COMPARISON BETWEEN EARLY AND LATE STAGE LUNG CANCER IN RELATION TO COST AND MORTALITY

BY

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Comparison Between Early and Late Stage Lung Cancer

in Relation to Cost and Mortality

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Abstracts

COMPARISON BETWEEN EARLY STAGE AND LATE STAGE LUNG CANCER IN RELATION TO COST AND MORTALITY

Background: Lung cancer (LC) is a life threatening disease associated with significant cost and high mortality. LC is diagnosed in either early stage or more frequently in late stage, the face of LC.

Objective: To make a comparison between early and late stage lung cancer (SLC) in relation to cost and mortality

Methods: The study is a random effects data analysis of a historical dataset the Nationwide Inpatient Sample (NIS). The study is based on the time period 2002, 2006 and 2011. The primary outcomes of interest is cost (total cost per day) and mortality (died/did not die). Two replicates samples for the years 2002, 2006 and 2011 were taken. Demographic factors that influence cost and mortality were co-varied out of the analysis. Descriptive Statistical analysis and bivariate analysis were done for cost includes ANOVA and ANCOVA. A statistical analysis for mortality includes Logistic Regression. Cost and mortality for early versus late (SLC) were measured in isolation and after accounting for age, gender, race, socio-economic status, number of diagnoses, length of stay, and number of procedures.

Results: In the three years, 3 samples of 2173, 13,032, and 15,771 including 3 replicate samples of 2060, 13,032 and 15,772 participated in the study. All significant relationships tested at an alpha level of ($P<0.05$). The cost for early (SLC) was higher compared to late (SLC) and is statistically significant. The number of procedures in part accounted for the difference. Late (SLC) had higher mortality compared to early (SLC) and is statistically significant. The number of diagnoses in part accounted for the difference. The study showed early (SLC) costs 14% more than late (SLC). Late stage is more deadly, however, the gap is surprisingly small at 30% or an odds ratio of 1.3 to 1.5 after adjusting for covariates.

Conclusion: This study of HCUP data revealed that early (SLC) is more expensive than late (SLC). Additionally, the data revealed that mortality is higher in late (SLC) compared to early (SLC). Overall, these finding highlight the important role of Health Informatics in understanding the cost and mortality of early and late (SLC).

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Chapter I

I. Introduction

Lung cancer (LC) is a life threatening disease with worldwide concern associated with significant cost and high mortality with a 5-year survival rate 2005-2011 at only 17.4% across all stages and 7% alive after 10 years. The disease is diagnosed essentially in late stage (extensive disease) and less often in early stage (limited disease). A small number are also unknown with no stage at diagnosis at 5%. The early stage of the disease (no distant metastases) includes mainly asymptomatic cases (insidious disease) which is why the vast majority of LC is detected in late stage when most treatments are ineffective and cure rates are low. A reason why LC is so deadly is because it is hard to diagnose LC in early stage with years for the cancer to grow and turn metastatic (spread to other sites in the body). The late stage LC, the face of LC, includes distant metastatic disease and symptomatic cases. Examples of distant metastases are tumor in the brain and/ or in the bone, liver, adrenal glands ***[American Lung Association, 2016; Crino et al., 2010; Dela Cruz et al., 2011; National Institute of Health, 2016; Wang et al., 2013].***

The single greatest risk factor for LC is tobacco use at 90%. Therefore it goes without saying LC related mortality is closely linked to tobacco smoking and second hand smoke exposure. Many epidemiological studies have repeatedly found tobacco use as a risk factor for LC. The U.S. Public Health Service made

public in 1972 a Surgeon General's report stating that an increase of 70% in death rates, tied to certain ages, were directly correlated with cigarette smoking. Even with a delayed diagnosis of LC in never smokers the LC mortality rate is better independent of stage of LC, treatment and number of diagnoses ***[American Lung Association, 2016; Dela Cruz et al., 2011].***

Aside from smoking, radon exposure causes 9-15% of LC, occupational carcinogen exposure 10% and outdoor air pollution 1-2% ***[American Lung Association, 2016].***

Parallels to LC based on demographic characteristics seem to be very correlated with historical cigarette smoking prevalence. Outside of this parallel is the very high rate of LC in black American men, a group whose very high LC death rate is not explainable simply by historical smoking patterns. LC prevalence and mortality trends are analyzed according to age, sex, and race in the U.S. A few studies have examined socio-economic status, comorbidities in LC in U.S. mortality ***[The Health Consequences of Smoking; a Report of the Surgeon General: 1972; Pinsky et al., 2006; Tammemagi et al., 2004; Ward; et al., 2004; Brewster et al., 2001; Williams et al., 1977; Adler et al., 1999; Mao et al., 2001; Grose et al., 2013].***

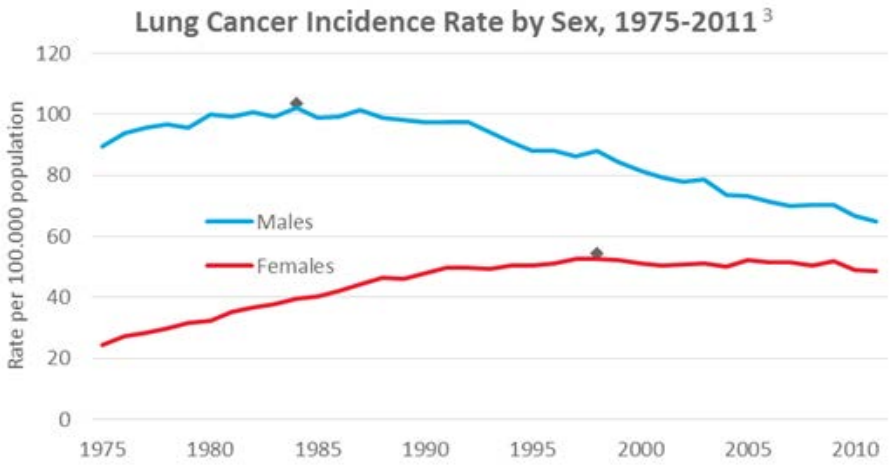
LC is common. LC is the second most common cancer for men and for women in the United States with new cases from 2008-2012 at 58.7 per 100,000 age-adjusted.

The number of deaths from LC in men and women from 2008-2012 age

adjusted was 47.2 per 100,000 persons ***[National Cancer Institute, 2016].*** LC was responsible for 26.8% of all cancer deaths in 2015.

In the past approximately 40 years the LC incidence rate for men has decreased 28% and increased 98% for women. The rate of new cases for men peaked at 102.1 per 100,000 in 1984 and then started declining. The rate for women of new cases continued to increase higher and did not peak at 52.9 per 100,000 until 1998 and has now started to decline ***[National Institute of Health 2016, National Cancer Institute. SEER Cancer Statistics Review, 1975-2011].***

Figure 1: Lung Cancer Incidence



National Institute of Health, **National Cancer Institute. SEER Cancer Statistics Review, 1975-2011**

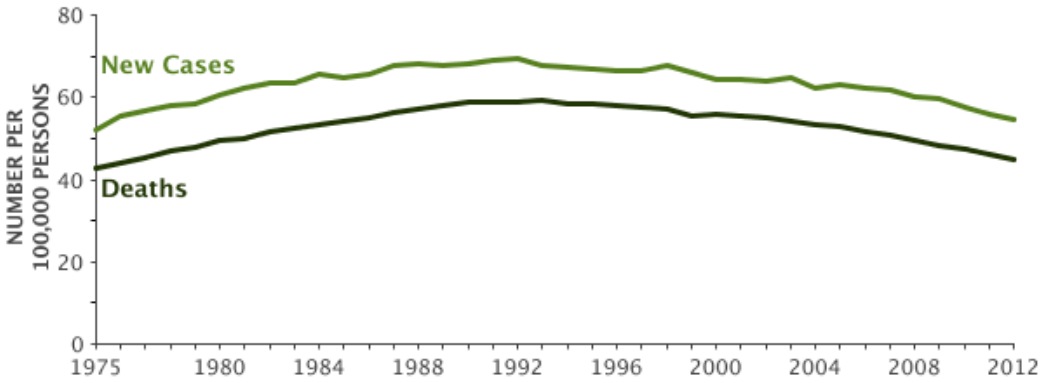
A critical decrease in the death rate trend in LC for men started in 1991. The LC death rate trend among women has recently stabilized.

The number of deaths due to LC has increased from 1999 to 2012. The

LC number of deaths has increased around 3.5*% [American Lung Association, 2016; American Cancer Society, 2015]*. These shifts have been attributed to many factors that have reduced the prevalence of cigarette smoking in the United States. There has been a noted decrease in American adults who smoke, falling from 24.1% in 1998 to 20.6% in 2008, equating to a 3.5 overall decrease ***[Dube et al., 2010].***

A critical smaller drop in LC death rates for women has been noted. Most probably due to a later decline in cigarette smoking rates among females. The incidence of LC is declining since the middle 1980s for men 3% every year and middle 2000s for women 2.2% every year ***[American Cancer Society Facts & Figures, 2015].***

Figure 2: Lung Cancer New Cases, Deaths



SEER 9 Incidence & U.S. Mortality 1975-2012, All Races, Both Sexes. Rates are Age-Adjusted

The CDC estimates for 2012 find 42.1 million individuals are current cigarette smokers over 18% of adults in the United States. The CDC report

cigarette smoking by age, race and ethnicity, education, and poverty status. Thirty-nine percent of cigarette smokers are younger individuals between 18-44 years of age and 28.4% are 45 years of age and older.

In 2012 by the U.S. Census prevalence was higher in the Midwest at 26.0% and south 19.7% as opposed to the northeast at 16.5% and west at 14.2%. In 2012 the CDC reported 20.5% adult men and 15.8 % of adult women were current smokers. The CDC reported that multiple race individuals were current smokers in 2012 at 26.1% followed by 22% American Indian/Alaska Native not Hispanic followed by whites non-Hispanic at 19.7%, Blacks non-Hispanic at 18.1%, Hispanics at 12.5%, Asians non-Hispanic at 11%. Sixty-five percent of individuals with a GRE diploma or high school diploma were reported by the CDC to be current smokers followed by people with 12 years or less of education with no diploma at 24.7 %, followed by 9.1% individuals with an undergraduate college degree and 5.9% with a graduate degree. Thirty percent of individuals living in poverty were reported by the CDC to be current smokers followed by 17 % living at the poverty line. Cigarette smoking is the leading cause of LC. However, half of all LC diagnosed in the U.S. are in former smokers around 50%.

President Obama signed a law in 2013. The first legislation requiring comprehensive plans of research action for high mortality cancers, which includes LC and will be given priority status for expedited attention. The first of its kind legislation, included in the National Defense Authorization Act of 2013, requires the National Cancer Institute (NCI) to develop scientific plan for addressing cancers

with survival rates of less than 50%, with first priority attention to LC ***[Center for Disease Control, 2016; National Institute of Health, 2015; American Cancer Society, 2015; American Lung Association, 2015; Rahib et al., 2014; National Cancer Institute, 2015].***

LC has the highest mortality of any cancer in 2016. It is estimated that 158,080 people will die (86,920 men and 72,160 women) of the disease and more than combined breast cancer with 90.5% survival rate, prostate cancer with 99.5% survival rate and colorectal cancer with 65% survival. Additional factors can be attributed to the fact that generally LC patients tend to have other medical condition that could impact their survival ***[Edwards et al., 2014; National Cancer Institute, 2016].*** Individuals who continue to smoke cigarettes have been shown to have worse survival rates in relation to their LC related mortality incidence rate ***[American Cancer Society, 2016; Videtic et al., 2003].***

Focusing closer on mortality for LC shows that it depends in large part on the stage (extent) of the disease at diagnosis.

It is known 85% of LC is diagnosed in late stage with 57% of LC are metastatic at diagnosis. In late stage LC that has spread beyond the primary original tumor, locally advanced is difficult to treat. Distant metastatic stage IV LC has a 5-year survival of only 4%. Approximately 95% of people diagnosed with LC have symptoms related to their LC. Symptoms occur late in the disease progress. LC is aggressive. LC metastases to the bone cause bone pain, liver metastases cause pain and can interfere with liver function, adrenal gland metastases can

produce no symptoms and brain metastases cause headache, vomiting, seizure, weakness, paralysis, vision, swallowing disturbances, loss of balance, coordination and confusion. LC can spread to any organ. Advanced treatments, radiation, chemotherapy, immunotherapy and surgery are not effective in improving the overall survival in late (SLC), the face of LC.

LC arises from the cells of the respiratory epithelium and can be divided into two broad categories. The two predominate primary LC types are non-small cell LC (NSCLC) and small cell LC (SCLC). Small cell LC (SCLC) is a very malignant tumor derived from cells exhibiting neuroendocrine characteristics and accounts for 15% of LC cases. Non-small cell LC (NSCLC) is the most commonly diagnosed type of LC which accounts for the remaining 85% of LC cases. LC is further divided into 3 major pathologic subtypes: adenocarcinoma, squamous cell carcinoma, and large cell carcinoma ***[Barzi et al., 2010; Roche, 2016; Dela Cruz et al., 2013; American Lung Association, 2015]***. Out of all LC cases 38.5% are adenocarcinoma, while 20% are squamous cell carcinoma, and 2.9% are large cell carcinoma. Significantly increased numbers of adenocarcinoma have been found, replacing the previous subtype, squamous cell carcinoma a type of NSCLC. The 5-year LC survival rate is dismal for the data collected between 2001-2007 ***[Howlader et al., 2014; Herbst et al., 2008].***

Other factors influencing LC mortality differences include age of patients. LC is described as a cancer of the elderly. The average age at diagnosis is 70 year of age for LC with less than 2% younger than 45 years of age. LC is worse for older

people. Gender is another factor influencing LC mortality. More men every year are diagnosed with LC than women. The death rate for men with LC is greater for men than women 56.1 to 36.4 per 100,000 persons respectively. LC is harder on men than women. Race is another factor influencing LC mortality differences. From 1999-2011, black men have the highest incidence and death rate for LC than any other group, 32% higher than white men even with lower exposure to risk factors, followed by American Indian/Alaska Native, Asian/Pacific Islander and Hispanics. For women, white women had the highest incidence for LC followed by black women, American Indian/Alaska Native, Asian/Pacific Islander and Hispanics. Shavers et al., 2002 reported on disparities in LC mortality in blacks and is worse than whites based on the medical services received in this ethnic group in all stages of the disease. LC is more difficult for blacks.

The number of diagnoses is another factor influencing LC differences. The number of diagnoses influences treatment decisions ***[National Cancer Institute, 2016; American Lung Association, 2016; American Cancer Society, 2015; Center Disease Control, 2015].***

LC is increasingly more prevalent in the less educated and poorer populations which lend itself to socio-economic status indicators. There are similar observations in many countries worldwide, including those with universal health care. Regardless of universal healthcare, the socio-economic status was a significant indicator for poor survival outcome. Socio-economic status also plays a role in the later stage LC diagnosis for those in the lower socio-economic status

ranks. Alder et al., 2013 found in a study LC survival does not differ in low income blacks and whites ***[Alberg et al., 2013; Mao et al., 2001; Booth et al., 2010].***

Early stage LC is rare. If LC is only detected in the lung where it started it is *localized* and has not spread to other sites in the body referred to as stage I, II and IIIA. ***[National Cancer Institute, 2016]***. Most early stage is found by accident as a result of tests for other medical conditions. Early stage LC is not as will researched as late stage LC, locally advanced and distant metastatic disease, because LC is treated and studied mainly as late stage disease. Early stage LC is often found by imaging tests such as a chest x-ray or chest CT scan, bronchoscopy or sputum exam tests. A microscopic examination of the cells in brought up phlegm done for other reasons in patients with heart disease, pneumonia, or other lung conditions. A small number of these patients do well and maybe cured of LC. Early stage LC has a 5-year survival rate of 54% ***[Varlotto et al., 2011; American Lung Association, 2016].***

Early (SLC) as a grouping is heterogeneous because not all early LC patients have the same outcomes. Not all early (SLC) patients are alive 5 years after diagnosis and many are never cured, 7% of all LC patients are alive 10 years after diagnosis. Early (SLC) patients with recurrent disease have a poor 5-year survival rate. Many early (SLC) patients that are not respectable have a poor 5-year survival rate around 16% with radiation. A total resection of the lung is associated with greater survival remission but only approximately 25% of early stage patients are candidates for surgical treatment at the time of staging. There is a 3% to 5%

mortality rate with early stage LC surgery called a lobectomy. Only about half are cured ***[Nesbitt et al., 1995; National Cancer Institute, 2016; Kagan et al., 2015].***

An important development in LC research occurred in 2011 after many decades with many failed studies to detect a benefit in screening for early stage LC, a study called the National Lung Screening Trial conducted by the American College of Radiology Imaging Network and the NCI published results reporting in the New England Journal of Medicine of a 20% decrease in LC mortality after screening current or former heavy smokers 55 to 74 years of age using low dose CT scans. It is one of the largest cancer screening trials ever conducted. This is the first study conducted now, evidence-based, supporting LC screening to reduce LC mortality with screening for early stage lung LC, and a major advancement in LC care. Detection of LC in early stage represents one of the most promising approaches to reducing increasing cancer challenge along with smoking cessation efforts. Early detection already has a pivotal role in the management of cervical and breast cancer. However, Lerner in 2014 reported that the American Cancer Society for centuries held the mantra that early detection saves live this however this is a theoretical question. The limitations have become more evident early detection may not save lives and it can lead to unnecessary procedures. The rethinking is based on the best way to fight disease is with evidence and we cannot pay for test that are not effective in spite of their name recognition and familiarity to patients. In 2014 Incisive Health reported on the United Kingdom that It is currently agreed on by everyone early diagnosis saves lives in cancer. However, National Health

Services has been restrained to implement finding having a diagnosis of cancer early is a priority and the thinking is costs are a significant factor ***[Aberle et al., 2011; Nanavaty et al., 2014; Etzioni et al., 2003].***

Considering early stage and LC subsequent screening research and programs all have been driven by the theory that screening can lower the risk of mortality if the disease is detected at an early stage and that the benefits of doing so not only include reduced LC mortality, but also the possibility of averting potentially expensive costly treatment courses that are associated with low success rates in the advanced stage setting ***[Cressman et al., 2014].*** Essentially the overall outcome of a late stage diagnosis is so strongly associated with poor survival that increasing the percentage of cancers diagnosed at an early stage is an important major ambition of the National Cancer Institute ***[National Cancer Institute, 2016].***

A number of challenging factors still remain and need to be considered with LC screening including the impact of complications, the effect of high false positive results, radiation risk, effect of over diagnosis and effect on smoking cessation **[*Nanavaty et al., 2014; National Cancer Institute, 2016; Fintelman et al., 2014].*** More data and research in the area of screening for LC and the shift from a majority of late stage to early stage LC is unclear until screening for LC is fully implemented. LC could be one cancer where the disease has spread early in its existence even if the cancer seemed local at the time of detection. There could be undetectable metastases in other sites in the body. LC is associated with high morbidity and mortality and is a significant burden to health care systems ***[Granger***

et al., 2016].

Addressing the other aspect of the LC worldwide concern the high cost of LC. In 2010 the National Cancer Institute (NCI) reported over 12.1 billion was spent in healthcare for LC. In 2004, costs of care in patients with LC were estimated to account for approximately 20 % ($4.2 billion) of all Medicare expenditures for the treatment of cancer. A figure that is greater than the estimated total cost of treatment among patients with colorectal or prostate cancer ($2 billion). The costs of LC treatments have been spiraling exponentially but have not led to a marked increase in survival long term rates. Some studies report the national estimated cost of LC varies by stage at diagnosis ***[Cipriano et al., 2011.*** The average annual costs of care in LC for individuals older than 65 in 2014 is $60,533 by the U.S. National Institutes of Health, National Cancer Institute.

LC patients could have a disproportionate range of costs related to stage of the disease ***[Yabroff et al., 2008; National Cancer Institute, 2016].*** People with LC face physical and emotional challenges. LC is a complex and life changing disease. LC devastates families and communities. Lost productivity because of cancer deaths is greatest for LC. The National Cancer Institute estimates that U.S. deaths from LC in 2009 accounted for 2,373,200 person-years of life lost, more than 3 times the number of years lost to breast cancer (770,700 person-years) and colorectal cancer (765,300 person-years). This translates to substantially higher indirect costs (or productivity loss) for LC and of the $134.8 billion indirect cost associated with cancer deaths in 2005, $36.1 billion (or over 25%) was attributable

to premature mortality from LC.

The Health Cost Utilization Project (HCUP) in 2006 found there were over half a million hospitalizations related to LC. The financial cost of LC is staggering. Aggregate costs for all hospitalizations related to LC totaled over 6 billion dollars. Between 1995 and 2006, the number of stays principally for LC remained relatively stable, while increasing about 15 percent as a secondary diagnosis ***[National Cancer Institute, 2015; National Institute of Health, 2016; Holmquist et al., 2006; American Lung Association, 2016].***

LC testing and diagnosis is the only way to confirm if LC is the reason for symptoms. Histology (cancerous cell tissue analysis) offers accurate diagnosis. There are a variety of available tests which can be used in LC diagnosis. Cytology collects a sputum sample for diagnosis confirmation. Bronchoscopy is an examination which includes visual inspection of the internal lungs and trachea. Tissue specimens may be taken for analysis from inside the lungs. Needle biopsy can be done in combination with a CT scan to gather cells for analysis. All of these can be used at various stages of LC, but finding the cancer early on is often block by no obvious symptoms, therefore delaying health care impacting costs.

The most common symptoms are non-specific and often ignored by patients. This leads to delayed medical diagnosis and treatment ***[Barzi et al., 2010; Roche, 2016].***

Symptoms include:

- A cough that does not go away

- A change in a cough that does not go away
- Coughing up sputum with blood
- Pain with breathing or coughing
- Shortness of breath
- Anorexia
- Tired feeling
- Losing weight while not dieting

Staging demonstrates the advancement of the LC and areas where the LC may have spread throughout the body. Staging is used in identifying the best treatment options available to the LC patient. A number of tests utilized to identify LC and what stages it has metastasized include:

- Radiological/Nuclear - X-rays: These can be used to detect a localized mass or enlarged Lymph node in the chest or lungs.
- CT scan or Computed tomography: Computer assisted imagery offering cross-sectional views of the body confirming location and size of mass or possible spread of LC.
- Magnetic resonance imaging (MRI) scan: Magnetic field imaging of the chest identifying the location of the LC and degree of spread.
- Bone scan: This imagery test informs of any spreading of the LC to bone tissue.
- Abnormal blood chemistry tests: Used to identify bone or liver

metastases.

- Surgical removal: Early stage detection offers cure through surgical removal of tumor.

Late stage diagnosis offers poor diagnosis utilizing surgical removal ***[Roche, 2016; Barzi et al., 2010].***

Stages of Classification include:

- Stage I: LC is isolated to one portion of the lung.
- Stage II: LC has spread to lymph nodes or chest wall tissue.
- Stage III: LC has spread extensively throughout the chest and major lymph nodes.
- Stage IV: LC has spread beyond the chest cavity into other body parts including the bone, adrenal glands, liver or brain tissues.

Treatment options for LC vary depending on the health status of the LC patient, the size of the cancer tumor, the stage of disease progression, and the kind of cancer tumor.

Surgery is the most common treatment for those diagnosed in the early stages of LC, offering the highest survival rate for this treatment group. Patients that are unable to receive surgical treatment can utilize radiotherapy alone or in combination with chemotherapy ***[Roche, 2016].***

Late stage LC is currently incurable, targeted therapies, like epidermal growth factor receptor *(*EGFR*)* have the potential to manage tumor growth. Even though currently there are just a few number of patients with LC that have the genetic abnormalities and are able to see favorable results from targeted therapies. Chemotherapy is used when the cancer has progressed beyond advanced stage 1 and has spread to other site in the body making it inoperable.

LC patients receiving platinum based chemotherapy have on average of only 10 month life expectancy. Patients who progress after initial treatment with Docetaxel chemotherapy they have only a small chance for long term survival. This treatment is given steps: first line and second line treatment. The first line treatment is the initial therapy received for advanced disease and is given until tumor has not progressed and maintenance therapy is then given. Second line treatment is given when the disease progresses. The U.S. Food and Drug administration approved the drug Nivolumab to treat squamous cell non-small cell LC which has progressed after chemotherapy. The use of Nivoumab, an immunotherapy was approved based on clinical trials. Compared to chemotherapy, Nivolumab improved the survival at 9 months compared to chemotherapy at 6 months. The 12 month survival rate increased to 42% from 24%.

Biological treatment is targeted to specific processes essential in tumor growth. Included in this therapy group are monoclonal antibodies, gene therapies and vaccines. Biological treatment attacks cancer specific processes and is proven to be more effective than traditional non-biological therapies, such as

chemotherapy and radiotherapy and has fewer adverse events. Biological therapy can be given in isolation or in conjunction with other therapies, depending upon the stage of the disease [***Roche, 2016; Howlader et al., 2011; American Society of Clinical Oncology,2015].***

The American Society of Clinical Oncology (ASCO) developed evidence-based recommendations to treat late stage LC. The kinds of therapies for treating late (SLC) include: Chemotherapy to destroy cancer cells and to prevent cancer cells from grow and dividing. Targeted therapy is used to treatment cancer specific genes, proteins, or the tissue environment that contributes to cancer growth and survival. Targeted therapies blocks the growth and spread of cancer cells while not harming the healthy cells, and the genetic changes known to help cancer growth. These are three types of genes are referred to as *EGFR*, *ALK*, and *ROS1.*

A third line of treatment includes clinical trials. Maintenance therapy follows the initial round of treatment. Maintenance treatment includes: chemotherapy, hormone therapy and targeted therapy. Maintenance therapy is not a new treatment and is used to prevent a return of cancer if the cancer is in a complete remission after initial therapy. A complete remission is reached when the cancer cannot be detected by testing and no symptoms are present.

The American Society of Clinical Oncology (ASCO) has recommendations that palliative (feel comfortable and not a cure) care be offered along with treatment for patients with metastatic cancer and those who have many and very

severe symptoms ***[American Society of Oncologist, 2015; Center for Disease Control, 2016; National Institute of Health, 2016; National Cancer Institute, 2016].***

1.1 Statement of the Problem

Late Stage LC is the face of LC characterized by high cost and high mortality. However, it was unclear how early stage LC compares to late stage LC in cost and mortality.

1.2 Importance of the Study and Significance

LC is a national crisis resulting in raising health care costs and high mortality. LC is the leading cause of cancer death in the United States and the second most common cancer for both men and women. LC is a global concern. LC accounts for 16.5% of all cancers worldwide; it is the most common type of cancer with more than 1.6 million new diagnoses per year and 1.38 million deaths ***[Ferlay GLOBOCAN, 2008;*** **Boyle, P. & Levin, B. 2008]**. According to the American Lung Association, 430,000 Americans are living with LC. The estimated number of individuals to be diagnosed with LC in 2016 is 224,390 and as many as 158,080 die of the disease ***[American Lung Association, 2016].*** The National Institute of Health estimated that LC cost the U.S. 12.1 billion due to lost productivity in 2010 ***[American Lung Association, 2016]***.

In 2014 a study in cancer research projects that by the year 2030, LC will remain the lead cause of cancer death in the United States. LC will have continued impact to our future population regarding morbidity and costs because hundreds of millions of individuals are at risk. Essentially current and former

cigarette smokers and individuals exposed to secondhand smoke have been identified as contributing to LC risk ***[Mathers et al., 2006; U.S. Department of Health and Human Services, 2014]*.**

Late (SLC), the face of LC, mortality and treatment costs with poor survival rates are not changed by new or existing treatments in any significant way. Early (SLC), this rare stage, is hypothesized to hold the theoretical promise of greater survival and lower cost if LC can be detected in an early stage. Crino et al., 2010 pointed out early stage theoretically is the best hope for modifying the outcomes of LC in terms of disease free and overall survival. This is based on the theoretical framework early detection theory which says early detection and treatment saves lives ***[American Cancer Society, 2016].*** However, this is an empirical question. Additionally, only 15% of LC is diagnosed in early stage surgical resection in early stage only 1 in 3 are eligible for surgical resection with 30% to 55% experience recurrence after resection and poor outcomes.

A current contrast on the relation of cost and mortality in LC patients will help inform cost-effectiveness and mortality evaluations of new strategies for the treatment of early stage and late stage LC. This information is more frequently a part of the disease management and reimbursement decision making. Assessment of early stage interventions consider the cost effects of treatment failure and disease progression and mortality which could be characterized using data among patients with early stage and late stage locally advanced and metastatic LC. Promote an all hands onboard approach including Health Informatics in addressing

the high cost and high mortality in LC.

Therefore, to use an historical dataset to determine how early (SLC) compared to late (SLC) in relation to cost and mortality including social, health and personal determinants of the disease helps to minimize the cost and to reduce the number of deaths among those patients with LC through further establishing the characteristics of the disease among these patients ***[Field and Duffy, 2008].***

1.3 Limitations

When studying direct costs, investigations often assess overall direct costs rather than net direct costs. Segal et al., 2006 found results in surveys that report health care charges like the National Inpatient Sample, the American Hospital Association Annual Survey, and other surveys specific to certain diseases, over project cost of an illness. Direct medical costs are:

Emergency room - outpatient

Hospital care - inpatient

Physician care - inpatient

Physician care - outpatient

Nursing home services

Hospice services

Rehabilitation services

Health care specialists; dermatologist, oncologists, etc.

Other health care professional care

Medical supplies

Diagnostic exams

Prescription medications

Drug accessories

Charges for health care are generally the only data available but it is often not accurate in describing the medical cost behind it. It is important to consider the cost associated with loses which include; medical bills not paid by insurance, medical bills not paid by patients and cost for buying and maintaining medical equipment. Most insurers negotiate medical billing rates and get large discounts from reported medical charges. Some other surveys specific to certain diseases omit patients based on various factors like age, race, ethnicity or income, disease stage and by healthcare insurance provider or type of insurance. The data essentially are not collected specifically for health research ***[Cipriano et al., 2011; Chang et al., 2004].***

The National Inpatient Sample does not capture professional cost related to disease only hospital charges. Professional costs include physician charges ***[Pfuntner et al., 2013].***

The study will be limited in terms of its generalizability to the total LC population. The National Inpatient Sample includes only community hospitals. All hospitals do not participate in the NIH sample. Additionally no private hospitals are included in the sample. While the proposed study sample should be very diverse. It remains certain that a portion of the hospitalized LC population will not be included.

1.4 Definitions

Operationally defined key terms.

Lung Cancer: LC is a type of cancer that begins in the lungs. LC that forms in tissues of the lung and bronchus mostly in the cells lining air passages. The two main types are small cell LC and non-small cell LC. These types are diagnosed based on how the cells look under a microscope.

Mortality: Died during an inpatient hospital stay.

Total Cost per Day: National Inpatient Sample total charge for an inpatient hospital stay rounded to whole dollar amount divided by length of stay.

Early Stage Lung Cancer: No distant metastases.

Late Stage Lung Cancer: Distant metastases, stage IV.

Cost/Benefit Analysis: A percent cost and percent mortality difference by year.

Chapter II

II. Literature Review

2.1 Early Stage Lung Cancer Cost

Early stage LC is rare. The cost of early stage LC is often estimated through modeling and least often with patient chart review.

The cost of cancer is predominately reported over a lifetime phase of care called 12 month phase of care. The phase of care method breaks down costs by an initial, continuum, and end of life phase. Cancer lifetime costs in the phase of care model creates a u-shaped cost pattern with time after diagnosis because the lowest cost are associated with the middle phase called the continuum and the highest costs are at the initial phase of care and at the end of life phase. If this method is used to examine costs in LC the specific cost of early stage LC is not clear because the phase of care method includes all stages of LC at every phase [***Demeter et al., 2007].***

In 2007 a reviewed of 60 analyses of treatment costs for cancer by Yabroff et al., found that half of them had unclear methods. Kagan et al., 2015 reported treatment modalities should be established upon efficacy and cost. Early stage LC is a case in point.

A patient with LC has a Median survival of less than 12 months and the 12 months phase of care method could obscure the u-shaped cost pattern typical in cancer. A shorter 6 month phase of care method has been shown to create the typical u-shaped cost pattern in LC patients ***[Demeter et al., 2007; Brown et al.,***

2002; Yaboroff et al., 2007; Brown et al., 2014; Warren et al., 2002; Brown et al., 2005]. LC patients are more challenging and different than the regular normal population with regard to health behaviors and act as their own control to determine cancer-attributable cost. Cancer related costs are developed using a case-control method finding controls from a 5% random sample from Medicare participants obtained from the SEER database ***[Etzioni et al., 2002; Tasi et al., 2003].***

A study by Marriotto et al., 2011 reported on annualized Mean net costs of care for LC by age, gender and phase of care per patient costs in 2010 in U.S. dollars. The authors estimated the cost of initial phase of LC is $60,885 for men and $60,533 for women adjusted for patient deductibles and coinsurance expenses. It is unclear what the cost of early stage LC is since initial phase includes all stage of LC, both early and late stage disease.

Yarboff et al., in 2007 reported on the Mean net costs of care by phase of care and tumor site in older cancer patients 65 years of age and older in the initial phase cost for LC that was reported over a 12 month period of $35,672 ($34,501 to $36,843) similar to findings by Marriotto et al., 2011. It is unclear what the cost of early stage LC is since initial phase include all stage of LC for both early and late.

Cipriano et al., 2011 studied the cost of LC by modeling for the costs in LC. The authors found the monthly treatment expenses for a patient standardized to 72 year of age, diagnosed in 2000 with LC. The cost varied by stage at diagnosis and the histologic type. The cost of early stage is broken out in this study within the

initial phase of care for both non-small cell LC and small cell LC in Figure 3. The authors reported for non-small cell LC staging I and II estimated cost with no treatment $2,687 and net cancer-attributed cost $1,779, with surgery $5,255 and net cancer-attributed cost $4,654 with radiotherapy $5,671 and net cancer-attributed cost $4,323 for average cost per month. Stage III estimated costs for no treatment $3,234 and net cancer-attributed cost $2,327, radiotherapy $5,794 and net cancer-attributed cost $4,855 and for chemotherapy and radiotherapy was $9,257 and net cancer-attributed cost $8,252. The cost for small cell LC, limited disease, no treatment cost $3,565 and net cancer-attributed cost $2,680, with chemotherapy $8,291 and net cancer-attributed cost $7533 and with chemotherapy and radiotherapy cost was $9,360 and net cancer-attributed cost $8,831 per month. The costs of stage III is unclear since stage IIIA is early stage LC, however, stage IIIB is late stage disease. Cipriano et al., 2011 reported on the cost in the continuum phase of care for stage I and II with no treatment $4,498 and net cancer-attributed cost $3,721 with surgery $2,602 and net cancer-attributed cost $1,996 with radiotherapy $5,403 and net cancer-attributed cost $4,428 for average cost per month. Stage III estimated costs for no treatment $5,199 and net cancer-attributed cost $4,313, radiotherapy $6,941 and net cancer-attributed cost $6,309 and for chemotherapy and radiotherapy was $8,196 and net cancer-attributed cost $7,758. The cost for small cell LC, limited disease, no treatment cost $5,975 and net cancer-attributed cost $5,127, with chemotherapy $9,445 and net cancer-attributed cost $8,834 and with chemotherapy and radiotherapy cost was $8,807

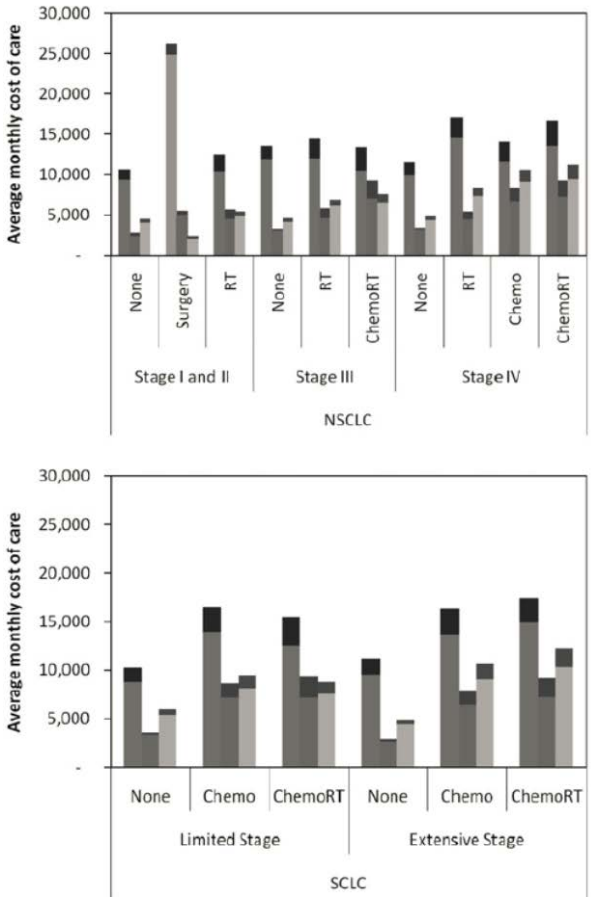
and net cancer-attributed cost $7,922 per month. It not clear the continuum phase is clearly less expensive than the initial phase, however, not all costs and appears to be a more a mix of expense for example radiation is more costly in the continuum phase or no treatment is more expensive in the continuum phase.

Cressman et al., 2014 studied the cost in LC in the Pan-Canadian Early Detection Study. The authors reported cost for early stage Mean expense per individual for staging workup, surgical treatment to cure, and a 24 month follow-up was $33,344 for those diagnosed with LC. The cost of early stage is unclear since this analysis included the cost for staging included in with early stage surgical treatment but appears to be more unclear with the cost of care almost double findings by Mariotto et al., 2011 and Yaboroff et al., 2007. Cressman et al., 2014 emphasized in the results the cost of early stage screening and curative surgery treatment with a 2 year follow-up for LC patients was less expensive than treating advanced stage LC with chemotherapy, radiation or supportive care alone at $33,344 vs $44,792.

Warren et al., 2008 reported in their study using data from the Surveillance, Epidemiology, and End Results (SEER) Medicare linked database for patients diagnosed in 2002, Medicare paid on average $39,891 for initial care for LC. Costs for any hospitalization accounted for the greatest amount of payments. Chemotherapy use rose significantly between 1991 and 2002, as did radiation therapy use. Total 2002 Medicare payments for initial health care was higher than $6.7 billion. LC being one of the most expensive overall. Statistically significant

increase in costs of initial cancer treatment shows more patients are getting surgery and adjuvant therapy and rising prices for these treatments procedures. The cost of early stage is unclear in this study specifically, however, surgery is the standard of care for early stage. The rising prices could potentially imply early costs are affected increasing as more and more patients are qualified for the surgical option.

Figure 3: Cost of Lung Cancer by Stage of Disease



In the study by Cipriano et al., 2011 the researchers break down the monthly treatment costs by phase of care and even further by stage of disease I, II, III and IV. The cost of surgery in stage I and II is the most expensive estimated

treatment cost at $25,000 per month for care illustrated in Figure 3. This surgery cost in stage I & II early stage is higher than any cost by all stages not even late stage treatment on average is as high as the cost of surgery which is the standard of care to treat stage I or II LC.

According to a report in the Journal of Thoracic Disease. The cost for an open lobectomy is $5,391 compared to a video assisted thoracic surgery (VATS). It is unclear based on the high surgery costs found in the study by Cipriano et al., 2011 for early stage how early stage LC is comported to be the less expensive form of the disease to treat. The cost in early appears to be clearly higher in stage I and II. Add to this cost to the costs if surgery fails and patients with early stage disease have a re-occurrence which is between 30% to 55% of patients with LC which develop recurrence and die of their disease despite curative resection. An estimate of the numbers could make early stage very expense but without evidence the cost is unclear for early stage ***[Cressman et al., 2014; Uramoto et al., 2014].***

Kutikova et al., reported in 2005 on the cost of treatment failure in LC. The authors reported $11,496 in cost in initial monthly treatment phase per patient were greater than expenses during the secondary treatment phase $3,733 for LC or in the terminal care phase $9,399. Notable increased costs associated with initial treatment failure. Patients failing treatment had additional costs of $10,370 per month in initial phase. Through the study the treatment failures had total costs of $120,650 compared to $45,953 for initial treatment only. The authors found the economic challenge of LC on the U.S. healthcare system is major and increased

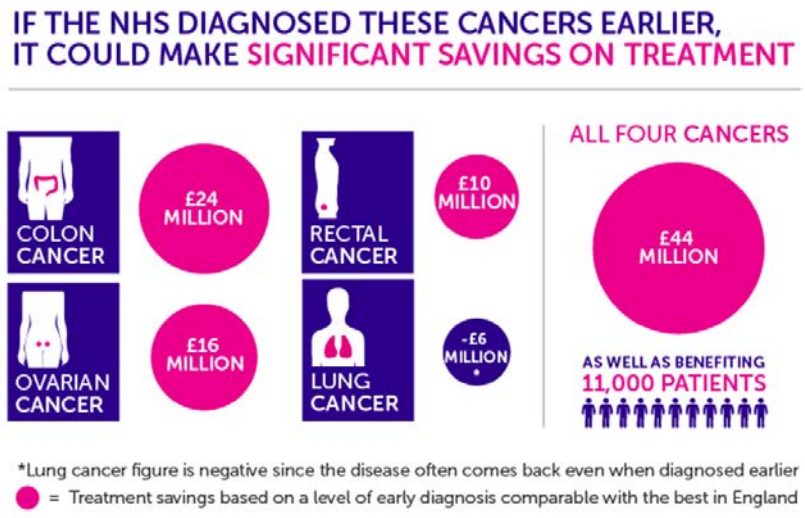
prevention, new treatments or adjuvant chemotherapy may bring down resource use and healthcare expenses. New options for LC that lower the numbers of hospitalization and/or stop or delay failure in treatment could even out some of the cost challenges associated with LC.

A report commissioned by Cancer Research UK found there is a clear financial dividend from earlier diagnosis. The researchers modeled the costs of treating LC cancer and assessed how the costs varied when LC was diagnosed at different stages – either early (stage 1 or 2) or late (stage 3 or 4). The results showed earlier stage treatment costs less, overall, treatment for stage 3 and 4 LC costs the National Health Services nearly two and a half times the amount spent on stage 1 and 2 services as illustrated in the Figure 3a shows:

Figure 3a: Cost of Lung Cancer Early and Late Stage

The researchers report LC patients would benefit from earlier diagnosis but because of higher numbers of recurrence in LC there would be a high cost of £6.4 million as illustrated in Figure 3b.

Figure 3b: Early Lung Cancer Cost



Woodward et al., 2007 reported in their study the cost effectiveness ratios are more encouraging for early stage disease, however, even with early stage LC the recommended value of medical advance for LC is rather limited. From the 1980s through the 1999s the survival in early stage rose by less than 1 month while costs per patient have increased by $20,157.

Under screening for LC Roth et al., 2014 argued more individual would get treatment for early stage LC. The researcher estimated 54,900 more cases of LC would being detected over 5 years than no screening of which would be 33% early stage which is now at only 15% with $9.3 billion in higher costs of

which $2.6 billion for LC cancer treatments. The cost of early stage from this analysis becomes clearer and cost would be significant. Roth et al., 2014 findings are challenged by the Chair of the Radiology Committee for LC Screening reporting Roth overestimates cost and false positive results. Rassmussen et al., 2014 reported low dose CT screening for LC increased costs compared with no screening.

Tachfouti et al., 2012 reported on the direct cost of LC management. The researchers reported on the total cost of early and advanced stages LC management during the first year were estimated to be $4,660 and $3,420 respectively. The authors report for stage I, II and IIIA total treatment cost in the 1st year totaled $35,170 and for stage IIIB and IV the total treatment cost were $26,250. The cost for staging could be subtracted giving a treatment cost higher for early stage based on the cost for surgery at $8,320.

In an attempting to evaluate the cost of LC looking at Cost of illness (COI) Molinier et al., 2006 estimating the overall cost of LC and not just treatment related costs. The researchers reported that of the COI studies reviewed, LC is a costly illness with hospitalization and treatment accounting for a majority of the direct cost. However, the COI studies lack a consensus on the methodology in the area of LC costs.

Shah et al., 2013 reported on studies from the Journal of Cancer and cost effectiveness of surgery in early stage LC. The cost effectiveness depended on whether the patients had clearly or marginally operable LC.

2.2 Early Stage Lung Cancer Mortality

Early stage LC mortality is 46% after 5 years. A little less than half of early stage patients are dead after 5 years. The mortality in LC is 93% of patients after 10 years that includes all stages. Even early stage patients succumb to the disease over time. Survival in early stage LC reported by the American Cancer Society for stage IA is 49%, stage IB 45%, stage 2A 30%, stage 2B 31% and stage IIIA 14%. The 5-year survival in one form of LC small cell LC limited disease is 6%. These survival rates are considerably lower in comparison to other cancers like colon with a 90% early stage 5-year survival rate, breast cancer with a 98% and prostate cancer at nearly 100%. The 10-years survival rate for colon cancer is 58%, breast 82% and prostate and 98%. The American Cancer Society clarifies that even if LC is found before symptoms in early stage you can still die from the disease.

It is reported that 30% of early stage LC patients will have a recurrence of their disease, and may go on to die of the disease, but are included as survivors in these five year survival statistics. It is still not known how to prevent recurrence and metastasis for LC patients or how many of the LC patients reported to have survived five years will go on to have a recurrence and metastasis. Verboom et al., 2003 reported up to 50% of the surgeries in LC are futile due to the presence of locally advance tumor or distant metastases. Brock et al., 2008 reported despite optimal early treatment resection in early stage LC many patients die of recurrent LC.

Nesbitt et al., in 1995 in their study reported on stage I and II early stage

LC has issues around different estimates of mortality reporting among others Martini et al., 1986, Williams et al., 1977, Naruke et al., 1988, Zhang et al., 1993, Mountain, 1986, Martini, 1992, Shimizu et al., 1993, Mountain, 1989 and Bulzebruck et al., 1992. Nesbitt et al., 1995 reported early stage I and II that as a group have unpredictable tumor biology, anatomic variability, inconsistent staging and dissimilar tumor morphology. Early stage LC is not a homogenous group. It is unclear who is associated with poor outcomes in early stage LC. Nesbitt et al., 1995 reports it is know that there are subgroups with in subgroups within early stage that have an impact on survival. The authors reported there is a significant difference in survival outcomes among patients with early stage LC. The best measure of variance in survival is in the comparison of the TNM subset end results, not the comparison of stage I and stage II LC.

Crino et al., 2010 reported surgery remains the pillar of early stage LC treatment, but only in stage I that is 5-year survival over 50% and it can range from 73% in stage IA to 58% in stage IB, with great room for improvement with systemic adjuvant or neoadjuvant treatments in stages II and III.

Ji et al., 2003 reported early stage LC prognosis after complete surgery is much better than having no resection. A good number of early stage LC patients develop distant metastases which are not curable currently. Currently there are no reliable biomarkers around that allow to accurately know when metastasis development in early stage LC patients has occurred. Metastatic spread of primary LC is the largest reason for death.

One in three LC patients with small cell LC are diagnosed in limited stage or early stage. Small cell LC is aggressive and progresses quickly. Few patients are candidates for resection at the time of diagnosis.

A study published in Annals of Thoracic Surgery in 2015 reported patients undergoing surgery for LC often wait too long to receive therapy and many neglect getting necessary diagnostic tests to determine the best therapy for their LC. The researchers found in the study that it took 6 weeks to 6 months for many patients to have surgery after x ray showed signs of LC. This delay can cause LC to advance and patient survival to be shorter ***[Faris, et al, 2015].***

Timmerman et al., 20010 reported that in LC on those who are medically inoperable. They cannot tolerate resection the standard of care. These LC patients have a high rate of mortality with 20-30% with 3 year survival.

Raz et al., 2007 reported on clinically indolent tumors in early stage. The researchers reported patient not treated long term survival was not common. The average survival time was about a year. Patients with early stage should not delay treatment even for indolent tumors.

Scagliotti et al., 2003 studied patient with local and metastatic recurrence treatment with chemotherapy or radiation has little impact on survival long term. Scagliotti et al., 2003 report the primary treatment for stage I, II and IIA LC is surgery and long term survival after primary therapy alone is mostly not satisfactory. I could contrast this report by Lang-Lazdunski et al., 2013 who indicated that early stage surgery can lead to a cure or is the best chance for a

cure. While true the researchers make no clarification that most patients do not achieve a cure.

Jackson et al., 2001 reports small cell LC disseminates early. Simon et al., 2003 reports the survival time for patients with early stage small cell LC is 18 months. The researchers report small cell LC which is refractory to treatment and recurrent has poor survival.

Yang et al., 2010 reported LC continues to carry a poor prognosis for all patients. Hu et al., 2010 reports one of the major clinical determinants in LC prognosis is tumor extension roughly characterized by stage, however, a large variability in disease outcome has been observed for a subset of patients with the same clinical features and the current staging systems are inadequate to predict the treatment outcome of LC.

Tammemagi et al., 2003 reports that several studies Sobue et al., 1991, Harpole et al., 1995; Langendijk et al., 1995 and Tammemagi et al., 2000 show that approximately 25-40% of predominantly stage I-III LC patients die of competing causes without evidence of LC recurrence or progression.

Le Chavelier et al., 2011 reported LC is a particular complex and non-homogenous disease there is little predictability when found.

The patients who survive a first LC many develop a second cancer either a second primary LC or a local recurrence. Survival in recurrence is poor because it is difficult to detect the recurrence. Thirty-eight percent of second primary tumor are not recurrence. Survival after second primary tumor is 4%.

Hammerman et al., 2011 report for squamous cell LC which rarely responds to treatment like target therapy and few treatments are available for this form of LC that comprises 25% of non-small cell LC. Target therapies for now are limited to adenocarcinoma tumors. Potti et al., 2006 reported on the prognosis in stage IA early stage LC. Potti et al., 2006 report the staging classification is not precise predictor of prognosis for stages IA around 25% of patient have recurrence after surgery so patients in this stage need more effective therapy. This stage IA is the stage early screening supporters refer to as the promise for achieving a cure in LC with no biomarkers to select those patient who will have reoccurrence locally or metastatic. It is unclear how early stage of LC is so promising with survival at 5-year. Saghir et al., 2012 reports a high frequency of early stage cancers is not advantageous in itself. The researchers studied LC findings in the Danish LC screening trial after 5 annual rounds of screening. The authors reported more early stage LC were detected indicating a degree of over diagnosis. A stage shift and reduction in mortality was not found leading to a need for greater follow-up.

Port et al., 2003 reported tumor size is an important determinant of survival in LC reports improved survival in stage I tumor size is a prognostic factor in stage IA treated with surgery has made interest in screening for LC to detect smaller and more curable tumors. Reports little data is available to determine if size remains an important determinant of survival. The idea that size of tumor is an important factor of improve survival if the shift to stage I is realized. Gajra et al., 2003 reports tumor size is a prognostic factor in stage IA treated with surgical resection.

In randomized trials Ou et al., 2007 reported adjuvant chemotherapy has failed to provide a survival benefit in patients with resected stage I LC. Despite surgical resection, approximately 40% of patients with stage I LC died within 5-years. The researchers identified increased age at diagnosis, male sex, no surgical intervention, low socio-economic status, and poorly differentiated histology as independent factors that carry an increased risk of mortality in patients with stage I LC.

Scagliotti et al., 2003 although radical surgery is the primary treatment for early LC and the long-term survival of patients who undergo surgery alone is largely unsatisfactory, with estimated 5-year survival rates ranging from 67% for those with stage IA disease to 39% for those with stage IIB disease.

2.3 Late Stage Lung Cancer Cost

Marriotto et al., 2011 reported on the average annual cost of care of LC: $92,524 (female); $95,318 (male); for individuals over age 65 and estimates adjusted for patient deductibles and coinsurance expenses. The authors estimate and project the national cost of LC cancer care through the year 2020 using the most recent available U.S. population projections, cancer incidence, survival, and cost of care data.

Davis et al., 2015 reported metastatic squamous cell LC contributes to 14-40% of the total medical spending on LC.

A few retrospective studies Kutikova et al., 2005, Hillner et al., 1998 and Fireman et al., 1997 have estimated the cost of metastatic LC in the US using

different designs and methods.

Using a U.S. Medicare claims database Fox et al., 2008 reported a total cost of at least $45,897 for a patient with LC. The incremental cost of disease progression in patient with stage IIIB or IV LC compared to patients with stable disease no progression was $12,322 for 3 months after progression.

Yabroff and colleagues reported that costs of care during the last year of life among patients with distant LC averaged $85,392 in 2010 U.S. dollars; hospitalization costs were the single largest component of cost among late stage patients. Arca et al., 2006 reported on hospitalization costs. The authors reported Mean cost for outpatient LC treatment was 62% lower than for hospitalization.

Vera-Llonch et al., 2011 reported costs among patients with metastatic LC among others Lang et al., 2009, Woodward et al., 2007, Au et al., 2006, Kutikova et al., 2005 and Fox et al., 2008. Vera-Llonch et al., 2011 reported receiving chemotherapy using a private health insurance database. Over a Median follow-up of 334 days, healthcare costs averaged $125,849 per patient. Chemotherapy and other outpatient medication accounted for 22% and 24% of total costs, respectively; other outpatient and inpatient services accounted for 34% and 20% of these costs, respectively. Major cost associated with outpatient services.

Fleming et al., 2008 studied cost in LC by stage of disease. The authors analysis showed significant differences in cost related to staging, co-morbidities, age, and deprivation.

Many financial analyses reported by Chouaid et al., 2009 in LC have been

made employing a variety of methods and in a number of different countries. The authors findings suggests that most therapies for LC are cost effective when the patient has a good performance status,

Mariotto et al., 2011 the study projects a 2% increase in final phase of care similar to initial treatment that is reflecting current trends. Late stage LC is expensive with poor treatment outcomes.

Cipriano et al., 2011 analyzed the costs for 72 year old patients diagnosed with LC. Their findings, which covered the years 1992-2003, found that in 2000, six months of treatment cost $2687 without receiving any active treatment upwards of $9360 with inclusion of chemotherapy and radiotherapy. Patient liability was highest with chemo-radiotherapy recipients, as high as 21.6% of total costs, equating to monthly payments by patients ranging from $1617 to $2004 across all stages. Coates et al., 2011 reported cost increased significantly with target therapy for LC.

Demeter et al., 2007 reported in a Canadian study LC actual cost based on patient chart review. The Median non-small cell LC and small cell LC costs were $10,928 ($49,234 to $11,047) and $15,350 ($13,053 to $21,436). The majority of LC costs are realized around the diagnosis in the early phase.

Kang et al., 2012 reported on a cost analysis of LC management in Australia. LC is associated with escalating costs. Hospitalization and cancer treatment particularly chemotherapy accounts for the major component of direct medical costs in the management of LC. Schwarzkopf et al., 2015 reported on cost

components of LC care within the first 3 years after initial diagnosis with regard to different treatment regimens. Cost initially higher in hospitalized treatment shifting to later chemotherapy treatment. The highest costs in patients with radiation and chemotherapy. The costs of newer therapies are high with Bevacizumab immunotherapy for late stage LC is 5,000 per average treatment. The cost of immunotherapy Opdivo $28 per mg of drug.

Delea et al., 2004 reported on the cost of metastatic disease to the bone in LC cost of skeletal related events, fractures, pain hypercalcemia and more. The researchers found the economic burden of skeletal related events is substantial.

Financial models studied by Bradley et al., 2003 reported on the benefit of reducing mortality to provide critical information to allocate resources to interventions with the greatest benefit.

Woodward et al., 2007 studied the cost of LC in the elderly population. The researchers found the using the SEER database and average increase in life expectance of .60 months. The lifetime LC cost increased by approximately $20,157 per patient. A cost effectiveness ratio for metastatic disease was $1,190,322.

2.4 Late Stage Lung Cancer Mortality

Heuvers et al., 2012 reported Metastatic LC is currently an incurable disease for which standard chemotherapy provides only minor improvement in overall survival. In addition, less than 30% of patients with late stage LC have a response to the most common first line treatment platinum-based chemotherapy. Long term

survival in LC has not changed in over 50 years.

Pollack et al., 2010 reported on small cell LC. The mortality rate remains very high. 3% to 8% of all patients survive with extensive disease 8 to 13 months.

Metastatic LC patients reported by Earle et al., 2000 have a Median survival of 24 weeks and a 1 year survival of 10-20%.

Nichols et al., 2012 reported cause of death in LC. LC can cause pneumonia making it the leading cause of death. Hemorrhage, pulmonary embolism and organ failure are caused by the burden of LC causing patient death. Respiratory failure the most frequent immediate cause of death.

Cetin et al., 2011 reported patients diagnosed with stage IV LC had a Median survival of 4 months 1 year and 5 year survival > 16% and 2% respectively. A gradual improvement in survival over the last few decades across histologic types has been observed an absolute increase of .07% and 1.4% in 1 and 5 year survival respectively.

Liang et al., 2014 studied survival and prognosis factors in stage IV LC. The researchers found that patients with a Karnofsky Performance Status of >70 and stable disease can benefit from treatments.

Blanchon et al., 2006 studied mortality in LC using a model a simple prognostic index for 4 years mortality based on data collected at the time of diagnosis. The researchers found the Median survival was 49 months. Mortality was greatest with age >70 male gender, TNM staging IIIA, IIIB or IV.

Kachroo et al., 2008 studied the prevalence and survival of patients with LC at tertiary center to determine factors on survival. The authors found survival of patients alive 2 years after diagnosis has increased 26.5% 1985-1989 and 40.8% in 2000-2004.

Molina et al., 2008 reported close to 70% of patients with LC present with locally advanced or metastatic disease at the time of diagnosis. The authors report introduction of angiogenesis, epidermal growth factor receptor inhibitors, and other new anticancer agents are changing the present and future of this disease and will certainly increase the number of LC survivors.

Brundage et al., 2002 reported on prognostic factors in LC and found comparatively little research has focused on patients at time points beyond their initial presentation. The authors report patients presenting with recurrent metastatic disease (following treatment with curative intent) are not generally distinguished in the literature from those whose initial presentation is with stage IV disease. Although some studies have considered the prognosis of patients with recurrent disease, prognostic factors relevant to the internal frame of reference for a given patient (for example, time since initial diagnosis or extent of initial disease) rarely have been studied. Brundage et al., 2002 performed a systematic review of the literature by investigating patient and tumor factors that were predictive of survival for patients with LC. Those authors concluded that individual studies typically were underpowered and remarkably heterogeneous in their conclusions.

They recommended that larger studies with clinically relevant modeling were required to address the usefulness of prognostic factors in defining the management of patients with LC.

An reductionist approach to cancer research by Nia et al., 2005 has led to an enormous amount of information and publications regarding the molecular biologic processes that take place in cancer tissue. However, the specific influence of this information on clinical practice has been limited.

Radiotherapy and chemotherapy are used in the treatment of many patients with locally advanced non-small cell lung carcinoma (NSCLC), multiagent chemotherapy is the standard treatment for health patients who have late stage NSCLC (TNM Stage IIIB with a positive pleural effusion and Stage IV).

The outcome of patients with advanced LC reported by Mandrekar et al., 2006 is generally poor and treatment appears to have a very modest effect on overall survival. Patients with a Stage IV disease and other factors fared significantly worse in terms of time to progression and overall survival. It is accepted stage IV disease is associated with a poor outcome.

Nordquist et al., 2004 reported adenocarcinoma is the most common histology found in LC in the U.S. The researchers wanted to look at the difference in survival in LC and reported statistical significant difference in never smokers and current smokers. The Kaplain-Meier at 5-years was 16% for current smokers and 23% for never smokers. The researchers found never smokers are mostly females and never smokers is a predictor of improved survival.

Zimmermann et al., 2014 reported LC characterized late stage by the highest incidence of solid tumor related brain metastases. The incidence of brain metastases has increased over the past 10 years.

The management of metastatic LC patients Wong et al., 2004 reported is complex and some care may be considered in suboptimal. The Median Survival data 5 months and 1 year survival was 19.8%

2.5 Health, Social and Personal Determinants

Investigators have determined there is a strong relationship between age and LC diagnosis. LC is more commonly diagnosed in older population. The average age for LC diagnosis is 70 years of age. Older LC patients have lower survival than younger LC patients. Older LC patients have more comorbidities and polypharmacy. The older LC populations receive active treatment for LC and may not be refused treatment based on their age ***[Shugarman et al., 2008].*** Active treatment decreases with increasing age ***[Blanco et al., 2008].*** LC treatment should be based on physiology rather than chronological age. Ludbrook et al., 2003 studied age and comorbidities in early stage small cell LC for survival retrospectively. Older patient survival was lower with advancing age but could be attributed to poor performance status and suboptimal treatment than age. Hurria et al., 2003 reported age is not a significant prognostic factor for overall survival and response to treatment for patients with either type of lung. Davidoff et al., 2010 reported on survival in elderly advance stage LC patients. The researchers report most elderly patients with advanced stage LC do not receive chemotherapy. The authors found clear

survival benefits after controlling for age, comorbidities and performance status. Kristiansen et al., 2015 reported elderly LC patients are a heterogeneous group in whom treatment should be offered according to comorbidity geriatric assessment.

Patel et al., 2015 studied race and ethnicity in LC and reported that differences in mortality are associated with socio-demographic, clinical and behavior factors. Focus on these factors may reduce racial and ethical differences in LC mortality. Saeed et al., 2012 studied the difference in race and ethnicity in LC, mortality in Hispanic LC patients in a population based study using the SEER database. The researchers reported compared to non-Hispanic whites and blacks. Hispanic whites LC patients had an overall survival advantage. Bryant et al., 2008 studied the impact of race in LC outcomes. The authors reported that findings are confounded by non-homogenous treatments and limited follow-up data. Bryant et al., 2008 reported a uniform staging treatments. The overall survival rates for black and white patients with LC are similar. Race cannot be taken out of context with the socio-economic status area, especially in relation to tobacco smoking. Wang et al., 2007 studied ethic disparities in survival of patients with LC. The authors studied 5-year survival by ethnicity in LC patients using the SEER database. Hardy et al., 2011 reported on racial and differences in length of stay in LC patients in hospice. The researchers found disparity in hospice has narrowed for minorities compared to whites. Some had greater length of stay at early stage. Blacks had the lowest survival rates compared to other groups and Hispanics with stage IV disease had greater improvement in survival. Coughlin et al., 2014 reported race

and socio-economic status are well known for influencing LC mortality in the U.S. Gallagher et al., 2009 studied statistically significant racial disparities in LC mortality. The researchers comparing black and white females found higher mortality for blacks in the Midwestern U.S. and higher mortality for white females in the Southeastern U.S. Gadgeel et al., 2003 reported race is not a biological variable in and of itself. Racial differences in LC have been reported in young black men and the high incidence rate reason is unclear. A racial difference in mortality has developed over the past 30 years with poor survival in black patients with LC. Tannenbaum et al., 2014 reported there are mixed reports on race and socio-economic status and LC survival. The researchers found racial and socio-economic status disparities in LC survival. The authors findings showed whites had worse survival than Asians. This is a unique finding. The researchers found an association between some modifiable factors and comorbidities and worse survival.

Hastert et al., 2015 reported disparities in cancer incidence and mortality has been observed by measure of area-level socio-economic status. The researchers found compared with the highest socio-economic status areas living in the lowest socio-economic status areas were associated with higher LC mortality when controlling for income and education. The observed association did not eliminate it. Albano et al., 2007 reported it is well know that socio-economic status and race have an influence on mortality in the US. Yang et al., 2010 reported disparities in LC are well documented. The disparities are multifactorial and continue to persist in LC. Mao et al., 2001 reported several epidemiology studies

have found that LC is inversely related to socio-economic status. Ou et al., 2007 reported racial minorities show poor survival with LC that is attributed to low socio-economic status. The researchers found low socio-economic status was an independent poor prognosis factor for survival in patients with stage I LC independent of surgery and race marital status. Hart et al., 2011 reported reducing socio-economic status inequities could help reduce mortality. Forrest et al., 2013 reported on socio-economic status inequities in LC. The researchers found LC patients living in more socio-economic status depravation circumstances are less likely to receive any type of treatment surgery and chemotherapy. The inequities cannot be accounted for by stage of disease at diagnosis.

Herndon et al., 2008 social determinate of health links socio-economic status to health and disease i.e. LC. Greenwald et al., 1996 reported income not education was a significant predictor of survival in LC patients. Tammemagi et al., 2004 reported no significant relationship between income estimated from census tract data and survival among a heterogeneous population of LC patients.

The length of stay is associated with hospitalized LC patients and quality of care. Costs are also impacted by the length of a hospital stay. The HCUP reported on a hospital stays for LC in a statistical brief in 2008. The researchers reported the average length of stay for LC patients was 7.5 days and the average cost was $1,900 per day ***[Holmquist, 2006].***

Wright et al., 2006 reported on prolonged length of stay after lobectomy for LC. The researchers reported prolonged length of stay had higher mortality and

more post operative event then those LC patients that had a normal length of stay. McDevitt et al., 2013 reported in a population based study on hospital length of stay following surgery for LC. Fifty percent of the LC patients had a length of stay of 13 days. The researchers reported deprivation a determinant of length of stay. Dedes et al., 2004 reported for LC costs the Median length of stay of hospitalization during the first year of treatment was 14 days and ranged for 0-112 days. LC patients with excessively long hospital stays caused very high costs. Skaug et al., 2009 reported on hospitalization days in patients with LC. The authors found in a population based study days in health care institutions involved a large part 19% of all survival time for those who died. Mequid et al., 2008 reported on-decreased in length of stay is associated with cost savings and increased productivity. The researchers found length of stay after segmentectomy and pneumonectomy is greatly decreased at hospitals with thoracic surgeons when compared to those with specialty. Yu et al., 2015 reported length of stay is an important factor influencing the medical expenses of patients with LC.

Verma et al., 2015 studied the number of procedures in LC and diagnosis timeliness in a retrospective study. Repeat procedures were done due to inadequate procedure, inaccessibility of lesion, inappropriate procedure. Fewer procedures were observed in those undergoing convex probe endobronchial ultrasound-transbronchial needle aspiration. The researchers reported reducing the number of procedures. This may translate into cost and resource savings.

Herder et al., 2006 reported analyzing PET immediately after LC diagnosis

to simplify staging to reduce the overall number of procedures. The authors convey by simplifying the staging process this could reduce cost and the number of investigations, morbidity and delays in diagnosis. The researchers found PET scan does not reduce the overall number of procedures. It maintains the TNM staging with less invasive surgery.

Kramer et al., 2004 reported on the use of endoscopic ultrasonography with fine needle aspiration is a procedure for tissue verification. The researchers reported the use of EUS-FNA may minimize the number of procedures and expense. EUS-FNA decreased costs by 40% per patient.

Wiener et al., 2011 reported that too many lung biopsies procedures are done in LC. The authors reported that not a rational use of resources utilization and biopsies may outweigh benefits while some regions of the U.S. do too few procedures. Others do too many procdures.

The National Cancer Institute PDQ has even provided guidance to help patients at end of life having conversations with their healthcare providers which can potentially lead to fewer procedures and a better quality of life.

Dale et al., 2012 ENB biopsy associated with decreased pneumothorax, but at increased cost. VanderLann et al., 2014 reported fewer futile thoracotomies. The EBUS-TBNA approach had a higher sensitivity and a higher negative predictive value leading to fewer unnecessary thoracotomies and slightly less expensive than surgical staging alone.

Obviously, the more surgical procedures the more cost and more recovery

challenges for LC patients at the risk of complications and even more added costs. Highly trained surgery is required for greater successful outcomes which can also add to cost even if there are just a few added surgeries. Healy et al., 2016 reported over use of positron emission tomography in detection of LC recurrence. The National Cancer Institute Journal reported on the pattern of variation in the use of positron emission tomography to detect LC recurrence without clear benefit in long term patient outcomes.

Mortality in LC is high. The presence of other diagnoses or comorbidities is known to influence outcomes ***[Grose et al., 2014].***

Islam et al., 2015 reported that LC patients with comorbidities had a nine month average survival shorter than the national average. The researchers reported 74% of LC patients had 1 or more comorbidities. Over half with comorbidities had pulmonary disease, diabetes, congestive heart failure. The researchers found in early LC one more comorbidity had a 30% higher mortality risk and in late stage metastatic LC comorbidity had less impact on survival but comorbidities were found to some impact on survival at every stage. Tammemagi et al., 2003 reported comorbidity count explained 2.5% of the survival variation and comorbidity has a major impact on survival in early and late stage disease. Even infrequent comorbidities are important collectively. Comorbidity count failed to capture much information. Shieh et al., 2012 reported that comorbidities tuberculosis or diabetes have an impact on survival in LC patients. Patients with tuberculosis or diabetes had significantly shorter average survival duration.

Battafarano et al., 2002 indicated that NSCLC patients with comorbidity have a two-fold increased risk of death compared with patients without comorbidity. Finlayson et al., 2007 reported for LC resection high comorbidity count adversely impacted 5-year survival. Survival with two or more comorbidities in older LC patients was worse than those with less comorbidity. Davidoff et al., 2010 reported high comorbidity increased mortality risk. Cardia et al., 2011 reported treatment in elderly patients with comorbidities did not influence survival and toxicity of treatments with chemo-radiotherapy. Blanco et al., 2008 found that in late stage LC age and comorbidity have a significant impact on treatment choice. Only the presence of more than 1 comorbid condition worsens the prognosis.

LC gender differences are well documented. Fu et al., 2005 reported the relative survival of women is better than that of men with the largest difference noted in patients with early stage LC. The results show in initial treatment, women with early stage disease underwent surgery more frequently than did men.

Cerfolio et al., 2006 reported the 5-year survival rate of women with stage I to III LC was better than men overall and at each stage.

A looked at gender differences Wisnivesky et al., 2011 reported in elderly women and LC and reported women have better survival in LC compared to men.

Moore et al., 2004 reported women have a survival advantage over men. Population based studies reinforce this point. Chakraborty et al., 2010 reported in the proportion of LC in women attributed to smoking is approximately half that

seen men. Women LC have increased. The researchers find estrogen in women may be a factor where estrogen receptors are found on LC tumor cells.

Scaglia et al., 2013 reported on gender in survival of surgical patients with LC stage I and stage II. The researchers reported that on retrospectively female gender is a protective factor for better survival in stage I but not in stage II LC patients. Chatkin et al., 2004 reported prognosis in LC better survival rate found with women. The researcher reported women live longer than men after resection for LC. Abreu et al., 2004 reported on long term survival in LC after surgery treatment and gender difference. The authors reported women live longer after surgery than men in early stage LC only.

Svensson et al., 2014 studied gender related survival in different stages of LC in a population based study. The researchers found a female survival advantage in LC stage I, II and III and not in metastatic disease stage. Females had better survival in both limited disease and extensive disease in small cell LC. Chiang et al., 2008 reported a high risk of LC deaths is male gender. Greenstein et al., reported LC mortality has always been higher in men than women.

Shugarman et al., 2007 reported women with LC are more likely to use inpatient skilled nursing facilities and home health and hospice services than men. Women average expenditures were higher than men. The researcher found gender disparities in expenditures are smaller at the end of life for LC. Yu et al., 2015 reported on factors influencing LC hospitalization expenses. The authors reported patients dimensions i.e. gender have a low impact on hospitalization costs. Visbal

et al., 2004 reported on gender differences in LC patient survival. The researchers reported gender has been found to have an influence on LC survival. Male gender is an unfavorable indicator for LC survival.

Cook et al., 2011 reported studies have shown that higher mortality in males and lower mortality rates in women. The authors reported higher mortality in males relative to females. The obvious differences may be real. It is not clear females tend to present with early stage, less aggressive lower grade than males or comorbidities could skew survival in favor of the female gender. Similar findings reported by Radzikowska et al., 2002 and Galdas et al., 2005 for female gender and better survival in LC since estrogen receptors are expressed in LC tumors.

2.6 Early Stage versus Late Stage

Goldberg et al., 2010 analyzed early versus late stage LC for mortality and survival. The authors reported comparing different cohorts such as mortality characteristics as an essential process. They reported mortality rates can provide insight into early stage and late stage LC mortality differences. The authors looked at differences by age, race, gender and histology and modeled mortality and survival reporting detecting LC in early stage. Early stage could save 70,000 more lives per year. Goldberg et al., 2010 reported using the Surveillance, Epidemiology and End Results (SEER) data set for making their actuarial analysis.

Corral et al., 2015 reported on the treatment cost of LC in Spain on a review of patient records. The researchers reported on the cost based on stage of disease. The authors reported there is no association between the Mean cost per patient

and the stage of the disease. There was no statistical significant difference in the Mean cost per patient between stages. The cost of stage II and stage IV were quite similar. The cost of surgery and chemotherapy was higher in stage II early stage. The advance stages III B and IV were associated with increasing chemotherapy costs and decreasing surgery costs. In the overall analysis the difference in cost canceled each other out and no association was observed between Mean cost per patient and stage of disease.

Virnig et al., 2009 studied race and compared the stage early versus late when LC was diagnosed and found mortality between whites and blacks. The researchers found blacks were less likely to survive 5 years after diagnosis. Blacks were diagnosed at a later stage and whites if diagnosed at an early stage it did not provide a survival advantage. The author reported there are differences because of racial inequalities and cannot be explained by risk factors, screening behavior, or tumor biology.

Horgan et al., 2010 reported analyzing early stage I, II and III versus late stage IIIB and IV in never smokers versus ever smoker. The researchers found never smokers have better prognosis then ever smokers as it is an effect that is reversed in late stage disease. Age and gender were not predictive of survival after accounting for smoking and stage.

Chapter III

III. Research Methodology

3.1 Goal

The main goal of the study is to contribute to the understanding of the characteristic of early (SLC) compared to late (SLC) in the question of cost and mortality to identify significant differences. This would help in reduce cost and mortality in patients with LC and improve the quality of life of those patients with early and late (SLC) through management of the identified factors.

3.2 Objectives

1. Measure differences in cost between early and late stage LC accounting for confounding variables.
2. Measure differences in mortality between early and late stage LC accounting for confounding variables.
3. Examine differences in cost/benefit between early and late stage LC accounting for confounding variables.
4. Examine differences in cost/mortality overtime between early and late LC accounting for confounding variables.
5. Identify the relative contribution of confounding variables in relation to cost for early and late stage LC.
6. Identify the relative contribution of confounding variables in the relation of mortality for early and late stage LC.

3.3 Hypothesis

Null Hypothesis

H_0: There is no significant difference in cost (dollars per patient day) between early and late stage LC.

H_0: There is no significant difference in cost (dollars per patient day) between early and late stage LC, after accounting for age, race, gender, socio-economic status, length of stay, number of diagnoses and number of procedures.

H_0: There is no significant difference in mortality between early and late stage LC.

H_0: There is no significant difference in mortality between early and late stage LC, after accounting for age, race, gender, socio-economic status, length of stay, number of procedures and number of diagnoses.

H_0: There is no significant difference in cost/benefits analysis between early and late stage LC, after accounting for age, race, gender, socio-economic status, length of stay, number of procedures and number of diagnoses.

H_0: There is no significant difference between 2002, 2006 and 2011 in the cost/mortality analysis for early and late stage LC.

H_0: There is no significant difference between 2002, 2006 and 2011 in the cost/ Mortality analysis for early and late stage LC, after accounting for age, race, gender, socio-economic status, length of stay, number of procedures, and number of diagnoses.

3.4 Data Management

The compressed ASCII data files were received by mail from HCUP with the Nationwide Inpatient Sample for the selected years 2002, 2006 and 2011. The data files were unzipped using Zip Reader and saved as ASCII files. The HCUP IBM SPSS statistics software loading program was used to import the 2002, 2006 and 2011 ASCII files into SPSS (IBM SPSS Statistical 20.0 software) for coding, cleaning and statistical analysis.

The SPSS loading program is available by year on the HCUP website at the website online at http://www.hcup-us.ahrq.gov/db/nation/nis/nisspssloadprog.jsp and was downloaded from the HCUP website. The NIS 2002, 2006 and 2011 datasets after loaded into SPSS were sorted for 2006 and 2011 since the data is not received from HCUP as two 10% samples A and B. Random numbers were generated to separate the datasets for 2006 and 2011 into two replicate samples A and B for each year so that 2002, 2006 and 2011 had two replicate in SPSS that were used for data analysis.

The replicates datasets generated for 2002, 2006 and 2011 were cleaned for missing data variables and coded as early or late (SLC) based on the ICD-9 primary diagnosis code reported in the DX1 field or primary diagnosis variable field and any subsequent DX fields. The ICD-9 codes reported for all diagnosis fields were manually checked in order to do a complete data analysis in SPSS for early versus late (SLC). The ICD-9 codes for early included 162.0 -Trachea, 162.2 - Main Bronchus, 162.3 - Upper Lobe, Bronchus or Lung, 162.4 - Middle Lobe, Bronchus or

Lung, 162.5 - Lower Lobe, Bronchus or Lung, 162.8 - other parts of Bronchus or Lung, 162.9 - Bronchus and Lung, unspecified,, 231.2 - Carcinoma in Situ of the Lung and V10.11 - History of LC and for late stage LC the ICD-9 codes included were 197.7 - Liver, 198.3 - Brain, 198.5 - Bone, and 198.7 - Adrenal Glands. Records files missing any of the data variables needed for analysis even if they were coded for early or late (SLC) for analysis were not included in the final analyses. Incomplete data records were removed from the replicate datasets for year 2002, 2006 and 2011 for sample A and B.

Year 2002, 2006 and 2011 replicate sample A was analyzed respectively for cost (total cost per day) and mortality (live or died during a hospital stay). The replicate sample B for year 2002, 2006 and 2011 was analyzed respectively for cost (total cost per day) and for mortality (lived or died during a hospital stay). The two replicates were evaluated to verify that the replicates validated each other. A cost (total charges per day) benefit (survival odds) analysis was done to consolidate and compare early (SLC) to late (SLC) for all 3 selected years 2002, 2006 and 2011 respectively. A cost/mortality analysis was conducted to ascertain if there is an increase or decrease in cost and mortality. The average changes and the average percent changes obtained over time 2011 and 2006 from the reference 2002.

3.5 Measure and Study Design

This study utilized the Quasi-experimental, cross-sectional design. (Campbell & Stanley, 1963). This study is a random effects secondary data analysis of an existing historical dataset the Nationwide Inpatient Sample (NIS). The

current study is based on the NIS data during the period 2002, 2006 and 2011. The NIS is a nationwide database of community hospital inpatient stays. Researchers and policymakers use the NIS data to identify, track, and analyze trends in health care utilization, access, charges, quality, and outcomes. The NIS is a national representative of all community hospitals (i.e., short-term, non-Federal, non-rehabilitation hospitals). The NIS is a sample which includes all patients from each hospital, regardless of the payer including the uninsured. It is drawn from a sampling frame that contains hospitals comprising about 90 % of all discharges in the United States ***[HCUP, 2016]***. The NIS collects data from 4 U.S. regions representing 35 states in 2002, 38 states in 2006 and 46 states in 2011. A detailed description of the HIS data is available at HCUP website at www.hcup–us.ahrq.gov. The Nationwide Inpatient Sample is selected for this study because it includes all payers unlike the Surveillance, Epidemiology, End Results (SEER) database for oncology. The NIS is also selected because additional variables of interest are also available including mortality, died or did not die during a hospital stay ***[HCUP, 2016].***

The design of the NIS sample does not allow for inclusion of specific hospitals to be selected for data analysis. The NIS contains a stratified probability sample of community hospitals from the HCUP State Inpatient Databases (SID) rather than a constant set of hospitals (panel design). HCUP takes a new sample of hospitals from the state databases each year to create the NIS. Since the sample is random, and no preference is given to hospitals that were in the sample in

previous years. This means that a particular hospital would not necessarily be included in the sample simply because it had been included in the previous year of the NIS. Detailed information on the NIS sample design can be found in the report Introduction to the NIS at (http://www.hcup-us.ahrq.gov/db/nation/nis/nisbdocumentation.jsp). For most of the hospitals included in both the 2006 and 2011 NIS, the HCUP hospital identifier (HOSPID) will be the same. However, the HOSPID reflects the American Hospital Association (AHA) view of a hospital and is a randomly assigned number based on the AHA hospital identifier (IDNUMBER and AHAID). If, between 2006 and 2011, there were hospital mergers or demergers that resulted in assignment of a new AHAID for a particular hospital, the HOSPID would not be the same in 2006 and 2011.

Compliance

1. This study complies with Rutgers University guidelines including anonymity and confidentiality. All analyses done blinded to patient identity. The study is compliant with the HIPPA Health Insurance Portability and Accountability Act of 1996 and federal guidance on Public Welfare and the Protection of Human Subjects (Code of Federal Regulations) Patients not identified directly or through any identifiers linked to the participants. De-identifying participant codes used.

2. A data use agreement provided by HCUP signed with a 30 minute training course completed on the content of the user agreement provided by HCUP.

Table 1: Study Design

Research Question	Hypothesis	Independent Variable	Dependent Variable	Covariates	Statistic
Does Late Cost More than Early?	H1	Late v Early Stage LC	$$	Age, Gender, SES, Race, LOS, Number of Diagnoses and Number of Procedures	ANOVA/ANCOVA
Does Late Kill More than Early?	H2	Late v Early Stage LC	Mortality	Age, Gender, SES, Race, LOS, Number of Diagnoses and Number of Procedures	Chi-Square/ Logistic Regression
What is the Cost/Benefit for Early and Late?	H3	$$ Difference Late v Early	Survival Odds	Age, Gender SES. Race, LOS, Number of Diagnoses and Number of Procedures	*Cost/ Benefit Analysis
Did Cost/ Mortality Change 2002-2006 and 2002-2011	H4	Time	% Change in Cost & Mortality	Age, Gender, SES, Race LOS, Number of Diagnoses and Number of Procedures	Cost/ Mortality Analysis

*Consolidate H1 and H2 results

A sample description and descriptive statistics measures of central tendency was used to compare participant characteristics, age, race, gender, length of stay, number of procedures, socio-economic status, number of diagnoses, total charges and mortality between early (SLC) and late (SLC). A bivariate analysis t-test and Chi-square analysis obtained p values for statistical comparison between early and late (SLC) by age, race, gender, length of stay, number of procedures, number of diagnoses, total charges and mortality. A univariate analysis ANOVA and ANCOVA compared cost differences between early and late (SLC). The ANCOVA analysis accounted for confounding variables age, race gender, socio-economic status, length of stay, number of procedures and number of diagnoses. The cost analysis was also conducted by U.S regions.

A Chi-square analysis was done for early (SLC) and late (SLC) for mortality (died or did not die). A binary logistic regression analysis was done to compare early and late [SLC] mortality controlling for confounding variables age, race, gender, socio-economic, length of stay, number of procedures and number of diagnoses. The mortality analysis was also conducted by U.S regions.

A cost/benefit analysis was done simply consolidating results from the cost and mortality analysis for each year 2002, 2006 and 2011. A percent cost and percent mortality difference is compared by year 2002, 2006 and 2011 for early and late (SLC).

A cost/mortality analysis was done comparing the percent change in cost, mortality over time from 2002 to 2006 and from 2002 to 2011. Confounding

variables statistically significant at alpha p-value <0.05 were considered to be contributing to the differences in cost and morality in part between early and late (SLC).

Chapter IV

VI. Results

4.1 Sample Description, Measure of Central Tendency and Descriptive Statistics

Table 2: Study sample distribution by a 12 month calendar year

Year	Sample	Frequency Early (SLC)	Percent	Frequency Late (SLC)	Percent	Total Percent
2002	A	1265	58.2	908	41.8	100
2002	B	1175	57.0	885	43.0	100
2006	A	7613	58.4	5419	41.6	100
2006	B	7708	59.2	5323	40.8	100
2011	A	9457	60.0	6314	40.0	100
2011	B	9408	59.7	6364	40.3	100

Table 2 shows in the selected three years (2002, 2006 and 2011) for sample A and B the frequency of early (SLC) and late (SLC). The sample size ranged for early (SLC) from lowest in 2002 with 1175 subjects included to the highest in 2011 with 9457 subjects included in the study. The sample size ranged for late (SLC) from lowest in 2002 with 885 subjects included to the highest in 2011 with 6364 subjects included in the study. There are close to 60% early (SLC) records. There are approximately 40% late (SLC) records.

Figure 4: The study sample distribution 2002, 2006 and 2011 by a 12 month calendar year

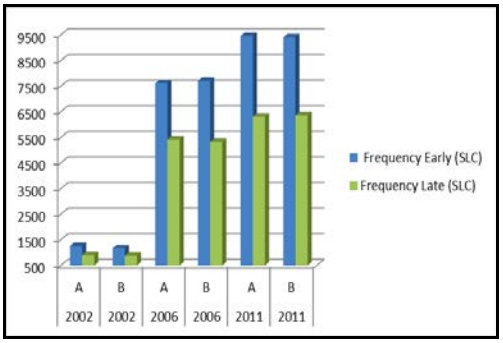


Table 3: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by age

Year/ Sample	ESLC N	ESLC Mean	ESLC SD	Std Error Mean	Min	Max	Range	Median	LSLC N	LSLC Mean	LSLC SD	Std Error Mean	Min	Max	Range	Median
2002/A	1265	68.25	11.030	.310	15	95	80	70.00	908	65.21	11.471	.381	27	94	67	66.00
2002/B	1175	68.03	11.493	.335	22	96	74	70.00	885	65.31	11.365	.382	27	96	69	67.00
2006/A	7613	68.45	11.239	.129	1	98	97	69.00	5419	65.61	11.568	.157	14	97	83	66.00
2006/B	7708	68.52	11.171	.127	7	98	91	70.00	5323	65.35	11.625	.159	22	97	75	66.00
2011/A	9457	68.93	10.942	.113	9	100	91	69.00	6314	65.94	11.102	.140	9	98	89	66.00
2011/B	9408	68.93	11.022	.114	4	105	101	70.00	6364	66.03	11.140	.140	16	98	82	66.00

Table 3 shows the Mean age of early and late (SLC). The Mean age for early (SLC) is 68 for all selected years sample A and B and late (SLC) is 65 for all selected years and sample A and B except for 2011 sample B the Mean age was 66. The Median age of early (SLC) is 70 years. The Median age for late (SLC) is 66 years.

Figure 5: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by age

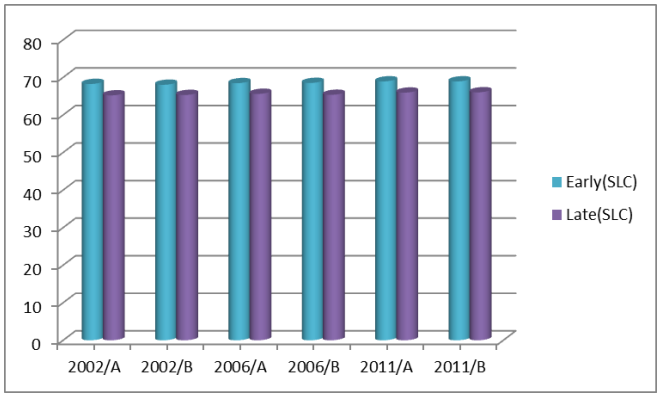


Table 4: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by gender

Year/Sample	Gender	Early (SLC)	Percent	Late (SLC)	Percent
2002/A	Male	579	45.8%	402	44.3%
	Female	686	54.2%	506	55.7%
2002/B	Male	535	45.5%	392	44.3%
	Female	640	54.5%	493	55.7%
2006/A	Male	3616	47.5%	2455	45.3%
	Female	3997	52.5%	2964	54.7%
2006/B	Male	3629	47.1%	2410	45.3%
	Female	4079	52.9%	2913	54.7%
2011/A	Male	4695	49.6%	2966	47.0%
	Female	4762	50.4%	3348	53.0%
2011/B	Male	4627	49.2%	3057	48.0%
	Female	4781	50.8%	3307	52.0%

Table 4 shows the percentage of early and late by gender by selected year 2002, 2006 and 2011. The percentage of females is more than 50% compared to males for both early and late (SLC) for all years.

Figure 6: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by gender

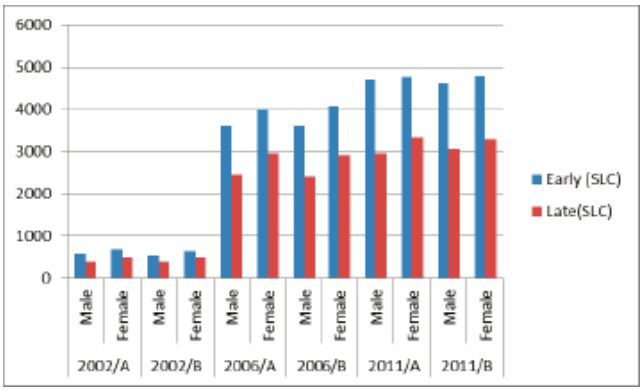


Table 5: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by race

Sample 2002/A	Race (uniform)	E(SLC)	Percent	L(SLC)	Percent	Total	Percent
	White	1043	82.5%	736	81.1%	1779	81.9%
	Black	147	11.6%	113	12.4%	260	12.0%
	Hispanic	34	2.7%	31	3.4%	65	3.0%
	Asian or Pacific Islander	22	1.7%	16	1.8%	38	1.7%
	Native American	2	.2%	2	.2%	4	0.2%
	Other	17	1.3%	10	1.1%	27	1.2%
Sample 2002/B	Race (uniform)	E(SLC)	Percent	L(SLC)	Percent	Total	Percent
	White	939	79.9%	702	79.3%	1641	79.7%
	Black	146	12.4%	117	13.2%	263	12.8%
	Hispanic	48	4.1%	41	4.6%	89	4.3%
	Asian or Pacific Islander	12	1.0%	7	0.9%	19	0.9%
	Native American	1	0.1%	3	0.3%	4	0.2%
	Other	29	2.5%	15	1.7%	44	2.1%
Sample 2006/A	Race (uniform)	E(SLC)	Percent	L(SLC)	Percent	Total	Percent
	White	6052	79.5%	4219	77.9%	10271	78.8%
	Black	858	11.3%	684	12.6%	1542	11.8%
	Hispanic	389	5.1%	288	5.3%	677	5.2%
	Asian or Pacific Islander	144	1.9%	114	2.1%	258	2.0%
	Native American	26	0.3%	20	0.4%	46	0.4%
	Other	144	1.9%	94	1.7%	238	1.8%
Sample 2006/B	Race (uniform)	E(SLC)	Percent	L(SLC)	Percent	Total	Percent
	White	6125	79.5%	4154	78.0%	10279	78.9%
	Black	857	11.1%	632	11.9%	1489	11.4%
	Hispanic	411	5.3%	285	5.4%	696	5.3%
	Asian or Pacific Islander	154	2.0%	125	2.3%	279	2.1%
	Native American	20	0.3%	24	0.5%	44	0.3%
	Other	141	1.8%	103	1.9%	244	1.9%
Sample 2011/A	Race (uniform)	E(SLC)	Percent	L(SLC)	Percent	Total	Percent
	White	7497	79.3%	4809	76.2%	12306	78.0%
	Black	1171	12.4%	929	14.7%	2100	13.3%
	Hispanic	357	3.8%	268	4.2%	625	4.0%
	Asian or Pacific Islander	197	2.1%	136	2.2%	333	2.1%
	Native American	28	0.3%	18	0.3%	46	0.3%
	Other	207	2.2%	154	2.4%	361	2.3%
Sample 2011/B	Race (uniform)	E(SLC)	Percent	L(SLC)	Percent	Total	Percent
	White	7553	80.3%	4883	76.7%	12436	78.8%
	Black	1064	11.3%	900	14.1%	1964	12.5%
	Hispanic	374	4.0%	287	4.5%	661	4.2%
	Asian or Pacific Islander	213	2.3%	136	2.1%	349	2.2%
	Native American	16	0.2%	16	0.3%	32	0.2%
	Other	188	2.0%	142	2.2%	330	2.1%

Table 5 shows the percentage of early and late by race by selected year 2002, 2006 and 2011 sample A and B. The highest percentage for both early

and late (SLC) sample A and B is found in whites. The lowest percentage for both early and late (SLC) is found in Native Americans.

Figure 7: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by race

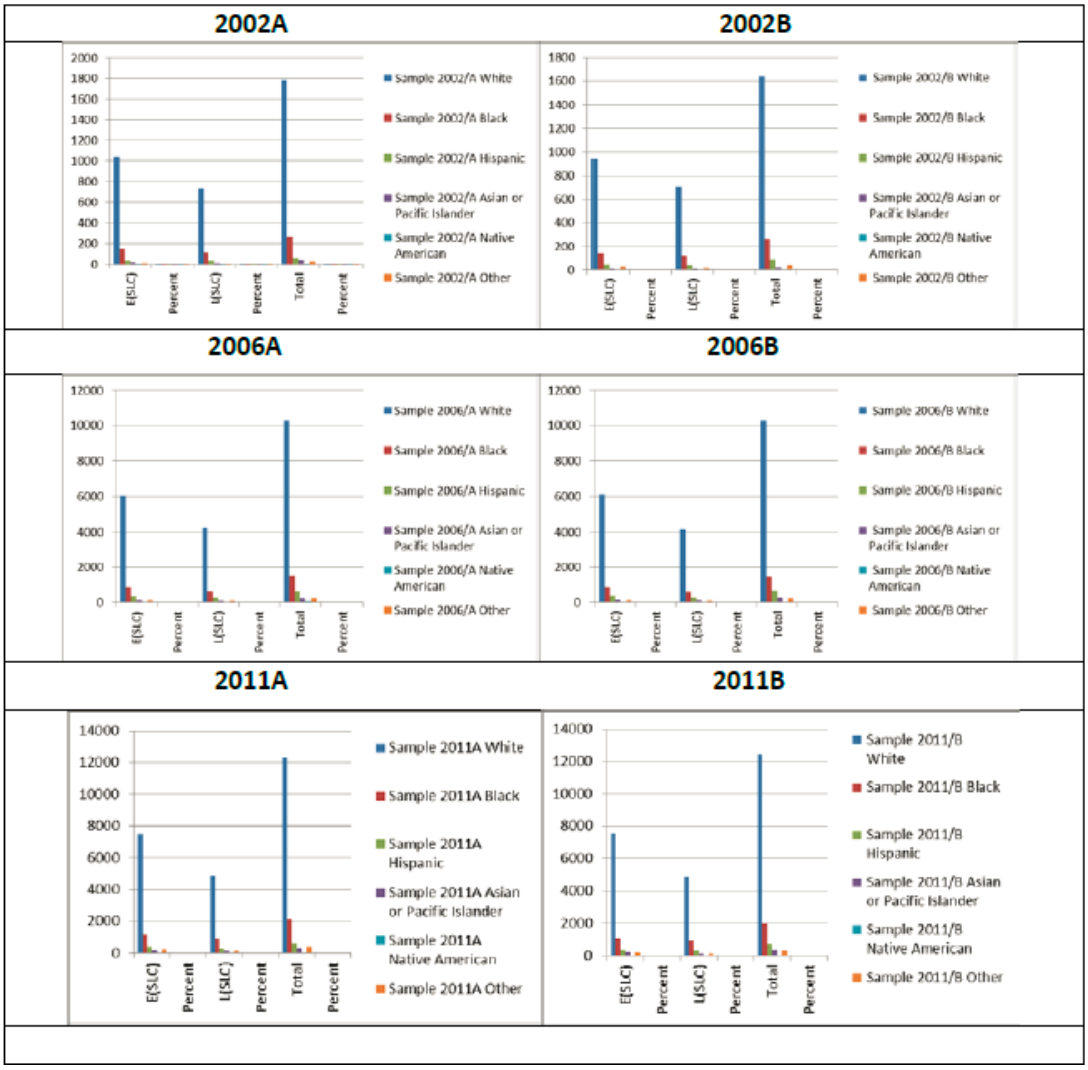


Table 6: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by income

Year 2002/A	Median household income category for patient's ZIP Code	E(SLC)	Percent	L(SLC)	Percent	Total	Percentage
	0-25th percentile	59	4.7%	49	5.4%	108	5.0%
	26th to 50th percentile (median)	276	21.8%	188	20.7%	464	21.4%
	51st to 75th percentile	353	27.9%	266	29.3%	619	28.5%
	76th to 100th percentile	577	45.6%	405	44.6%	982	45.2%
Year 2002/B	**Median household income category for patient's ZIP Code**	**E(SLC)**	**Percent**	**L(SLC)**	**Percent**	**Total**	**Percentage**
	0-25th percentile	70	6.0%	36	4.1%	108	5.1%
	26th to 50th percentile (median)	247	21.0%	205	23.2%	452	21.9%
	51st to 75th percentile	345	29.4%	236	26.7%	581	28.2%
	76th to 100th percentile	513	43.7%	409	46.1%	921	44.7%
Year 2006/A	**Median household income national Quartile for patient ZIP Code**	**E(SLC)**	**Percent**	**L(SLC**	**Percent**	**Total**	**Percentage**
	0-25th percentile	2185	28.7%	1511	27.9%	3696	28.4%
	26th to 50th percentile (median)	1970	25.9%	1420	26.2%	3390	26.6%
	51st to 75th percentile	1784	23.4%	1275	23.5%	3059	23.5%
	76th to 100th percentile	1674	22.0%	1213	22.4%	2887	22.2%
Year 2006/B	**Median household income national Quartile for patient ZIP Code**	**E(SLC)**	**Percent**	**L(SLC)**	**Percent**	**Total**	**Percentage**
	0-25th percentile	2263	29.4%	1531	28.4%	3776	29.0%
	26th to 50th percentile (median)	1957	25.4%	1379	25.9%	3336	25.6%
	51st to 75th percentile	1786	23.2%	1288	24.2%	3074	23.6%
	76th to 100th percentile	1702	22.1%	1143	21.5%	2845	21.8%
Year 2011/A	**Median household income national Quartile for patient ZIP Code**	**E(SLC)**	**Percent**	**L(SLC)**	**Percent**	**Total**	**Percentage**
	0-25th percentile	2757	29.2%	1827	28.9%	4584	29.1%
	26th to 50th percentile (median)	2211	23.4%	1528	24.2%	3739	23.7%
	51st to 75th percentile	2333	24.7%	1566	24.8%	3899	24.7%
	76th to 100th percentile	2156	22.8%	1393	22.1%	3549	22.5%
Year 2011/B	**household income national Quartile for patient ZIP Code**	**E(SLC)**	**Percent**	**L(SLC)**	**Percent**	**Total**	**Percentage**
	0-25th percentile	2667	28.3%	1927	30.3%	4594	29.1%
	26th to 50th percentile (median)	2215	23.5%	1500	23.6%	3715	23.6%
	51st to 75th percentile	2277	24.2%	1566	24.6%	8843	24.4%
	76th to 100th percentile	2249	23.9%	1371	21.5%	3620	23.0%

Table 6 shows the percentage of early and late (SLC) by income. The distribution of income for early and late (SLC) is higher for the lower income (0-25th percentile) in 2006 and 2011 sample A and B and the distribution of

income is higher for higher income (76th to 100th percentile) in 2002 for both early and late (SLC) sample A and B.

Figure 8: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by income

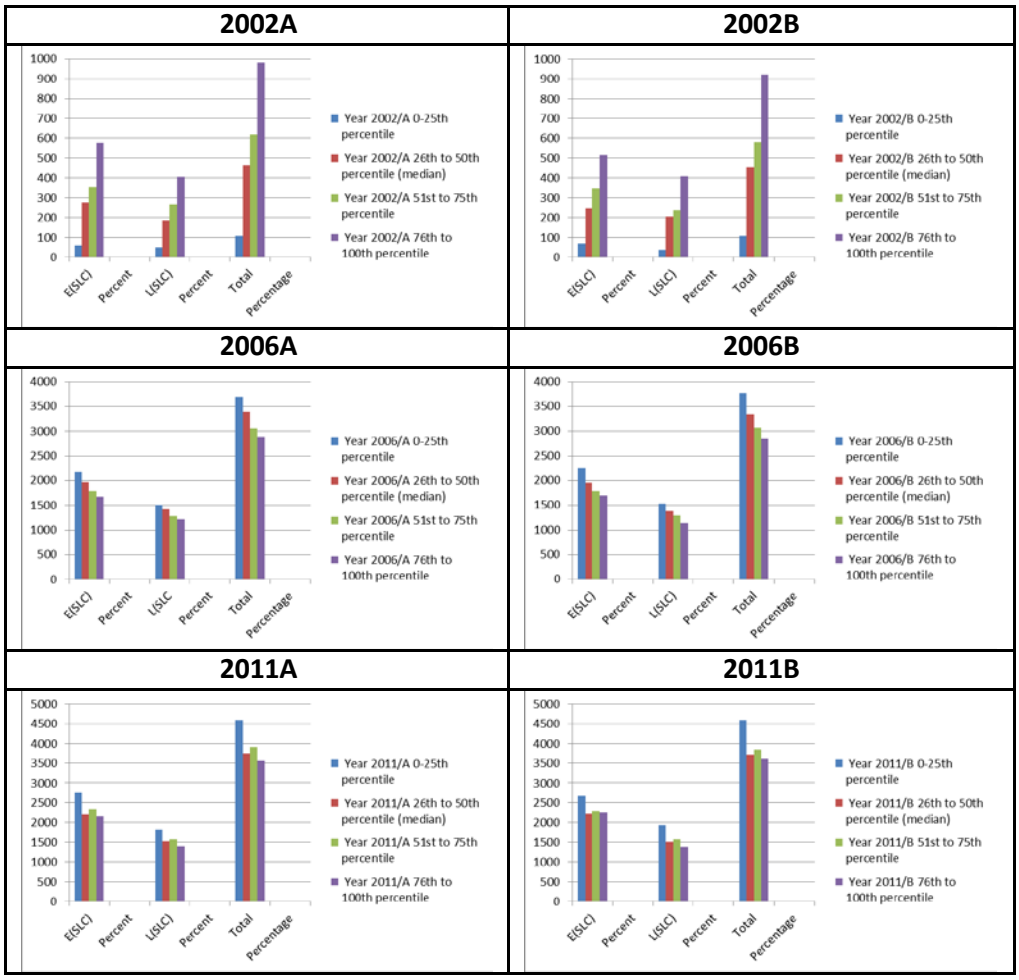


Table 7: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by a length of stay

Year/ Sample	ESLC N	ESLC Mean	ESLC SD	Std Error of the mean	Min	Max	Range	Median	LSLC N	LSLC Mean	LSLC SD	Std Error of the mean	Min	Max	Range	Median
2002/A	1265	8.21	8.540	.240	1	98	97	6.00	908	8.29	12.59	.418	1	316	315	6.00
2002/B	1175	7.87	6.882	.201	1	73	72	6.00	885	7.78	6.722	.226	1	49	48	6.00
2006/A	7613	7.80	7.078	.081	1	85	84	6.00	5419	7.41	7.279	.99	1	138	137	5.00
2006/B	7708	7.70	6.972	.079	1	102	101	6.00	5323	7.56	6.746	.092	1	96	95	6.00
2011/A	9457	6.78	6.152	.063	1	161	160	5.00	6314	6.85	6.315	.079	1	89	88	5.00
2011/B	9408	6.86	6.484	.067	1	135	134	5.00	6364	6.73	6.243	.078	1	101	100	5.00

Table 7 shows the percentage of early and late (SLC) by length of stay. The Mean length of stay is 7 days for both early and late (SLC). The Median length of stay is 6 days for both early and late (SLC) for all selected years sample A and B.

Figure 9: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by length of stay

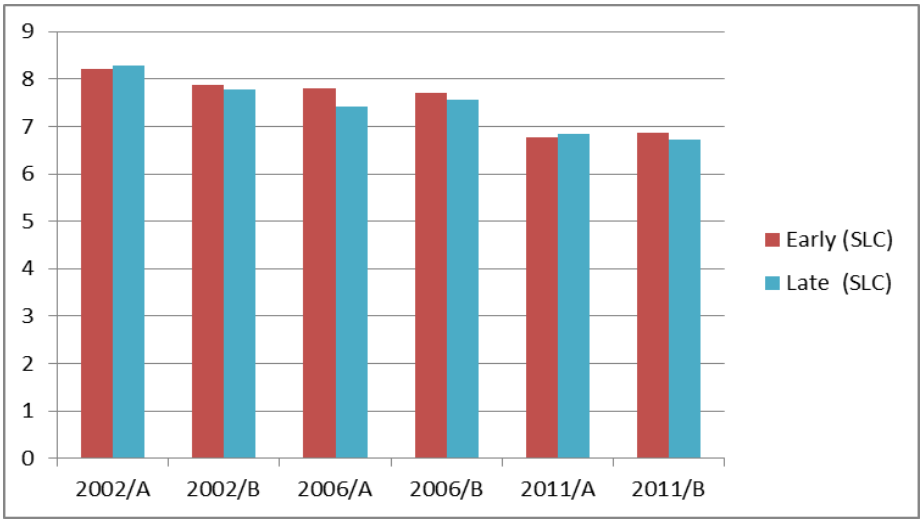


Table 8: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by number of diagnoses

Year/ Sample	ESLC N	ESLC Mean	ESLC SD	Std Error of the mean	Min	Max	Range	Median	LSLC N	LSLC Mean	LSLC SD	Std Error of the mean	Min	Max	Range	Median
2002/A	1265	6.80	2.715	.076	1	19	18	7.00	908	7.25	2.611	.087	2	19	17	7.00
2002/B	1175	6.86	3.034	.089	1	26	25	7.00	885	7.38	2.552	.086	2	16	14	8.00
2006/A	7613	8.34	3.857	.044	1	30	29	8.00	5419	9.22	3.797	.052	2	31	29	9.00
2006/B	7708	8.29	3.979	.045	1	31	30	8.00	5323	9.24	3.841	.053	2	31	28	9.00
2011/A	9457	11.25	5.501	.057	1	41	40	10.00	6314	12.76	5.295	.067	2	31	29	12.00
2011/B	9408	11.20	5.455	.056	1	39	38	10.00	6364	12.75	5.280	.066	2	31	29	12.00

Table 8 shows the Mean number of diagnoses in early and late stage. The Mean number of diagnoses is between 6 and 11 for early and 7 and 12 for late (SLC). The Median number of diagnoses is between 7 and 10 for early (SLC) and 7 and 12 days for late (SLC). Late (SLC) has 1 more diagnosis than early (SLC) all years both samples A and B.

Figure 10: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by number of Diagnoses

Table 9: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by number of Procedures

Year/ Sample	ESLC N	ESLC Mean	ESLC SD	Std Error of the mean	Min	Max	Range	Median	LSLC N	LSLC Mean	LSLC SD	Std Error of the mean	Min	Max	Range	Median
2002/A	1265	2.53	2.192	.062	0	14	14	2.00	908	1.59	1.885	.063	0	13	13	1.00
2002/B	1175	2.47	2.107	.061	0	16	16	2.00	885	1.63	1.812	.061	0	10	10	1.00
2006/A	7613	2.70	2.390	.027	0	27	27	2.00	5419	1.80	2.189	.030	0	17	17	1.00
2006/B	7708	2.69	2.366	.027	0	22	22	2.00	5323	1.81	2.130	.029	0	17	17	1.00
2011/A	9457	2.90	2.515	.026	0	25	25	2.00	6314	1.94	2.258	.028	0	26	26	1.00
2011/B	9408	2.93	2.576	.027	0	29	29	2.00	6364	1.90	2.221	.028	0	25	25	1.00

Table 9 shows the Mean number of procedures for early and late (SLC). The Mean number of procedures is 3 for early and 2 for late (SLC). The Median number of procedures is 2 for early (SLC) and 1 procedure for late (SLC). Early had one more procedure than late (SLC) all years selected for samples A and B.

Figure 11: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by number of Procedures

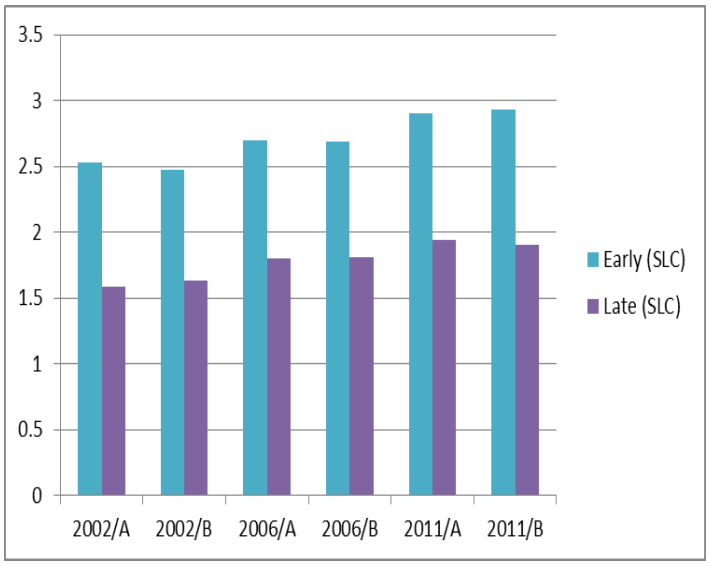


Table 10: Early (SLC) and late (SLC) in the study sample 2002, 2006 and 2011 by total charges

Year/ Sample	ESLC N	ESLC Mean	ESLC SD	Std Error of the mean	Min	Max	Range	Median	LSLC N	LSLC Mean	LSLC SD	Std Error of the mean	Min	Max	Range	Median
2002/A	1265	34526.91	47199.2	1327.0	489	584648	584159	23468.00	908	28406.6	49265.3	1634.9	497	960195	959698	17877.00
2002/B	1175	32703.08	38640.92	1127.21	290	626547	626257	23422.00	885	27526.98	31367.66	1054.4	266	317508	317242	17930.00
2006/A	7613	46714.0	53962.73	618.466	120	876401	876281	33076.00	5419	38149.95	48346.7	656.76	185	946806	946621	24991.00
2006/B	7708	45726.44	51219.69	583.40	28	744021	743993	32825.00	5323	39208.37	45642.08	625.58	121	797894	797773	25785.00
2011/A	9457	63478.8	66078.46	679.49	357	1284255	1283898	46349.00	6314	55756.41	62829.07	790.69	504	990162	989658	37044.00
2011/B	9408	64943.61	74782.65	770.996	248	1958260	1958012	46317.00	6364	54342.12	63573.37	796.91	294	1071784	1071490	36327.5

Table 10 shows the Mean number of total charges for early and late (SLC). The Mean total charges are between 34k and 64k for early (SLC) and between 28K and 54K for late (SLC). The Median total charge for early (SLC) is between 23K to 46K and 17K to 37K for late (SLC).

Figure 12: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by total charges

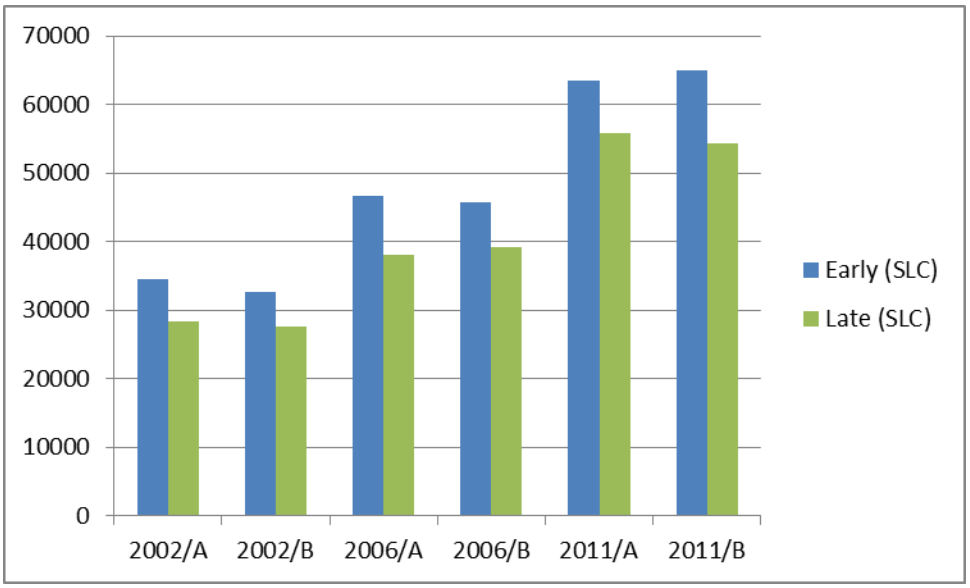


Table 11: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by mortality (died or did not die)

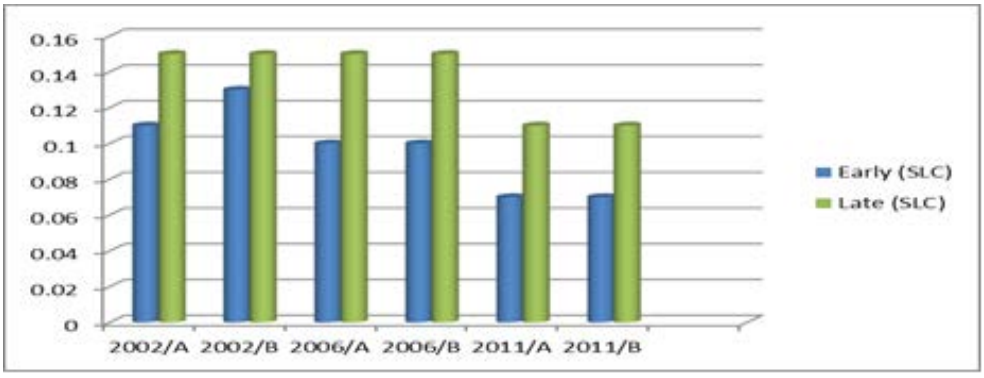
Year/ Sample	ESLC N	ESLC Mean	ESLC SD	Std Error of the mean	LSLC N	LSLC Mean	LSLC SD	Std Error of the mean
2002/A	1265	0.11	0.315	0.0	908	0.15	0.354	0.012
2002/B	1175	0.13	0.333	0.01	885	0.16	0.371	0.012
2006/A	7613	0.10	0.302	0.003	5419	0.15	0.354	0.005
2006/B	7708	0.10	0.298	0.00	5323	0.15	0.358	0.005
2011/A	9457	0.07	0.255	0.003	6314	0.11	0.31	0.004
2011/B	9408	0.07	0.256	0.003	6364	0.11	0.315	0.004

Table 11 shows the Mean for mortality for early and late (SLC).

The Mean mortality rate is between 7 and 13 percent for early (SLC)

and between 11 and 16 percent for late (SLC).

Figure 13: Early (SLC) and late (SLC) distribution in the study sample 2002, 2006 and 2011 by mortality (died or did not die)



4.2 Bivariate analysis

Table 12: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by gender

Year/ Sample	Gender	Early (SLC)	Percent	Late (SLC)	Percent	X^2 Test	p-value
2002/A	Male	579	45.8	402	44.3		
	Female	686	54.2	506	55.7	.479	.489
2002/B	Male	535	45.5	392	44.3		
	Female	640	54.5	493	55.7	.313	.576
2006/A	Male	3616	47.5	2455	45.3		
	Female	3997	52.5	2964	54.7	6.125	. 013
2006/B	Male	3629	47.1	2410	45.3		
	Female	4079	52.9	2913	54.7	4.129	.042
2011/A	Male	4695	49.6	2966	47.0		
	Female	4762	50.4	3348	53.0	10.012	.001
2011/B	Male	4627	49.2	3057	48.0		
	Female	4781	50.8	3307	52.0	1.995	.158

Table 12 shows the percentage of early versus late by gender by select year 2002, 2006 and 2011 sample A and B. The chi-square test shows a statistical significant difference between early and late stage for gender in 2006 (sample A & B) and 2011 (sample A only) at alpha (P<0.05).

Figure14: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by gender

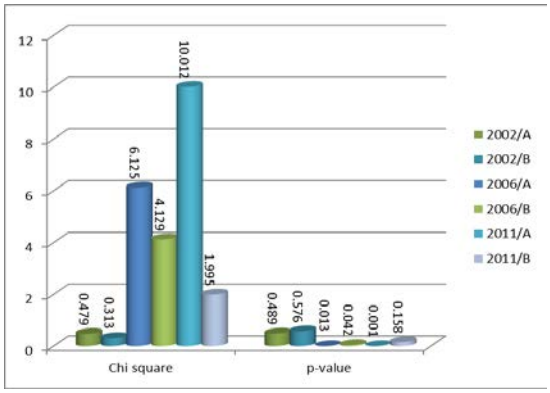


Table 13: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by race

Sample 2002/A	Race (uniform)	E(SLC)	Percent	L(SLC)	Percent	X^2 Test	p-value
	White	1043	82.5	736	81.1		
	Black	147	11.6	113	12.4		
	Hispanic	34	2.7	31	3.4		
	Asian or Pacific Islander	22	1.7	16	1.8		
	Native American	2	.2	2	.2		
	Other	17	1.3	10	1.1	1.721	.886
Sample 2002/B	Race (uniform)	E(SLC)	Percent	L(SLC)	Percent	X^2 Test	p-value
	White	939	79.9	702	79.3		
	Black	146	12.4	117	13.2		
	Hispanic	48	4.1	41	4.6		
	Asian or Pacific Islander	12	1.0	7	0.9		
	Native American	1	0.1	3	0.3		
	Other	29	2.5	15	1.7	4.001	.549
Sample 2006/A	Race (uniform)	E(SLC)	Percent	L(SLC)	Percent	X^2 Test	p-value
	White	6052	79.5	4219	77.9		
	Black	858	11.3	684	12.6		
	Hispanic	389	5.1	288	5.3		
	Asian or Pacific Islander	144	1.9	114	2.1		
	Native American	26	0.3	20	0.4		
	Other	144	1.9	94	1.7	7.442	.190
Sample 2006/B	Race (uniform)	E(SLC)	Percent	L(SLC)	Percent	X^2 Test	p-value
	White	6125	79.5	4154	78.0		
	Black	857	11.1	632	11.9		
	Hispanic	411	5.3	285	5.4		
	Asian or Pacific Islander	154	2.0	125	2.3		
	Native American	20	0.3	24	0.5		
	Other	141	1.8	103	1.9	7.791	.168
Sample 2011/A	Race (uniform)	E(SLC)	Percent	L(SLC)	Percent	X^2 Test	p-value
	White	7497	79.3	4809	76.2		
	Black	1171	12.4	929	14.7		
	Hispanic	357	3.8	268	4.2		
	Asian or Pacific Islander	197	2.1	136	2.2		
	Native American	28	0.3	18	0.3		
	Other	207	2.2	154	2.4	23.391	.000
Sample 2011/B	Race (uniform)	E(SLC)	Percent	L(SLC)	Percent	X^2 Test	p-value
	White	7553	80.3	4883	76.7		
	Black	1064	11.3	900	14.1		
	Hispanic	374	4.0	287	4.5		
	Asian or Pacific Islander	213	2.3	136	2.1		
	Native American	16	0.2	16	0.3		
	Other	188	2.0	142	2.2	35.627	.000

Table 13 shows the percentage of early and late by race by selected year 2002, 2006 and 2011 sample A and B. The Chi-square test shows a statistical significant difference between early and late stage for race in 2011 (sample A and B) at alpha ($P<0.05$).

Figure 15: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by race

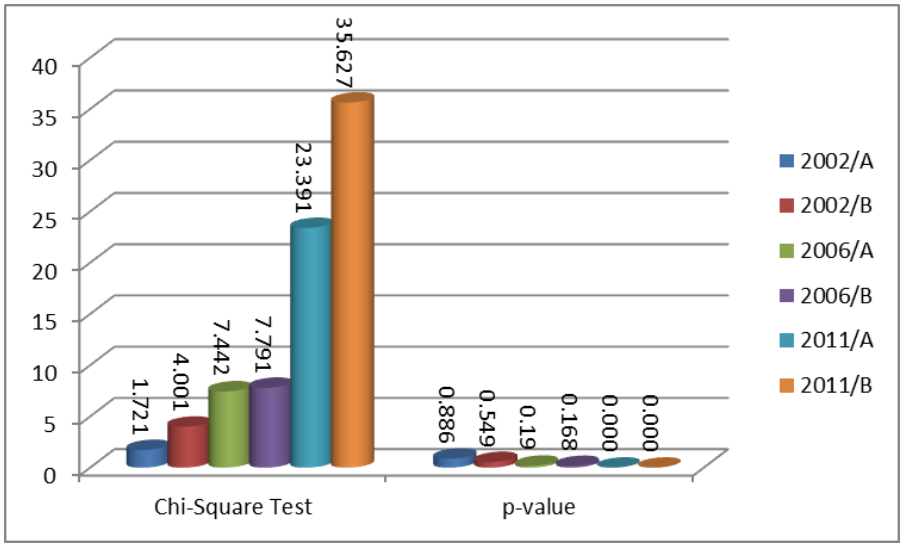


Table 14 shows the percentage of early versus late by income by the selected year 2002, 2006 and 2011 for sample A and B. The Chi-square test shows a statistical significant difference between early and late stage by income for year 2011 (sample B only) at alpha ($P<0.05$).

Table 14: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by income

Year 2002/A	Median household income category for patient's ZIP Code	E(SLC)	Percent	L(SLC)	Percent	X^2 Test	df	p-value
	0-25th percentile	59	4.7	49	5.4			
	26th to 50th percentile (median)	276	21.8	188	20.7			
	51st to 75th percentile	353	27.9	266	29.3			
	76th to 100th percentile	577	45.6	405	44.6	1.355	3	.716
Year 2002/B	Median household income category for patient's ZIP Code	E(SLC)	Percent	L(SLC)	Percent	X^2 Test	df	p-value
	0-25th percentile	70	6.0	36	4.1			
	26th to 50th percentile (median)	247	21.0	205	23.2			
	51st to 75th percentile	345	29.4	236	26.7			
	76th to 100th percentile	513	43.7	409	46.1	6.532	3	.088
Year 2006/A	Median household income category for patient's ZIP Code	E(SLC)	Percent	L(SLC))	Percent	X^2 Test	df	p-value
	0-25th percentile	2185	28.7	1511	27.9			
	26th to 50th percentile (median)	1970	25.9	1420	26.2			
	51st to 75th percentile	1784	23.4	1275	23.5			
	76th to 100th percentile	1674	22.0	1213	22.4	1.112	3	.774
Year 2006/B	Median household income national Quartile for patient ZIP Code	E(SLC)	Percent	L(SLC)	Percent	X^2 Test	df	p-value
	0-25th percentile	2263	29.4	1531	28.4			
	26th to 50th percentile (median)	1957	25.4	1379	25.9			
	51st to 75th percentile	1786	23.2	1288	24.2			
	76th to 100th percentile	1702	22.1	1143	21.5	3.218	3	.359
Year 2011/A	Median household income national Quartile for patient ZIP Code	E(SLC)	Percent	L(SLC)	Percent	X^2 Test	df	p-value
	0-25th percentile	2757	29.2	1827	28.9			
	26th to 50th percentile (median)	2211	23.4	1528	24.2			
	51st to 75th percentile	2333	24.7	1566	24.8			
	76th to 100th percentile	2156	22.8	1393	22.1	2.075	3	.557
Year 2011/B	Median household income national Quartile for patient ZIP Code	E(SLC)	Percent	L(SLC)	Percent	X^2 Test	df	p-value
	0-25th percentile	2667	28.3	1927	30.3			
	26th to 50th percentile (median)	2215	23.5	1500	23.6			
	51st to 75th percentile	2277	24.2	1566	24.6			
	76th to 100th percentile	2249	23.9	1371	21.5	14.346	3	.002

Figure 16: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by income

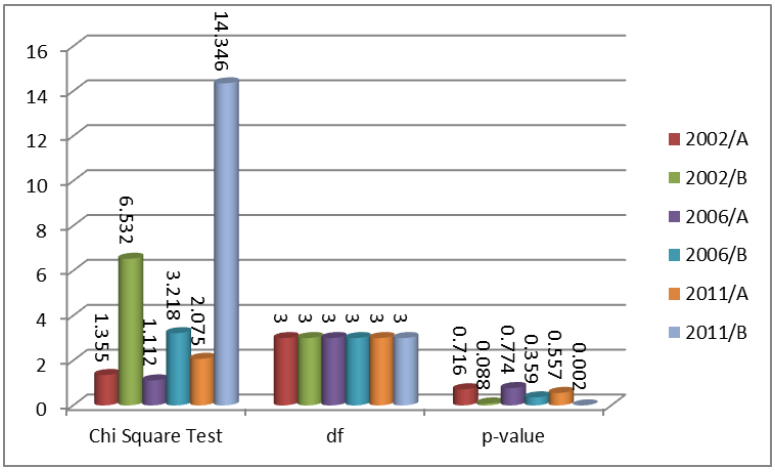


Table 15: Early (SLC) verses late (SLC) the study sample 2002, 2006 and and2011 by age

Year/ Sample	ESLC N	ESLC Mean	ESLC SD	LSLC N	LSLC Mean	LSLC SD	t	Mean Difference	df	SE Difference	p-value
2002/A	1265	68.25	11.030	908	65.21	11.471	6.191	3.040	1907.5	.491	.000
2002/B	1175	68.03	11.493	885	65.31	11.365	5.369	2.729	1914.8	.508	.000
2006/A	7613	68.45	11.239	5419	65.61	11.568	13.97	2.839	11462.1	.203	.000
2006/B	7708	68.52	11.171	5323	65.35	11.625	15.54	3.169	11144.4	.204	.000
2011/A	9457	68.93	10.942	6314	65.94	11.102	16.673	2.991	13395.7	.179	.000
2011/B	9408	68.93	11.022	6364	66.03	11.140	16.14	2.906	13558.8	.180	.000

Table 15: shows the Mean age of early verses late (SLC) for selected year 2002, 2006 and 2011 sample A and B. We compared the age of early and late (SLC) using t-test, which showed that there is a statistical significant difference in the age of early and late (SLC) at alpha P<0.05).

Figure 17: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by age

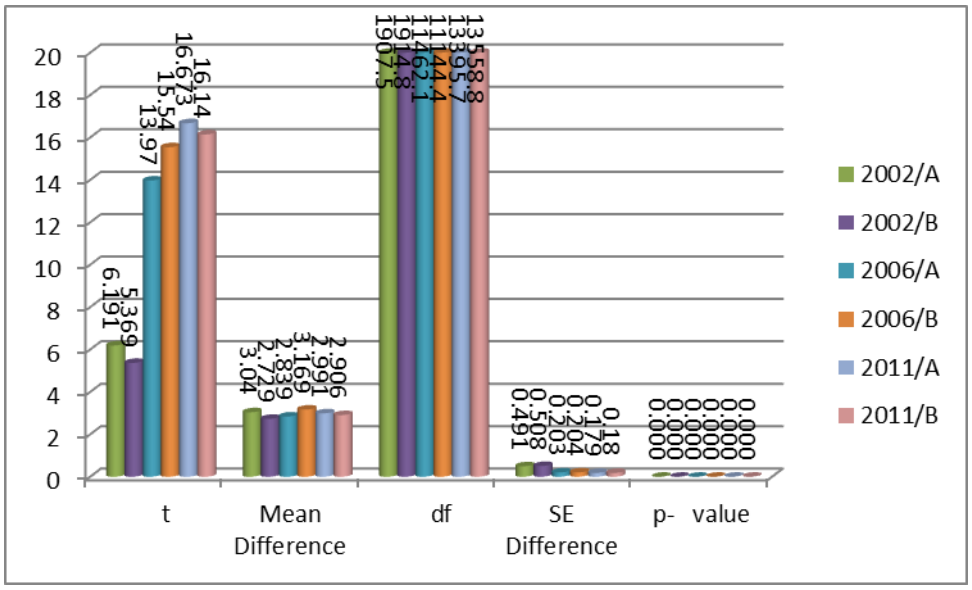


Table 16: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by a length of stay

Year/ Sample	ESLC N	ESLC Mean	ESLC SD	LSLC N	LSLC Mean	LSLC SD	t	Mean Difference	df	SE Difference	p-value
2002/A	1265	8.21	8.540	908	8.29	12.590	-.167	.080	1488.5	.482	.868
2002/B	1175	7.87	6.882	885	7.78	6.722	.287	.087	1926.5	.302	.774
2006/A	7613	7.80	7.078	5419	7.41	7.279	3.124	.400	11467.5	.128	.002
2006/B	7708	7.70	6.972	5323	7.56	6.746	1.180	.144	11680.0	.122	.238
2011/A	9457	6.78	6.152	6314	6.85	6.315	.671	.068	13286.4	.102	.502
2011/B	9408	6.86	6.484	6364	6.73	6.243	1.304	.134	13996.8	.103	.192

Table 16 shows the Mean length of stay (LOS) in early versus late stage for selected year 2002, 2006 And 2011 sample A and B. I compared the LOS for early versus late stage using t-test, which showed that there is statistical significant difference in the LOS for early and late (SLC) in 2006 (sample A only) at alpha (P<0.05).

Figure 18: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by length of stay

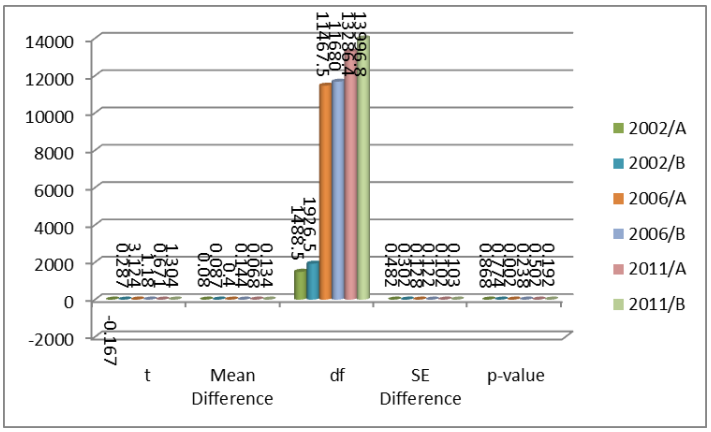


Table 17: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by number of Procedures

Year/Sample	ESLC N	ESLC Mean	ESLC SD	LSLC N	LSLC Mean	LSLC SD	t	Mean Difference	df	SE Difference	p-value
2002/A	1265	2.53	2.192	908	1.59	1.885	10.602	.931	2101.3	.088	.000
2002/B	1175	2.47	2.107	885	1.63	1.812	9.720	.841	2022.2	.087	.000
2006/A	7613	2.70	2.390	5419	1.80	2.199	22.357	.904	12239.8	.040	.000
2006/B	7708	2.69	2.366	5323	1.81	2.130	22.243	.884	12157.9	.040	.000
2011/A	9457	2.90	2.515	6314	1.94	2.258	25.028	.962	14471.7	.038	.000
2011/B	9408	2.93	2.576	6364	1.90	2.221	26.948	1.037	14879.8	.038	.000

Table 17 shows the Mean number of procedures for early versus late (SLC) for selected years 2002, 2006 and 2011 sample A and B. I compared early versus late (SLC) using t-test, which showed that there is statistical significant difference in the number of procedures for the selected years samples A and B for early and late stage at alpha (P<0.05).

Figure 19: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by number of procedures

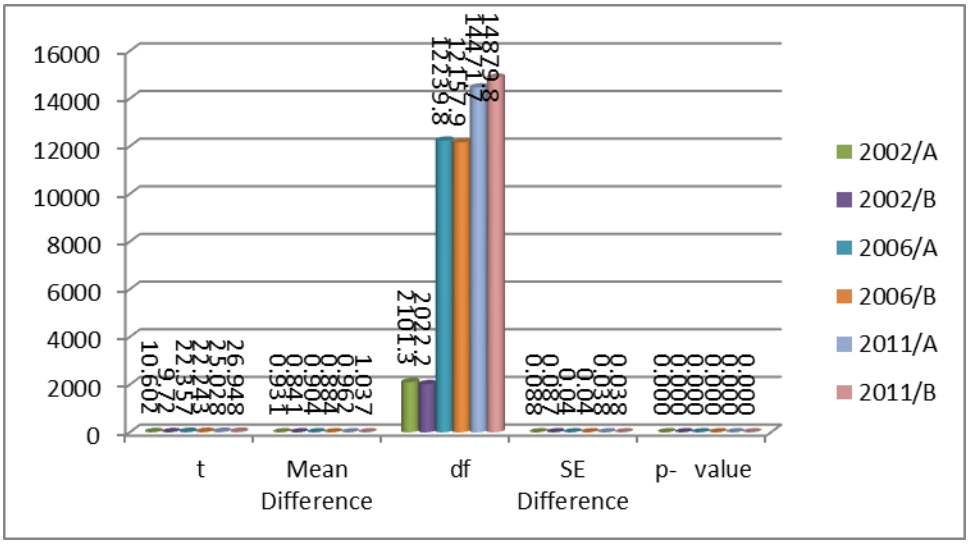


Table 18: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by number of diagnoses

Year/Sample	ESLC N	ESLC Mean	ESLC SD	LSLC N	LSLC Mean	LSLC SD	t	Mean Difference	df	SE Difference	p-value
2002/A	1265	6.80	2.715	908	7.25	2.611	-3.878	-.448	1997.8	.115	.000
2002/B	1175	6.86	3.034	885	7.38	2.552	-4.235	-.522	2033.0	.123	.000
2006/A	7613	8.34	3.857	5419	9.22	3.797	-12.85	-.873	11777.2	.068	.000
2006/B	7708	8.29	3.979	5323	9.24	3.841	-13.76	-.956	11696.8	.069	.000
2011/A	9457	11.25	5.501	6314	12.76	5.295	-17.35	-1.517	13878.6	-1.517	.000
2011/B	9408	11.2	5.4556	6364	12.75	5.280	-17.83	-1.549	13950.3.	.087	.000

Table 18 shows the Mean number of diagnoses for early verses late (SLC). I compared early versus late (SLC) using t-test, which showed there is statistical significant difference in the number of diagnoses for the selected years sample A and B for early and late (SLC) for the alpha (P<0.05).

Figure 20: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by number of diagnoses

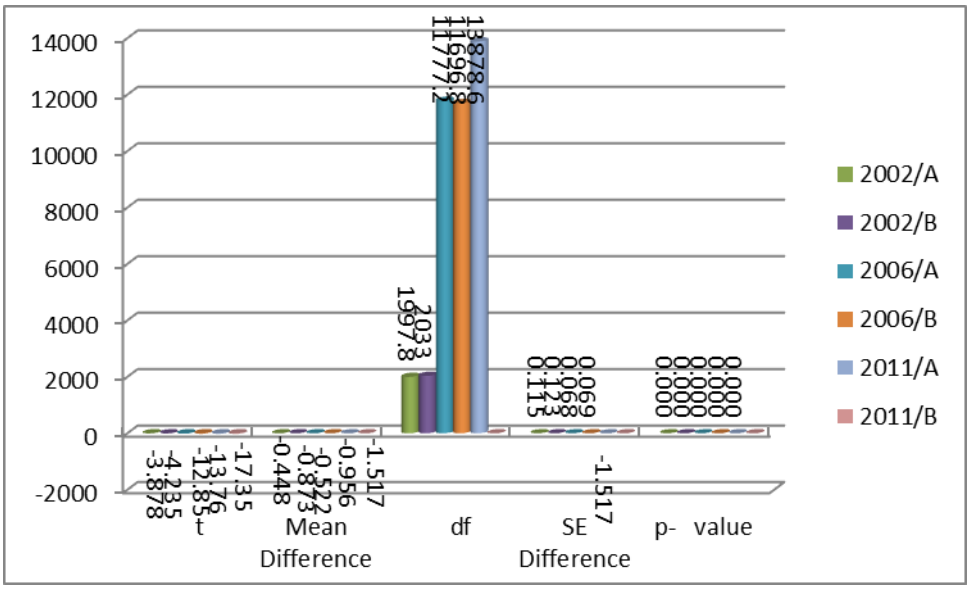


Table 19: Comparison early versus late stage lung cancer 2002/Sample A most frequent procedures

ICD-9 PROCEDURE CODE	Early (SLC)		Late (SLC)		X^2 Test	df	p-value
	N	%	N	%			
No PROCEDURE	212	16.8	321	35.4			
LOBECTOMY OF LUNG	295	23.3	6	0.7			
OTHER EXCISION OR DESTRUCTION OF LESION OR TISSUE OF BRAIN	0	0	50	5.5			
OTHER LOCAL EXCISION OR DESTRUCTION OF LESION OR TISSUE OF LUNG	74	5.8	1	0.1			
SEGMENTAL RESECTION OF LUNG	48	3.8	0	0.0			
PNEUMONECTOMY	31	2.5	1	32			
CLOSED BIOPSY OF BRONCHUS	99	7.8	46	5.1			
CLOSED BIOPSY OF LUNG	52	4.1	41	4.5			
CLOSED ENDOSCOPIC BIOPSY OF LUNG	107	8.5	51	5.6			
OPEN BIOPSY OF LUNG	22	1.7	1	0.1			
INJECTION INTO THORACIC CAVITY	39	3.1	13	1.4			
VENOUS CATHETERIZATION, NOT ELSEWHERE CLASSIFIED	8	0.6	24	2.6			
CLOSED BIOPSY LIVER	0	0	22	2.4			
TELERADIOTHERAPY USING PHOTONS	6	0.5	27	3.0			
OTHER RADIOTHERAPEUTIC PROCEDURE	8	0.6	39	4.3			
INJECTION OR INFUSION OF CANCER CHEMOTHERAPEUTIC SUBSTANCE	11	0.9	18	2.0	833.652	166	.000

Table 20: Comparison early versus late stage lung cancer 2002/sample B most frequent procedure

ICD-9 PROCEDURE CODE	Early (SLC)		Late (SLC)		X^2 Test	df	p- value
	N	%	N	%			
No PROCEDURE	200	17.0	286	32.3			
OTHER EXCISION OR DESTRUCTION OF LESION OR TISSUE OF BRAIN	0	0	38	4.3			
OTHER LOCAL EXCISION OR DESTRUCTION OF LESION OR TISSUE OF LUNG	89	7.6	6	0.7			
SEGMENTAL RESECTION OF LUNG	43	3.7	1	0.1			
LOBECTOMY OF LUNG	266	22.6	7	0.8			
PNEUMONECTOMY	30	2.6	1	0.1			
CLOSED BIOPSY OF BRONCHUS	101	8.6	53	6.0			
CLOSED BIOPSY OF LUNG	57	4.9	28	3.2			
CLOSED ENDOSCOPIC BIOPSY OF LUNG	85	7.2	61	6.9			
OPEN BIOPSY OF LUNG	18	1.5	3	0.3			
MEDIASTINOSCOPY	26	2.2	4	0.5			
EXCISION OR DESTRUCTION OF LESION OR TISSUE OF MEDIASTINUM	0	0	1	0.1			
EXCISION OR DESTRICTION OFLESION OF CHEST WALL	0	0	1	0.1			
THORACENTESIS	31	2.6	12	1.4			
VENOUS CATHETERIZATION, NOT ELSEWHERE CLASSIFIED	14	1.2	17	1.9			
CLOSED BIOPSY LIVER	0	0	23	2.6			
TELERADIOTHERAPY USING PHOTONS	5	0.4	21	2.4			
TELERADIOTHERAPY USING PHOTONS	8	0.7	54	6.1			
TRANSFUSION OF PACKED CELLS	15	1.3	20	2.3			
INJECTION OR INFUSION OF CANCER CHEMOTHERAPEUTIC SUBSTANCE	16	1.4	22	2.5	744.31	153	.000

Table 21: Comparison early versus late stage lung cancer 2006/Sample A most frequent procedures

ICD-9 PROCEDURE CODE	Early (SLC)		Late (SLC)		X^2 Test	df	p-value
	N	%	N	%			
No PROCEDURE	1230	16.2	1778	32.8			
OTHER EXCISION OR DESTRUCTION OF LESION OR TISSUE OF BRAIN	0	0	244	4.5			
OTHER LOCAL EXCISION OR DESTRUCTION OF LESION OR TISSUE OF LUNG	524	6.9	20	0.4			
SEGMENTAL RESECTION OF LUNG	244	3.2	5	0.1			
LOBECTOMY OF LUNG	1891	24.8	33	0.6			
PNEUMONECTOMY	156	2.0	6	0.1			
CLOSED BIOPSY OF BRONCHUS	488	6.4	227	4.2			
CLOSED BIOPSY OF LUNG	498	6.5	277	5.1			
CLOSED ENDOSCOPIC BIOPSY OF LUNG	538	7.1	297	5.5			
OPEN BIOPSY OF LUNG	185	2.4	10	0.2			
THORACENTESIS	237	3.1	92	1.7			
VENOUS CATHETERIZATION, NOT ELSEWHERE CLASSIFIED	62	0.8	106	2.0			
CLOSED BIOPSY LIVER	2	0.0	168	3.1			
TELERADIOTHERAPY USING PHOTONS	15	0.2	101	1.9			
OTHER RADIOTHERAPEUTIC PROCEDURE	34	0.4	295	5.4			
TRANSFUSION OF PACKED CELLS	128	1.7	175	3.2			
INJECTION OR INFUSION OF CANCER CHEMOTHERAPEUTIC SUBSTANCE	84	1.1	109	2.0	4582.56	340	.000

Table 22: Comparison early versus late stage lung cancer 2006/Sample B most frequent procedures

ICD-9 PROCEDURE CODE	Early (SLC)		Late (SLC)		X^2 Test	df	p-value
	N	%	N	%			
No PROCEDURE	1217	15.8	1718	32.3			
OTHER EXCISION OR DESTRUCTION OF LESION OR TISSUE OF BRAIN	0	0	288	5.4			
OTHER LOCAL EXCISION OR DESTRUCTION OF LESION OR TISSUE OF LUNG	595	7.7	15	0.3			
SEGMENTAL RESECTION OF LUNG	275	3.6	4	0.1			
LOBECTOMY OF LUNG	1911	24.8	27	0.5			
PNEUMONECTOMY	126	1.6	3	0.1			
CLOSED BIOPSY OF BRONCHUS	514	6.7	253	4.8			
CLOSED BIOPSY OF LUNG	466	6.0	255	4.8			
CLOSED ENDOSCOPIC BIOPSY OF LUNG	574	7.4	298	5.6			
OPEN BIOPSY OF LUNG	194	2.5	13	0.2			
BRONCHIAL DILATION	223	2.9	99	1.9			
VENOUS CATHETERIZATION, NOT ELSEWHERE CLASSIFIED	50	0.6	115	2.2			
BIOPSY OF BONE, OTHER	1	0	75	1.4			
CLOSED BIOPSY LIVER	7	0.1	112	2.1			
INSERTION OF TOTALLY IMPLANTABLE VASCULAR ACCESS DEVICE	61	0.8	58	1.1			
TELERADIOTHERAPY USING PHOTONS	20	0.3	108	2.0			
OTHER RADIOTHERAPEUTIC PROCEDURE	65	0.8	295	5.5			
TRANSFUSION OF PACKED CELLS	116	1.5	148	2.8			
INJECTION OR INFUSION OF CANCER CHEMOTHERAPEUTIC SUBSTANCE	102	1.3	109	2.0	4670.54	333	.000

Table 23: Comparison early versus late stage lung cancer 2011/Sample A most frequent procedures

ICD-9 PROCEDURE CODE	Early (SLC)		Late (SLC)		X^2 Test	df	p-value
	N	%	N	%			
No PROCEDURE	1218	12.9	1751	27.7			
OTHER EXCISION OR DESTRUCTION OF LESION OR TISSUE OF BRAIN	0	0	506	8.0			
THORACOSCOPIC EXCISION OF LESION OR TISSUEOF LUNG	759	8.0	23	0.4			
OTHER LOCAL EXCISION OR DESTRUCTION OF LESION OR TISSUE OF LUNG	278	2.9	5	0.1			
THORACOSCOPIC SEGMENTAL RESECTION OF LUNG	191	2.0	2	0.0			
OTHER AND UNSPECIFIED SEGMENTAL RESECTION OF LUNG	144	1.5	2	0.0			
THORACOSCOPIC LOBECTOMY OF LUNG	952	10.4	15	0.2			
OTHER LOBECTOMY OF LUNG	1457	15.4	34	0.5			
CLOSED BIOPSY OF BRONCHUS	640	6.8	292	4.6			
CLOSED BIOPSY OF LUNG	532	5.6	349	5.5			
CLOSED ENDOSCOPIC BIOPSY OF LUNG	453	4.8	240	3.8			
THORACENTESIS	427	4.5	231	3.7			
BIOPSY OF LYMPHATIC STRUCTURE	152	1.6	143	2.3			
CLOSED BIOPSY LIVER	1	0.0	182	2.9			
OTHER RADIOTHERAPEUTIC PROCEDURE	70	0.7	345	5.5			
TRANSFUSION OF PACKED CELLS	154	1.6	215	3.4			
INJECTION OR INFUSION OF CANCER CHEMOTHERAPEUTIC SUBSTANCE	68	0.7	114	1.8	5969.70	348	.000

Table 24: Comparison early versus late stage lung cancer 2011/Sample B most frequent procedure

ICD-9 PROCEDURE CODE	Early (SLC)		Late (SLC)		X^2 Test	df	p-value
	N	%	N	%			
No PROCEDURE	1168	12.4	1859	29.2			
OTHER EXCISION OR DESTRUCTION OF LESION OR TISSUE OF BRAIN	0	0	493	7.7			
THORACOSCOPIC EXCISION OF LESION OR TISSUEOF LUNG	726	7.7	19	0.3			
OTHER LOCAL EXCISION OR DESTRUCTION OF LESION OR TISSUE OF LUNG	316	3.4	9	0.1			
THORACOSCOPIC SEGMENTAL RESECTION OF LUNG	195	2.1	1	0.0			
THORACESCOPIC LOBECTOMY OF LUNG	897	9.5	13	0.2			
OTHER LOBECTOMY OF LUNG	1514	16.1	29	0.5			
CLOSED BIOPSY OF BRONCHUS	590	6.3	299	4.7			
CLOSED BIOPSY OF LUNG	564	6.0	374	5.9			
CLOSED ENDOSCOPIC BIOPSY OF LUNG	450	4.8	229	3.6			
THORACENTESIS	457	4.9	201	3.2			
BIOPSY OF LYMPHATIC STRUCTURE	146	1.6	145	2.3			
CLOSED BIOPSY LIVER	5	0.1	188	3.0			
BIOPSY OF BONE, OTHER	3	0	115	1.8			
OTHER RADIOTHERAPEUTIC PROCEDURE	67	0.7	323	5.1			
TRANSFUSION OF PACKED CELLS	163	1.7	230	3.6	6088.54	360	.000

Table 19-24 shows early versus late (SLC) in most frequency of procedures. We compared the most frequent procedures for early versus late (SLC) using chi-square, which showed that there is statistical significant difference in the frequency of procedures for early versus late (SLC) at alpha ($P<0.05$).

Table 25: Early (SLC) verses late (SLC) in the study sample 2002, 2006 and 2011 by total charges

Year/ Sample	ESLC N	ESLC Mean	ESLC SD	LSLC N	LSLC Mean	LSLC SD	t	Mean Difference	df	SE Difference	p-value
2002/A	1265	34526.9	47199.2	908	28406.6	49265.3	2.90	6120.26	1903.0	2105.72	.004
2002/B	1157	32703.0	38640.9	885	27526.9	31367.6	3.35	5176.10	2046.5	1543.54	.001
2006/A	7613	46714.0	53962.7	5419	38149.9	48346.7	9.49	8564.05	12366.1	902.12	.000
2006/B	7708	45726.4	51219.6	5323	39209.3	45642.0	7.62	6518.06	12221.1	855.402	.000
2011/A	9457	63478.8	66078.4	6314	55756.4	62829.0	7.40	7722.38	13987.3	1042.54	.000
2011/B	9408	64943.6	74782.6	6364	54342.1	63573.3	9.56	10601.49	14975.0	1108.83	.000

Table 25 shows the Mean total charges for early versus late (SLC) for selected year 2002, 2006 and 2011 sample A and B. We compared the early versus late (SLC) using the t-test, which showed there is statistical significant difference in the total charges for early and late stage at alpha (P<0.05).

Figure 21: Early (SLC) verses Late (SLC) the study sample 2002, 2006 and 2011 by total charges

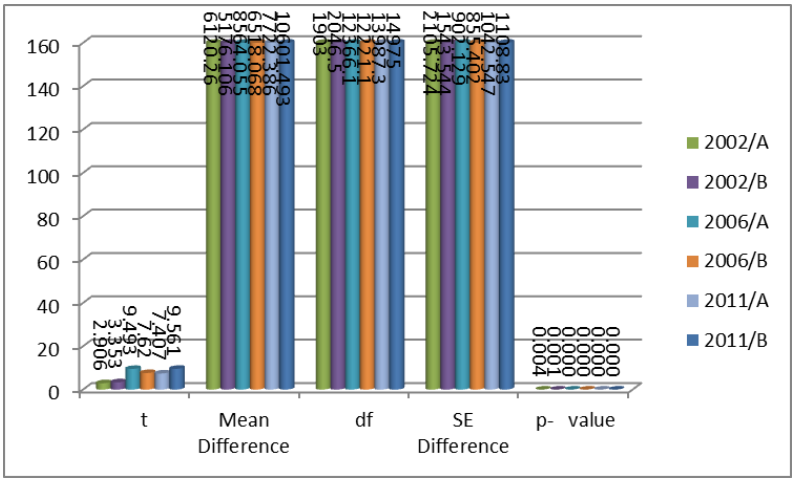


Table 26: Early (SLC) verses Late (SLC) the study sample 2002, 2006 and 2011 by mortality (died or did not die)

Year/ Sample	ESLC N	ESLC Mean	ESLC SD	LSLC N	LSLC Mean	LSLC SD	t	Mean Difference	df	SE Difference	p-value
2002/A	1265	.11	.315	908	.15	.354	-2.38	-.035	1811.2	.015	.017
2002/B	1175	.13	.333	885	.16	.371	-2.41	-.038	1785.4	.016	.016
2006/A	7613	.10	.302	5419	.15	.354	-7.62	-.045	10487.5	.006	.000
2006/B	7708	.10	.298	5323	.15	358	-8.91	-.053	10025.4	.006	.000
2011/A	9457	.07	.255	6314	.11	.310	-8.06	-.038	11701.8	.005	.000
2011/B	9408	.07	.256	6364	.11	.315	-8.73	-.042	11719.7	.005	.000

Table 26 shows early and late (SLC) mortality (died or did not die) for the selected year 2002, 2006 and 2011 sample A and B. We compared mortality of early versus late (SLC) using t-test, which showed there is statistical significant difference in mortality for early and late (SLC) at alpha ($P<0.05$).

Figure 22: Early (SLC) verses Late (SLC) the study sample 2002, 2006 and 2011 by mortality (died or did not die)

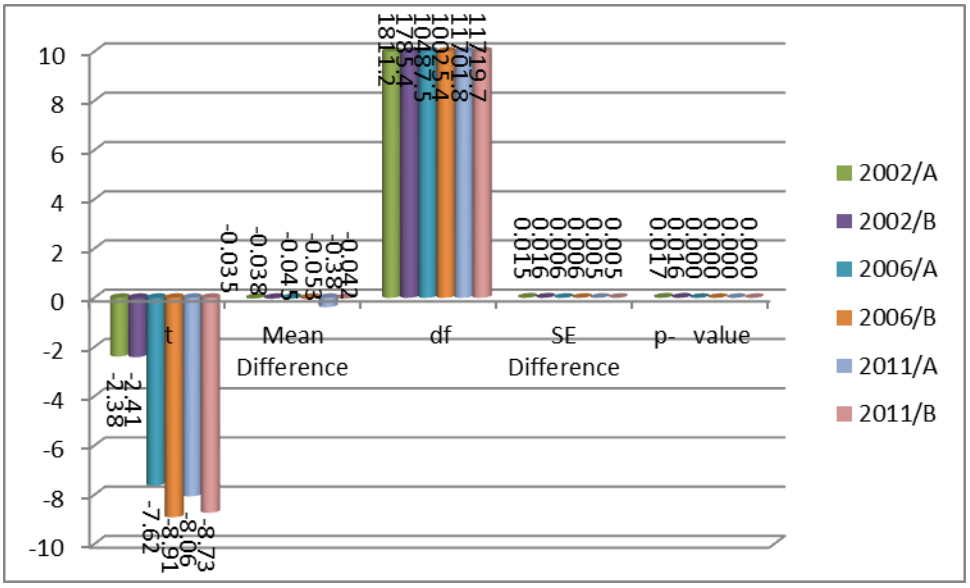


Table 27: Comparison early versus late stage lung cancer 2002/Sample A most frequent diagnoses

DIAGNOSES	Early (SLC)		Late (SLC)		X^2 Test	df	p-value
	N	%	N	%			
No DIAGNOSES	16	1.3	0	0			
SECONDARY AND UNSPECIFIED MALIGNANT NEOPLASM OF INTRATHORACIC LYMPH NODES	99	7.8	5	0.6			
CONGESTIVE HEART FAILURE	23	1.8	2	0.2			
ATRIAL FIBRILLATION	40	3.2	8	0.9			
PNEUMONIA ORGANISM NOS	110	8.7	25	2.8			
EMPHYSEMA NEC	43	3.4	5	0.6			
OBSTRUCTIVE CHRONIC BRONCHITIS WITH (ACTUTE) EXACERBATION	27	2.1	8	0.9			
PULMONARY COLLAPSE	24	1.9	1	0.1			
PLEURAL EFFUSION NOS	37	2.9	3	0.3			
CHRONIC AIRWAY OBSTRUCTION NEC	177	14.0	19	2.1			
ACUTE RESPIRATORY FAILURE	25	2.0	5	0.6			
CONVULSIONS NEC	4	0.3	25	2.8			
VOLUME DEPLETION	21	1.7	21	2.3	1490.61	273	.000

Table 28: Comparison early versus late stage lung cancer 2002/Sample B most frequent diagnoses

DIAGNOSES	Early (SLC)		Late (SLC)		X^2 Test	df	p-value
	N	%	N	%			
No DIAGNOSES	15	1.3	0	0			
SECONDARY AND UNSPECIFIED MALIGNANT NEOPLASM OF INTRATHORACIC LYMPH NODES	104	8.9	11	1.2			
SECOND MALIGNANT NEOPLASM OF PLEURA	53	4.5	20	2.3			
CONGESTIVE HEART FAILURE	24	2.0	3	.3			
ATRIAL FIBRILLATION	32	2.7	6	.7			
PNEUMONIA ORGANISM NOS	88	7.5	25	2.8			
EMPHYSEMA NEC	41	3.5	3	.3			
OBSTRUCTIVE CHRONIC BRONCHITIS WITH (ACTUTE) EXACERBATION	32	2.7	12	1.4			
PULMONARY COLLAPSE	16	1.4	3	.3			
PLEURAL EFFUSION NOS	28	2,4	3	1			
CHRONIC AIRWAY OBSTRUCTION NEC	135	11.5	15	1.7			
ACUTE RESPIRATORY FAILURE	24	2.0	7	.8			
CONVULSIONS NEC	4	.3	24	2.7			
VOLUME DEPLETION	14	1.2	20	2.3			
LATROGENIC PNEUMOTHORAX	32	2.7	1	.1			
HYPERTENSION NOS	27	2.3	8	.9			
HYPOSMOLALITY	14	1.2	2	.2			
HEMOPTYSIS	29	2.5	5	.6			
SECONDARY MALIGNANT NEOPLASM OF MEDIASTINUM	15	1.3	10	1.1			
SECONDARY MALIG NEO LUNG	12	1.0	7	.8			
SECONDARY MALIG NEO NEC	23	2.0	11	1.2	1383.41	259	.000

Table 29: Comparison early versus late stage lung cancer 2006/Sample A most frequent diagnoses

DIAGNOSES	Early (SLC)		Late (SLC)		X^2 Test	df	p-value
	N	%	N	%			
No DIAGNOSES	112	1.5	0	0			
SECONDARY AND UNSPECIFIED MALIGNANT NEOPLASM OF INTRATHORACIC LYMPH NODES	437	5.7	63	1.2			
SECOND MALIGNANT NEOPLASM OF PLEURA	305	4.0	88	1.6			
CONGESTIVE HEART FAILURE	169	2.2	27	0.5			
ATRIAL FIBRILLATION	296	3.9	24	0.4			
PNEUMONIA ORGANISM NOS	563	7.4	232	4.3			
EMPHYSEMA NEC	199	2.6	18	0.3			
OBSTRUCTIVE CHRONIC BRONCHITIS WITH (ACTUTE) EXACERBATION	203	2.7	45	0.8			
PULMONARY COLLAPSE	129	1.7	20	0.4			
PLEURAL EFFUSION NOS	203	2.7	47	0.9			
CHRONIC AIRWAY OBSTRUCTION NEC	999	13.1	168	3.1			
ACUTE RESPIRATORY FAILURE	127	1.7	64	1.2			
URIN TRACT INFECTION NOS	61	0.8	39	0.7			
DEHYDRATION	122	1.6	102	1.9			
LATROGENIC PNEUMOTHORAX	195	2.6	12	0.2			
HYPERTENSION NOS	195	2.6	14	0.3			
HYPOSMOLALITY	72	0.9	23	0.4			
HEMOPTYSIS	177	2.3	31	0.6			
SECONDARY MALIGNANT NEOPLASM OF MEDIASTINUM	99	1.3	17	0.3			
CHRONIC OBST ASTHMA NOS	78	1.0	8	0.1			
SECONDARY MALIG NEO NEC	103	1.4	44	0.8			
TOBACCO USE DISORDER	62	0.8	4	0.1			
POST TRAUM PULM INSUFFIC	77	1.0	3	0.1			
SURG COMPL-HEART	55	0.7	2	0.0			
SURGERY MALIG NEO LUNG	58	0.8	38	0.7			
SPONT PNEUMOTHORAX NEC	55	0.7	7	0.1	7534.40	716	.000

Table 30: Comparison early versus late stage lung cancer 2006/Sample B most frequent diagnoses

DIAGNOSES	Early (SLC)		Late (SLC)		X^2 Test	df	p-value
	N	%	N	%			
No DIAGNOSES	112	1.5	0	0			
SECONDARY AND UNSPECIFIED MALIGNANT NEOPLASM OF INTRATHORACIC LYMPH NODES	435	5.6	53	1.0			
SECOND MALIGNANT NEOPLASM OF PLEURA	345	4.5	93	1.7			
CONGESTIVE HEART FAILURE	151	2.0	30	0.6			
ATRIAL FIBRILLATION	274	3.6	35	0.7			
PNEUMONIA ORGANISM NOS	593	7.7	224	4.2			
EMPHYSEMA NEC	199	2.6	23	0.4			
OBSTRUCTIVE CHRONIC BRONCHITIS WITH (ACTUTE) EXACERBATION	187	2.4	42	0.8			
PULMONARY COLLAPSE	124	1.6	19	0.4			
PLEURAL EFFUSION NOS	200	2.6	28	0.5			
CHRONIC AIRWAY OBSTRUCTION NEC	1016	13.2	180	3.4			
ACUTE RESPIRATORY FAILURE	148	1.9	48	0.9			
CONVULSIONS NEC	27	0.4	129	2.4			
DEHYDRATION	123	1.6	103	1.9			
LATROGENIC PNEUMOTHORAX	202	2.6	7	0.4			
HYPERTENSION NOS	221	2.9	17	0.3			
HYPOSMOLALITY	78	1.0	29	0.5			
HEMOPTYSIS	211	2.7	25	0.5			
TOBACCO USE DISORDER	88	1.1	3	0.1			
POST TRAUM PULM INSUFFIC	72	0.9	3	0.1			
SECONDARY MALIG NEO NEC	99	1.3	37	0.7	7607.06	691	.000

Table 31: Comparison early versus late stage lung cancer 2011/Sample A most frequent diagnoses

DIAGNOSES	Early (SLC)		Late (SLC)		X^2 Test	df	p-value
	N	%	N	%			
No DIAGNOSES	81	0.9	0	0			
SECONDARY AND UNSPECIFIED MALIGNANT NEOPLASM OF INTRATHORACIC LYMPH NODES	378	4.0	59	0.9			
SECOND MALIGNANT NEOPLASM OF PLEURA	108	1.1	18	0.3			
SPONT PNEUMOTHORAX NEC	82	0.9	3	0.0			
ATRIAL FIBRILLATION	88	0.9	14	0.2			
PNEUMONIA ORGANISM NOS	1144	12.1	654	10.4			
EMPHYSEMA NEC	95	1.0	4	0.1			
OBSTRUCTIVE CHRONIC BRONCHITIS WITH (ACTUTE) EXACERBATION	153	1.6	26	0.4			
PULMONARY COLLAPSE	181	1.9	25	0.4			
PLEURAL EFFUSION NOS	210	2.2	55	0.9			
CHRONIC AIRWAY OBSTRUCTION NEC	347	3.7	24	0.4			
ACUTE RESPIRATORY FAILURE	450	4.8	249	3.9			
DIABETES MELLITUS	110	1.2	14	0.2			
ACUTE & CHONIC RESP FAIL	137	1.4	44	0.7			
LATROGENIC PNEUMOTHORAX	343	3.6	12	0.2			
HYPERTENSION NOS	228	2.4	17	0.3			
HYPOSMOLALITY	144	1.5	42	0.7			
AC POSTHEMOEEHAG ANEMIA	123	1.3	3	0.0			
CEREBRAL EDEMA	3	0.0	642	10.2			
PULM EMBOL/INFARCT NEC	114	1.2	129	2.0			
SECONDARY MALIG NEO NEC	99	1.0	19	0.3			
POST TRAUM PULM INSUFFIC	184	1.9	19	0.3			
HEMOPTYSIS NOS	119	1.3	18	0.3			
ACUTE KIDNEY FAILURE NOS	139	1.4	83	1.3			
URIN TRACT INFECTION	96	1.0	31	0.5	7732.51	926	.000

Table 32: Comparison Early versus late stage lung cancer 2011/sample B most frequent diagnoses

DIAGNOSES	Early (SLC)		Late (SLC)		X^2 Test	df	p-value
	N	%	N	%			
No DIAGNOSES	77	0.8	0	0			
SECONDARY AND UNSPECIFIED MALIGNANT NEOPLASM OF INTRATHORACIC LYMPH NODES	387	4.1	52	0.8			
SECOND MALIGNANT NEOPLASM OF PLEURA	88	0.9	14	0.2			
NEUROHYPOPHYSIS DIS NEC	72	0.8	19	0.0			
ATRIAL FIBRILLATION	76	0.8	3	0.0			
PNEUMONIA ORGANISM NOS	1151	12.2	661	10.4			
EMPHYSEMA NEC	92	1.0	8	0.1			
OBSTRUCTIVE CHRONIC BRONCHITIS WITH (ACTUTE) EXACERBATION	154	1.6	27	0.4			
PULMONARY COLLAPSE	184	2.0	19	0.3			
PLEURAL EFFUSION NOS	224	2.4	59	0.9			
CHRONIC AIRWAY OBSTRUCTION NEC	355	3.8	33	0.5			
ACUTE RESPIRATORY FAILURE	433	4.6	273	4.3			
HEMOPTYSIS NOS	131	1.4	25	0.4			
PULM EMBOL/INFARCT NEC	111	1.2	114	1.8			
LATROGENIC PNEUMOTHORAX	333	3.5	6	0.1			
HYPERTENSION NOS	209	2.2	19	0.3			
HYPOSMOLALITY	161	1.6	49	0.8			
CEREBRAL EDEMA	1	0.0	662	10.4			
URIN TRACT INFECTION	88	0.9	43	0.7			
AC POSTTHEMORRHAG ANEMIA	111	1.2	5	0.1			
ACUTE KIDNEY FAILURE NOS	135	1.4	76	1.2			
INTRACEREBRAL HEMORRHAGE	2	0.0	91	1.4			
MALIGNANT PLEURAL EFFUSN	385	4.1	124	1.9			
POST TRAUM PULM INSUFFIC	187	2.0	14	0.2			
ACUTE & CHRONIC RESP FAIL	132	1.4	56	0.9			
SURG COMPL-HEART	78	0.8	0	0.0	7626.11	932	.000

Table 27-32 shows early versus late (SLC) for frequency of diagnoses.

I compared the most frequent diagnoses for early versus late (SLC) using Chi-square test, which showed that there is statistical significant difference in the frequency of diagnoses for early versus late (SLC) at alpha ($P<0.05$).

4.3 Univariate Analysis

ANOVA and ANCOVA

The descriptive statistics for the 2002, 2006 and 2011 sample A and B for the analysis of variance (ANOVA) analysis are shown in Table 33. The descriptive measures Median, Mean and Standard Deviation, Minimum and Maximum are shown.

Table 33: Descriptive statistic ANOVA cost per day early (SLC) versus late (SLC) 2002, 2006 and 2011 Sample A and B

Year 2002A	N	Mean	SD	Min	Max
Eary	1265	4467	2990	145.19	32399.00
Late	908	3872	4081	376.00	58008.00
Total	2173	4218	3499	145.19	58008.00
2002B					
Eary	1175	4407	2950	145.00	28597.00
Late	885	3897	3286	29.56	37729.00
Total	2060	4188	3108	29.56	37729.00
2006A					
Eary	7613	6490	4579	16.92	54921.00
Late	5419	5644	4241	46.25	65725.00
Total	13032	6138	4461	16.92	65725.00
2006B					
Eary	7708	6498	4734	5.60	79440.00
Late	5323	5698	4504	8.75	72735.00
Total	13031	6171	4658	5.60	79440.00
2011A					
Eary	9457	10773	8418	119.00	163387.00
Late	6314	9304	8637	339.00	308329.50
Total	15771	10185	8537	119.00	308329.50
2011B					
Eary	9408	10618	8031	35.56	157220.00
Late	6364	9246	8545	49.00	280782.00
Total	15772	10065	8269	35.56	280782.00

The difference in Means for 2002, 2006 and 2011 sample A and B for early versus late (SLC) including the F Statistic for the ANOVA analysis are presented in Table 34. The differences in the Mean cost per day is statistically significantly for 2002, 2006 and 2011 for both samples A and B alpha ($p < 0.05$). Early (SLC) cost per day is higher than late (SLC) for 2002, 2006 and 2011 sample A and B.

Table 34: Early versus late stage lung cancer cost mean difference, percent difference and ANOVA F Statistic - Raw

Year/Sample	Mean Difference	%Difference	F Statistic
2002/Sample A	595	15.30%	F(1,2058)=13.651, p .000
2002/Sample B	510	13.00%	F(1,2171)=15.377, P .000
2006/Sample A	846	14.98%	F(1,13030)=114.754, p .000
2006/Sample B	800	14.04%	F(1,13029)=93.395, p.000
2011/Sample A	1469	15.78%	F(1,15769)=112.898, p .000
2011/Sample B	1372	14.83%	F(1,15770)=105.134, p .000

Table 34 provides the F statistic for ANOVA analysis and p-values. Early (SLC) mean difference and percent difference from late (SLC) and the Mean percent difference ranged from 13 to 15 percent for the selected years 2002, 2006 and 2011 sample A and B and the difference in cost early versus late (SLC) is statistically significant at alpha ($p < 0.05$).

Table 35: ANOVA cost per day early versus late stage lung cancer - Raw

Year	2002/Sample A				
	Sum of Squares	df	Mean Square	F	P
L1E0	187082796.8	1	187082796.8	15.37	0.000
Error	2.64E+10	2171	12166463.98		
Total	6.53E+10	2173			
Year	2002/Sample B				
L1E0	131121669.9	1	131121669.9	13.651	0.000
Error	1.98E+10	2058	9604943.145		
Total	5.60E+10	2060			
Year	2006/Sample A				
L1E0	2264328317	1	2264328317	114.754	0.000
Error	2.57E+11	13030	197319689.9		
Total	7.51E+11	13032			
Year	2006/Sample B				
L1E0	2012686314	1	2012686314	93.395	0.000
Error	2.81E+11	13029	21550330.88		
Total	7.79E+11	13031			
Year	2011/Sample A				
L1E0	8170618538	1	8170618538	112.898	0.000
Error	1.14E+12	15769	72371425.1		
Total	2.79E+12	15771			
Year	2011/Sample B				
L1E0	7143101014	1	7143101014	105.134	0.000
Error	1.07E+12	15770	67942676.08		
Total	2.68E+12	15772			

Table 35 present the ANOVA analysis results. Based on these results I would reject the hypothesis 1. Early SLC is more expensive than late (SLC) across all years 2002, 2006 and 2011. Early (SLC) is more expensive than late as presented in Table 36 ANCOVA analysis presented after co-varying out age, race, gender, socio-economic status, number of diagnoses, number of procedures and length of stay.

The difference in cost between early (SLC) and late (SLC) for the ANCOVA analysis was statistically significant in the 2006 samples A and B only at alpha ($P<0.05$).

Table 37 presents the F Statistic for the ANCOVA analysis for the selected year 2002, 2006 and 2011 sample A and B.

Table 36: ANCOVA cost per day early versus late stage lung cancer - Corrected

	Sum of Squares	df	Mean Square	F	p
Year	2002/Sample A				
L1E0	5025602.644	1	5025602.644	0.451	0.502
Error	2.41E+10	2164	11154670.36		
Total	6.53E+10	2173			
Year	2002/Sample B				
L1E0	4145621.484	1	4145621.484	0.486	0.486
Error	1.75E+10	2051	8526703.46		
Total	5.60E+10	2060			
Year	2006/Sample A				
L1E0	385518658.9	1	385518658.9	21.929	0.000
Error	2.29E+11	13023	17580470.66		
Total	7.51E+14	13032			
Year	2006/Sample B				
L1E0	217654878.2	1	217654878.2	11.303	0.001
Error	2.51E+11	13022	19256841.69		
Total	7.79E+11	13031			
Year	2011/Sample A				
L1E0	1866994155	1	186694154.9	2.956	0.086
Error	9.96E+11	15762	63164450.83		
Total	2.79E+12	15771			
Year	2011/Sample B				
L1E0	112964043.9	1	112964043.9	1.907	0.167
Error	9.34E+11	15763	59236917.11		
Total	2.68E+12	15772			

Table 37: Early versus Late stage lung cancer cost and ANCOVA F Statistic – Corrected

Year/Sample	F Statistic
2002/Sample A	F(1,2164)= .451, p .502
2002/Sample B	F(1,2051)= .486, p .486
2006/Sample A	F(1,13023)=21.929, P.000
2006/Sample B	F(1,13022)=11.303, p.001
2011/Sample A	F(1,15762)=2.956, p .086
2011/Sample B	F(1,15763)=1.907, p .167

Table 38 presents the estimated Mean after accounting for age, race, gender, socio-economic status, number of diagnosis, number of procedures and length of stay. Early (SLC) is more expensive than late (SLC) for cost per day with the corrected Mean show in Table 38 for the selected years 2002, 2006 and 2011 sample A and B.

Table 38: Estimated Mean ANCOVA cost per day early (SLC) versus late (SLC) 2002, 2006 and 2011

	Estimated Mean	Std. Error	95% Confidence	
			Lower Bound	Upper Bound
Year	**2002/Sample A**			
Early (SLC)	4261	95.961	4073.172	4449.542
Late (SLC)	4158	114.206	3934.847	4382.777
Year	**2002/Sample B**			
Early(SLC)	4229	87.009	4058.532	4399.804
Late(SLC)	4134	100.935	3936.146	4332.04
Year	**2006/Sample A**			
Early(SLC)	6291	49.04	6194.982	6387.234
Late(SLC)	5925	58.592	5810.314	6040.013
Year	**2006/Sample B**			
Early(SLC)	6284	51.077	6184.733	6384.972
Late(SLC)	6008	62.045	5886.433	6129.668
Year	**2011/Sample A**			
Early(SLC)	10279	83.628	10115.842	10443.684
Late(SLC)	10045	103.487	9842.159	10247.853
Year	**2011/Sample B**			
Early(SLC)	10139	81.332	9979.583	10298.424
Late(SLC)	9956	100.021	9759.952	10152.058

Table 39 shows both the raw and corrected Mean for the selected years 2002, 2006 and 2011 sample A and B for cost per day early versus late (SLC).

Table 39: Total dollar cost per patient per day analysis for late (SLC) versus early (SLC) Raw by ANOVA and Corrected by ANCOVA Estimated Means

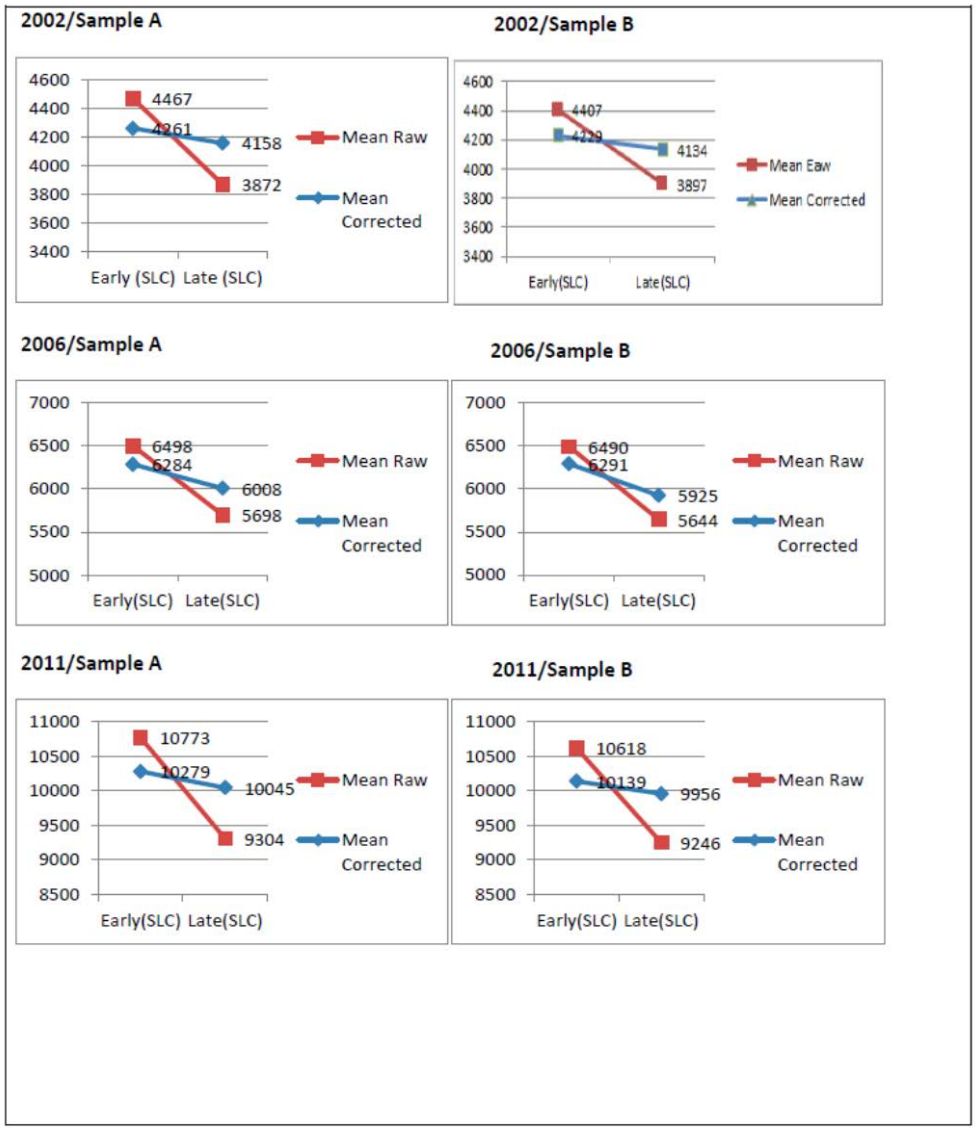


Table 40: Total dollar cost per patient per day analysis for late (SLC) and early (SLC) 2002, 2006 and 2011 Raw by ANOVA and Corrected by ANCOVA Estimated Means

Raw			Corrected		
SLC	2002/Sample A	%Difference	SLC	2002/Sample A	%Difference
Early	4467	15.36%	Early	4261	2.40%
Late	3872		Late	4158	
	2002/Sample B			2002/Sample B	
Early	4407	13.08%	Early	4229	2.29%
Late	3897		Late	4134	
	2006/Sample A			2006/Sample A	
Early	6490	14.90%	Early	6291	6.17%
Late	5644		Late	5925	
	2006/Sample B			2006/Sample B	
Early	6498	14.04%	Early	6284	4.59%
Late	5698		Late	6008	
	2011/Sample A			2011/Sample A	
Early	10773	15.78%	Early	10279	2.32%
Late	9304		Late	10045	
	2011/Sample B			2011/Sample B	
Early	10618	14.83%	Early	10139	1.83%
Late	9246		Late	9956	

Table 40 shows the percent differences for the raw Mean and the corrected or estimated Mean after accounting for age, race, gender, socio-economic status, number of diagnoses, number of procedures and length of stay. The percent difference decreased across all selected years sample A and B with the corrected Mean for cost per day. The greatest decrease in the percent difference is 1.83 % a decrease from 14.8 % in sample B 2011. The estimated Mean is only significant in sample A and B for 2006 at alpha ($p < 0.05$). The decrease in the percent difference in part can be attributed to the number of procedures in early (SLC) as shown in Table 41.

Table 41: Total dollar cost per patient per day analysis for late (SLC) and early (SLC) 2002, 2006 and 2011 corrected Mean for procedures by ANCOVA

Variables	Type of Sum of Square	*df*	Mean Square	f	Sig	Partial Eta^2
2002 Sample A						
L1E0	5025602.644	1	1837168776	.451	**.502**	.000
Number of Procedures	1837168776	1	1837168776	164.700	**.000**	.054
2002 Sample B						
L1E0	4145621.484	1	4145621.484	.486	**.486**	.000
Number of Procedures	1762239	1	1762239387	206.673	**.000**	.092
2006 Sample A						
L1E0	385518658.9	1	385518658.9	21.929	**.000**	.002
Number of Procedures	19757483529.254	1	19757483529.254	1123.83	**.000**	.079
2006 Sample B						
L1E0	217654878.2	1	217654878.2	11.302	**.001**	.001
Number of Procedures	20660768371.933	1	20660768371.933	1072.905	**.000**	.076
2011 Sample A						
L1E0	186694154.884	1	186694154.884	2.956	**.086**	.000
Number of Procedures	96532584269.540	1	96532584269.540	1528.274	**.000**	.088
2011 Sample B						
L1E0	112964043.872	1	112964043.872	1.907	**.167**	.000
Number of Procedures	92655667289.154	1	92655667289.154	1564.154	**.000**	.090

Note: L1E0: early versus late

Table 41 shows the number of procedures is statistically significant across all selected years sample A and B in the ANCOVA analysis. The number of procedures shown in Table 41 is the only variable accounted for in part for the higher cost per day in early (SLC) versus late (SLC). The other demographic covariates accounted for are not statistically significant across all selected years sample A and B consistently.

When I conduct the ANCOVA analysis the difference in the Mean for 2002 and 2011 sample A and B are no longer statistically significant.

Table 42: Total dollar cost per patient per day analysis for late (SLC) versus early (SLC) 2002, 2006 and 2011 by ANOVA by U.S. Region North, Midwest, South and West

	2002A			2002B			2006A			2006B			2011A			2011B		
North	**Early**	**Late**	**Total**	**Early**	**Late**	**Total**	**Early**	**Late**	**Total**	**Early**	**Late**	**Total**	**Early**	**Late**	**Total**	**Early**	**Late**	**Total**
N	397	288	685	346	290	636	1837	1452	3289	1889	1465	3354	2294	1461	3755	2297	1455	3752
Mean	4785	4160	4522	4888	4367	4650	6530	5736	6179	6441	5770	6148	12525	9963	11528	12366	10143	11504
SD	3236	4825	3991	3667	4108	3880	4380	4323	4372	4203	4818	4493	9657	11879	10649	9423	11330	10261
Min	710.5	425.5	425.5	621.0	590.8	590.8	66.2	426.5	66.2	99.2	550.0	99.2	797.0	541.3	541.3	462.8	643.0	643.0
Max	29233.0	58008.0	58008.0	28597.0	355515.0	355515.0	47815.0	55862.0	55862.0	38337.0	56201.0	56201.0	105917.6	308329.5	308329.5	146021.0	280782.0	280782.0
Midwest																		
N	190	164	354	182	146	328	1040	844	1884	1099	817	1916	1778	1323	3101	1752	1313	3065
Mean	4194	3217	3742	4335	3084	3788	5704	4868	5329	5464	4849	5202	9066	7925	8579	8771	8049	8462
SD	2447	1944	2278	2468	3788	2302	3736	3571	3686	3722	3409	3604	5810	5958	5899	5326	6185	5720
Min	145.2	727.8	145.2	145.0	29.6	29.6	120.0	120.2	120.0	5.6	431.0	5.6	119.0	339.0	119.0	629.4	49.0	49.0
Max	19268.0	15628.0	19268.0	13937.0	12084.5	13937.0	36035.0	120.0	36035.0	40213.0	30348.0	40213.0	71777.0	61410.0	71777.0	48328.0	78097.0	78097.0
South																		
N	658	434	1092	614	426	1040	3677	2371	6048	3651	2331	5982	4194	2676	6870	4145	2740	6885
Mean	4331	3982	4192	4167	3864	4043	5802	5169	5554	5914	5147	5615	9225	8213	8831	9223	8222	8824
SD	2931	4206	3496	2625	3040	2805	3968	3956	3975	4367	3799	4172	7303	6449	7000	6771	6742	6777
Min	376.0	376.0	376.0	337.0	362.0	337.0	16.9	46.3	16.9	36.25	8.75	8.75	164.0	504.0	164.0	35.6	134.9	35.6
Max	32399.0	56568.0	56568.0	20858.0	37729.0	37729.0	45066.0	65725.0	65725.0	79440.0	60683.0	79440.0	163387.0	78623.8	163387.0	15722.0	116790.0	157220.0
West																		
N	20	22	42	33	23	58	1059	752	1811	1069	710	1779	1191	864	2045	1214	856	2070
Mean	5208	2809	3951	4114	3747	3963	9581	7828	885	9658	8338	9131	15400	13734	14705	14741	12837	13954
SD	3989	1070	3071	2050	1878	1972	6110	4868	5692	6231	5895	6131	10245	9905	10135	10009	10044	10065
Min	913.7	1173.8	913.7	842.5	904.9	842.5	432.0	325.2	325.2	312.3	227.6	227.6	256.0	564.2	256.0	248.0	859.1	248.0
Max	19682.0	4587.2	19682.0	8746.0	8237.0	8746.0	54921.0	40555.5	54921.0	56816.0	72735.0	72735.0	107464.0	68435.5	107464.0	150046.0	111526.5	150046.0

ANOVA and ANCOVA by Region

The descriptive statistics for the 2002, 2006 and 2011 sample A and B by U.S. region North, Midwest, South and West for the analysis of variance (ANOVA) analysis are shown in Table 42. The descriptive measures Median, Mean and Standard Deviation, Minimum and Maximum are shown.

Table 43 shows by U.S region North, Midwest, South and West the percent differences for the raw Mean and the corrected, estimated Mean after accounting for age, race, gender, socio-economic status, number of diagnosis, number of procedures and length of stay

The regional ANOVA and ANCOVA results are not as robust as the overall ANOVA and ANCOVA analysis results for cost per day, however, are trending similar to the overall cost per day analysis. Early (SLC) versus late (SLC) is more expensive by all U.S. regions in part due to the number of procedures in early (SLC) for selected years sample A and B compared to late (SLC). The number of

procedures is statistically significant across all selected years sample A and B for all U.S. regions North, Midwest, South and West consistently. The number of procedures p-value was statistically significant from p-value 0.000 and 0.006 for number of procedures.

Overall from the raw results, the West region of the U.S. highest Mean cost per day, followed by the North, Midwest and South. Overall, the least expensive region is the Midwest for selected years 2002, 2006 and 2011 sample A and B by region as is shown in Table 43.

Table 43: Total dollar cost per patient per day analysis for late (SLC) and early (SLC) 2006 sample B costs by region North, Midwest, South and West 2002, 2006 and 2011 - raw and corrected

		Raw Mean			Corrected Mean	
	SLC	**2002/Sample A**	**%Difference**	**SLC**	**2002/Sample A**	**%Difference**
North	Early	4785	15.0%	Early	4613	4.9%
	Late	4160		Late	4397	
Midwest	Early	4194	30.3%	Early	4001	16.2%
	Late	3217		Late	3441	
South	Eary	4331	8.7%	Early	4111	-4.7%
	Late	3982		Late	4315	
West	Early	5208	85.4%	Early	5214	85.9
	Late	2809		Late	2804	
		Raw Mean			Corrected Mean	
	SLC	**2002/Sample B**	**%Difference**	**SLC**	**2002/Sample B**	**%Difference**
North	Early	4888	11.9%	Early	4737	4.1%
	Late	4367		Late	4547	
Midwest	Early	4353	41.1%	Early	4155	24.7%
	Late	3084		Late	3330	
South	Early	4167	7.8%	Early	3985	-3.4%
	Late	3864		Late	4127	
West	Early	4114	9.7%	Early	4052	5.6%
	Late	3747		Late	3837	
		Raw Mean			Corrected Mean	
	SLC	**2006/SampleA**	**%Difference**	**SLC**	**2006/Sample A**	**%Difference**
North	Early	6530	13.8%	Early	6302	4.5%
	Late	5736		Late	6025	
Midwest	Early	5704	17.1%	Early	5423	4.0%
	Early	4868		Late	5214	
South	Late	5802	12.2%	Early	5629	3.5%
	Early	5169		Late	5437	
West	Early	9581	22.4%	Early	9280	12.3%
	Late	7828		Late	8262	
		Raw Mean			Corrected Mean	
	SLC	**2006/Sample B**	**%Difference**	**West**	**2006/Sample B**	**%Difference**
North	Early	6441	11.6%	Early	6214	2.5%
	Late	5770		Late	6062	
Midwest	Early	5464	12.6%	Early	5224	1.0%
	Late	4849		Late	5171	
South	Early	5914	14.9%	Early	5692	3.6%
	Late	5147		Late	5494	
West	Early	9658	15.8%	Early	9289	4.4%
	Late	8338		Late	8894	
		Raw Mean			Corrected Mean	
	SLC	**2011/Sample A**	**%Difference**	**SLC**	**2011/Sample A**	**%Difference**
North	**Early**	12525	25.7%	**Early**	11762	5.3%
	Late	9963		**Late**	11160	
Midwest	**Early**	9066	14.9%	**Early**	8631	1.4%
	Late	7925		**Late**	8510	
South	**Early**	9225	12.3%	**Early**	8859	0.8%
	Late	8213		**Late**	8788	
West	**Early**	15400	12.1%	**Early**	14986	4.7%
	Late	13734		**Late**	14312	
		Raw Mean			Corrected Mean	
	SLC	**2011/Sample B**	**%Difference**	**SLC**	**2011/Sample B**	**%Difference**
North	**Early**	12366	21.9%	**Early**	11768	6.1%
	Late	10143		**Late**	11088	
Midwest	**Early**	8771	8.9%	**Early**	8290	-4.6%
	Late	8049		**Late**	8691	
South	**Early**	9223	12.1%	**Early**	8897	1.9%
	Late	8222		**Late**	8729	
West	**Early**	14741	14.8%	**Early**	14206	4.5%
	Late	12837		**Late**	13597	

Figure 23-28 shows both the raw and corrected, estimated Mean for the selected years 2002, 2006 and 2011 sample A and B by U.S. region North, Midwest, South and West for cost per day early versus late (SLC).

Figure 23: 2002 Sample A By Region –Raw and Corrected Mean

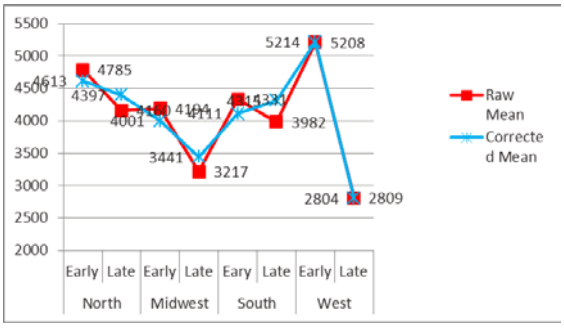


Figure 24: 2002 Sample B By Region –Raw and Corrected Mean

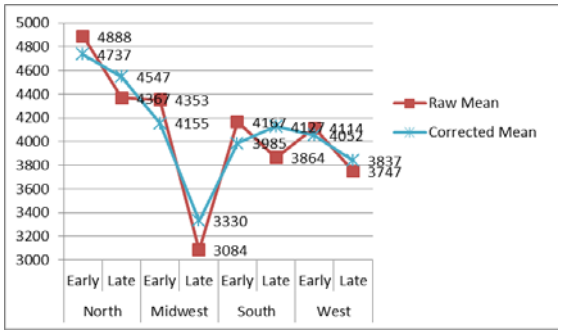


Figure 25: 2006/Sample A by Region – Raw and Corrected Mean

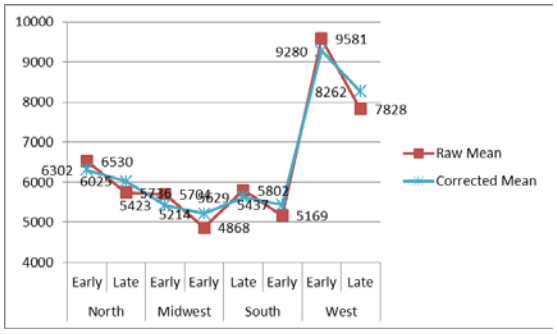


Figure 26: 2006 Sample B Region–Raw and Corrected Mean

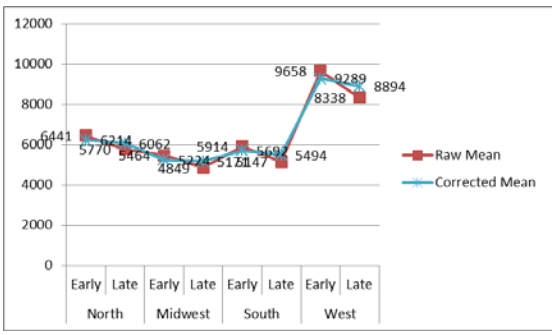


Figure 27: 2011/Sample A by Region –Raw and Corrected Mean

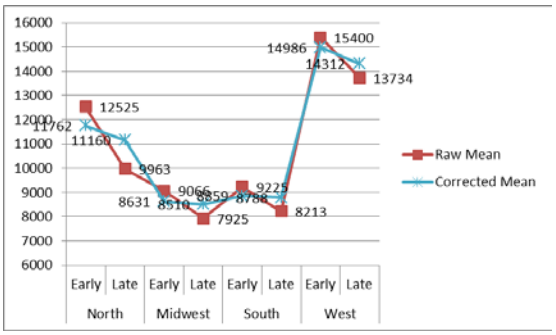
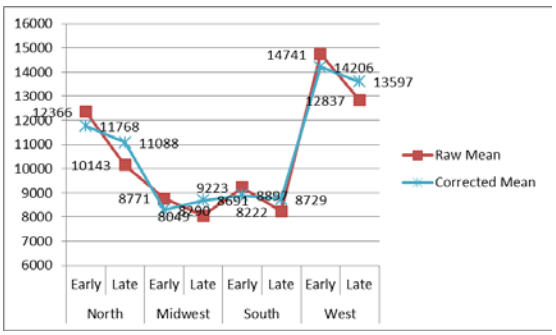


Figure 28: 2011/Sample B by Region –Raw and Corrected Mean



A summary of the data results for cost per day by U.S. region North, Midwest, South and West for ANCOVA, raw Mean, and ANCOVA, corrected Mean. For 2002 sample A the raw data showed all results are significant at p-value <0.05 except for the South. Raw: North F (1,683) = 4.114, p-value = .043; Midwest F

(1,352) = 16.929, p-value = 0.000; South F (1,1090) = 2.609, p-value 0.107; West F (1.40) = 7.385, p-value 0.010. For 2002 sample A the corrected data all results are significant except for North, South and West. Corrected: North F (1,676) = 0.467, p-value = 0.495; Midwest F (1,345) = 6.720, p-value = 0.010; South F (1, 1083) = 0.906, p-value = 0.341; West F (1,33) = 5.620, p-value = 0.24.

For 2002 sample B the raw data shows all results are statistically significant at p-value <0.05 except for the North, South and West. Raw: North F (1,634) = 2.850, p-value =.092; Midwest F (1,326) = 26.545, p-value = .000; South F (1,1038) = 2.945, p-value = .086; West F (1,54) = .466, p-value = .498. For 2002 sample B the corrected data all results are significant except for North, South and West. Corrected: North F (1,627) = 0.368, p-value = 0.544; Midwest F (1,319) = 13.413, p-value = .000; South F (1, 1031) = .702, p-value = .402; West F (1,47) = .172, p-value = .680.

For 2006 sample A the raw data all results are statistically significant p-value <.05. Raw: North F (1,3287) = 26.933, p-value = .000; Midwest F (1,352) = 19.406, p-value = .000; South F (1,6046) = 36.799, p-value = .000; West F (1,1809) = 42.164, p-value = .000. For 2006 sample A the corrected data all results are significant except for the North and South. Corrected: North F (1,3280) = 3.272, p-value = .071; Midwest F (1,345) = 8.653, p-value = .003; South F (1, 6039) = 3.492, p-value = .062; West F (1,1802) = 14.384, p-value = .000.

For 2006 sample B the raw data all results are statistically significant p <.05. Raw: North F (1,3352) = 18.449, p-value = .000; Midwest F (1,1914) = 13.690, p-

value = .000; South F (1,5980) = 48.468, p-value = .000; West F (1,1777) = 19.975, p-value = .000. For 2006 sample B the corrected data all results are not significant. Corrected: North F (1,3345) = .515, p-value = .473; Midwest F (1,1907) = .113 p-value = .737; South F (1, 5973) = 3.279, p-value = .070; West F (1,1770) = 1.934, p-value = .165.

For 2011 sample A the raw data shows all results are statistically significant p <.05. Raw: North F (1,3753) = 52.336, p-value = .000; Midwest F (1,3099) = 28.635, p- value = .000; South F (1,6868) = 34.342, p-value = .000; West F (1,2043) = 13.518, p-value = .000. For 2011 sample A the corrected data all results are not significant. Corrected: North F (1,3746) = 2.852, p-value = .091; Midwest F (1,3092) = .387, p-value = .534; South F (1, 6861) = .172, p-value = .678; West F (1,2036) = 2.261, p-value = .133.

For 2011 sample B the raw data all results are statistically significant p-value = <.05. Raw: North F (1,3750) = 42.273, p-value = .000; Midwest F (1,3063) = 11.990, p-value = .000; South F (1,6883) = 36,126, p-value = .000; West F (1,2068) = 18.114, p-value = .000. For 2011 sample B the corrected data all results are significant except for South and West. Corrected: North F (1,3743) = 3.886, p-value = .049; Midwest F (1,3056) = 4.538, p-value = .033; South F (1, 6876) = .907, p-value = .341; West F (1,2061) = 1.921, p-value = .166.

4.4 Binary Logistic Regression Analysis

The contingency cross tabulation table for the selected years 2002, 2006 and 2011 sample A and B shows the counts and percentages to summarize mortality (died or did not die) for early (SLC) versus late (SLC) are shown in Table 44. Based on these results I would reject hypothesis 2. Late (SLC) has higher mortality versus early (SLC) for all selected years sample A and B. In Table 45 the cross tabulation results for early versus late (SLC) mortality difference in the percentages are tested for statistical significance with Chi-square test.

Table 44: Mortality Cross Tabulation early versus late stage lung cancer 2002, 2006 and 2011 sample A and B

Year	2002/Sample A		
Mortality	EarlyCount%	LateCount%	Total
Did not Die	1124(88.9%)	775(85.4%)	1899(87.4%)
Died	141(11.1%)	133(14.6%)	274(12.6%)
Total	1265(100%)	908(100%)	2173(100%)
Year	2002/Sample B		
Did not Die	1026(87.3%)	739(83.5%)	1765(85.7%)
Died	149(12.7%)	146(16.5%)	295(14.3%)
Total	1175(100%)	885(100%)	2060(100%)
Year	2006/sample A		
Did not Die	6841(89.9%)	4625(85.3%)	11466(88.0%)
Died	772(10.1%)	794(14.7%)	1566(12.0%)
Total	7613(100%)	5419(100%)	13032(100%)
Year	2006/Sample B		
Did not Die	6951(90.2%)	4517(84.9%)	11468(83.0%)
Died	757(9.8%)	806(15.1%)	1563(12.0%)
Total	7708(100%)	5323(100%)	13031(100%)
Year	2011/Sample A		
Did not Die	8798(93%)	5635(89.2%)	14433(91.5%)
Died	659(7.0%)	679(10.8%)	1338(8.5%)
Total	9457(100%)	6314(100%)	15771(100%)
Year	2011/Sample B		
Did not Die	8746(93.0%)	5652(88.8%)	14398(91.3%)
Died	662(7.0%)	712(11.2%)	1374(8.7%)
Total	9408(100%)	6364(100%)	15772(100%)

Table 45 shows the statistical significance of the cross tabulation for mortality for early versus late (SLC).

The Pearson likelihood ration results for Chi-square computed for all selected years sample A and B was less than alpha p-value <0.05 which Mean the difference is statistically significant. The variables are not independent and statistically significant relationship exists between LC stage and mortality.

Table 45: Mortality Chi-square early versus late stage lung cancer 2002, 2006 and 2011 sample A and B

Year/ Sample	Statistic Pearson Chi-Square Value	df	Asymp. Sig. (2-sided)
2002/Sample A	5.881	1	0.015
2002/Sample B	5.9	1	0.014
2006/Sample A	60.946	1	0.000
2006/Sample B	84.449	1	0.000
2011/Sample A	69.88	1	0.000
2011/Sample B	84.264	1	0.000

Table 46-47 presents the results of the logistic regression analysis for mortality early (SLC) versus late (SLC) and the adjusted odd ratio Ep(B) after accounting for age, race, gender, socio-economic status, number of diagnoses, number of procedures and length of stay. Late (SLC) is still more deadly than early (SLC) after accounting for age, race, gender, length of stay, number of diagnoses, number of procedure and socio-economic status for the selected years 2002, 2006 and 2011 sample A and B as is shown in Table 49.

Table 46-47 shows the results of the Logistic Regression analysis. The corrected odds rations are decreased compared to the raw odds ratio calculated from the cross tabulation counts and percent for early versus late stage mortality shown in Table 49, however, Late (SLC) is more deadly versus early (SLC) even after

covering out age, race gender, LOS, number of diagnoses, socio-economic status and number of procedures.

Table 46: Mortality: Logistic Regression Results for 2002 Sample A and B, 2006 Sample A - Corrected

Year/Sample	2002/Sample A					
Variable	**B**	***B/S.E.***	**Wal**	**df**	**Sig**	**Ep(B)**
Age	.005	.006	.662	1	.416	1.005
L1E0	.193	.137	1.973	1	**.160**	**1.212**
Gender	-.197	.133	2.180	1	.140	.821
Length of Stay	.012	.007	2.748	1	.097	1.012
Number of Diagnosis	.134	.026	25.980	1	**.000**	1.143
Number of Procedures	- .094	.037	6.428	1	.011	.910
Race	- .089	.093	.905	1	.341	.915
Income	- .037	.072	.261	1	.610	.964
Constant	-2.939	.531	30.596	1	.000	.053
Model Chi-	49.787					

Year/Sample	2002/Sample B					
Variable	**B**	***B/S.E.***	**Wal**	**df**	**Sig**	**Ep(B)**
Age	.008	.006	2.072	1	.150	1.008
L1E0	.254	.133	3.654	1	**.056**	**1.289**
Gender	-.227	.130	3.054	1	.081	.797
Length of Stay	.014	.010	2.068	1	.150	1.014
Number of Diagnosis	.079	.024	11.067	1	**.001**	1.083
Number of Procedures	- .055	.037	2.172	1	.141	.946
Race	- .028	.075	.143	1	.706	.972
Income	.029	.069	.176	1	.675	1.020
Constant	-3.015	.496	36.907	1	.000	.049
Model Chi-	31.363					

Year/Sample	2006/Sample A					
Variable	**B**	***B/S.E***	**Wal**	**df**	**Sig**	**Ep(B)**
Age	.008	.002	10.938	1	.001	1.008
L1E0	.376	.057	43.915	1	**.000**	**1.457**
Gender	-.225	.055	16.654	1	.000	.798
Length of Stay	.028	.004	53.531	1	.000	1.028
Number of Diagnosis	.035	.007	22.870	1	**.000**	1.035
Number of Procedures	- .052	.014	13.899	1	.011	.950
Race	.086	.027	10.156	1	.001	1.089
Income	- .018	.024	.565	1	.452	.982
Constant	-3.117	.194	257.407	1	.000	.044
Model Chi-	200.9					

Note: L1E0: early versus late

Table 47: Mortality: Logistic Regression Results for 2006 Sample B, 2011 Sample A and B – Corrected

Year/Sample	2006/Sample B					
Variable	**B**	***B/S.***	**Wald**	**df**	**Sig**	**Ep(B)**
Age	.008	.003	10.880	1	.001	1.008
L1E0	.422	.057	54.557	1	**.000**	**1.525**
Gender	-.295	.055	28.317	1	.000	.745
Length of Stay	.021	.004	27.016	1	.000	1.021
Number of Diagnosis	.044	.007	40.541	1	**.000**	1.045
Number of Procedures	- .069	.014	23.400	1	.000	.933
Race	.007	.029	.067	1	.796	1.007
Income	.042	.025	2.862	1	.091	1.042
Constant	-3.137	.195	257.676	1	.000	.043
Model Chi-	218.406					
Year/Sample	**2011/Sample A**					
Variable	**B**	***B/S.E.***	**Wald**	**df**	**Sig**	**Ep(B)**
Age	.004	.003	1.730	1	.188	1.004
L1E0	369	.061	36.922	1	**.100**	**1.446**
Gender	-.193	.058	10.931	1	.001	.825
Length of Stay	.009	.005	4.020	1	.045	1.009
Number of Diagnosis	.069	.005	166.280	1	**.000**	1.071
Number of Procedures	-.019	.013	2.223	1	.136	.981
Race	.085	.028	9.565	1	.002	1.089
Income	.004	.026	020	1	.889	1.004
Constant	-3.734	.212	309.812	1	.000	.024
Model Chi-	299.373					
Year/Sample	**2011/Sample B**					
Variable	**B**	***B/S.E.***	**Wald**	**df**	**Sig**	**Ep(B)**
Age	.002	.003	.338	1	.561	1.002
L1E0	.372	.060	38.219	1	**.000**	**1.451**
Gender	-.192	.057	11.202	1	.001	.825
Length of Stay	.020	.004	20.741	1	.000	1.020
Number of Diagnosis	.065	.005	148.329	1	**.000**	1.067
Number of Procedures	-.052	.013	15.31	1	.000	.949
Race	.020	.030	.428	1	.513	1.020
Income	-.017	.025	.455	1	.500	.983
Constant	-3.364	.208	262.758	1	.000	.035
Model Chi-	299.659					

Note: L1E0: early versus late

Table 48 shows the logistic regression classification plots from the logistic regression analysis for the selected year 2002, 2006 and 2011 sample A and B. The classification plots provide a visual of the analysis. The classification plots in all selected years show cases bunching up with observations toward the left end of the graphs this indicates a good predicting model for 2002, 2006 and 2011 sample A and B.

Table 48: Mortality: Logistic Regression Classification Plots Results for 2006 Sample B, 2011 Sample A and B – Corrected

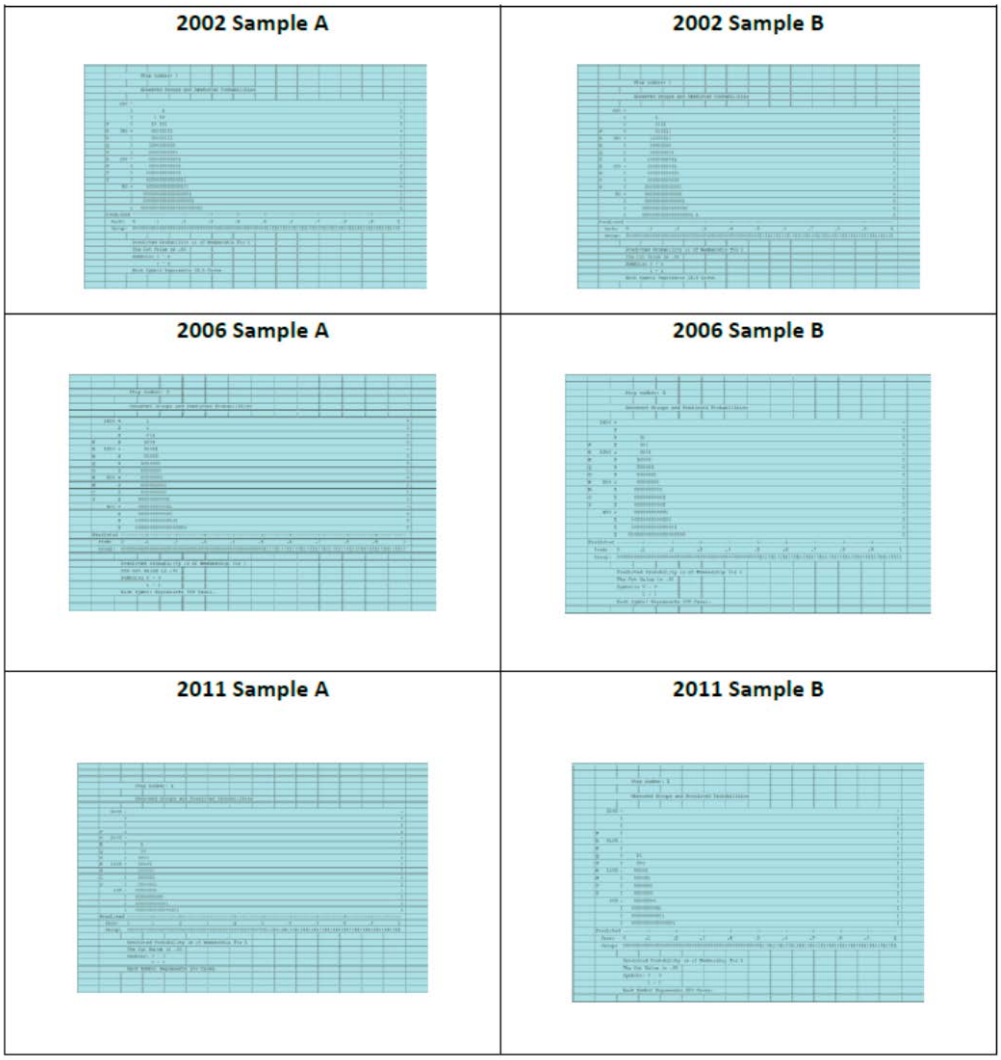


Table 49 shows raw odds ratio and the corrected odds ratio after accounting for age, race, gender, socio-economic status, number of diagnoses, number of procedures and length of stay in the Regression analysis for mortality early versus late (SLC). The corrected odds ratio decreased across all selected years sample A and B for mortality. The greatest decrease in the odds ratio is shown in sample B 2011. The corrected odds ratio drop to 1.45 from 1.66. The raw odds

ratios for all years selected are statistically significant at alpha p-value <0.05 except in sample B for 2002. The corrected odds all odds ratios are statistically significant except 2002 sample A and B and 2011 sample A. The decrease in the odds ratios in part can be attributed to the number of diagnoses in late (SLC) as versus early (SLC) as shown in Table 46. The odds ratio for early stage gets worse when the number of diagnoses are co-varied out in the regression analysis. Out of all the covariates the number of diagnoses is the only co-variate consistently statistically significant for all selected years and sample A and B.

Table 49: Mortality Odds Rations: 2002, 2006 and 2011 Sample A and B Raw and Corrected

2002/Sample A	Early	Late		
	Raw		Corrected	
Did not Die	1124(88.8%)	775(85.4%)	-	-
Died	141 (11.1%)	133(14.6%)	-	-
Odds Ratio	1.36[a]		1.21	
2002/Sample B				
Did not Die	1026(87.3%)	739(83.5%)	-	-
Died	149(12.7%)	146(16.5%)	-	-
Odds Ratio	1.36[b]		1.28	
2006/Sample A				
Did not Die	6841(89.9%)	4625(85.3%)	-	-
Died	772(10.1%)	794(14.1%)	-	-
Odds Ratio	1.52[c]		1.45	
2006/Sample B				
Did not Die	6951(90.2%)	4517(84.9%)	-	-
Died	757(9.8%)	806(15.1%)	-	-
Odds Ratio	1.63[d]		1.52	
2011/Sample A				
Did not Die	8798(93.0%)	5635(89.2%)	-	-
Died	659(7.0%)	679(10.8%)	-	-
Odds Ratio	1.60[e]		1.44	
2011/Sample B				
Did not Die	8746(93.0%)	5652(88.8%)	-	-
Died	662(7.0%)	712(11.2%)	-	-
Odds Ratio	1.66[f]		1.45	

Note: Odds ratio 95% CI: a = 1.0612-1.7636, p = 0.015, b = 1.0626-1.7417, p 0.014, c =.3685-1.6912, p <0.0001, d = 1.4736-1.8217, p <0.0001, e = 1.4379-1.7998, p <0.001, f = 1.4895-1.8590, p <0.0001.

Mortality by Region

Table 50 shows by U.S. region North, Midwest, South and West the contingency cross tabulation table for the selected years 2002, 2006 and 2011 sample A and B with the counts and percentages to summarize mortality (died or did not die) for early (SLC) versus late (SLC).

By U.S. region late (SLC) has higher mortality versus early (SLC) for all selected years sample A and B except the West 2002 sample B early mortality is 15 % versus late 4% mortality. In Table 51 the cross tabulation results for early versus late (SLC) mortality difference in the percentages are tested for statistical significance with Chi-square test by U.S. region North, Midwest, South and West.

Table 50: Cross tabulation early versus late stage lung cancer 2002, 2006 and 2011 sample A and B by US region North, Midwest, South and West

		2002/Sample A		
Region	Mortality	EarlyCount%	LateCount%	Total
North	Did not Die	352(88.7%)	244(84.7%)	596(87.0%)
	Died	45(11.3%)	44(15.3%)	89(13.0%)
	Total	397(100.0%)	288(100.0%)	685(100.0%)
Midwest	Did not Die	172(90.5%)	140(85.4%)	312(88.1%)
	Died	18(9.5%)	24(14.6%)	42(11.9%)
	Total	190(100.0%)	164(100.0)	354(100.0%)
South	Did not Die	581(88.3%)	372(85.7%)	953(87.3%)
	Died	77(11.7%)	62(14.3%)	139(12.7%)
	Total	658(100.0%)	434(100.0%)	1092(100.0%)
West	Did not Die	19(95.0%)	19(86.4%)	38(90.5%)
	Died	1(5.0%)	3(13.6%)	4(9.5%)
	Total	20(100.0%)	22(100.0%)	42(100%)
Region	Year	2002/Sample B		
North	Did not Die	301(87.0%)	236(81.4%)	537(84.4%)
	Died	45(13.0%)	54(18.6%)	99(15.6%)
	Total	346(100.0%)	290(100.0%)	636(100%)
Midwest	Did not Die	157(86.3%)	124(84.9%)	281(85.7%)
	Died	25(13.7%)	22(15.1%)	47(14.3%)
	Total	182(1900.0%)	146(100.0%)	328(100.0%)
South	Did not Die	540(87.9%)	357(83.8%)	897(86.3%)
	Died	74(12.1%)	69(16.2%)	143(13.8%)
	Total	614(100.0%)	426(100.0%)	1040(100.0%)
West	Did not Die	28(84.8%)	22(95.7%)	50(89.3%)
	Died	5(15.2%)	1(4.3%)	6(10.7%)
	Total	33(100.0%)	23(100.0%)	56(100.0%)
Region	Mortality	2006/Sample A		
North	Did not Die	1663(90.5%)	1189(81.9%)	2852(86.7%)
	Died	174(9.5%)	263(18.1%)	437(13.3%)
	Total	1837(100.0%)	1452(100.0%)	3289(100.0%)
Midwest	Did not Die	924(88.8%)	725(85.9%)	1649(87.5%)
	Died	116(11.2%)	119(14.1%)	235(12.5%)
	Total	1040(100.0%)	844(100.0%)	1884(100.0%)
South	Did not Die	3297(89.7%)	2060(86.9%)	5357(88.6%)
	Died	380(10.3%)	311(13.1%)	691(11.4%)
	Total	3677(100.0%)	2371(100.0%)	6048(100.0%)
West	Did not die	957(90.4%)	651(86.6%)	1608(88.8%)
	Died	102(9.6%)	101(13.4%)	203(11.2%)
	Total	1059(100.0%)	752(100.0%)	1811(100.0%)
Region	Mortality	2006/Sample B		
North	Did not Die	1715(90.8%)	1216(83.0%)	2931(87.4%)
	Died	174(9.2%)	249(17.0%)	423(12.6%)
	Total	1889(100.0%)	1465(100.0%)	3354(100.0%)
Midwest	Did not Die	991(90.2%)	704(86.2%)	1695(88.5%)
	Died	108(9.8%)	113(13.8%)	221(11.5%)
	Total	1099(100.0%)	817(100.0%)	1916(100.0%)
South	Did not Die	3273(89.6%)	1992(85.5%)	5265(88.0%)
	Died	378(10.4%)	339(14.5%)	717(12.0%)
	Total	3651(100.0%0	2331(100.0%)	5982(100.0%)
West	Did not Die	972(90.9%)	605(85.2%)	1577(88.6%)
	Died	97(9.1%)	105(14.8%)	202(11.4%)
	Total	1069(100.0%)	710(100.0%)	1779(100.0%)
Region	Mortality	2011/Sample A		
North	Did not Die	2144(93.5%)	1281(87.7%)	3425(91.2%)
	Died	150(6.5%)	180(12.3%)	330(8.8%)
	Total	2294(100.0%)	1461(100.0%)	3755(100.0%)
Midwest	Did not Die	1644(92.5%)	1191(90.0%)	2835(91.4%)
	Died	134(7.5%)	132(10.0%)	266(8.6%)
	Total	1778(100.0%)	1323(100.0%)	3101(100.0%)
South	Did not Die	3906(93.1%)	2397(89.6%)	6303(91.7%)
	Died	288(6.9%)	279(10.4%)	567(8.3%)
	Total	4194(100.0%)	2676(100.0)	6870(100.0%)
West	Did not Die	1104(92.7%)	766(89.7%)	766(89.7%)
	Died	87(7.3%)	88(10.3%)	88(10.3%)
	Total	1191(100.0%)	854(100.0%)	854(100.0%)
Region	Mortality	2011/Sample B		
North	Did not Die	2168(94.4%)	1276(87.7%)	3444(91.8%)
	Died	129(5.6%)	179(12.3%)	308(8.2%)
	Total	2297(100.0%)	1455(100.0%)	3752(100.0%)
Midwest	Did not Die	1617(92.3%)	1176(89.6%)	2793(91.1%)
	Died	135(7.7%)	137(10.4%)	272(8.9%)
	Total	1752(100.0%)	1313(100.0%)	3065(100.0%)
South	Did not Die	3837(92.6%)	2429(88.6%)	6266(91.0%)
	Died	308(7.4%)	311(11.4%)	619(9.0%)
	Total	4145(100.0%)	2740(100.0%)	6885(100.0%)
West	Did not Die	1124(92.6%)	771(90.1%)	1895(91.5%)
	Died	90(7.4%)	85(9.9%)	175(8.5%)
	Total	1214(100.0%)	856(100.0%)	2070(100.0%)

Table 51 shows by U.S. region North, Midwest, South and West the statistical significance of the cross tabulation for mortality for early versus late (SLC). The Pearson likelihood ratio results for chi-square computed show not all regions are statistically significant for difference in percentages for early versus late (SLC) for mortality from the selected years sample A and B by U.S. region. The regional data is not as robust as the overall mortality data. Approximately half of the regional data is statistically significant for the percent differences in mortality for early versus late stage with alpha ($p < 0.05$). Although not as robust the U.S. regional data shows late (SLC) is more deadly than early (SLC) and trends strongly toward a significant relationship exists between LC stage and mortality by U.S. region.

Table 51: Mortality: Chi-Square 2002, 2006 and 2011 Sample A and B by US Region North, Midwest, South and West

Region/Year/ Sample	Statistic Pearson Chi-Square Value	df	Asymp. Sig. (2-sided)
North 2002/Sample A	2.295	1	0.130
Midwest 2002/Sample A	2.242	**1**	0.134
South 2002/Sample A	1.571	**1**	0.210
West 2002/Sample A	0.907	**1**	0.341
North 2002/Sample B	3.784	**1**	0.052
Midwest 2002/Sample B	0.117	**1**	0.732
South 2002/Sample B	3.644	**1**	0.056
West 2002/Sample B	1.654	**1**	0.198
North 2006/Sample A	52.558	**1**	**0.000**
Midwest 2006/Sample A	3.703	**1**	0.054
South 2006/Sample A	11.027	**1**	**0.001**
West 2006/Sample A	6.377	**1**	0.120
North 2006/Sample B	45.377	**1**	**0.000**
Midwest 2006/Sample B	7.363	**1**	**0.007**
South 2006/Sample B	23.674	**1**	**0.000**
West 2006/Sample B	13.843	**1**	**0.000**
North 2011/Sample A	37.219	**1**	**0.000**
Midwest 2011/Sample A	5.763	**1**	**0.016**
South 2011/Sample A	27.328	**1**	**0.000**
West 2011/Sample A	5.719	1	**0.017**
North 2011/Sample B	52.851	**1**	**0.000**
Midwest 2011/Sample B	6.910	**1**	**0.009**
South 2011/Sample B	30.975	**1**	**0.000**
West 2001/Sample B	4.107	**1**	**0.043**

Table 52: Logistic regression mortality early (SLC) and late (SLC) raw and corrected by US region North, Midwest, South and West 2002, 2006 Sample A and B

Year/Sample		2002/Sample A						
Variable	**E1L0**	**B**	***B/S.E.***	**Wald**	**df**	**Sig**	**Ep(B)**	**Model chi**
Region	North	.076	.248	.094	1	.759	1.079	32.057
	Midwest	.538	.352	2.748	1	.097	1.791	12.490
	South	.129	.194	.440	1	.517	1.138	23.551
	West	1.506	1.979	.579	1	.447	4.509	7.921
Year/Sample		**2002/Sample B**						
Variable	**E1L0**	**B**	***B/S.E.***	**Wald**	**df**	**Sig**	**Ep(B)**	**Model chi**
Region	North	.345	.232	2.204	1	.138	1.412	13.768
	Midwest	.041	.343	.014	1	.905	1.042	6.889
	South	.315	.189	2.770	1	.096	1.370	21.835
	West	-1.800	1.489	1.461	1	.227	.165	10.372
Year/Sample		**2006/Sample A**						
Variable	**E1L0**	**B**	***B/S.E.***	**Wald**	**df**	**Sig**	**Ep(B)**	**Model chi**
Region	North	.700	.111	40.048	1	.000	2.014	122.516
	Midwest	.270	.147	3.384	1	.066	1.310	14.795
	South	.216	.086	6.265	1	.012	1.241	100.770
	West	.162	.161	1.011	1	.315	1.175	51.803
Year/Sample		**2006/Sample B**						
Variable	**E1L0**	**B**	***B/S.E.***	**Wald**	**df**	**Sig**	**Ep(B)**	**Model Chi**
Region	North	.596	.112	28.172	1	.000	1.815	113.012
	Midwest	.221	.154	3.104	1	.078	1.311	31.406
	South	.320	.085	14.222	1	.000	1.378	74.589
	West	.440	.162	7.353	1	.007	1.553	94.542

Table 53: Logistic regression mortality early (SLC) and late (SLC) raw and corrected by US region North, Midwest, South and West 2011 sample A and B

Year/Sample		2011/Sample A						
Variable	**E1L0**	**B**	***B/S.E.***	**Wald**	**df**	**Sig**	**Ep(B)**	**Model chi**
Region	North	.487	.126	15.017	1	.000	1.628	201.719
	Midwest	.215	.137	2.467	1	.116	1.240	70.962
	South	.333	.093	12.900	1	.000	1.396	70.953
	West	.245	.171	2.047	1	.152	1.278	65.779
Year/Sample		**2011/Sample B**						
Variable	**E1L0**	**B**	***B/S.E.***	**Wald**	**df**	**Sig**	**Ep(B)**	**Model chi**
Region	North	.650	.129	25.246	1	.000	1.916	127.240
	Midwest	.256	.135	3.611	1	.057	1.292	46.291
	South	.315	.090	12.289	1	.000	1.370	120.367
	West	.166	.170	.950	1	.330	1.181	66.234

Note: E1L0 = early versus late stage

Table 52-53 shows by U.S. region North, Midwest, South and West the results of the logistic regression analysis for mortality early (SLC) versus late (SLC) and the adjusted odd ration Ep(B) after accounting for age, race, gender, socio-economic status, number of diagnoses, number of procedures and length of stay. Late (SLC) is still more deadly than early (SLC) after accounting for age, race, gender, LOS, number of diagnoses, number of procedure and socio-economic status for the selected years 2002, 2006 and 2011 sample A and B as is shown in Table 55, however, the corrected odds ratio for survival in early (SLC) is not as robust as the overall mortality data. Table 55 shows the results of the logistic regression analysis. The corrected odds rations are decreased compared to the raw odds ratio calculated from the cross tabulation counts and percent for early versus late stage mortality shown in Table 50 except for the Midwest and West 2002 sample A, and Midwest 2006 sample A.

The adjusted odds ratio increased with higher odds for survival for early (SLC) verses late (SLC).

Overall, the regional results for mortality are not robust enough in 2002 and 2006 sample A and B. The 2011 sample A and B are trending toward the number of diagnoses accounting for in part the difference in survival odds for early (SLC) survival compared to late (SLC). There a signal that the number diagnoses are in part accounting for the higher mortality in late (SLC) in all regions in sample A and B in 2011.

Table 54: Mortality: Logistic Regression Classification Plots Results for 2002, 2006 2011 Sample A and B – Corrected By Region North, Midwest, South and West

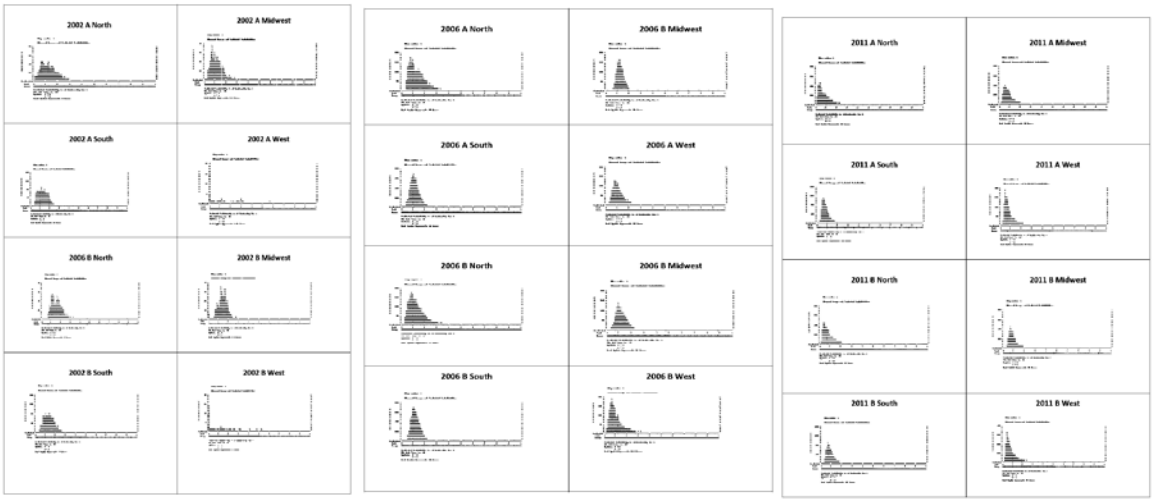


Table 54 shows by U.S. region North, Midwest, South and West the logistic regression classification plots from the logistic regression analysis for the selected year 2002, 2006 and 2011 sample A and B. The classification plots provide a similar visual guide as the overall classification plots for mortality in Table 48. The classification plots in all selected years by region show cases bunching up with observations toward the left end of the graphs as this was shown for the overall mortality regression analysis and indicates a good predicting model for 2002, 2006 and 2011 sample A and B for the U.S. regions North, Midwest, South and West.

The regression analysis by selected year identify the number of diagnoses is consistently statistically significant out of all the covariates age, race, gender, length of stay, number of procedures and socio-economic status and accounts for the variance in mortality for all selected years. The number of diagnoses is

significantly associate in part with the higher mortality in late (SLC) versus early (SLC) by region which is detectable in the 2011 sample A and B.

Table 55: Mortality Odds Rations: 2002, 2006 and 2011 Sample A and B - Raw and Corrected By US Region North, Midwest, South and West

2002/Sample A		Number of Diagnoses
Odds Ratio	Raw	Corrected
North	1.41[a]	1.07 (NS) NDX .001
Midwest	1.63[b] ----	**1.79** (NS) NDX **.396**(NS)
South	1.25[c]	1.13 (NS) NDX .000
West	3.00[d] ----	**4.50** (NS) NDX **.449**(NS)
2002/Sample B		
Odds Ratio	Raw	Corrected
North	1.53[e]	1.412 (NS) NDX **.063**(NS)
Midwest	1.11[f]	1.042 (NS) NDX **.092**(NS)
South	1.41[g]	1.370 (NS) NDX **.016**(NS)
West	0.25[h]	0.165 (NS) NDX **.620**(NS)
2006/Sample A		
Odds Ratio	Raw	Corrected
North	2.11[i]	2.014 (Significant p-value .00) NDX .000
Midwest	1.30[j] -----	**1.310** (NS) NDX **.499**(NS)
South	1.30[k] -----	1.241 (Significant p-value .012) NDX **.638**(NS)
West	1.45[l]	1.175 (NS) NDX .000
2006/Sample B		
Odds Ratio	Raw	Corrected
North	2.01[m]	1.815 (Significant p-value .000) NDX .000
Midwest	1.47[n] -----	1.311 (NS) NDX **074**(NS)
South	1.47[o] -----	1.378 (Significant p value .000) NDX **.550**(NS)
West	1.73[p]	1.553 (Significant p value .007) NDX .000
2011/Sample A		
Odds Ratio	Raw	Corrected
North	2.00[q]	1.628 (Significant p value .000) NDX .000
Midwest	1.35[u]	1.240 (NS) NDX .000
South	1.57[r]	1.396 (Significant p value .000) NDX .000
West	1.45[s]	1.278 (NS) NDX .000
2011/Sample B		
Odds Ratio	Raw	Corrected
North	2.3576t	1.916 (Significant p value .000) NDX .000
Midwest	1.3954[v]	1.292 (NS) NDX .000
South	1.5950[w]	1.370 (Significant p value .000) NDX .000
West	1.3769[x]	1.181 (NS) NDX .000

Note: Odds Ratio 95% Cl: a= 0.9026-2.2044, p-value 0.13, b= 0.8547-3.1397, p-value 0.1371, c= 0.8784-1.8005, p-value 0.2107, d= 0.2859-31.4836, p-value 0.359, e=0.9949-2.3546, p- value 0.052, f= 0.5997-2.00701, p-value 0.732, g= 0.9897-2.0099, p-value 0.057, h= 0.0277-2.3402, p-value 0.226, i= 1.7214-2.5963, p-value< 0.0001, j= 0.9945-1.7189, p-value 0.0548, k=1.1166-1.5366, p- value 0.000, l= 1.0864-1.9504, p-value 0.011, m=1.6407-2.4828, p-value <0.000, n=1.1122-1.9505, p-value 0.006, o=1.2597-1.7238, p-value <0.000, p=1.2980-2.3337, p-value 0.000, q=1.5998-2.5214, p-value <0.0001, u=1.0572-1.7489, p-value 0.0167, r=1.3287- 1.8755, p-value <0.0001, s=1.0689-1.9883, p-value 0.0173, t=1.8607-2.9872, p-value <0.0001, u=0.7834-1.2945, p-value 0.9563, v=1.0875-1.7904, p-value 0.0088,w=1.0096-1.8778, p-value 0.0434, x=1.0096-1.8778, p-value 0.043. NS=Not Significant

4.5 Cost Benefit and Cost Mortality Analysis

A cost mortality analysis over time between 2002 and 2006 and 2002 and 2011 was conducted to explore the difference in cost and mortality over time for early and late (SLC).

Tables 56-64 show cost results over time for research question 4, hypothesis 4. The 2011 cost were greater than 2002 and 2006. It was noted that from 2002 to 2011, as shown in Table 58 for raw early (SLC) costs jumped from $4437 to $10695 per day (141%) and late SLC jumped from $3884 to $9293 per day (139%) for the selected years.

Table 56: Cost over Time 2002 and 2006 - Raw

SLC	2002A	2002B	Avg 2002	2006A	2006B	Avg 2006	Increase
Early	4467	4407	4437	6490	6498	6494	46%
Late	3872	3897	3884	5644	5698	5671	46%

In Table 56 the cost for early (SLC) is higher than late (SLC). The increase in cost is similar for early and late (SLC). In Table 57 the cost between 2002 and 2006 is similar to the cost for early and late (SLC) correct after accounting for co-variates.

Table 57: Cost over Time 2002 and 2006 - Corrected

SLC	2002A	2002B	Avg 2002	2006A	2006B	Avg 2006	Increase
Early	4261	4229	4209	6291	6284	6287	49%
Late	4158	4134	4146	5925	6008	5966	44%

Table 58: *C*ost over Time 2002 and 2011 - Raw

SLC	2002A	2002B	Avg 2002	2011A	2011B	Avg 2011	Increase
Early	4467	4407	4437	10773	10618	10695	141%
Late	3872	3897	3884	9304	9246	9293	139%

Table 56 shows early (SLC) cost are higher than late (SLC) between 2002 and 2006 cost increase 46% for both early and late (SLC).

Table 59: Cost over Time 2002 and 2011 - Corrected

SLC	2002A	2002B	Avg 2002	2011A	2011B	Avg 2011	Increase
Early	4261	4229	4209	10279	10139	10209	143%
Late	4158	4134	4146	10045	9956	10000	141%

Table 59 shows early cost are higher than late (SLC) after co-varying out covariates. The corrected 2002 to 2011 cost, shown in Table 59, early SLC costs jumped from $4209 to $10209 per day (143%) and Late SLC jumped from $4146 to $10000 per day (141%).

Table 60: Cost over Time 2006 and 2011 - Raw

SLC	2006A	2006B	Avg 2006	2011A	2011B	Avg 2011	Increase
Early	6490	6498	6494	10773	10618	10695	65%
Late	5644	5698	5671	9304	9246	9293	64%

Table 60 showed cost between 2006 and 2011 was higher in early (SLC) versus late (SLC). Table 61 showed after co-varying out co-variates early cost is greater than late (SLC) but late had a greater increase in cost between 2006 and 2011.

Table 61: Cost over Time 2006 and 2011 - Corrected

SLC	2006A	2006B	Avg 2006	2011A	2011B	Avg 2011	Increase
Early	6291	6284	6287	10279	10139	10209	62%
Late	5925	6008	5966	10045	9956	10000	68%

Table 62 shows that the increase from 2002 to 2011 were evident in early (SLC) and late (SLC) in each region. Increases from 2002 to 2011 ranged from 109% early (SLC) in the Midwest and South to 305% for late (SLC) in the West.

Table 62: Cost over Time by Region 2002 and 2011 – Raw and Corrected

		Raw			Corrected		
Region	SLC	2002	2011	Increase	2002	2011	Increase
North	Early	4836	12445	157%	4675	11765	151%
	Late	4263	10053	136%	4472	11124	149%
Midwest	Early	4273	8918	109%	4078	8460	107%
	Late	3150	7987	154%	3385	8600	154%
South	Early	4249	9224	117%	4048	8878	119%
	Late	3923	8217	109%	4221	8758	107%
West	Early	4661	15070	223%	4633	14596	215%
	Late	3278	13285	305%	3320	13954	320%
Total	Early	4504	11414	153%	4358	10924	151%
	Late	3653	9885	171%	3849	10608	176%

Table 63: Cost over Time by Region – 2002 and 2006 Raw and Corrected

		Raw			Corrected		
Region	SLC	2002	2006	Increase	2002	2006	Increase
North	Early	4836	6485	34%	4675	6258	34%
	Late	4263	5753	35%	4472	6043	35%
Midwest	Early	4273	5584	31%	4078	5323	31%
	Late	3150	4858	54%	3385	5192	53%
South	Early	4249	5858	38%	4048	5660	40%
	Late	3923	5158	31%	4221	5465	29%
West	Early	4661	9619	106%	4633	9284	100%
	Late	3278	8083	147%	3320	8578	158%
Total	Early	4504	6886	53%	4358	6631	52%
	Late	3653	5963	63%	3849	6319	64%

Table 63 shows the cost has increased for both early and late (SLC) between 2002 and 2006. Late (SLC) has increased in every region over early (SLC) except for the South early was up 38% and late 31%. Table 68 shows the mortality in both early and late (SLC) decreased in all regions North, Midwest, South and West from 2002 to 2011. The largest average percent change per year in mortality is in the North at -5.7%. The lease average percent change over time in mortality is late (SLC) in the West at less than 1%.

Table 64: Cost over Time by Region – 2006 and 2011 Raw and Corrected

		Raw			Corrected		
Region	SLC	2006	2011	Increase	2006	2011	Increase
North	Early	6485	12445	92%	6258	11765	88%
	Late	5753	10053	75%	6043	11124	84%
Midwest	Early	5584	8918	60%	5323	8460	59%
	Late	4858	7987	64%	5192	8600	66%
South	Early	5858	9224	57%	5660	8878	57%
	Late	5158	8217	59%	5465	8758	60%
West	Early	9619	15070	57%	9284	14596	57%
	Late	8083	13285	64%	8578	13954	62%
Total	Early	6886	11414	66%	6631	10924	65%
	Late	5963	9885	66%	6319	10608	68%

In Table 64 the West for both early (SLC) and for late (SLC) had the highest overall costs in 2002 and 2011, while the lowest cost per day was in the South and Midwest.

Table 65: Mortality over Time 2002 and 2011

SLC	2002A	2002B	Avg 2002	2011A	2011B	Avg 2011	Avg Change	Avg % Change per year
Early	11%	13%	12%	7%	7%	7%	-5%	-4.6%
Late	14%	16%	15%	11%	11%	11%	-4%	-2.9%
OR Raw	1.36	1.36	1.36	1.60	1.66	1.63	0.27	2.2%
OR Corrected	1.21	1.28	1.24	1.44	1.45	1.44	0.20	1.7%

Avg % Change is = (((old - new) / old) x 100) div by time
Note: odd ratio confidence range and p-values are reported in Table 46, 47 and 49

Tables 65-72 show mortality over the selected years. Table 65 shows the average percent change in mortality for early and late (SLC). Average percent change shows change over time. It is a way to evaluate progress or decline over the selected unit. If the new value exceeds the old value the percent change has increased if the value is less than it has decreased. Mortality over time between 2002 and 2011 for early and late (SLC) has decreased. Early (SLC) had a greater decrease in mortality than late (SLC) between 2002 and 2011. Table 65 shows mortality decreased 42% in early stage and by 27% in late stage 2002 to 2011.

Table 66: Mortality over Time 2002 and 2006

SLC	2002A	2002B	Avg 2002	2006A	2006B	Avg 2006	Avg Change	Avg % Change per year
Early	11%	13%	12%	10%	10%	10%	-2%	-4.1%
Late	14%	16%	15%	14%	15%	14%	-1%	-1.6%
OR Raw	1.36	1.36	1.36	1.52	1.63	1.57	0.21	3.86%
OR Corrected	1.21	1.28	1.24	1.45	1.52	1.48	0.24	4.8%

Avg % Change is = (((old - new) / old) x 100) div by time
Note: odd ratio confidence range and p-values are reported in Table 46, 47 and 49

Table 66 shows the average percent change shows the decline over time between 2002 and 2006 in mortality. Early (SLC) had a greater decrease in mortality between 2002 and 2006 than late (SLC). Table 66 shows mortality decreased 17% in early stage and by 6% in late stage 2002 to 2006.

Table 67: Mortality over Time 2006 and 2011

SLC	2006A	2006B	Avg 2006	2011A	2011B	Avg 2011	Avg Change	Avg % Change per year
Early	10%	10%	10%	7%	7%	7%	-3%	-6%
Late	14%	15%	14.5%	11%	11%	11%	-3.5%	-4.8%
OR Raw	1.52	1.63	1.57	1.60	1.66	1.63	0.06	0.76%
OR Corrected	1.45	1.52	1.48	1.44	1.45	1.44	-0.04	-0.54%

Avg % Change is = (((old - new) / old) x 100) div by time
Note: odd ratio confidence range and p-values are reported in Table 46, 47 and 49

Table 67 shows the average percent change in mortality for early and late (SLC). The average percent change shows the decline over time between 2006 and 2011 in mortality.

Table 68: Mortality over Time 2002 and 2011 by Region

Region	SLC	2002A	2002B	Avg 2002	2011A	2011B	Avg 2011	Avg Change	Avg % Change per year
North	Early	11%	13%	12%	6%	5%	5.5%	-6.5%	-5.7%
	Late	15%	18%	16.5%	12%	12%	12%	-4.5%	-3.00%
OR Raw		1.41	1.53	1.47	2.0	2.3	2.1	0.63	4.7%
OR Corrected		1.07	1.41	1.24	1.6	1.91	1.75	0.5	4.6%
Midwest	Early	9%	14%	11.5%	7%	8%	7.5%	-4%	-3.86%
	Late	15%	15%	15%	10%	10%	10%	-5%	- 3.7%
OR Raw		1.63	1.11	1.37	1.35	1.39	1.37	0	0%
OR Corrected		1.79	1.04	1.41	1.24	1.29	1.26	-0.15	-1.18%
South	Early	11%	12%	11.5%	7%	7%	7.0%	-4.5%	-4.3%
	Late	14%	16%	15%	10%	11%	10.5%	-4.5%	-3.3%
OR Raw		1.25	1.41	1.33	1.57	1.59	1.58	0.25	2.0%
OR Corrected		1.13	1.37	1.25	1.27	1.37	1.32	0.07	0.6%
West	Early	4%	15%	9.5%	7%	7%	7%	-2%	-2.9%
	Late	15%	4%	9.5%	10%	10%	10.0%	0.5%	0.58%
OR Raw		3.0	.254	1.62	1.45	1.37	1.41	-0.21	-1.44%
OR Corrected		4.5	.165	2.3	1.27	1.18	1.22	-1.0	- 5.2%

Avg % Change is = (((old - new) / old) x 100) div by time. Odds ratio CI range and p-values in Table 55

Table 69: Mortality over Time 2002 and 2006 by Region

Region	SLC	2002A	2002B	Avg 2002	2006A	2006B	Avg 2006	Avg Change	Avg % Change per year
North	Early	11%	13%	12%	9%	9%	9%	-3%	-6.25%
	Late	15%	18%	16.5%	18%	17.5%	17%	1%	1.5%
OR Raw		1.41	1.53	1.47	2.11	2.01	2.06	0.59	10%
OR Corrected		1.07	1.41	1.24	2.01	1.81	2.0	.076	15.3%
Midwest	Early	9%	14%	11.5%	11%	10%	10.5%	-1%	-2.17%
	Late	9%	14%	11.5%	14%	14%	14%	2.5%	5.4%
OR Raw		1.68	1.11	1.39	1.30	1.47	1.38	-0.01	-0.17%
OR Corrected		1.79	1.04	1.44	1.31	1.37	1.34	-0.1	-1.7%
South	Early	11%	12%	11.5%	10%	10%	10%	-1.5%	-3.2%
	Late	14%	16%	15%	13%	15%	14%	-1%	-1.6%
OR Raw		1.28	1.41	1.34	1.30	1.47	1.38	0.04	0.74%
OR Corrected		1.13	1.37	1.25	1.24	1.37	1.30	0.05	1%
West	Early	4%	15%	9.5%	9%	9%	9%	-0.5%	-1.31%
	Late	15%	4%	9.5%	13%	15%	14%	4.5%	11.8%
OR Raw		3.7	.254	1.97	1.45	1.73	1.59	-0.38	-4.8%
OR Corrected		4.5	.165	2.3	1.17	1.55	1.51	-0.79	-8.5%

Avg % Change is = (((old - new) / old) x 100) div by time
Note: odd ratio confidence range and p-values are reported in Table 55

Table 70: Mortality over Time 2006 and 2011 by Region

Region	SLC	2006A	2006B	Avg 2006	2011A	2011B	Avg 2011	Avg Change	Avg % Change per year
North	Early	9%	9%	9%	6%	5%	5.5%	-3.5%	-7.7%
	Late	18%	17%	17.5%	12%	12%	12%	-5.5%	-6.2%
OR Raw		2.11	2.01	2.06	2.0	2.3	2.15	0.09	0.87%
OR Corrected		2.01	1.81	1.91	1.6	1.91	1.75	-0.25	-1.67%
Midwest	Early	11%	10%	10.5%	7%	8%	7.5%	-3%	-5.71%
	Late	14%	14%	14%	10%	10%	10%	-4%	- 5.7%
OR Raw		1.30	1.47	1.38	1.35	1.39	1.37	-0.01	-0.14%
OR Corrected		1.31	1.37	1.34	1.24	1.29	1.26	-0.08	-1.19%
South	Early	10%	10%	10%	7%	7%	7%	-3 %	-6%
	Late	13%	15%	14%	10%	11%	10.5%	-3.5%	-5%
OR Raw		1.30	1.47	1.38	1.57	1.59	1.58	0.2	2.89%
OR Corrected		1.24	1.37	1.30	1.39	1.37	1.38	0.08	1.2%
West	Early	9%	9%	9%	7%	7%	7%	-2%	- 4.4%
	Late	13%	15%	14%	10%	10%	10.0%	-4%	- 5.7%
OR Raw		1.45	1.55	1.5	1.45	1.37	1.41	-0.09	-1.16%
OR Corrected		1.17	1.73	1.45	1.27	1.18	1.22	-0.23	-2.6%

Avg % Change is = (((old - new) / old) x 100) div by time
Note: Note: odd ratio confidence range and p-values are reported in Table 55

Table 69 shows early (SLC) mortality decreased in all regions between 2002 and 2006. Late (SLC) mortality increased in all regions except the South from 2002 to 2006.

Table 70 shows both early (SLC) and late (SLC) mortality decreased in all U.S. regions in 2006 to 2011.

Table 71: Cost – benefit summary for early (SLC) and late (SLC)

	2002		2006		2011	
	Cost	Survival Odds	Cost	Survival Odds	Cost	Survival Odds
Early	4437	7.4:1	6494	9.0:1	10696	13.3:1
Late	3885	5.4:1	5671	5.7:1	9275	8.1:1
Difference	14%		14%		15%	
OR		1.4		1.6		1.7
Adjusted OR		1.3		1.5		1.5

Table 71 is a summary of the averages for the selected years 2002, 2006 and 2011 after collapsing the replicate data for the selected years sample A and B for cost and mortality. The results show for research question, hypothesis 3 after consolidating and contrasting the results from hypothesis 1 and hypothesis 2 that early (SLC) is more expensive than late (SLC). Early (SLC) cost 14% more on average for the selected years in this snap shot of the selected years. The results show the difference or gap between early and late mortality. Late stage is more deadly, however, the gap it is surprisingly small at 30% or an odds ratio of 1.3 to 1.5 after adjusting for covariates.

By U.S region I looked at some regional differences in a North, Midwest, South, and West fashion. Costs are slightly more expensive in the West than the

other regions with the Midwest and South the least expensive. The North had the lowest survival and the West had the highest survival but across all regions and all replicates costs were increasing over time and survival was increasing over time regardless were you were in the country.

Chapter V

V. Discussion

This study shows that early (SLC) compared to late (SLC) has lower mortality with higher costs. Mortality is lower in early (SLC) with greater costs for survival. This is in agreement with the results by Goldberg et al., 2010, Edwards et al., 2014 and Roth et al., 2014 respectively.

This research shows that higher mortality in late (SLC) is due in part to the number of diagnoses this is in agreement with prior studies by Edwards et al., 2014, Tammemagi et al., 2003 and Grose et al., 2014. Ramsey et al., 2004, Firat et al., 2006 and Tammemagi et al., 2003 reported comorbidity has a large impact on mortality in early and late (SLC) but tended to have a greater magnitude in early stage. This is in agreement with Blanco et al., 2008 in this study in LC mortality the number of comorbidities and not the specific disease had a significant impact on mortality.

This study shows that higher cost in early (SLC) is due in part to the number of procedures as in contrast to prior studies reporting lower cost in early (SLC) treatment procedures ***[Cressman, et al., 2014].*** My results are indirectly in agreement with Verboom et al., 2003 researcher which reported in their study the total cost were lower in LC mainly due to reduction in futile operations.

In this study the findings for cost and mortality for early (SLC) versus late

(SLC) is consistent across U.S. regions. Early (SLC) is more expensive than late (SLC) essentially across the North, Midwest, South and West for the selected years 2002, 2006 and 2011. This regional cost analysis is supported by prior research in a population based cohort study looking at resource utilization and cost management in resectable NSCLC. Cost for treatment by geographic region varied. In my study the Mean cost varied for cost for the selected years sample A and B. Early (SLC) had consistently higher cost than late (SLC). Maher et al., 2014 findings showed understanding the regional variation for cost is important with regard to showing the optimal treatment cost effectiveness.

This study research showed that late (SLC) had higher mortality than early (SLC) essentially across all U.S. regions.

The U.S. regional data is not as robust as the main analysis and it does not have the statistical significance as is found in the main analysis, however, for early versus late the regional results does trend overall as the main analysis trends for cost and mortality.

This study shows that overtime mortality is decreasing over the selected years 2002, 2006, and 2011 by -5% for early (SLC) and -4% for late (SLC). This finding is supported by an annual report to the nation on the status of cancer 1975-2011. Kohler et al., 2015 reports LC mortality from 2002 to 2011 decreased significantly 2.6% per year for men and 1.3% for women per year. This finding is similar to prior literature shows a statistically significant decrease trend for LC mortality in and after 1990 for blacks and whites in people over 55 years of age

or older ***[Jemal et al., 2001].***

This decrease in mortality was consistent across all U.S. regions: North -5.7% for early and -3.0% for late; Midwest -3.8 % for early and -3.7 % for late; the South -4.3 % for early and -3.3 % for late; West -2.9 % for early and 0.58 % for late. This is in agreement with the U.S. Atlanta Cancer Statistic Working Group US Cancer Statistics 1999-2012 Incidence and Mortality web-based report that showed LC mortality decreased from 2002 (54.8 %) to 2006 (53.2 %) and from 2006 (53.2%) to 2011 (50.4%). Mortality from 2002 to 2011 in the North decreased from 56.4 % to 51.6 % and 58.0 % to 56.5 % in the Midwest, and in the South 60.2 % to 54 % in the South, and 41.8 % to 36.9% in the West. In contrast a study by Jemal et al., 2012 showed between 1973 to 2007 their finding of an increase in LC mortality in Southern and Midwestern states for women younger than 50 years.

In my study the cost is increasing over the selected years 143% for early (SLC) and 141% for late (SLC). This finding is consistent with a study by Warren et al., 2008 showed an upward trend for treating Medicare patients between 1991 and 2002. They attributed the increase cost in LC to radiation and chemotherapy. The study showed for LC the average cost for treating a patient with LC went up $7,139 to an average of $39,891. They found hospital cost made up the largest portion of increased costs. They expect cost to increase into the future as others expected costs to increase.

The cost increase was consistent across all U.S. regions: North 157% for

early and 136% for late; Midwest 109% for early and 154% for late; South 117% for early and 109% for late; West 223% for early and 305% for late ***[Jemal et al; 2001; Jemal et al., 2012; Mariotto, et al., 2011; Yabroff et al., 2008; National Cancer Institute, 2016].***

The greatest change over the selected years in cost is seen in 2006 early and late (SLC) at 165% and 164% respectively. The greatest change in mortality is seen 2006 to 2011 with an average percent change over time of -6% for early (SLC) and -4.8 % for late (SLC) in 2006 to 2011. By U.S. region the greatest percent change in mortality is in the North for early (SLC) at -7.7% and late (SLC) at -6.2%. For cost by U.S. region the greatest change in cost is in the West 2002 to 2006 100% for early and 158% for late.

The significance after accounting for co-variants for early (SLC) versus late (SLC) varies and is not a unique finding for early versus late for cost and mortality and some of the co-variants accounted for have agreement with prior literature.

In this study early (SLC) is more common at approximately 60% participation. Late (SLC) has approximately 40% participation. Compared to the LC population more late (SLC) is diagnosed at approximately 85% versus approximately only 15% for early (SLC).

Compared to LC population the Mean age for LC diagnosis is 65 years of age an older in 2 out of 3 patients. In this study a statistically significant difference was detected by Chi-square. The Mean age is 68 years of age for early

and 65 years of age for late in this study. Only 1.2 % to 6.2% are under 40 years of age. Most younger LC patients have late stage LC. It is common that younger patients have a delay in diagnosis and are misdiagnosed with other illnesses ***[Kozielski et al., 2012].*** Another study conducted looked at the very young >40 and the very old <80 with LC and found no difference in disease stage severity between the two groups. The younger group did better for survival with more aggressive treatment with surgery ***[Kuo et al., 2000; Antkowiak et al., 1989].***

More females are effected a little more than half are females 53% early (SLC) and 54% late (SLC) in this study. No statistical difference detected in this study by Chi-square for early (SLC) versus late (SLC) for gender. Compared to the LC population LC rates have been trending down for men compared to women for the past two decades. More men are still affected by LC then women but more women are living with LC, in both early and late stage. A survey study of NSCLC substantiated the finding of an increase proportion of women with NSCLC. In a prospective cohort study LC survival rates favored females overall 60% vs. 50% 5-year survival rates. By stage I survival favored women 69% vs. 64%. By stage II 60% vs. 50% favored women. By stage III survival favored women 46% vs. 37%. Mainly studies show women live longer than men at every stage of LC early and late. A cohort study in 2012 showed survival in LC was associated with female sex. Although women are more likely to be diagnosed with early stage LC in 2016 it is projected 11,450 more men will be diagnosed with LC then women in the U.S. and approximately 13,760 more

men will die than women ***[Gasper et al., 2012; Little et al., 2007].***

In the LC population LC is 51% higher in black men than white men. Black men are 20% more likely to develop LC than white men. Compared to this study whites are 81% of the participants of which 12% are black on average from all selected samples including both men and women. In this study no statistically significance was detected by Chi-square for race. U.S government reports from combined data from the NCI and the SEER national cancer registry report black men have the highest LC rates over all other groups followed by white men and white women. The rate of LC is lower in back women than in white women. Virning et al., 2009 reported blacks receive a diagnosis in LC in late stage more than whites do ***[Cerfolio et al., 2006;*** **Dudley et al., 2013; McGovern et al., 2009*****; Cook et al., 2011; Center for Disease Control, 2016; American Cancer Society, 2016].***

In this study the health care variable length of stay was similar in both early (SLC) and late (SLC). The Mean number of days for early (SLC) was 7.5 and 7.1 day for late (SLC). The results in this study are in agreement with the HCUP prior literature on LC. A study by the HCUP reported the length of stay for LC patients was on average 7.5 days ***[Holmquist, et al., 2008].***

The difference in early versus late (SLC) for length of stay was not statistically significant by t-test. In this study socio-economic status was similar for early (SLC) versus late (SLC). The Chi-square test did not detect a statistically significant difference for income for early (SLC) versus late stage. The low

income 0-25th percentile and high income 76th-100th percentile are similarly distributed for both early and late (SLC). No income percentile group was more predominant for either early or late (SLC).

The study showed early (SLC) versus late (SLC) for total charges are statistically significant for the selected years. Early (SLC) Mean average total charges were $50,000 versus $41,000 for late (SLC).

The study showed that late stage mortality was statistically significant. The Mean average mortality for early (SLC) is 10% and 14% for late (SLC) from the selected years. The t-test analysis for total charges and mortality showed a statistically significant difference exits between early and late (SLC).

What is accounting for the differences in early versus late (SLC) for cost and mortality could not be explained by the t-test or Chi-square further analysis by ANOVA and ANCOVA and logistic regression were applied to investigate further.

As mentioned previously for cost and mortality the results showed that cost in early (SLC) is more expensive than late (SLC) and that late (SLC) is more deadly than early (SLC). The results are based on the ANOVA and Chi-square analysis respectively.

The ANCOVA analysis for cost and the regression analysis for mortality showed after co-varying out and accounting for personal variables; age, race and gender, these variables did not have a statistically significant effect on the difference in cost and mortality between early and late (SLC). A prior study

done in 2014 is in agreement finding race was not important predictor of survival in patients with early (SLC) ***[Biswas et al., 2015].*** Another population based study in 2015 found a race disparity in LC mortality for black compared with whites ***[Hunt et al., 2015].*** A study by Harrison et al., 2015 using logistic regression showed a race related mortality in lobectomy LC patients. Blacks have a 66% more likely to die odds ratio 1.55 95% CL 1.17-2.27 p value .005. Another study reported by Shugarman et al., 2009 the study considered race and sex disparities in the timing and appropriateness of treatment.

Nor did co-varying out in the ANCOVA analysis for cost and regression analysis for mortality socio-economic status. This is in contrast to a population study founding socio-economic status and race vary greatly with mortality and inverse relationship between socio-economic status and mortality for black men and white men and women. Another population based study looked at the association between socio-economic status and LC mortality over time. The study showed the impact of socio-economic on LC mortality increased 0.5% per year during the study period ***[Rubin et al., 2014].*** A study by Hastert et al., 2015 reported socio-economic status disparities are there and the differences are not totally explained by personal socio-economic status ***[Albano et al., 2007].*** Erhunmwunsee et al., 2012 reported low socio-economic status was identified as an independent prognostic factor for poor survival in patients both early and late stage LC. Worst mortality in limited educated LC patients living in high poverty places.

Nor did co-varying out in the in the ANCOVA analysis for cost and regression for mortality the heath care variable length of stay (LOS). This is in contrast to Yu et al., 2015 reported length of stay is an important factor influencing the medical expenses of patients with LC.

Dissimilarly the study analysis ANCOVA showed when the number of procedures was co-varied out the number of procedures in part accounted for the higher cost but not significant for mortality in the regression analysis in early (SLC) versus late (SLC). The study analysis showed in agreement with Kramer et al., 2004 showed that reducing staging procedures by more than 50% reduces costs by 40%.

In this study the frequency of procedures identified for early (SLC) versus late (SLC) were statistically significant by Chi-square analysis. The top procedure for early is lobectomy the top most frequent procedures for late (SLC) for the selected years is closed endoscopic biopsy of the lung and other excision for destruction of lesions or tissue of brain.

According to published data lobectomy (removing a section of a lung) has hospital cost of approximately $21,000. Lobectomy is the top procedure for early (SLC) and is having tremendous impact on early (SLC) costs in this study compared to late (SLC).

The logistic regression showed the number of diagnoses in part accounted for the higher mortality in late (SLC) versus early (SLC) but the number of diagnoses was not significant for cost in the ANCOVA analysis in early

(SLC) versus late (SLC). This is in agreement with Grose et al., 2014 a prior population based cohort study that showed a difference between early and late (SLC) for comorbidity. The results are in agreement with Islam et al., 2015 LC patients with comorbidities had a nine month average survival shorter than the national average. They reported comorbidities have important role in LC survival. A survey study in LC showed that 76.3% of patients had significant comorbidities ***[Little et al., 2005].*** Another prior study showed the incidence of a thrombotic event is the highest in LC out of all other cancers ***[Corrales-Rodriquez et al., 2012].*** A study reported in 2000 on looked at the cost of neutropenia in late (SLC) they found in late (SLC) monitoring and treating neutropenia put a major burden on health care system ***[Stokes et al., 2009].*** In my study neutropenia and thrombotic events were not a major co-diagnosis.

The study showed for the selected years that the top most frequent diagnoses reported for early (SLC) is chronic airway obstruction and pneumonia organism. The top diagnoses for late (SLC) pneumonia organism, convulsions and cerebral edema. The difference in frequency in diagnoses between early (SLC) and late (SLC) is statistically significant.

These analyses presented in this study describe the early versus late (SLC) population. The raw data analysis is the results for early versus late (SLC) for cost and mortality. The corrected data is the results after accounting for co-variates in order to explain the raw data. I used ANCOVA to study cost for early versus late (SLC) and logistic regression to study mortality for early versus late (SLC). I

found that the number of procedures had a significant impact on early stage cost versus late (SLC) cost and the number of diagnoses has a significant impact on mortality for late (SLC).

For the selected years early (SLC) cost between 13% and 15% more than late with a 30% difference in mortality between early and late or a 1.3 to 1.5 odds ratio.

By U.S. region for the selected years both early (SLC) and late (SLC) cost increased and survival increased no matter where you lived in the country.

The data showed no statistical significant difference was detected when age, race gender, length of stay, socio-economic status and number of diagnoses were co-varied out of the ANCOVA analysis for cost.

The logistic regression analysis for mortality co-varied out number of diagnoses instead of number of procedures produced similar results. The results are in agreement with Otake et al., 2016 researchers reported that higher numbers of comorbidities correlated with higher postoperative mortality and length of stay in LC. When considering the ANCOVA analysis with and without the number of procedures for cost. The number of procedures is tremendously impactful on cost of early (SLC). The estimated Mean percent difference with number of procedures not co-varied out of ANCOVA analysis is statistically significant for the selected years: 2002A at 15%; for 2002B; at 13%; for 2006A at 15 %; for 2006B at 14%; for 2011A at 15%; for 2011B at 15%. Early is more expensive than late (SLC) by 13% to 15%.

When the number of procedures are co-varied out of the ANCOVA analysis along with the other listed co-variants the estimated Mean percent difference is no longer statistically significant except for 2006 sample A and B and there is now a much smaller % difference for 2002A at 2%, for 2002B at 2%, for 2006 at 6%, for 2006A at 4%, for 2011A at 2% and 2011B at 2%. Early is more expensive than late (SLC) but now between only 2% to 6% difference in the Means. This shows that the number of procedures is accounting in part for the difference in cost between early (SLC) and late (SLC). A small difference is still not accounted for by the number of procedure and other co-variants listed so additional types of co-variants are also impacting cost and not accounted for or possible the length of stay (LOS).

When considering logistic regression analysis for mortality with and without the number of diagnoses. The number of diagnoses is significantly impacting mortality in late (SLC). The odds ratio with the number of diagnoses not co-varied out of ANCOVA analysis is statistically significant for the selected years: 2002A at 1.36; for 2002B; at 1.36; for 2006A at 1.52; for 2006B at 1.63; for 2011A at 1.60; for 2011B at 1.67. Early has greater survival than late (SLC). Early survival odds ranged from 36% to 67% greater for early (SLC).

When the number of diagnoses are co-varied out of the regression analysis along with the other listed co-variants the corrected odds ratio is still statistically significant. Early stage has better survivability than late (SLC) but early (SLC) survivability does get worse demonstrated by the corrected odds

ratio for the selected years: 2002A at 1.2; for 2002B at 1.2; for 2006 at 1.4, for 2006A at 1.5, for 2011A at 1.4 and 2011B at 1.4. All the odds ratios go down early and late (SLC) get closer to 1 odds ratio where early and late (SLC) would be the same. The results show that the number of diagnoses is accounting in part for the difference in mortality for early (SLC) versus late (SLC). This is in agreement with Tammemagi et al., 2003. Comorbidity has a major impact on survival in early and late stage disease, and even the rare comorbidities are significant collectively. This is in contrast to the cancer report to the nation for LC found the influence of comorbidities on survival was relatively small, probably because prognosis is often poor, even at early stages of the disease. This however is not totally clear the impact based on the number of comorbidities specifically ***[Edwards et al., 2014].*** The difference in mortality is still not accounted for completely by the number of diagnoses and so other co-variants are affecting mortality in early versus late (SLC).

The classification plots support the regression analysis generated for the selected years. The plots predict membership and overall the regression models are accurate no 1 and 0 in the middle of the plot graphs generated for all selected years for all the regression analyses and the more accurate the model the clearer the middle of the plot graph.

In this study findings for ANCOVA for cost and logistic regression for mortality are trending similarly across U.S. regions for early versus late (SLC).

The regional results are not as robust as the main cost and mortality analyses some of the results are statistically significant.

The results shows for the U.S. regional data for both early and late trend for higher cost in early stage and is similarly accounted for in part by the number of procedures.

Mortality is trending similarly greater in late stage in part accounted for by the number of diagnoses for the selected years. In some cases early survival gets better after correcting the odds ratio and still in some other instances early stage gets worse for survivability but is nearly always better than late (SLC) in all cases.

The U.S. regional data is trending similarly to the main analysis overall and further supports the main analysis results for cost and mortality for early versus late (SLC). The cost of LC is the highest in the West for early and late (SLC) for all years selected the West has the lost mortality rate for early and late (SLC). The cost of early and late (SLC) is not reflective of just high mortality. Overall LC costs are rising between 2002 to 2006 and from 2006 to 2011 for both early (SLC) and late (SLC). This finding is in agreement with Mariotto et al., 2011 reporting cost of LC to rise 2% to possibly 5% through 2020 based on different scenarios due to the challenge of estimating costs. The projected rising cost are associated with new technologies and better understanding of cost based on phase of care and higher cost at the initial phase and end of life phase.

Study Advantages:

A. Several years of research records included.

B. Cross-sectional look at the data records over 10 years.

C. A large dataset; thousands of data records.

Study Disadvantages

A. Retrospective study design; the data is what it is.

B. The data set is not an oncology dataset; the structure of the data set is not geared to study oncology health care data;

C. A manual coding of early and late stage LC records was required to conduct the statistical analyses and has the potential for data errors.

Before we reach any strong conclusions it is important to point out that the study was limited by the sample and the HCUP only includes public hospitals no private hospitals and limited to only to the variables in the study unlike a prospective study were you could just decide to measure what you want to measure. The study also was limited by fact that the stage of cancer was inferred from the ICD-9 codes and that I did not have a direct cause of death. I just know they died and was not sure LC was the cause of death. The study was limited by the design in that it is retrospective data and no long term follow-up of patients could be made.

VI. Summation and Closing

6.1 Summation and Closing

My study researched the cost and mortality between early (SLC) and late (SLC). The study measure was the Nationwide Inpatient Sample (NIS). My research involved a Quasi-experimental, secondary analysis of an historic dataset comparing early versus late (SLC) in relation to cost and mortality. Not always in agreement with the prior literature the results of the cost and mortality analysis were consistent in significance in all samples across all U.S. regions.

After accounting for co-variates the results vary after taking out the co-variates to account for the significant difference in cost and mortality in early (SLC) versus late (SLC).

Focusing more precisely on the data for gender both early and late (SLC) affects males and females almost equally. Women average 52% and males 48% for both early and late (SLC). The difference in gender between early and late (SLC) is not statistically significant.

Observing race for both early and late (SLC) whites are most affected followed by blacks, Hispanic, Asian or Pacific Islander, Other and Native American. The difference in race between early and late (SLC) is not statistically significant.

Observing age for both early and late (SLC) both are similar in age range. Early (SLC) average age is 68 years and late (SLC) average is 65 years of age. The difference in age between early and late (SLC) is not statistically significant.

Observing socio-economic status for early and late (SLC) both are similar overall with no income status not found in early versus late (SLC) and is not statistically significant.

Focusing on length of stay a health variable used in part to calculate the cost of early versus late (SLC). For early stage and late stage both were similar. Early (SLC) had on average 7.5 days for length of stay and late had on average 7.1 days for length of stay. The length of stay difference was not statistically significant for early versus late (SLC) overall.

Observing the number of procedures for both early and late (SLC), early had on average 2 procedures while late (SLC) had 1 procedure on average. The difference in the number of procedures between early and late (SLC) is statistically significant.

Focusing on the number of diagnoses for early and late (SLC), early had 7 on average diagnoses while late had on average 8 diagnoses. The difference in the number of diagnoses for early versus late (SLC) is statistically significant.

Observing the total charges for early and late (SLC), early (SLC) had higher average Mean total charges versus late (SLC) in all samples selected in all U.S. regions.

The higher total charges were statistically significant. Early is more

expensive than late stage as the Chi-square test showed but why early is more expensive is not known from the Chi-square test. ANOVA and ANCOVA analysis were done to investigate cost in early versus late (SLC)

Observing mortality for early and late (SLC), late stage is more deadly than early stage in all samples selected in all U.S. regions. The higher mortality was statistically significant. Late is more deadly than early (SLC) as the t-Test shows but why is late more deadly is not explained by the T-test. Chi-Square and regression analysis were done to study the mortality in early versus late (SLC).

The ANOVA analysis showed early (SLC) is more expensive than late (SLC) in all samples selected across all U.S. regions. The ANCOVA analysis showed that after co-varying out age, race, gender, race, socio-economic status, length of stay, number of procedures and number of diagnoses. The difference in cost between early versus late (SLC) was overall no longer statistically significant. The number of procedures is the variable that was significant in the ANCOVA results. The number of procedures in part accounted for the high Mean cost in early (SLC) versus late (SLC) but did not account for all the difference.

The Chi-square test analysis for mortality early versus late (SLC) showed late (SLC) is more deadly than early (SLC) in all samples selected across all U.S. regions.

The logistic regression analysis showed late (SLC) is more deadly than early (SLC) after co-varying out age, race, gender, race, socio-economic status, length of stay, number of procedure, and number of diagnoses was still

statistically significant. The number of diagnoses is the variable that was significant in the regression results. The number of diagnoses in part accounted for the higher mortality in late (SLC) versus early (SLC) but did not account for all the difference.

The study showed that the cost for both early and late (SLC) is increasing and mortality is decreasing over the selected years essentially in all U.S. regions.

The study analyses unveiled the variables impacting on the cost and mortality in early versus late (SLC).

The study analyses showed that health variables, the number of procedures and the number of diagnoses, in part account have the greatest impact for the differences in cost and mortality respectively.

The study analysis showed how the variables interact impacting or not impacting on LC cost and mortality in early versus late stage.

6.2 Future Research and Recommendations

Some important areas for future research the most important area I believe is to replicate the present study with prospective studies and to include private hospitals and have better operational definitions of early and late stage LC and cause of death and do longer term follow-up not just looking at what the cost were directly during a particular hospital visit. Another important area for future research is to determine how we can best incorporate health informatics to improve the disease management process which means we need improved

data entry and retrieval systems and we need to train healthcare professionals in order to not only enter the data but retrieve the data in an effective way either towards making inference to treating their patients or towards publishing research at their facility and lastly these findings show we really do need to make a stronger effort to help informatics community stronger focus on the early stage LC because it quite expensive has quite a high death rate

Support by health care professionals performing a greater comprehensive retrieval of information on early (SLC) versus late (SLC). Collecting and tracking the information on early compared to late (SLC) regarding cost and mortality will lead to more accurate assessment of cost and mortality in LC management by stage of disease. The study measure is the Nationwide Inpatient Sample (NIS) that collects essential data points. More health care data is needed on early verses late (SLC). A stronger focus on early (SLC) can be achieved.

Future research can incorporate Health Informatics to improve disease management processes through improved entry, retrieval systems and train healthcare professionals. The education of healthcare professionals on importance of tracking and acquiring informational data on early versus late (SLC) on cost and mortality which will add evidence based informatics data collection to the management of LC too better target the causes of high mortality and associated high cost in early and late stage LC. Educating LC patients on the sharing their health data can translate into aiding in acquiring

greater knowledge about the disease.

All the additional information collected on early versus late (SLC) will assist in expanding and enhancing the benefits already known about the differences in early versus late (SLC). The LC disease management processes can improve with informatics evidence based data collection and tracking with LC disease management systems.

6.3 Implications and Concluding Statement

These finding imply that important implications for the health care informatics community in understanding that patients with early (SLC) are going to be expensive for the hospital and even though the mortality is not as high as late (SLC) still quite high in mortality and for researchers the implication is we need strategies to reduce cost and to promote improved outcomes for LC patients The implications for researchers we need strategies to reduce costs and improve LC outcomes. For Health Informatics and medical professionals understand that patients with early (SLC) have higher costs than late (SLC) and high mortality.

This study of HCUP data revealed that early (SLC) is more expensive than late (SLC). The study showed the number of procedures in part accounted for the higher cost in early stage compared to late (SLC). Additionally, the data reveled that mortality is higher in late (SLC) compared to early (SLC). The study showed the number of diagnoses in part accounted for the higher mortality in late (SLC). This study adds to the body of research knowledge

on LC. Overall, these finding highlight the important role of Health Informatics in understanding the cost and mortality of early and late (SLC).

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Appendices

Appendix 1: Abbreviations and acronyms

AHA	American Hospital Association
AHAID	American Health Association Identifier
ALA	American Lung Association
ACS	American Cancer Society
ASCII	American Standard Code for Information Interchange
CDC	Center for Disease Control
CI	Confidence Interval
HCUP	HealthCare Cost and Utilization Project
HOSPID	Hospital Identifier
LC	Lung Cancer
LOS	Length of Stay
NCI	National Cancer Institute
NIH	National Institutes of Health
NIS	National Inpatient Sample
NSCLC	Non-Small Cell Lung Cancer
OR	Odds Ratio
SLC	Stage Lung Cancer
SEER	Surveillance, Epidemiology and End Results Program
SID	State Inpatient Database