265		1396	
Uncensored Obs (Tobit)			1744			
R^2	0.0492		0.0932		0.0009	
LL			-19601.583			

The models at the level of yearly expenditures largely, shown in Table 4.21, confirm the findings done at the quarterly level. Blacks are confirmed as incurring distinctly high costs. A higher number of treatment counts appear to result in lower levels of terminal period expenditure. In total, the yearly observation do a much poorer job than do the quarterly ones which makes prostate cancer distinctly different than many other diseases.

TABLE 4.22-PROSTATE CANCER: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**.117**	.037	.085	.043
Total Spending t-2	.0317	.056	-.003	.054
Total Spending t-3	.034	.065	.0675	.068
Total Spending t-4	**.182**	.057	**.205**	.055
Total Spending t-5	.130	.073	.031	.081
Total Spending t-6	-.0759	.073	.002	.084
Total Spending t-7	-.017	.074	-.04	.067
Age Death	-27.26	14.34	.538	16.8
Black	**1656.5**	420.7	**1222.4**	453.7
Male	**1485.9**	373.3	2203.9	3101.4
Cons	**3681.6**	1313.13	450.9	3358.8
Observations	1420		982	
Uncensored Obs (Tobit)	1372			
R^2	.0042		.0419	
LL	-13667			

As shown in Table 4.22, there appears to be a steady positive relationship between total expenditures in the quarters leading up to death and death-related costs among prostate cancer patients. The remainder of the results of these models simply confirms the picture outlined by other specifications and those of the general findings in other literature.

Bladder Cancer

TABLE 4.23-BLADDER CANCER: IN DISEASE EXPENDITURES IN YEAR OF DEATH

188	**OLS**		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.172**	0.003	**0.882**	0.056	**0.091**	0.038
t-2	**0.098**	0.007	**1.274**	0.116	-0.049	0.082
t-3	**0.230**	0.007	**1.238**	0.104	0.111	0.074
t-4	**0.109**	0.009	**1.249**	0.142	-0.061	0.099
Age	0.197	0.110	**35.515**	7.054	3.784	14.076
Black	-2.865	4.076	**-719.097**	289.196	24.449	603.098
Male	**8.890**	2.474	**1592.720**	161.417	239.112	303.021
Cons	-11.524	8.947	-13983.080	750.718	782.734	1180.637
Observations	60214		60214		496	
Uncensored Obs (Tobit)			591			
R^2	0.0922		0.0727		0.0173	
LL			-7665.0347			

As shown in Table 4.23, bladder cancer appears to exhibit a steady positive path of persistence in expenditures with higher level of costs at any point in the year prior to death associated with higher terminal period expenditures. Age at death positively influences terminal period expenditures, contrary to the normal finding. Blacks are found to have normal expenditures in the Tobit model. Men make up the majority of cases and are associated with higher expenditures.

TABLE 4.24-BLADDER CANCER: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.109**	0.002	**0.974**	0.048	0.035	0.032
Count Mean	**-0.526**	0.150	**-44.198**	9.267	-23.387	17.589
Age Death	0.002	0.122	**17.335**	7.841	-6.601	15.731
Black	-4.207	4.194	**-844.515**	305.702	7.678	603.079
Male	**8.629**	2.555	**1577.134**	169.453	145.317	304.149
Cons	13.403	11.002	-12696.690	834.309	2046.392	1407.052
Observations	60265		60265		496	
Uncensored Obs (Tobit)			591			
R^2	0.038		0.0476		0.0061	
LL			-7873.0268			

As is typical with other cancers, higher expenditures prior to death are related to higher terminal period expenditures, as shown in Table 4.24. In addition, the common finding that increased levels of treatment numbers are associated with lower expenditures holds for bladder cancer as well. There is evidence incur lower expenditures, while men generate higher costs.

TABLE 4.25-BLADDER CANCER: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**.33**	.072	**.153**	
Total Spending t-2	.126	.12	-.031	
Total Spending t-3	-.024	.12	.007	
Total Spending t-4	.068	.13	-.217	
Total Spending t-5	.282	.16	**.457**	
Total Spending t-6	.023	.15	-.087	
Total Spending t-7	**.332**	.13	**.262**	
Age Death	-40.6	22.6	-20.8	
Black	**2006.7**	850.7	145.9	
Male	876.1	491.9	1016	
Cons	**4815.5**	2042.6	4381.8	
Observations	820		335	
Uncensored Obs (Tobit)	772			
R^2	.0060		.076	
LL	-7925.65			

The profile of total expenditures prior to death, as shown in Table 4.25, bears little relation to in disease terminal spending. For decedents of bladder cancer, the demographic impacts are the same as for the general sample.

Lung Cancer

TABLE 4.26-LUNG CANCER: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.265**	0.006	**1.37**	0.03	**-.055**	0.02
t-2	**0.13**	0.009	**0.99**	0.05	**-0.13**	0.03
t-3	**0.075**	0.009	**0.47**	0.04	-0.05	0.03
t-4	**0.056**	0.012	**0.71**	0.06	**-0.15**	0.04
Age	**-2.474**	0.038	**-50.39**	3.66	-0.76	7.23
Black	-17.372	-14.12	**-581.22**	138.53	264.71	214.55
Male	**43.585**	8.57	**896.22**	81.00	8.94	123.94
Cons	**279.524**	31.1	**-4494.07**	295.45	**2456.38**	553.30
Observations	60214		60214		3675	
Uncensored Obs (Tobit)			4647			
R^2	0.05		0.0438		0.0124	
LL			-54,372.137			

As shown in Table 4.26, lung cancer decedents follow an expenditure path that is similar to other cancers with a very strong increase in expenditures approaching death. Age at death is distinctly negative in its impact on in disease terminal expenditures. Men are over represented in decedents and have significantly higher costs. Blacks typically incur lower terminal expenditures for lung cancer contrary to the general finding in other diseases. The results for lung cancer should be viewed in the light that it is the disease that motivated a significant portion of hospice admissions. The expenditure pattern for lung cancer may well be atypical in the absence of hospice and only through hospice be brought down.

TABLE 4.27-LUNG CANCER: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.098**	0.004	**0.764**	0.023	**-0.077**	0.017
Count Mean	**-6.828**	0.516	**-109.060**	5.009	**-30.656**	7.602
Age Death	**-5.461**	0.421	**-94.856**	4.021	-16.300	8.267
Black	-22.769	14.399	**-629.654**	140.614	242.571	214.460
Male	**45.072**	8.767	**933.452**	83.038	-36.689	124.192
Cons	**640.504**	37.814	493.332	339.204	**3878.203**	681.103
Observations	60265		60265		3675	
Uncensored Obs (Tobit)			4647			
R^2	0.015		0.0206		0.0115	
LL			-55695.465			

In general, the models, shown in Table 4.27, describing lung cancer terminal expenditures are relatively weak. The yearly averages confirm the positive association between prior and terminal expenditures as well as the strong negative age at death impact. Blacks are confirmed to have lower costs and men are found to be particularly expensive. Men make up roughly 60% of decedents in the sample. Treatment counts continue to exhibit a negative impact. This may well argue against the efficacy of the hospice program in reducing expenditures. The reason for this is that hospice expenditures are not itemized

under Medicare as are other treatments. A high number of treatments indicates that the patient is likely not in the hospice program for much of the time prior to death. While crude, the evidence from the coefficient on treatments suggests hospice may not be a low cost alternative.

TABLE 4.28-LUNG CANCER: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.107**	0.029	0.052	0.03
Total Spending t-2	0.0084	0.04	-0.043	0.041
Total Spending t-3	-0.06	0.045	-0.047	3.037
Total Spending t-4	0.027	0.052	-0.022	0.041
Total Spending t-5	0.045	0.054	-0.061	0.051
Total Spending t-6	0.075	0.049	-0.64	0.056
Total Spending t-7	-0.108	0.058	**-0.12**	0.057
Age Death	**-85.62**	12.38	**-31.63**	15.09
Black	**1197.6**	417.55	457.68	444.5
Male	384.94	229.93	442.96	244.3
Cons	**10443.9**	1025.43	**6632.23**	1194.3
Observations	2786		2040	
Uncensored Obs (Tobit)	2738			
R^2	0.0019		0.0124	
LL	-27737.49			

The path of total spending for lung cancer, as shown in Table 4.28, suggests no clear picture about the determinates of terminal period expenditures. In disagreement with the other specification, total spending indicates that blacks experience higher costs than whites even among lung cancer decedents. Little else is clear from looking at total spending. The

hospice impact on total spending may be stronger than the expenditure specifically related to lung cancer. The result would be a significant hospice bill for lung cancer, but almost no other spending as per hospice program procedures.

Colorectal Cancer

TABLE 4.29-COLORECTAL CANCER: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.118**	0.005	**1.104**	0.021	**-0.070**	0.030
t-2	**0.105**	0.009	**1.495**	0.077	**-0.168**	0.049
t-3	**0.068**	0.010	**1.112**	0.087	**-0.140**	0.056
t-4	**0.120**	0.013	**1.621**	0.103	**-0.163**	0.067
Age	-0.292	0.380	-1.395	7.624	-8.343	12.855
Black	-4.987	14.136	-296.286	283.764	40.595	430.977
Male	1.830	8.578	263.478	167.288	73.020	246.917
Cons	87.780	31.042	-**15453.19**	685.800	**3406.870**	1037.954
Observations	60214		60214		1904	
Uncensored Obs (Tobit)			2035			
R^2	0.0167		0.038		0.0171	
LL			-26134.76			

Colorectal cancers present a puzzle. With roughly 2000 decedents in the sample, they represent a single cause of death ripe for analysis. The models above in Table 4.29 yield an inconsistent picture. The contradiction between the Tobit model and the OLS model on decedents is striking. The characteristics of the sample which support the models are essentially identical. It may well be the case that significant levels of diagnostic testing for colorectal cancer among Medicare beneficiaries generate many observations with small positive claims for colorectal cancer treatment. This remains to be investigated. Among decedents, higher levels of claims during the year prior to death are associated with high terminal period claims in the Tobit specification and lower levels of claims in the OLS on decedents. The fact that the OLS on the total sample agrees with the Tobit lends credence to the explanation posited, though in no way proves the conjecture. The models demonstrate no significance of race, sex, or age in terminal period expenditures.

The unusual contradiction between the OLS and the Tobit models continues even at the yearly level, as shown in Table 4.30. Decedents appear to have lower terminal period costs than do the general population who have some positive treatment for colorectal cancer. A comparison of the intercept terms of the OLS models further suggests there may be something to the colorectal screening hypothesis. Age at death has a negative impact in the OLS and Tobit models, though not in an otherwise strong OLS on decedents model.

TABLE 4.30-COLORECTAL CANCER: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.06**	0.003	**1.05**	0.03	**-0.13**	0.02
Count Mean	**-2.47**	0.51	**-116.97**	10.27	-1.37	15.21
Age Death	**-1.10**	0.41	**-36.49**	8.17	-13.60	14.22
Black	-6.46	14.21	380.84	286.14	82.48	430.52
Male	-4.28	8.65	-72.21	169.03	122.37	247.04
Cons	**196.37**	37.28	**-11068.82**	755.24	**3983.14**	1233.77
Observations	60265		60265		1904	
Uncensored Obs (Tobit)			2035			
R^2	0.0052		0.0252		0.0156	
LL			-26482.75			

TABLE 4.31-COLORECTALCANCER: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.23**	0.053	0.038	0.042
Total Spending t-2	-0.12	0.068	-0.044	0.055
Total Spending t-3	0.076	0.077	-0.088	0.069
Total Spending t-4	0.054	0.075	-0.056	0.068
Total Spending t-5	0.07	0.099	-0.14	0.093
Total Spending t-6	-0.104	0.094	-0.07	0.058
Total Spending t-7	0.103	0.096	0.057	0.078
Age Death	**-88.11**	20.19	**-67.53**	24.29
Black	185.2	701.4	-363.1	809.3
Male	82.8	403.7	22.9	441.12
Cons	**11019.06**	1746.4	**10742.5**	2043.3
Observations	1525		1179	
Uncensored Obs (Tobit)	1477			
R^2	0.002		0.0138	
LL	-15358.66			

The expenditure paths exhibited by colorectal cancer in the Tobit models and OLS on decedents above in Table 4.31 continue in the analysis of history of total spending. However, neither of these models is strong enough to make any significant claims. Age at death is confirmed as lowering expected terminal expenditures.

Leukemia

TABLE 4.32-LEUKEMIA: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.348**	0.0073	**2.189**	0.139	0.027	0.081
t-2	**0.284**	0.009	**1.201**	0.157	0.088	0.094
t-3	0.0235	0.015	**1.738**	0.264	**-0.398**	0.176
t-4	**0.421**	0.027	**2.911**	0.467	0.052	0.292
Age	-0.881	0.246	-28.35	16.05	**-108.3**	31.92
Black	0.258	9.09	-1189.7	654.4	1829.7	1270.2
Male	9	5.15	1783.5	369.6	-21.34	690.3
Cons	**89.9**	19.95	**-24943.4**	1604	**12676.28**	2551.97
Observations	60214		60214		417	
Uncensored Obs (Tobit)			573			
R^2	0.0781		0.0416		0.0456	
LL			-8195.752			

As shown in Table 4.32, leukemia presents an expenditure pattern similar to that of the other cancers. A significant positive slope to terminal period costs is clear. Age at death is strongly negative. Sex and race appear to have little impact on the path of expenditures. Decedents seem to be representative of the general sample, equally likely to be male and black and of a similar age. All the specifications prove to be rather weak at explaining variation in terminal period expenditures.

TABLE 4.33-LEUKEMIA: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.1222**	0.0054	**1.353**	0.108	-0.0171	0.0594
Count Mean	**-1.62**	0.337	**-96.66**	22.93	**-96.72**	40.27
Age Death	**-1.58**	0.275	**-71.7**	18.16	**-137.5**	34.5
Black	-2.99	9.42	-1343	696	1819.1	1259.6
Male	9.36	5.74	**2015.5**	398.5	-243.67	687.23
Cons	**174.5**	24.72	**-22647.5**	1834.8	**16354**	2993.22
Observations	60265		60265		417	
Uncensored Obs (Tobit)			573			
R^2	0.0078		0.0148		0.0493	
LL			-8425.034			

In the OLS and Tobit models shown in Table 4.33, Leukemia exhibits significant positive persistence in in-disease expenditures. Among decedents the relationship is ambiguous. It is clear that treatment counts are strongly associated with lower levels of terminal period expenditures. Age at death is negative, and blacks appear to have lower terminal period costs. Sex appears to be a weal predictor.

TABLE 4.34-LEUKEMIA: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.278**	0.077	0.008	0.091
Total Spending t-2	0.117	0.107	0.099	0.13
Total Spending t-3	0.073	0.0121	-0.018	0.14
Total Spending t-4	**0.52**	0.142	**0.39**	0.19
Total Spending t-5	-0.099	0.115	-0.05	0.14
Total Spending t-6	-0.29	0.167	-0.25	0.3
Total Spending t-7	**0.381**	0.14	-0.014	0.18
Age Death	**-133.6**	25.05	**-122.19**	52.84
Black	651.2	960.04	-431.3	2049.6
Male	-703.41	550.8	-1680.6	1000.2
Cons	**1469.8**	2218.7	**17863.1**	4289.9
Observations	829		290	
Uncensored Obs (Tobit)	781			
R^2	0.0072		0.0559	
LL	-8125.31			

The Tobit model as shown in Table 4.34 finds a significant relationship between higher costs in the first and fourth quarters prior to the terminal period and terminal period expenditures. Advanced age at death is correlated with lower levels of terminal period expenditures in both the Tobit and OLS specifications.

Non-Hodgkin's Lymphoma

TABLE 4.35-NON-HOGKIN'S LYMPHOMA: IN DISEASE EXPENDITURES IN YEAR OF DEATH

202	**OLS**		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.188**	0.005	**1.298**	0.074	-0.014	0.046
t-2	**0.361**	0.007	**1.508**	0.106	**0.158**	0.067
t-3	**0.209**	0.011	**1.324**	0.147	0.022	0.095
t-4	**0.031**	0.013	**1.311**	0.175	-0.207	0.114
Age	**-0.448**	0.154	**-26.938**	7.186	-25.426	13.851
Black	0.555	5.707	**-1143.587**	320.516	603.785	628.181
Male	3.923	3.463	**350.945**	162.166	346.604	289.029
Cons	**51.143**	12.536	**-10615.910**	662.150	**3926.562**	1103.916
Observations	60214		60214		625	
Uncensored Obs (Tobit)			820			
R^2	0.1079		0.0612		0.0258	
LL			-10748.021			

Non-Hodgkin's Lymphoma demonstrates above in Table 4.35 an expenditure profile that appears much the same as the other cancers. It exhibits high levels of expenditure at least three quarters prior to the terminal period. Men appear to have higher levels of expenditures, while blacks seem to incur lower costs. Age at death is significantly negative.

TABLE 4.36- NON-HOGKIN'S LYMPHOMA: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.089**	0.003	**0.977**	0.050	-0.031	0.027
Count Mean	**-1.561**	0.214	**-84.467**	10.630	**-69.076**	16.354
Age Death	**-1.204**	0.175	**-66.414**	8.245	**-48.425**	14.301
				354.50		
Black	-11.763	5.987	**-1537.628**	5	475.151	620.405
				177.32		
Male	3.342	3.645	**408.118**	3	299.386	285.854
	140.17			753.87		1210.99
Cons	**3**	15.707	**-7754.456**	7	**6762.04**	0
Observations	60265		60265		625	
Uncensored Obs (Tobit)			820			
R^2	0.0171		0.0276		0.04553	
			-11133.90			
LL			1			

Higher level of yearly average expenditures predict increased terminal period expenditures. An increased number of treatments per quarter have a significant reducing effect on costs incurred at time of death. The findings on demographic variables in Table 4.36 are consistent with the models above and with those of the other cancers.

TABLE 4.37- NON-HOGKIN'S LYMPHOMA: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.25**	0.055	0.084	0.05
Total Spending t-2	0.23	0.081	0.045	0.07
Total Spending t-3	-0.09	0.101	**-0.21**	0.092
Total Spending t-4	**0.101**	0.13	-0.103	0.113
Total Spending t-5	**0.092**	0.143	-0.087	0.118
Total Spending t-6	**0.15**	0.148	0.036	0.115
Total Spending t-7	0.14	0.11	0.103	0.85
Age Death	**-78.4**	23.14	**-89.23**	28.94
Black	**2257.75**	900.4	2292.8	1302
Male	291.1	496.9	802.8	554.8
Cons	**9213.1**	2039.8	**12126.8**	2363.7
Observations	953		418	
Uncensored Obs (Tobit)	905			
R^2	0.0054		0.0682	
LL	-9380.919			

As shown in Table 4.37, except for the period immediately preceding death, history of total spending gives no clear indication about the level of terminal period expenditures. Among decedents, the OLS finds an anomalous negative relationship three quarters prior to the terminal period. In all other aspects the findings are similar or at least not contradictory to the more detailed models.

Cerebrovascular Disease

TABLE 4.38-CEREBROVASCULAR DISEASE: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.175**	0.0044	**0.492**	0.0139	**0.081**	0.017
t-2	0.0007	0.004	**0.083**	0.0144	**-0.041**	0.016
t-3	**0.025**	0.007	**0.215**	0.024	**-0.06**	0.029
t-4	**0.017**	0.007	**0.186**	0.022	**-0.072**	0.026
Age	**1.38**	0.217	**14.9**	1.037	**7.08**	3.25
Black	36.6	8.01	**318.05**	34.48	**235.88**	98.4
Male	-3.63	4.87	**-66.49**	22.27	80.4	64.8
Cons	**-44.14**	17.66	**-3167.79**	88.65	105.52	272.19
Observations	58603		58603		3910	
Uncensored Obs (Tobit)			9170			
R^2	0.0302		0.011		0.0144	
LL			-94902			

The models, as shown in Table 4.38, are relatively weak in explaining variation in terminal period expenditures for cerebrovascular disease. While the variables in the model are mostly significant, they together explain little. Interestingly, age at death has a large positive impact on terminal period expenditures. Cerebrovascular disease affects women more commonly than it does men, and men seem to have lower costs associated with dying of the disease. Race is a significant factor with blacks having increased terminal period

costs.

TABLE 4.39- CEREBROVASCULAR DISEASE: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.015**	0.0014	**0.122**	0.0048	**-0.037**	0.0072
Count Mean	-0.542	0.294	**-5.23**	1.37	**-8.11**	3.93
Age Death	**1.41**	0.237	**14.83**	1.16	2.76	3.64
Black	**44.5**	8.11	**346.69**	35.27	**249.19**	98.4
Male	-5.38	4.9	**-78.56**	22.87	58.47	65.3
Cons	-29.34	21.4	-3111.96	107.44	655.7	334.75
Observations	58676		58676		3910	
Uncensored Obs (Tobit)			9170			
R^2	0.0035		0.0053		0.0116	
LL			-95462.8			

At the annual level, higher costs in the run up to the terminal period have a positive influence on terminal cerebrovascular disease expenditures, as shown in Table 4.39. Treatment counts are found to negatively influence the expense. The rest of the findings are consistent with the above model.

TABLE 4.40- CEREBROVASCULAR DISEASE: HISTORY OF TOTAL SPENDING

History of total spending	Tobit		OLS on Decedents	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.176**	0.021	**0.08**	0.017
Total Spending t-2	-0.039	0.3	-0.02	0.023
Total Spending t-3	0.112	0.44	0.06	0.32
Total Spending t-4	**0.052**	0.041	**0.08**	0.033
Total Spending t-5	0.02	0.048	-0.08	0.038
Total Spending t-6	0.12	0.046	0.053	0.033
Total Spending t-7	0.08	0.045	-0.03	0.01
Age Death	**-88.7**	11.85	**-24.63**	9.9
Black	**1392.5**	367.34	576.3	296.6
Male	**627.3**	232.61	**601.5**	193.9
Cons	**11490.9**	1023.23	**4861.5**	853.1
Observations	4282		2837	
Uncensored Obs (Tobit)	4218			
R^2	0.0034		0.0255	
LL	-43659.8			

It is evident from the results in Table 4.40 that costs one quarter out from the terminal period are strongly correlated with terminal period expenditures. There appears to be some significance for the time period a year prior to death, though not for the intervening two quarters. Reflecting the sex distribution of patients of cerebrovascular disease, the sex variable is significant in both specifications. In contradiction to the other models however, the evidence suggest that men experience increased costs. Blacks have distinctly higher

terminal expenditures from cerebrovascular disease.

Stroke

TABLE 4.41-STROKE: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.161**	0.011	**1.33**	0.107	-144	0.08
t-2	-0.012	0.017	0.376	0.224	**-0.262**	0.1232
t-3	-0.014	0.019	**0.59**	0.212	-0.233	0.146
t-4	**0.059**	0.014	0.277	0.167	-0.089	0.01
Age	-0.311	0.32	-2.4	7.16	-26.38	17.8
Black	**40.26**	11.88	**525.21**	256.65	**1408.7**	599.63
Male	4.64	7.21	-16.36	161.86	273.04	383.29
Cons	**75.92**	26.07	**-14564.99**	657.65	**5030.09**	1465.74
Observations	60214		60214		988	
Uncensored Obs (Tobit)			1679			
R^2	0.0043		0.0039		0.0228	
LL			-22704.8			

It is clear that people with positive levels of spending in stroke experience higher than normal terminal expenditure patterns. As shown in Table 4.41, the coefficients in the OLS and Tobit models are generally positive and strictly positive when found to be significant. Those individuals flagged as having died from a stroke however show a different picture. The coefficients in the OLS on decedents model are negative and approaching

significance at a casual level. Decedents are generally older than the sample in the Tobit and older than the general population, so it may be the case that it is the age at death effect that is pulling down terminal period expenditures for them. Blacks appear to have significantly higher costs related to strokes. Men seem to have no different expenditures than women.

TABLE 4.42-STROKE: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	0.011	0.006	**0.286**	0.0867	**-0.1883**	0.07
Count Mean	**-1.49**	0.426	**-56.68**	9.66	-28.87	22.74
Age Death	**-0.78**	0.347	**-19.81**	7.7	-37.84	19.86
Black	**39.75**	11.9	469.3	258.14	**1522.41**	601.97
Male	2.69	7.24	-72.16	162.73	351.1	382.9
Cons	**137.09**	31.19	**-1240.7**	736.77	**6145.37**	1773.24
Observations	60265		60265		988	
Uncensored Obs (Tobit)			1697			
R^2	0.0005		0.001		0.0191	
LL			-22771.4			

As shown in Table 4.42, the pattern demonstrated on the quarterly model is reinforced by the yearly averages. Individuals in the OLS and Tobit samples show positive persistence in stroke related expenditures while decedents show a reduction. Treatment counts are strongly negative but least so among decedents. Age at death is confirmed as

lowering terminal period expenditures. There is some evidence at the yearly level that women are more likely to have expenditures for stroke than are men. It is clear that blacks have higher levels of costs for stroke.

TABLE 4.43-STROKE: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.24**	0.056	**0.165**	0.06
Total Spending t-2	0.79	0.97	0.071	0.103
Total Spending t-3	0.049	0.066	-0.104	0.112
Total Spending t-4	**0.22**	0.103	0.07	0.11
Total Spending t-5	0.086	0.13	-0.133	0.16
Total Spending t-6	0.086	0.11	-0.092	0.12
Total Spending t-7	0.17	0.113	0.058	0.12
Age Death	**-65.16**	18.74	**-94.7**	30.8
Black	1083.8	704.5	39.8	1045.6
Male	-50.3	411.3	431.3	627.8
Cons	**8804.3**	1633.6	**12538.8**	2596.4
Observations	1252		584	
Uncensored Obs (Tobit)	1204			
R^2	0.0035		0.0415	
LL	-12423.63			

Total spending in Table 4.43 shows a slightly different pattern than does in disease spending. The quarter prior to the terminal period is positive for the Tobit and OLS on decedents samples. This may indicate that many of the services stroke patients receive are coded under other diseases. To the extent that stroke effects the frail, it could likely occur in people with significant levels of co-morbidities. Thus total spending would be higher while in disease spending is lower. In general, the upward slope of expenditure is confirmed, while the findings on the demographic variables are consistent with the consensus of the literature.

COPD

Chronic pulmonary obstruction disorder has a strong positive pattern of persistence both in the OLS and the Tobit specifications while the evidence that there is in the OLS on decedents specification is consistent. In Table 4.44, there appears to be rapidly-rising costs in the path of expenditures with costs in the final six months of life at a particularly high level. Men are over represented in decedents and seem to have higher expenditures. The evidence on the impact of race is inconclusive.

TABLE 4.44-COPD: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.233**	0.009	**0.768**	0.024	**0.105**	0.031
t-2	**0.073**	0.0104	**0.363**	0.028	-0.012	0.036
t-3	**0.126**	0.0145	**0.595**	0.4	-0.013	0.052
t-4	**0.329**	0.0153	**0.813**	0.42	**0.221**	0.055
Age	**-2.41**	0.544	**-20.79**	2.16	**-15.99**	6.67
Black	29.03	20.07	**-614.28**	84.68	**1439.88**	283
Male	8.1	12.2	**499.21**	47.65	-143.2	134.4
Cons	**278.77**	44.47	**-2926.44**	176.12	**2495.68**	525.1
Observations	58603		58603		5035	
Uncensored Obs (Tobit)			10400			
R^2	0.0411		0.017		0.0139	
LL			-113747			

TABLE 4.45-COPD: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.096**	0.0025	**0.367**	0.007	**0.038**	0.011
Count Mean	**-6.97**	0.731	**-55.76**	2.92	**-38.29**	8.25
Age Death	**-4.56**	0.593	**-37.2**	2.35	**-30.83**	7.458
Black	17.76	20.21	**-677.17**	85.79	**1455.25**	283.04
Male	3.55	12.32	**466.78**	48.38	-186.92	134.75
Cons	**565.99**	53.45	**-830.64**	209.17	**4253.01**	640.89
Observations	58676		58676		5035	
Uncensored Obs (Tobit)			10400			
R^2	0.0259		0.0142		0.0132	
LL			-114090			

The general trend of positive persistence is also clear is the yearly averages, as shown in Table 4.45. The relative flatness of the slope implied by the coefficient on mean yearly expenditures may likely come from the fact that the periods prior to six months before death are not strongly significant indicators of terminal period expenditures. Treatment counts have a strong negative effect on expenditure at time of death related to chronic airway obstruction disease. Age at death is strongly negative. Blacks appear to have higher expenditures among decedents thought the Tobit sample (which is twice as large) finds a negative impact. Men are more likely to experience positive expenditures on the disease and having the disease seem to have higher costs.

TABLE 4.46-COPD: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.27**	0.024	**0.26**	0.027
Total Spending t-2	0.043	0.03	0.06	0.034
Total Spending t-3	-0.014	0.044	0.022	0.043
Total Spending t-4	0.066	0.042	0.018	0.04
Total Spending t-5	0.017	0.047	-0.021	0.047
Total Spending t-6	0.06	0.043	0.079	0.051
Total Spending t-7	0.06	0.046	-0.016	0.051
Age Death	**-81.4**	11.9	**-62.24**	13.5
Black	**2370.9**	500.2	**2906.6**	610.3
Male	108.07	239.9	-37.02	265.16
Cons	**11205.9**	993.1	**8512.8**	1080.9
Observations	5316		3804	
Uncensored Obs (Tobit)	5251			
R^2	0.0028		0.0501	
LL	-55130.5			

History of total spending, as shown in Table 4.46, agrees with the findings from in disease expenditures. Persistence is present at least one quarter out and certainly not negative up to two years out. Age at death is confirmed to be negative, blacks appear to have higher costs, and the evidence about men's expenditures related to chronic airway obstruction disease is inconclusive.

Pneumonia

TABLE 4.47-PNEUMONIA: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.08**	0.0073	**0.34**	0.02	**-0.101**	0.022
t-2	0.017	0.0099	**0.14**	0.028	**-0.131**	0.029
t-3	**0.064**	0.016	**0.28**	0.047	**-0.195**	0.049
t-4	**0.07**	0.017	**0.31**	0.048	**-0.179**	0.052
Age	**3088**	0.754	**37.39**	2.63	**-12.31**	5.53
Black	**144.24**	28.04	**370.22**	96.36	**1580.578**	230.6
Male	**51.68**	17.01	**493.98**	58.97	-159.63	134.27
Cons	-5.5	61.58	**-7893.02**	223.21	**3564.41**	470.48
Observations	60214		60214		6806	
Uncensored Obs (Tobit)			13242			
R^2	0.0039		0.0023		0.0185	
LL			-148640			

The presence of medical expenditures related to pneumonia, as shown in Table 4.47, clearly predicts higher terminal period expenditures for the general sample and for the individuals whose observations support the Tobit model. Decedents from pneumonia have the opposite pattern. This may well be because decedents from pneumonia are distinctly older than the general population and than a representative individual in the Tobit sample. Those individuals who have positive spending in pneumonia but that are classified as having died from a different disease incur significantly higher costs in their terminal period related

to their pneumonia-specific expenditures. Decedents from pneumonia show a decline in terminal period expenditures associated with increased pre-terminal period costs. Blacks show higher level of terminal period expenditures than do non-blacks. Men are distinctly more costly from pneumonia. In general, pneumonia is widespread, affecting at least one quarter of the sample and causing the death of more than 10%.

TABLE 4.48-PNEUMONIA: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.045**	0.004	**0.208**	0.0135	**-0.081**	0.019
Count Mean	**-8.86**	1.01	**-46.26**	3.53	**-37.74**	7.96
Age Death	1.37	0.818	**24.05**	2.85	**-22.11**	6.01
Black	**146.21**	28.03	**393.61**	96.23	**1435.46**	230.87
Male	44.14	17.06	**460**	59.12	-240.58	135.11
Cons	**324.71**	73.53	**-6155.5**	261.24	**4755.45**	556.99
Observations	60265		60265		6806	
Uncensored Obs (Tobit)			13242			
R^2	0.0036		0.0021		0.0137	
LL			-148679			

The yearly averages, as shown in Table 4.48, confirm the quarterly observations. Treatment counts are a strongly negative predictor of terminal period expenditures. The decedents from pneumonia are clearly distinct from those who simply have positive expenditures. Demographic variables are confirmed in their pattern with the quarterly

averages and are similar to the consensus in the literature on the Medicare population.

TABLE 4.49-PNEUMONIA: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.2**	0.023	**0.107**	0.019
Total Spending t-2	0.023	0.031	-0.048	0.026
Total Spending t-3	**0.12**	0.042	0.025	0.034
Total Spending t-4	0.055	0.04	-0.018	0.035
Total Spending t-5	-0.015	0.05	0.019	0.042
Total Spending t-6	0.069	0.05	0.067	0.041
Total Spending t-7	0.037	0.05	**0.097**	0.041
Age Death	**-112.7**	11.9	**-53.23**	9.8
Black	**2136.12**	446.5	**3070.9**	410.31
Male	-378.43	257.3	-16.55	225.61
Cons	**15712.9**	1034.23	**9045.23**	856.54
Observations	5847		4915	
Uncensored Obs (Tobit)	5799			
R^2	0.0026		0.0333	
LL	-61495			

The pattern of total spending, in Table 4.49, reveals a positive though somewhat erratic expenditure path to the terminal period. Decedents from pneumonia experience higher terminal period costs though the strong age effect coupled with the high average age of decedents makes the expenditure path less distinct. In all other characteristics, pneumonia patients are revealed to be similar in their expenditures as the general population.

Diabetes Mellitus

TABLE 4.50-DIABETES MELLITUS: IN DISEASE EXPENDITURES IN YEAR OF DEATH

250	**OLS**		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.185**	0.006	**0.492**	0.019	**0.170**	0.031
t-2	**0.056**	0.008	**0.297**	0.026	0.006	0.041
t-3	**0.031**	0.008	**0.275**	0.029	-0.026	0.047
t-4	**0.174**	0.009	**0.462**	0.032	**0.169**	0.051
Age	**-1.257**	0.281	**-24.403**	1.452	-9.187	5.675
Black	20.033	10.397	**350.339**	50.150	-19.496	181.823
Male	-6.975	6.312	**-138.131**	33.212	-83.789	135.790
Cons	**130.656**	22.970	**-1268.324**	116.300	**1285.440**	449.840
Observations	58603		58603		2592	
Uncensored Obs (Tobit)			7075			
R^2	0.0399		0.0165		0.0202	
LL			-76221.887			

As shown in Table 4.50, diabetes mellitus is an expensive chronic disease that results in elevated terminal period expenditures. The expenditure path is strongly positive, though expenses seem to remain at a flat, high level throughout the terminal year. The more elderly an individual is, the lower a level of terminal period expenditures they tend to have associated with diabetes. Blacks are indicated as having higher costs, while there is some evidence that men experience lower expenditures. Diabetes is commonly co-morbid and

diabetes expenditures are present with a large number people who are flagged as having passed away from something else. The support for the Tobit model is toughly twice as large as that of the OLS on decedents model. Decedents are a bit younger than the general sample. Age at death is strongly negative.

TABLE 4.51-DIABETES MELLITUS: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.03**	0.0012	**0.15**	.004	**0.02**	0.01
Count Mean	**-1.958**	0.3807	**-14.69**	2.04	**-26.76**	8.26
Age Death	**-2.074**	0.309	**-29.02**	1.60	**-16.36**	6.11
Black	**31.15**	10.541	**389.35**	51.40	21.82	182.98
Male	-9.867	6.42	**-141.12**	34.19	-92.94	136.74
Cons	**233.84**	27.83	**-761.34**	141.56	**2405.46**	542.75
Observations	58676		58676		2592	
Uncensored Obs (Tobit)			7075			
R^2	0.0118		0.0113		0.007	
LL			-76635.62			

As shown in Table 4.51, yearly averages mirror the pattern suggested by the quarterly observations. A high stable level of expenditures is typical of a diabetes patient on Medicare. Men appear to have lower expenditures, though among decedents from diabetes the result is inconclusive.

TABLE 4.52-DIABETES MELLITUS: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.266**	0.033	**0.326**	0.034
Total Spending t-2	-0.06	0.043	-0.095	0.045
Total Spending t-3	0.012	0.043	0.019	0.046
Total Spending t-4	-.007	0.054	0.05	0.057
Total Spending t-5	**0.139**	0.067	**0.17**	0.064
Total Spending t-6	-0.052	0.064	0.022	0.057
Total Spending t-7	0.008	0.057	-0.048	0.054
Age Death	**-136.3**	14.54	**-56.45**	14.65
Black	**1504.6**	477.44	**1449.52**	450.9
Male	275.82	324.03	126.36	338.8
Cons	**15880.4**	1241.3	**7419.25**	1200.26
Observations	3002		2058	
Uncensored Obs (Tobit)	2938			
R^2	0.0043		0.0838	
LL	-30893.002			

As shown in Table 4.52, total spending largely confirms the picture made by the prior two models. There is an anomalous finding nine months prior to death among the decedents from diabetes. It suggests that those people who spend less at that time experience a more costly death than those who spend more. All other results point to a significant persistence in diabetes related expenditures to the terminal period.

Alzheimer's Disease

TABLE 4.53-ALZHEIMER'S DISEASE: IN DISEASE EXPENDITURES IN YEAR OF DEATH

331	**OLS**		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.167**	0.004	**0.491**	0.022	**0.125**	0.024
t-2	**0.045**	0.004	**0.145**	0.024	0.022	0.024
t-3	**0.144**	0.005	**0.320**	0.031	**0.114**	0.032
t-4	0.009	0.006	**0.134**	0.039	-0.028	0.038
Age	0.1512	0.0752	**10.24**	0.9302	**-6.89**	3.18
Black	-4.404	2.796	-7.1881	32.59021	-119.05	125.54
Male	-1.638	1.697	-49.2644	19.549	28.484	66.5
Cons	-0.06145	6.14	**-2655.9**	84.8227	**900.3**	269.24
Observations	60214		60214		1414	
Uncensored Obs (Tobit)			3164			
R^2	0.0718		0.0172		0.0425	
LL			-34137.6			

The models run on Alzheimer's patients shown in Table 4.53 reveal a consistent upward sloping path of expenditures which is distinct in that all three models agree. It does not appear that decedents see a reduction in expenditure relative to the general population despite the fact that decedents are considerably older than the general sample. There appears to be an interesting stair step effect with sharp increases in expenditure nine months and three months out from the terminal period, with much more subtle increases at a year and six

months out. Age at death has conflicting indicators being significantly negative among decedents while strongly positive for the rest of the population. Blacks experience lower expenditures relative to non-blacks from Alzheimer's disease. Men have lower expenditures in the OLS and Tobit models, but among decedents the evidence is inconclusive.

TABLE 4.54-ALZHEIMER'S DISEASE: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.019**	0.001	**0.122**	0.008	-0.010	0.009
Count Mean	0.108	0.104	**6.982**	1.248	-4.425	3.800
Age Death	**0.236**	0.085	**13.680**	1.103	**-10.293**	3.527
Black	-3.62	2.89	5.60	34.62	-56.20	127.30
Male	-1.89	1.76	**-47.50**	20.91	25.55	67.96
Cons	-4.76	7.60	**-3147.86**	108.50	**1345.97**	323.41
Observations	60265		60265		1414	
Uncensored Obs (Tobit)			3164			
R^2	0.004		0.0059		0.008	
LL			-34531.9			

The yearly observations in Table 4.54 reveal a weak positive, though strongly significant association between high expenditures prior to the terminal period. Except for decedents, treatment counts are revealed to be predictors of increased terminal expenditures.

Decedents show no evidence that treatment counts matter. The positive influence of treatment counts is unusual among diseases for Medicare beneficiaries. Racial indicators are inconclusive, as is the measured impact of the sex of the patient.

TABLE 4.55-ALZHEIMER'S DISEASE: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.35**	0.061	**0.311**	0.042
Total Spending t-2	-0.0004	0.076	-0.048	0.051
Total Spending t-3	0.018	0.101	**0.2**	0.065
Total Spending t-4	0.133	0.1	-0.122	0.07
Total Spending t-5	0.202	0.119	-0.01	0.065
Total Spending t-6	-0.085	0.138	-0.127	0.09
Total Spending t-7	-0.05	0.092	**0.222**	0.074
Age Death	**-54.41**	16.96	-15.84	13.08
Black	**1451.67**	589.1	-329.3	505.63
Male	490.1	344.15	**787.04**	257.74
Cons	**6543.44**	1495.9	**2369.04**	1123.74
Observations	1072		975	
Uncensored Obs (Tobit)	1025			
R^2	0.004		0.1005	
LL	-10303.42			

The history of total spending shown in Table 4.55 seems to bear little relation to the terminal expenditures for Alzheimer's patients. Patients tend to be old relative to the sample and have a high level of outside of disease expenditures. The payments specifically

attributed to Alzheimer's disease seem to decline as patients enter extreme old age, though total payments remain high.

Kidney Failure

Models for kidney disease, as shown in Table 4.56, explain a significant part of the variation in terminal period expenditures. Models demonstrate a strong upward path in expenditures and a high terminal period cost. Diseases of the kidney have long been recognized as requiring very expensive treatments over a long period of time. It is for this reason that people under the normal age of Medicare eligibility are often granted benefits under the End-Stage Renal Disease Program. The fact that the persistence of cost for kidney disease is revealed to be so strong makes it clear that that program at least is well-targeted. Given that typical Medicare beneficiary suffering from kidney disease is distinctly younger than the normal pool, analysis on the expenditure path is a bit further a field than in other diseases covered. Decedents are seven years younger on average than a typical Medicare decedent. The findings indicate that older patients experience terminal period expenditures and that blacks have higher expenditures than non-blacks.

TABLE 4.56-KIDNEY FAILURE: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.284**	0.0051	**0.791**	0.024	**0.171**	0.03
t-2	**0.02**	0.0058	**0.157**	0.027	-0.037	0.03
t-3	**0.11**	0.0066	**0.348**	0.03	0.049	0.04
t-4	**0.04**	0.0052	**0.121**	0.024	0.0054	0.26
Age	**-0.67**	0.152	**-22.22**	1.29	3.43	3.05
Black	**24.27**	5.58	**440.83**	42.52	134.2	99.43
Male	4.39	3.38	**93.08**	30.23	75.99	85.39
Cons	**69.04**	12.44	**-1371.15**	102.69	**489.52**	235.31
Observations	58603		58603		2024	
Uncensored Obs (Tobit)			4286			
R^2	0.2037		0.0739		0.0272	
LL			-45351.7			

TABLE 4.57-KIDNEY FAILURE: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.033**	0.00046	**0.113**	0.0025	**0.009**	0.0028
Count Mean	**-1.92**	0.214	**-18.27**	2.01	**-16.82**	5.18
Age Death	**-2.11**	0.175	**-35.69**	1.54	1.93	3.23
Black	**39.77**	5.94	**574.42**	47.48	121.65	100.77
Male	2.29	3.62	**87.45**	33.67	80.02	86.03
Cons	**226.75**	15.78	**-344.67**	131.58	**1092.46**	273.11
Observations	58676		58676		2024	
Uncensored Obs (Tobit)			4286			
R^2	0.0942		0.0408		0.0105	
LL			-46981.4			

Yearly averages, as shown in Table 4.57, reflect the same strong pattern of persistence in kidney disease expenditures with high levels of maintenance expenses predicting high terminal costs. The number of treatment an individual receives seems to reduce terminal period expenditures. This is counter to an intuitive perception that individuals requiring dialysis for kidney disease would have both a high number of treatment counts and high expenditures. The finding that blacks have higher costs is confirmed in the yearly data. Evidence on the impact of the sex of the patient is inconclusive.

TABLE 4.58-KIDNEY FAILURE: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.25**	0.028	**0.099**	0.035
Total Spending t-2	-0.061	0.036	-0.015	0.045
Total Spending t-3	0.067	0.043	0.041	0.052
Total Spending t-4	0.008	0.046	-0.06	0.053
Total Spending t-5	0.002	0.048	0.013	0.056
Total Spending t-6	0.027	0.048	0.003	0.057
Total Spending t-7	0.3	0.049	0.008	0.054
Age Death	**-118.6**	13.68	**-61.67**	16.99
Black	**1419.1**	460.11	**2009.4**	534.6
Male	-4.97	346.37	3.2	466.7
Cons	**14760.61**	1165.9	**10773.86**	1359.22
Observations	3416		1663	
Uncensored Obs (Tobit)	3352			
R^2	0.0043		0.0273	
LL	-35695.2			

The history of total spending among kidney disease patients shown in Table 4.58 fails to show any significant long run relationship to terminal period expenditures. That is surprising given the generally high level of expenditures for these patients. It may be that the End Stage Renal Disease program results in most expenditures being coded as kidney-related, thus making other expenditures more random.

Septicemia

TABLE 4.59-SEPTICEMIA: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.157**	0.009	**0.736**	0.046	**-0.167**	0.043
t-2	**0.046**	0.01	**0.406**	0.076	**-0.258**	0.066
t-3	**0.21**	0.0176	**0.796**	0.092	-0.129	0.084
t-4	**0.3**	0.013	**0.253**	0.06	**-0.247**	-0.079
Age	**-3.18**	0.588	**-17.87**	4.25	**-61.1**	9.54
Black	**171.16**	21.86	**1901**	146	**839**	337
Male	**-33.39**	12.24	**-375**	99.25	-347	243
Cons	**439**	48	**-8149**	359	**8316**	796
Observations	60214		60214		2831	
Uncensored Obs (Tobit)			5685			
R^2	0.01		0.0046		0.03	
LL			-69537			

As shown in Table 4.59, individuals who die because of septicemia tend to do so at an expense which is correlated with their prior spending. This combined with the advanced age of the affected population, may well indicate that frailty is an unnamed cause for many of these deaths. While the models find strong significance on most of the coefficients, they do little to explain the variation in terminal period expenditures. Blacks are found to incur significantly higher costs, while men generate lower expenditures. The older a patient with

septicemia is the less likely they are to receive high levels of medical interventions reimbursed under Medicare.

TABLE 4.60-SEPTICEMIA: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

Average In Disease Spending in Final Yr 38

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.04**	0.006	**0.323**	0.03	**-0.206**	0.0405
Count Mean	**-5.16**	0.785	**-60.13**	5.927	-24.84	14.21
Age Death	**-4.93**	0.639	**-36.38**	4.614	**-66.16**	10.32
Black	**180.3**	21.9	**1939**	147	**741.3**	337.2
Male	**-42.3**	13.33	**-469.6**	100.2	-341.5	243.9
Cons	**666**	57.47	**-5813**	420.6	**8914**	939.8
Observations	60265		60265		2831	
Uncensored Obs (Tobit)			5685			
R^2	0.004		0.003		0.024	
LL			-69638			

The impression given by the yearly models is consistent with that from the quarterly based models above in Table 4.60. The Tobit finds that individuals with significant levels of septicemia related expenditures in the year prior to death experience higher terminal period expenditures. Treatment counts for septicemia are strongly negative for terminal expenses which also supports the conjecture that frailty is playing a major part. The coefficients on demographic variables match the general trend in the Medicare beneficiary pool.

TABLE 4.61-SEPTICEMIA: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.21**	0.028	**0.107**	0.032
Total Spending t-2	**-0.094**	0.039	-0.01	0.044
Total Spending t-3	0.036	0.045	-0.03	0.046
Total Spending t-4	0.074	0.049	0.02	0.063
Total Spending t-5	-0.041	0.06	-0.05	0.07
Total Spending t-6	0.076	0.062	0.072	0.072
Total Spending t-7	**0.15**	0.063	0.071	0.061
Age Death	**-141.74**	16.7	**-124.8**	18.85
Black	**1308.3**	522.3	**1587.08**	634.9
Male	-666.2	375.5	-33.1	447.57
Cons	**18648.3**	1354.6	**16162.83**	1627.83
Observations	3276		1992	
Uncensored Obs (Tobit)	3228			
R^2	0.0035		0.0465	
LL	-34513.5			

History of total spending in Table 4.61shows little relation to septicemia related terminal expenditures. For the most part, septicemia is not a chronic condition but a complication that can arise often in healthcare settings. It is commonly fatal among the very old. One would not expect to find a particularly long history of expenditures related to septicemia given the acuteness of the disease.

Parkinson's Disease

TABLE 4.62-PARKINSON'S DISEASE: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.26**	0.004	**0.92**	0.05	**0.20**	0.04
t-2	**0.10**	0.005	**0.53**	0.06	0.06	0.06
t-3	**0.07**	0.005	**0.43**	0.06	0.05	0.06
t-4	0.00	0.006	**0.62**	0.08	-0.10	0.07
Age	0.10	0.053	**10.95**	2.07	3.91	6.52
Black	-0.41	1.96	**-391.30**	89.94	162.00	296.17
Male	**3.82**	1.19	**352.10**	43.37	192.67	114.81
Cons	-6.00	4.32	**-4357.60**	205.10	-49.27	532.01
Observations	58603		58603		548	
Uncensored Obs (Tobit)			913			
R^2	0.1058		0.0507		0.0626	
LL			-10811.6			

Looking at Table 4.62, Parkinson's disease seems to affect a great number more people than it kills. Most people affected by it can expect a steadily increasing level of Medicare expenditures along with an increased number of treatments that motivate them. Parkinson's decedents seem to older than average. The impact of age one their expenditures is surprisingly positive. This is contrary to most other diseases, though most similar to Alzheimer's disease. The results on the models as regard race is inconclusive, though the

Tobit model suggests that black incur lower expenditures. There is strong evidence that men have higher terminal period expenditures from Parkinson's disease than do women.

TABLE 4.63-PARKINSON'S DISEASE: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.018**	0.0009	**0.300**	0.015	-0.031	0.017
Count Mean	-0.037	0.075	4.753	2.920	**-18.861**	7.822
Age Death	**0.135**	0.061	**17.130**	2.650	-8.248	7.815
Black	-0.961	2.064	**-402.830**	99.660	264.757	300.541
Male	**5.377**	1.259	**435.124**	49.592	181.264	117.535
Cons	-6.498	53.449	**-5421.789**	280.453	1413.297	710.685
Observations	58676		58676		548	
Uncensored Obs (Tobit)			913			
R^2	0.0065		0.03		0.0277	
LL			-11047.5			

The yearly averages shown in Table 4.63 indicate a high level of persistence in expenditures for Parkinson's. An increased number of treatments yields higher terminal period expenditures in contrast to the relationship found in other diseases. The demographic variables are generally consistent with the above models. None of them do a very good job explaining variations in terminal period expenditures.

TABLE 4.64-PARKINSON'S DISEASE: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
Total Spending t-1	**0.223**	0.07	**0.19**	0.043
Total Spending t-2	-0.08	0.106	0.074	0.076
Total Spending t-3	0.11	0.14	-0.067	0.072
Total Spending t-4	0.069	0.14	-0.038	0.087
Total Spending t-5	0.09	0.13	0.072	0.075
Total Spending t-6	0.018	0.14	0.16	0.089
Total Spending t-7	0.21	0.13	0.026	0.087
Age Death	-26.53	17.96	-18.5	20.4
Black	**2606.65**	712.96	14.7	1013.7
Male	**984.54**	371.12	**1015.7**	356.5
Cons	**4166.96**	1593.5	2739.04	1678.3
Observations	1498		436	
Uncensored Obs (Tobit)	1434			
R^2	0.0017		0.1044	
LL	-14780.02			

History of total spending for Parkinson's patients shown in Table 4.64 is significant only in the last quarter prior to the terminal period. The whole series of total spending forms a reasonable model of terminal period expenditures for Parkinson's decedents though yearly totals may be a stronger predictor than any particular quarter other than the last. Parkinson's patients have a high level of medical expenditures but they are spread randomly through out the terminal year. Given the fact that twice as many individuals are affected by Parkinson's as have been flagged as having died from it, it is likely commonly co-morbid with other diseases. It is probable that frailty is a significant issue for Parkinson's patients.

Multiple Sclerosis

TABLE 4.65-MULTIPLE SCLEROSIS: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.254**	0.017	**3.642**	0.472	-0.062	0.496
t-2	**0.108**	0.029	**1.755**	0.738	0.401	0.790
t-3	**0.060**	0.021	**1.145**	0.519	-0.234	0.538
t-4	**0.06**	0.018	**2.517**	0.4884	-0.2835	0.5105
Age	-0.14	0.0781	**-129.7**	13.54	41.39	38.13
Black	**7.12**	2.884	-345.5	494.1	**9822**	2322
Male	-2.36	1.754	**-824.7**	319.45	-732.6	1104.5
Cons	12.55	6.37	**-4558**	843.1	-1596	2598.4
Observations	58603		58603		91	
Uncensored Obs (Tobit)			152			
R^2	0.0099		0.1073		0.193	
LL			-2049.86			

Multiple sclerosis generally affects much younger individuals than the Medicare population. The average age of decedents from Multiple Sclerosis on Medicare is lower than the total population average. As shown in Table 4.65, the progression of expenditures leading up to death is particularly strong for patients with Multiple Sclerosis. The pattern of costs for decedents however is unclear and in fact generally negative. It appears that individuals that have Multiple Sclerosis having reached the age of Medicare eligibility are

a diverse lot. There is strong evidence that those individuals have a high level of expenditures both in Multiple Sclerosis and for other disorders. The impression made by the pattern of expenditures is that of beneficiaries and a long term period of chronic disease and high costs. Decedents from Multiple Sclerosis show no distinct pattern in expenditures likely due to the frailty associated with their condition.

The impression given by the yearly model shown in Table 4.66 is consistent with that discussed above. There is a significant level of persistence demonstrated in the yearly model. Age at death is found to be strongly negative in the Tobit model though positive among decedents. Treatment counts continue to be a clear predictor of lower levels of expenditures. Men with Multiple Sclerosis incur lower costs than do women and blacks seem to have dramatically higher expenditures when stricken with Multiple Sclerosis at an age of Medicare eligibility.

TABLE 4.66- MULTIPLE SCLEROSIS: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.025**	0.001	**0.387**	0.039	**0.012**	0.037
Count Mean	**-0.141**	0.104	**-40.343**	17.978	**-36.281**	65.948
Age Death	-0.191	0.085	**-140.055**	13.913	**32.771**	403.360
Black	**6.721**	2.885	**-659.044**	503.684	**9724.529**	2288.783
Male	**-2.582**	1.760	**-881.163**	310.721	-549.070	1085.727
Cons	**19.068**	7.623	**-3196.411**	930.407	**-740.531**	3563.435
Observations	58676		58676		91	
Uncensored Obs (Tobit)			152			
R^2	0.0071		0.0744		0.1897	
LL			-2125.49			

TABLE 4.67- MULTIPLE SCLEROSIS: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
Total Spending t-1	0.16	0.089	0.37	0.29
Total Spending t-2	-0.06	0.14	0.19	0.25
Total Spending t-3	0.026	0.223	0.044	0.31
Total Spending t-4	0.006	0.234	-0.26	0.38
Total Spending t-5	0.044	0.242	0.89	0.23
Total Spending t-6	-0.16	0.275	1.07	0.52
Total Spending t-7	-0.21	0.236	**-1.4**	0.513
Age Death	-38.14	18.89	-5.5	48.3
Black	**2485.6**	785.37	232.3	3558.1
Male	565.82	416.65	-835.5	1553.3
Cons	**5221.7**	1688.3	976.64	3439.9
Observations	1249		73	
Uncensored Obs (Tobit)	1185			
R^2	0.0013		0.5114	
LL	-12245.938			

Total spending among Multiple Sclerosis patients shown in Table 4.67 provides little indication as to what level of expenditures one could expect to be associated with their terminal period. The results form the models on history of total spending are inconclusive on any matter of substance though they confirm the perception that the group of people living with Multiple Sclerosis in their late 60s and 70s face medical challenges distinctly different than non-sufferers.

Muscular Dystrophy

TABLE 4.68-MUSCULAR DYSTROPHY: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.15**	0.0008	**0.27**	0.04	**0.14**	0.02
t-2	**0.08**	0.0038	**0.91**	0.24	0.08	0.12
t-3	**0.07**	0.0092	**2.27**	0.70	0.06	0.40
t-4	**0.07**	0.0088	**2.26**	0.54	-0.12	0.28
Age	**-0.03**	0.0119	**-23.68**	4.83	-4.92	9.57
Black	0.19	0.44	183.94	200.53	-403.94	827.61
Male	0.38	0.27	97.55	114.58	441.27	313.96
Cons	**2.29**	0.97	**-2947.42**	440.88	279.03	593.32
Observations	58603		58603		36	
Uncensored Obs (Tobit)			77			
R^2	0.3727		0.0589		0.6331	
LL			-1080.7421			

Muscular Dystrophy, shown in Table 4.68, presents a picture similar to that of Multiple Sclerosis. Individuals among the Medicare population stricken with Muscular Dystrophy have high levels of costs throughout the year leading up to their terminals period. The costs ramp up considerably in the last six months of life. Decedents from Muscular Dystrophy are significantly younger than the general sample. There are very few of either decedents or people in this sample with positive expenditures on Muscular Dystrophy but

who are flagged as having died from something else. The fact that strong results can come from such a small sample indicates the dramatic difference in expenditure paths that the elderly suffering from Muscular Dystrophy go through.

TABLE 4.69- MUSCULAR DYSTROPHY: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.03**	0.0016	**0.74**	0.12	-0.03	0.08
Count Mean	**-0.07**	0.02	-15.68	8.37	-55.28	30.11
Age Death	**-0.05**	0.02	**-29.02**	6.19	-17.24	15.81
Black	0.04	0.55	-257.37	254.27	144.53	1273.08
Male	0.41	0.34	133.79	142.33	376.32	424.62
Cons	**5.24**	1.46	**-3477.30**	603.41	2170.36	1311.17
Observations	58676		58676		36	
Uncensored Obs (Tobit)			77			
R^2	0.0064		0.0371		0.1531	
LL			-1105.853			

The yearly model shown in Table 4.69 concurs with the results form the quarterly models in demonstrating that Muscular Dystrophy patients among the Medicare population exhibit high and increasing levels of expenditures. The sample sizes are too small to establish very much about the demographic distribution of Muscular Dystrophy, but it is clear that advanced age at death is associated with lower terminal period expenditures. The number of treatment counts appears to be associated with a reduction in terminal period

expenditures, though the effect is unclear and the evidence is inconclusive.

TABLE 4.70- MUSCULAR DYSTROPHY: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.3**	0.093	0.24	0.216
Total Spending t-2	-0.12	0.118	-0.769	1.73
Total Spending t-3	0.063	0.253	1.32	1.2
Total Spending t-4	0.022	0.302	2.11	1.17
Total Spending t-5	-0.13	0.641	2.38	3.4
Total Spending t-6	0.17	0.37	**-5.8**	2.72
Total Spending t-7	-0.18	0.31	**-6.3**	3
Age Death	**-47.7**	21.4	-530.62	272.38
Black	**2350.7**	863.3	19898.03	15298.07
Male	321.43	465.3	**-13365.6**	5903.7
Cons	**6239.8**	1920.8	**51780.5**	18758.09
Observations	1228		20	
Uncensored Obs (Tobit)	1164			
R^2	0.0012		0.5413	
LL	-12145.5			

History of total spending shown in Table 4.70 has little power to predict terminal period expenditures among Medicare beneficiaries stricken with Muscular Dystrophy. It is likely that, similar to the case of Multiple Sclerosis, seniors living with Muscular Dystrophy form a unique group whose experiences are not easily comparable to the general sample. The OLS model finds that men incur considerably lower cost in their terminal period than do women and the Tobit finds that blacks generate a higher level of total expenditure.

Hip Fracture

TABLE 4.71-HIP FRACTURE: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.115**	0.005	**1.497**	0.056	**-0.14**	0.02
t-2	**-0.0167**	0.006	**0.5498**	0.0801	**-0.23**	0.03
t-3	0.007	0.007	**0.6138**	0.1016	**-0.22**	0.04
t-4	-0.0019	0.007	**0.384**	0.1143	**-0.25**	0.03
Age	**2.34**	0.2864	**118.7**	8.165	-4.19	7.47
Black	**-42.17**	10.58	**-2207.663**	340.31	-210.41	334.24
Male	**-16.24**	6.44	**-961.2**	161.26	**523.45**	145.32
Cons	**-100.5**	23.35	**-22865.9**	804.26	**2416.00**	636.46
Observations	58603		58603		2335	
Uncensored Obs (Tobit)			1802			
R^2	0.012		0.0317		0.0751	
LL			-23338.88			

Hip fracture by its nature is of a different character in expenditures, as shown in Table 4.71, than the diseases both chronic and acute that have been considered. The occurrence of a hip fracture indicates a singular event in a patient's medical history, and often causes a change in the course of medical expenditures. The OLS model finds a strong positive impact of expenditures in the quarter prior to the terminal period on terminal period expenditures and a significant negative impact of expenditures six months before the terminal period. The Tobit model demonstrates, in contrast, a consistent high positive slope on the expenditure path. In further contract the OLS on decedents model shows a strong downward trend in expenditures. It may well be the case that the factor which explains the inconsistencies is age at death. Individuals who die of a hip fracture (or who die in a time when hip fracture treatments make up the majority of their expenditures) are the oldest group of decedents among the conditions considered. Younger individuals who experience hip fractures often enter a period of poor health with higher costs and thus generate the upward sloping expenditure profile.

TABLE 4.72-HIP FRACTURE: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	-0.004	0.002	**0.218**	0.031	**-0.190**	0.015
Count Mean	0.54	0.39	**23.77**	9.53	**-19.93**	8.67
Age Death	**2.74**	0.31	**134.82**	9.06	-12.47	8.40
Black	**-45.84**	10.62	**-2371.14**	339.06	-175.76	333.50
Male	**-19.95**	6.49	**-1083.09**	161.13	**545.24**	145.11
Cons	**-129.16**	28.13	**-24332.12**	934.21	**3276.40**	777.26
Observations	58676		58676		2335	
Uncensored Obs (Tobit)			1802			
R^2	0.0023		0.0113		0.0763	
LL			-23832.71			

The yearly expenditure model with treatment counts shown in Table 4.72 presents the same contradictory impression that the quarterly models do, but without the level of detail to make sense of them independently. The results from the OLS model on the entire sample show a negative relationship between hip fracture expenditures and terminal period expenditures attributed to hip fracture. The impression is consistent with a common story that many seniors do not survive a hip fracture, but that those who do are not likely to experience another one. The results from the Tobit model seem to demonstrate a story more related to a hip fracture pushing a senior into a declining period of poor health with high costs continuing to be attributed to the fracture.

TABLE 4.73-HIP FRACTURE: HISTORY OF TOTAL SPENDING

	Tobit		**OLS on Decedents**	
	Coeff	Std Err	Coeff	Std. Err
Total Spending t-1	**0.161**	0.044	**0.091**	0.031
Total Spending t-2	-0.074	0.075	-0.024	0.04
Total Spending t-3	0.35	0.089	0.026	0.045
Total Spending t-4	**0.03**	0.096	0.026	0.047
Total Spending t-5	**0.13**	0.99	0.0006	0.053
Total Spending t-6	**0.232**	0.091	0.024	0.051
Total Spending t-7	0.14	0.097	**-0.12**	0.05
Age Death	**-55.74**	15.63	-27.44	17.5
Black	**1086.95**	669.24	267.9	726.1
Male	**11.76**	315.84	**1159.9**	338.8
Cons	**8500.55**	1381.2	**6070.9**	1526.6
Observations	2110		1733	
Uncensored Obs (Tobit)	2046			
R^2	0.0029		0.019	
LL	-21080.08			

The history of total spending for hip fracture patients, shown in Table 4.73, matches the mix of stories proposed above. The very elderly often die from complications brought on by the hip fracture. Many individuals change course in their medical spending after a hip fracture even if they survive it. Age at death seems to predict the survivability of the accident and thus the pattern of spending for hip fracture patients.

Other

TABLE 4.74-OTHER: IN DISEASE EXPENDITURES IN YEAR OF DEATH

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err.	Coeff	Std. Err.	Coeff	Std. Err.
t-1	**0.011**	0.005	**0.315**	0.011	**0.089**	0.016
t-2	**0.066**	0.006	**0.149**	0.0149	0.033	0.02
t-3	**0.038**	0.0073	**0.157**	0.0186	-0.0024	0.026
t-4	0.012	0.0082	**0.119**	0.021	**-0.058**	0.029
Age	-0.0068	0.313	0.245	0.982	-2.26	2.85
Black	**61.79**	11.58	**208.85**	35.4	**474.46**	114.16
Male	-7.54	7.04	**-148.276**	22.3	117.35	72.16
Cons	**70.24**	25.56	**-1786.13**	81.08	**649.06**	236.68
Observations	58603		58603		5544	
Uncensored Obs (Tobit)			13417			
R^2	0.0225		0.0055		0.0126	
LL			-136018.34			

The “Other” category of disease combines all those diseases not otherwise itemized in this work. In general, the results on the “Other” category, shown in Tables 4.74, 4.75, and 4.76, are consistent with a model run without distinguishing diseases. The general pattern of an increasing profile of disease expenditures leading to the terminal period is again confirmed and the demographic regularities found in this and other literature are again demonstrated.

TABLE 4.75-OTHER: AVERAGE IN DISEASE SPENDING AND TREATMENT COUNTS IN FINAL YEAR

	OLS		**Tobit**		**OLS on Decedents**	
	Coeff	Std. Err	Coeff	Std Err	Coeff	Std. Err
Expenditure Mean	**0.0115**	0.0013	**0.06**	0.0036	-0.01	0.0063
Count Mean	**-1.8**	0.43	**-5.95**	1.37	**-20.88**	4.1
Age Death	-0.47	0.343	-0.632	1.08	**-7.74**	3.03
Black	**78.58**	11.68	**272.62**	35.85	**536.91**	112.87
Male	-12.93	7.13	**-159.72**	22.77	73.99	71.97
Cons	**148.45**	30.84	**-1631.99**	98.43	**1499.87**	280.74
Observations	58676		58676		5595	
Uncensored Obs (Tobit)			13417			
R^2	0.0024		0.0015		0.0103	
LL			-136578.21			

To the extent that the “other” category serves as a proxy for the entire Medicare population without considering specific disease categories, the results of the yearly count models are fairly interesting. While the persistence in expenditures is an empirical fact demonstrated in the literature, the demonstration of the negative impact of counts is fairly

novel. Decedents of “other” diseases form an interesting group in that the relationship between their maintenance expenditures and their terminal period expenditures is not clear but a negative coefficient is suggested. This coupled with the strong age at death effect may again demonstrate that frailty is playing a part. History of total spending distinct from spending in other diseases is not imagined to be a fruitful distinction. The corresponding table on total spending is therefore suppressed.

Summary Findings

The tables below provide a condensed illustration of the findings of the models above. Their focus is the qualitative aspects of the models and the quantitative elements are not included. They provide a simple means of identifying those diseases and variables that have suggested relationships and what those relationships are. For each disease the following information is provided: a number of past expenditure quarters that prove significant in terminal year expenditures (as well as the direction) the direction of impact, if any, of black and male indicator variables, expenditure mean, count mean, total spending, and age at death. The OLS model does not have total spending analysis, because in total spending OLS and OLS on decedents are identical.

TABLE 4.76-SUMMARY FINDINGS OF OLS

	In-Disease Expenditure	**Age at Death**	**Black**	**Male**	**Expenditure Mean**	**Count Mean**
Heart Disease	3	-			+	-
Heart Failure	4				+	-
Breast Cancer	3	-		-	+	-
Skin Cancer	4				+	-
Cancer of the Larynx	3			+	+	-
Cervical Cancer	4			-	+	
Prostate Cancer	4	+	+	+	+	-
Bladder Cancer	4			+	+	-
Lung Cancer	4	-		+	+	-
Colorectal Cancer	4				+	-
Leukemia	3				+	-
Non-Hodgkin's Lymphoma	4	-			+	-
Cerebrovascular Disease	3	+			+	
Stroke	2		+			-
COPD	4	-			+	-
Pneumonia	3	+	+	+	+	-
Diabetes Mellitus	4	-			+	-
Alzheimer’s Disease	3				+	
Kidney Failure	4	-	+		+	-
Septicemia	4	-	+	-	+	-
Parkinson’s Disease	3			+	+	
Multiple Sclerosis	4		+		+	-
Muscular Dystrophy	4	-			+	-
Hip Fracture	2	+	-	-		
Other	3		+		+	-

TABLE 4.77-SUMMARY FINDINGS OF TOBIT

	In-Disease Expenditure	Age at Death	Black	Male	Expenditure Mean	Count Mean	Total Spending
Heart Disease	4		+		+	-	2
Heart Failure	4	+	-		+	-	1
Breast Cancer	4	-		-	+	-	1
Skin Cancer	4				+	-	1
Cancer of the Larynx	4	-		+	+	-	1
Cervical Cancer	3	-		-	+	-	1
Prostate Cancer	4	+	+	+	+	-	2
Bladder Cancer	4	+	-	+	+	-	2
Lung Cancer	4	-	-	+	+	-	1
Colorectal Cancer	4				+	-	1
Leukemia	4				+	-	3
Non-Hodgkin's Lymphoma	4	-	-	+	+	-	4
Cerebrovascular Disease	4	+	+	-	+	-	2
Stroke	2		+		+	-	2
COPD	4	-	-	+	+	-	1
Pneumonia	4	+	+	+	+	-	2
Diabetes Mellitus	4	-	+	-	+	-	2
Alzheimer's Disease	4	+			+	+	1
Kidney Failure	4	-	+	+	+	-	1
Septicemia	4	-	+	-	+	-	-1
Parkinson's Disease	4	+	-	+	+		1
Multiple Sclerosis	4	-		-	+	-	
Muscular Dystrophy	4	-			+		1
Hip Fracture	4	+	-	-	+	+	4
Other	4		+	-	+	-	n/a

TABLE 4.78-SUMMARY FINDINGS OF OLS ON DECEDENTS

	In-Disease Expenditure	Age at Death	Black	Male	Expenditure Mean	Count Mean	Total Spending
Heart Disease	-4	-			-	-	1,-2
Heart Failure	-3				-	-	3
Breast Cancer	1					-	
Skin Cancer	1	+					
Cancer of the Larynx							
Cervical Cancer	1						
Prostate Cancer	1		+			-	1
Bladder Cancer	1						3
Lung Cancer	-3				-	-	-1
Colorectal Cancer	-4				-		
Leukemia	-1	-				-	1
Non-Hodgkin's Lymphoma	1					-	-1
Cerebrovascular Disease	-3	+	+		-	-	2
Stroke	-1		+		-		1
COPD	2	-	+		+	-	1
Pneumonia	-4	-	+		-	-	2
Diabetes Mellitus	2				+	-	2
Alzheimer’s Disease	2	-					3
Kidney Failure	1				+	-	1
Septicemia	-3	-	+		-		1
Parkinson’s Disease	1					-	1
Multiple Sclerosis			+		+	-	-1
Muscular Dystrophy	1						-2
Hip Fracture	-4			+	-	-	1,-1
Other	1		+			-	n/a

The most notable feature of Table 4.77 is the consistency across disease of the impact of expenditure and count means on total terminal period expenditure. Also interesting is the variance in the number of periods that have predictive power.

The Tobit models in Table 4.78 prove to be far stronger than the OLS model as is demonstrated by comparing the table above to the one immediately before it. There are no obvious important contradictions between the two tables, other than those noted in the more detailed analysis.

The models run only on decedents of specific diseases shown in Table 4.79 are uniformly weak. In many cases the predictive power of prior spending is directly contrary to the model preceding it. Positive expenditures leading up to the terminal period in many cases are associated with lower terminal period expenditures. It is likely the case this is evidence of accumulated frailty and the resulting withholding of invasive medical procedures.

In sum, the preceding three tables may well serve as an index for the findings that make up the bulk of this chapter. Given the coarseness of analysis undertaken, there are but a handful of compelling results and the summary tables make them more accessible.

Directed Analysis: Age at Death

The following tables, starting with aggregate results in Figure 4.1 and Table 4.80, analyze the history of the impact of age on the cost of dying within the sample. The intent is to demonstrate the observed fact that the age expenditure profile for Medicare recipients has become steeper over time. This means that the older a person is the less likely they are to receive expensive and/or invasive medical procedures in a given state of health and that that differential has been increasing. The graph immediately below illustrates that while inflation-adjusted (or possibly inflation-over adjusted) terms the cost of dying has been relatively stable across the time period over which data is available. It also demonstrates that individuals who pass away at an age one standard deviation above the mean have a distinctly different expenditure profile. Beginning in 1995, according to the data, those individuals who die at an advanced age spend less than mean aged individuals and the differential increases throughout the period. By 2001, beneficiaries passing away at an age of 88 spend fully 40% less than those in their death cohort who are aged at the mean of 77.

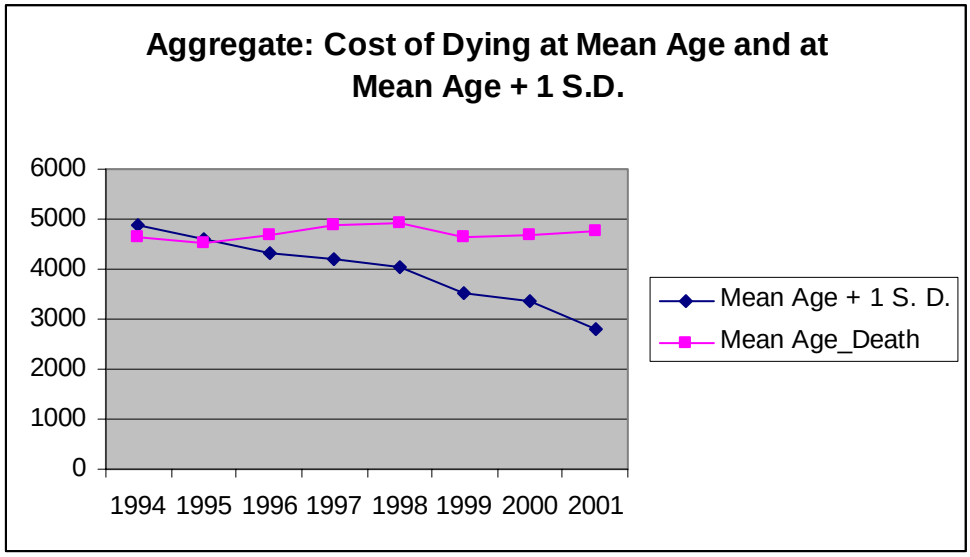

FIGURE 4.1. AGGREGATE: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

TABLE 4.79-AGGREGATE RESULTS: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

Aggreg.	**Coeff**	**Std Err**	**Cons**	**Mean**
1994	-99.53	10.88	13649	4620.56
1995	-80.62	8.97	11684	4510.18
1996	-105.73	8.71	13634	4695.14
1997	-116.84	8.67	14486	4861.81
1998	-114.19	9.06	14083	4917.04
1999	-108.43	7.88	13062	4627.97
2000	-108.25	8.14	12877	4694.59
2001	-132.48	7.53	14453	4740.39

The following graphs and charts replicate what is done above but now taking advantage of the level of detail available in the data. The patterns of terminal expenditure impacts from age at death differ across diseases to a considerable degree. From the abstraction of looking simply at expenditure profiles, the reasons behind significant differences across diseases have to remain ambiguous. It could likely be that changes in the standards of treatment or the adoption of alternative means of treatment at any point could cause a significant shift in disease-specific expenditures. It could also well be the case that those changes would differentially affect people at advanced ages.

The graphs below, Figures 4.2 -4.11 with corresponding Tables 4.81-4.91, consist of measures of mean terminal period expenditures for individuals dying of specific diseases as well as an estimate of expenditures for the same individuals if they were one standard deviation older than the typical decedent. In effect, this demonstrates the total effect of age at death at a level that is relevant to diseases individually. The mean ages and the standard deviation of the age are calculated with a pooled sample across all the years in the window of observation. Thus, the impact of the progression of medical science and any improved success of extending the lives of patients with these conditions is minimized though not likely entirely cleaned from the estimation.

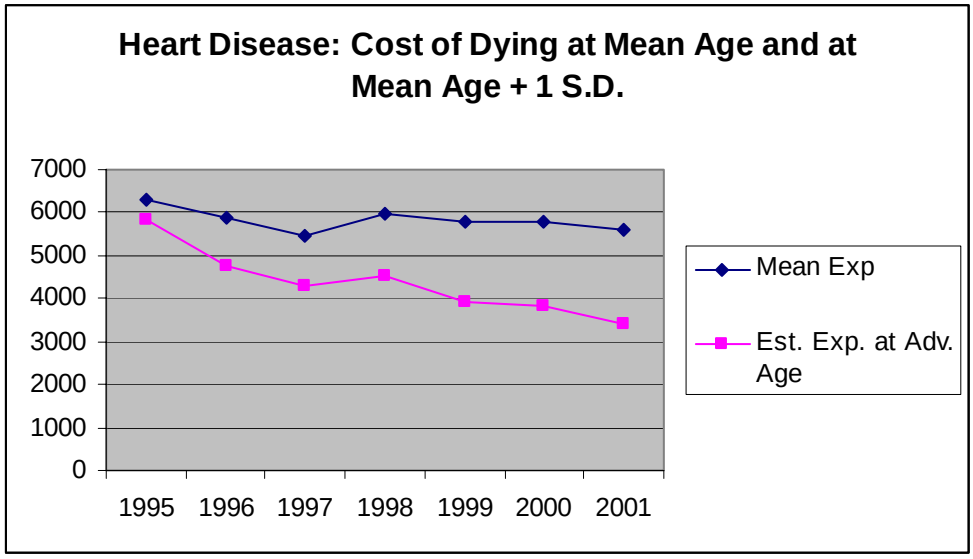

FIGURE 4.2. HEART DISEASE: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

TABLE 4.80-HEART DISEASE: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

Heart

	Age_Death	Stand Err.	Cons	Mean	Obs
1995	-102.37	35.58	14826	6317.08	781
1996	-177.18	32.04	20365	5884.38	836
1997	-154.92	28.08	17912	5451.91	951
1998	-135.65	33.65	16466	5982.86	992
1999	-156.44	31.28	17693	5810	1020
2000	-146.14	31.08	16695	5793	1087
2001	-139.49	26.99	15705	5580	1198

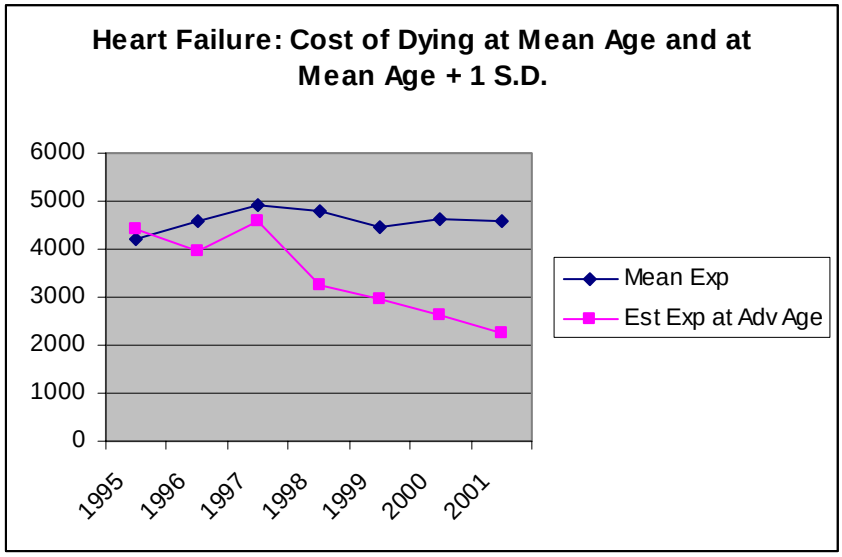

FIGURE 4.3. HEART FAILURE: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

TABLE 4.81-HEART FAILURE: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

428					
	Age_Death	**Stand Err.**	**Cons**	**Mean**	**Obs**
1995	-125.54	29.24	15716	4224	651
1996	-142.98	22.96	16822	4592	733
1997	-125.88	27.35	15903	4914	784
1998	-186.49	32.04	20052	4771	844
1999	-144.95	21.36	16013	4445	901
2000	-158.53	20.98	16896	4619	935
2001	-156.91	20.5	16388	4589	991

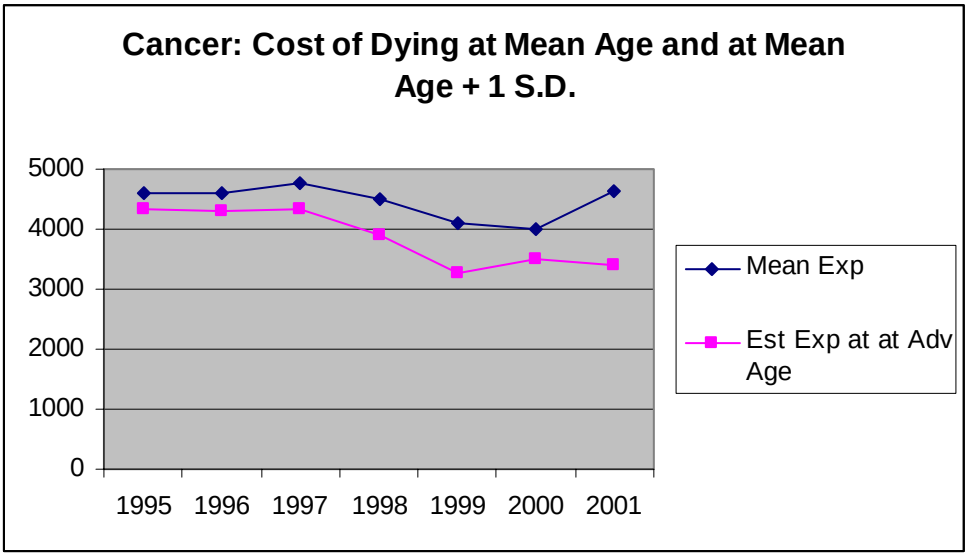

FIGURE 4.4. CANCER: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

TABLE 4.82-CANCER: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

Cancer

	Age_Death	Stand Err.	Cons	Mean	Obs
1995	-74.34	24.88	10580	4608	1007
1996	-53.72	18.44	8808.47	4591	1083
1997	-52.84	23.57	8778.77	4754	1065
1998	-71.21	19.07	9866	4510	1007
1999	-78.15	21.14	9816.55	4102	1008
2000	-40.87	18.37	6937	4015	1081
2001	-82.97	25.51	10379	4621	1074

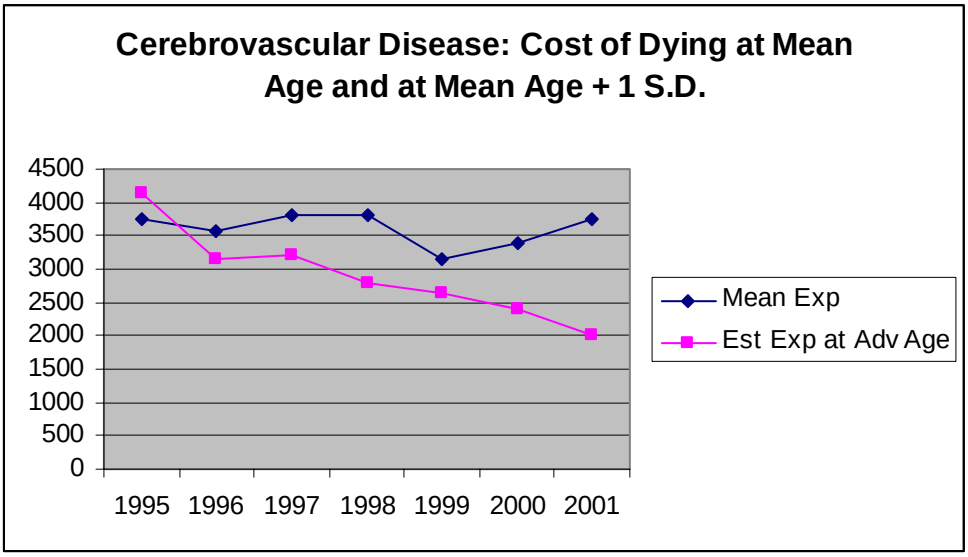

FIGURE 4.5. CEREBROVASCULAR DISEASE: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

TABLE 4.83-CEREBROVASCULAR DISEASE: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

	Age_Death	Stand Err.	Cons	Mean	Obs
1995	-120.34	40.78	14965	3737	426
1996	-148.93	35.12	16542	3585	406
1997	-140.22	34.4	15834	3812	495
1998	-153.99	33.41	16642	3819	515
1999	-67.73	20.82	8727	3148	544
2000	-85.02	24.89	10040	3389	624
2001	-123.75	24.98	13146	3747	617

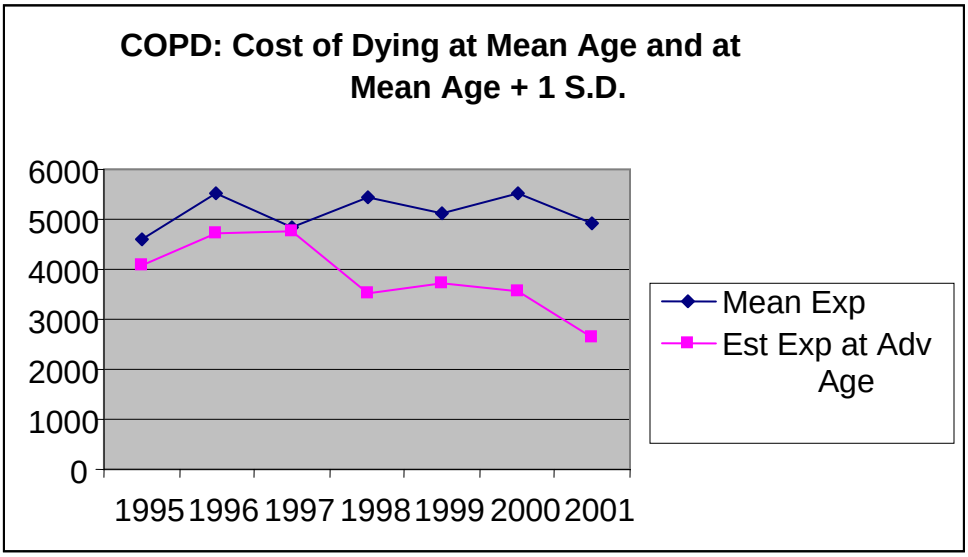

FIGURE 4.6. COPD: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

TABLE 4.84- COPD: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

	Age_Death	Stand Err.	Cons	Mean	Obs
1995	-102.37	40.35	12889	4604	502
1996	-110.63	42.55	14251	5527	544
1997	-1.37	28.97	4882	4826	521
1998	-171.84	40.54	18286	5458	579
1999	-111.2	41.18	13284	5126	632
2000	-133.68	42.86	15039	5510	704
2001	-132.21	29.98	14007	4916	689

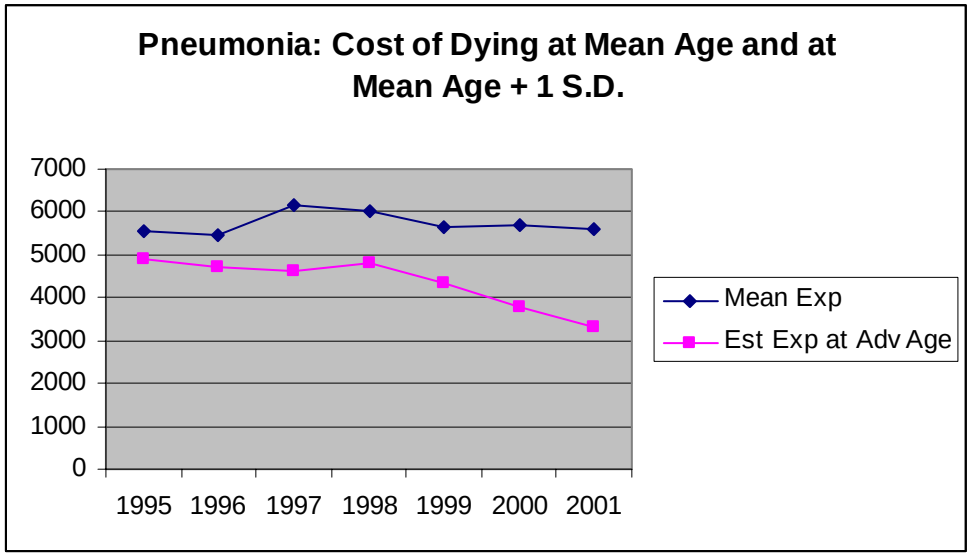

FIGURE 4.7. PNEUMONIA: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

TABLE 4.85-PNEUMONIA: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

Pneu

	Age_Death	Stand Err.	Cons	Mean	Obs
1995	-97.7	22.12	13906	5569	752
1996	-95.47	26.48	13485	5465	765
1997	-154.5	27.39	18848	6177	769
1998	-99.35	28.45	13944	6009	833
1999	-84.33	23.43	12095	5629	875
2000	-113.17	24.02	14196	5676	908
2001	-123.88	21.24	14714	5607	870

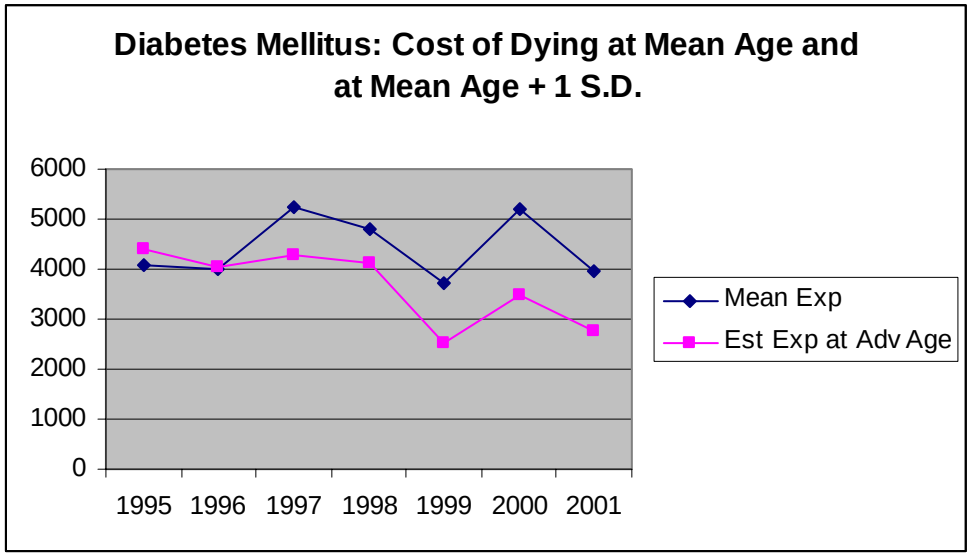

FIGURE 4.8. DIABETES MELLITUS: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

TABLE 4.86-DIABETES MELLITUS: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

	Age_Death	Stand Err.	Cons	Mean	Obs
1995	-37.81	42.29	7684	4072	209
1996	-97.05	36.58	12496	3990	240
1997	-163.64	40.01	18533	5240	321
1998	-113.67	39.08	14005	4808	341
1999	-112.02	25.72	12257	3722	319
2000	-136.36	49.48	15332	5191	382
2001	-91.69	28.01	10753	3953	379

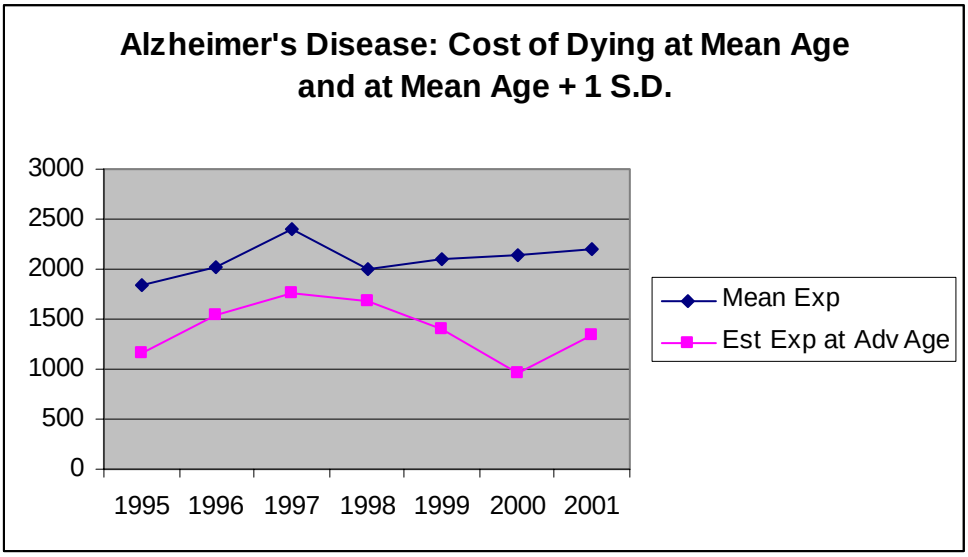

FIGURE 4.9.ALZHEIMER'S DISEASE: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

TABLE 4.87-ALZHEIMER'S DISEASE: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

	Age_Death	Stand Err.	Cons	Mean	Obs
1995	-117.31	23.71	11845	1844	114
1996	-76.01	27.18	8452	2026	134
1997	-93.37	40.76	10248	2409	181
1998	-28.4	35.72	4268	2006	143
1999	-63.8	27.9	7215	2108	180
2000	-87.11	23.19	8878	2149	188
2001	-54.37	34.54	6287	2200	219

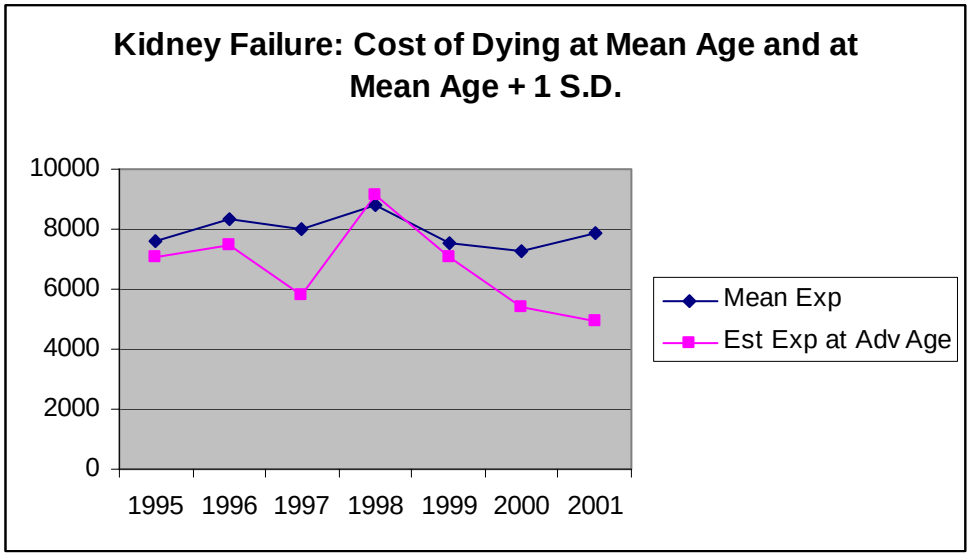

FIGURE 4.10. KIDNEY FAILURE: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

TABLE 4.88-KIDNEY FAILURE: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

	Age_Death	Stand Err.	Cons	Mean	Obs
1995	-58.17	53.18	11895	7602	184
1996	-88.46	54.06	14780	8352	188
1997	-183.58	49.05	21041	7968	217
1998	29.2	54.19	6691	8780	259
1999	-30.76	33.57	9616	7563	308
2000	-104.17	32.82	14018	7234	317
2001	-159.68	41.02	18201	7856	331

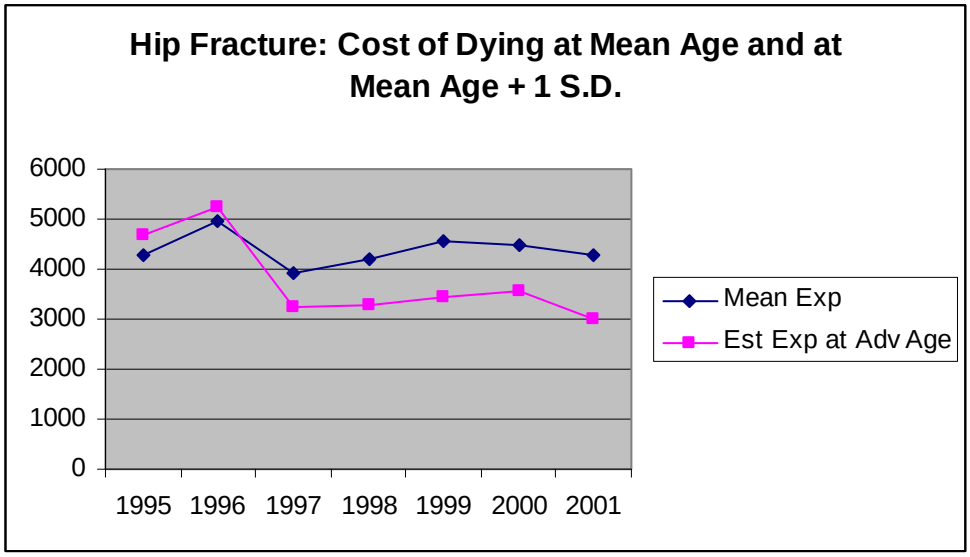

FIGURE 4.11. HIP FRACTURE: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

TABLE 4.89- HIP FRACTURE: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

	Age_Death	Stand Err.	Cons	Mean	Obs
1995	-48.82	44.71	9176	4287	240
1996	-55.08	73.98	10309	4947	256
1997	-143.59	35.94	16464	3930	293
1998	-125.03	43.86	14798	4193	303
1999	-119.69	37.81	14443	4542	339
2000	-93.07	47.43	12123	4463	332
2001	-97.34	39.38	11953	4290	342

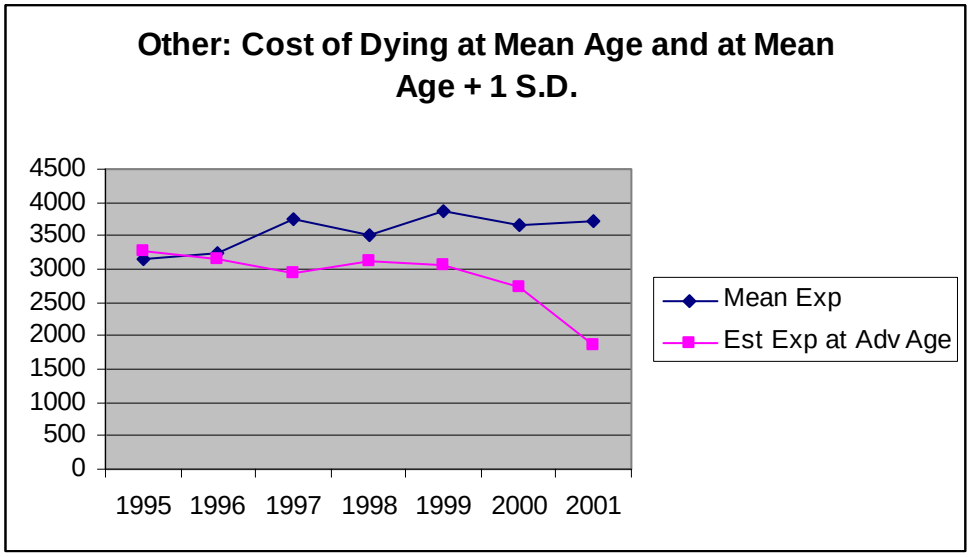

FIGURE 4.12. OTHER: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

TABLE 4.90-OTHER: COST OF DYING AT MEAN AGE AND AT MEAN AGE + 1 S.D.

	Age_Death	Stand Err.	Cons	Mean	Obs
1995	-16.46	21.84	4759	3139	1032
1996	-37.18	18.34	6523	3244	1002
1997	-98.99	23.39	11956	3754	938
1998	-61.26	21.01	8681	3512	1051
1999	-70.22	20.53	9463	3863	1016
2000	-66.7	19.72	8798	3646	1108
2001	-113.27	18.86	12158	3730	1175

Age at death is a strong determinant of total terminal period expenditure though its influence is consistent neither across diseases nor across time. As suggested above, the change in the impact of age at death in a specific disease could come from any number of causes, so it is beyond the scope of this work to explain the path in any particular disease. That said it is evident that in general the influence of age at death has become more strongly negative and is among the most significant determinants of terminal period expenditure. This is among the most striking findings of this work.

Conclusion

Taken together, the relationships revealed between expenditures in the terminal period and the demographic variables and in disease expenditures prove to be quite consistent across diseases. While this is evidence of an empirical irregularity that may well be exploited to gain further insight into these diseases, it makes the recitation of the fact in each disease rather tedious. In a few cases, the models performed well in explaining the variation in terminal period expenditures. In most cases however the models proved too weak. This should not be a surprise. The natural variation in death experiences and the expenditures they generate make a tighter model a goal that is likely unreachable. The models serve as a "first cut" of the data and the problem and open the door for future work. The hopes and goal of that future work will be outlined in the next chapter.

CHAPTER V

CONCLUSIONS, DISCUSSIONS, AND PLANS FOR FUTURE WORK

The progression of expenditures in terminal disease reimbursed by the Medicare program is highly dependent on the characteristics of the individual beneficiary. The work in the preceding chapters has attempted to illuminate commonalities between groups of people and diseases that drive expenditures for which the Medicare program is by design liable. The method adopted was designed to refine the understanding of expenditure paths, to make use of new data, to expose existing relationships and to provide a structure to motivate future research.

The detail provided by the data used allows the models to identify the sources of many of the empirical irregularities previously established in the literature which have predominantly used more coarse aggregated data. While not terribly useful for the pressing funding problems that the Medicare programs faces, the approach is ideally geared to identify those disease particularly impacted by the structure of the Medicare program's reimbursement policies. The diseases are all treated by the same modeling procedure. The results themselves present interesting commonalities sand differences among diseases and among demographic groups. They do not serve to answer many questions of import, but further the literature by passing the diseases and groups of beneficiaries through a finer sieve

than has been done before. The method allows for a clear distinction between those diseases who pass through it easily and those who are different enough to generate mixed signals under the adopted procedure. To a large degree, it is the disorders which fail to “fall open” for the models in the previous chapters which draw attention for further research.

The contribution made by this work is in some sense, through presenting the challenges and difficulties and monotony, made possible by a much finer level of detail now available to researchers. The method adopted made use of quarterly level observations. The data in its raw form actually exists in daily observations. It is an open question whether a finer level of detail can offer any additional level of insight without clouding the issue by necessitating extravagant econometric techniques. It is certainly the case that the models presented have not pushed the envelope in econometric detail. One reason for this, and a primary contribution of this work, is the fact that the adopted procedure serves to “test the waters” both of disease specific expenditure profiles and of quarterly data on medical expenditures.

The net result of the findings presented is that there are vast differences in the way in which people die in the modern era and the expenses they incur in doing so. The procedure adopted, while crude and arbitrary, has served to illuminate many potential avenues of future research. The Medicare program has in the past adopted special programs focused on specific disease categories to augment and streamline financing solutions for individuals suffering from them. A prime example is the End-Stage Renal Disease Program. The results

of the present work serve to bring to light specific diseases whose sufferers may well benefit from a tailored Medicare funding program. None of the results are conclusive enough to be the basis of such a policy, but the work serves as a reference to motivate the research that would.

The promise embodied in the previous chapters comes from the refinement in modeling technique and the focus on important areas made possible by this first pass through the problem and through the data. It now remains to follow the research herein presented with targeted investigations of specific diseases and the expenditure relationships that will impact the efficacy of any changes in Medicare funding to do better by the Medicare program and its beneficiaries.

While the research accomplished is less than penetrating and largely descriptive in nature, it represents a necessary and distinct step in a useful understanding of the matter at hand. A deeper and more expansive investigation of all the diseases considered would certainly have been possible though would likely have strained attention and focus even more so than the present work has done. A finer and more targeted approach to a smaller set of diseases may well have been more entertaining and directly useful, but without the contribution made by this general and comprehensive treatment the selection of those diseases would be arbitrary and fail to give confidence that the important issues had been addressed.

The next step in the research made possible by the present work will be to identify

classes of diseases and tailor modeling techniques useful and appropriate to each class. For example, it may well be important to distinguish between chronic and acute conditions and model their expenditure profiles with different tools. Another intriguing avenue of research would be to begin by stacking individuals, not on death, but on the first instance of expenditure for the disease that ultimately causes that persons death. That avenue would allow consideration of the efficacy of treatments in extending a persons life and evaluate the impact on expenditure paths from any specific intervention, as well as evaluate the importance of the timing of that intervention. These and countless other potential investigations are brought to mind and made possible through this initial work and the investment in data organization required for it.

It is hoped that the efforts presented herein have served to further the literature and refine the understanding of disease expenditures under the Medicare program. The intended contribution is imagined to be important though almost by necessity rather modest. A goal and intention of the work has been to present the complex and intricate world of Medicare, Medicare beneficiaries, their health and the diseases which threaten it in a way that serves to organize and promote further research into the important problems faced by the program. As morbid, various, and analytically challenging as the death experience on Medicare is, it is an area of prime importance for the individuals affected and for the Medicare program in total.

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