THE PREDICTORS OF HOSPITAL MORTALITY AMONG ADULT PATIENTS WITH DIABETES

By

Hosam Bamashmous

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APPROVAL PAGE

Dr. Sayed Haque, Dissertation Advisor & Chairman	**(Date)**
Dr. Dinesh Mital, Dissertation Committee Member	**(Date)**
Dr. Shankar Srinivasan, Dissertation Committee Member	**(Date)**
Dr. Masayuki Shabata, Dissertation Committee Member	**(Date)**

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Abstracts

THE PREDICTORS OF HOSPITAL MORTALITY AMONG ADULT PATIENTS WITH DIABETES

Background: Diabetes Mellitus is a lifelong chronic disease with higher risks of mortality and morbidity. The disease is associated with acute and chronic complications.

Objective: To study of the risk factors, including the social determinants of the disease ***to*** help in mitigating the complications and reducing the deaths among patients with DM.

Methods: The study is a secondary data analysis of existing dataset based on the Nationwide Inpatient Sample (NIS). The current study is based on the NIS data during the period 2007 to 2010 inclusive. The analysis will include only adult population (18 years age or older). My primary outcomes of interest will be the mortality (dead/alive) or (living status of adult diabetic subjects). Risk factors that will be investigated are Personal and demographic characteristics, socioeconomic factors, Medical factors, and health related factors. Descriptive (means and proportions/percentage) and

bivariate analyses (chi-square and t-test) where appropriate. Regression models to evaluate the crude association between each potential predictor variable and all outcomes of interest. Then, a hierarchical generalized linear modeling (HGLM) approach will be used to assess the odds of changing death rate controlling for potential confounders.

Results: A sample of 438838 participated in the 4 year included in the study. Death Rate among diabetic patients decreased from 2007-2010 significantly. Race, income, insurance, patient living location, admission source, admission type, other diagnosis, drugs, age and many other factors have statistical significant difference between rate of death among diabetic patients compared to non diabetic subjects. We found that age, total charge, no of diagnosis, no of procedures, drug risk mortality and severity, LOS, and comorbid conditions are statistically significant risk factors for higher mortality among diabetic subjects compared to non diabetic subjects controlling for the other factors and potential confounders. All significant relationships were tested at the alpha level of ($P<0.05$).

Conclusion: The study shows the different risk factors for mortality in the adult diabetic patients. The study showed demographic socioeconomic, and health conditions risk factors. The crude analysis showed the individual effect of each factor and the prediction model showed how these factors play in the existence and controlling for the other factors.

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Chapter I

I. Introduction

Diabetes mellitus is a lifelong chronic disease with high risks of mortality and morbidity. The disease is associated with acute and chronic complications. The acute complications include severe hypoglycemia or ketoacidosis, which may be fatal. The chronic complications affect many systems; Examples of chronic complications are cardiovascular disease nephropathy, retinopathy, and neuropathy ***(Nickerson and Dutta, 2012)***.

Diabetic Mellitus is one of the major risk factors of Cardiovascular Disease (CVD); Hence Diabetes related mortality is closely linked to CVD and its complications. Studies have shown the close relationship between coronary artery disease (CAD) and high mortality rates in patients with non-insulin dependent DM, this relationship decreases in value as the age of diagnosis increases and has some conflicting results when sex is considered as an influencing factor ***(Wannamethee et al., 2004; de Fine Olivarius et al., 1997; Morgan et al., 2000; Eberly et al., 2003; Muggeo et al., 1995; Berger et al., 1999; (Gu et al., 1998; Mulnier et al., 2006)***.

The last few decades have witnessed significant decreases in mortality among non-diabetic subjects with CVD. Over the last few decades

a huge improvement has been achieved in the control of smoking, diet and the treatment of high lipid and blood pressure which in turn was reflected in the general population of non-diabetic individuals in lowering of cardiovascular disease and in turn in lowering of their mortality incidence. Unfortunately these improvements in life style and advanced treatment options did not translate in an immediate lowering of the incidence in CVD in diabetic patients when compared to non-diabetic and especially in woman. The reason can be attributed to the fact that diabetic patients are generally individuals who smoke and tend to be overweight ***(Eliasson et al., 2005)***. People who suffer from episodes of Myocardial Infarction (MI) suffer even worse prognosis after the event in relation to their diabetes related mortality incidence rate ***(Gitt et al., 2003)***.

Looking closely at the risk factors for diabetes shows that it depends on the type of diabetes. It is unknown what caused the development of type 1 diabetes mellitus but it is thought that genetic factors play a great role and having a parent or a relative increases the chances of develop type 1 diabetes.

Environmental factors were suggested to play a role in the cause of type 1 diabetes, exposure to a viral illness is an example.

Other risk factors for developing diabetes include immune system disease that causes damage cause by autoantibodies. Diet low in vitamin D, children who have not been breast-fed or were fed with cow's milk.

Type 1 diabetes was to be prevalent in certain countries like Sweden and Finland; it also was more common in whites.

Prediabetes and type 2 diabetes had different rick factors, although scientists don't fully understand why a certain patient gets diabetes. One of the problems of diabetes is when cells become resistance to insulin. Fat cells increase the chance of body cells to becoming resistance to insulin.

Physical inactivity and excess body weight increases the subjects chances of developing type 2 diabetes, and exercise and activity help the body consume glucose in the form of energy and increases cell's responsiveness to insulin.

People with parents or sibling who have diabetes increase their chance of developing the disease, also certain races are more common to have type 2 diabetes like blacks and American Indians.

The risk of type 2 diabetes increases with age and the risk of developing type 2 diabetes after developing gestational diabetes also

increase. Women with certain diseases like polycystic ovary syndrome have an increases risk of developing diabetes.

Hypertension and low levels of high-density lipoprotein (HDL) in addition to high levels of Triglycerides all cause an increased risk of diabetes.

The longer a patient has high blood sugar the more damage that causes to the internal organs and complications. Diabetes causes an increase in the cardiovascular complications, examples are coronary artery disease, heart attacks, and stokes.

Another complication of diabetes is neuropathy in which the high blood sugar causes damage to the nerves themselves and to the blood selves that supply them with blood. The lower limps are affected the most and the severe cases can cause loos of sensation' also the gastrointestinal system can be affected and can cause vomiting and diarrhea. The genitourinary system can be affected and it manifests as erectile dysfunction.

Nephropathy is another complication in which the damage occurs to the blood vessels in the kidney tissue and in severe cases it causes failure of

the kidneys and dialysis or kidney replacement may be required for treatment.

Damage to the blood vessels that supply the eye by high blood sugar causes retinopathy, which may lead to blindness; Diabetes also causes cataract and glaucoma.

A decrease to the blood flow to the feet causes feet damage in the form of infections or in some cases amputations. Diabetes may also cause skin infections, and gum infections. Lower mineralization of the bone caused by diabetes can lead to osteoporosis.

Patients with diabetes suffer from an increased risk of developing Alzheimer's disease caused either by strokes or by the inflammatory effect of high insulin in the blood or lack of insulin causing lower supply of glucose to the brain tissue.

Although the etiology of it is not clear but the risk of cancer development is higher with type 2 diabetic patients.

Gestational diabetes when left uncontrolled can cause a number of complication, examples are enlarged placenta, low blood sugar in newborn babies, respiratory distress syndrome (RDS), jaundice, development of diabetes late in life for the mother, and death of the baby. Other

complications include mother developing a higher blood pressure (preeclampsia) and the mother suffering from gestational diabetes in future pregnancies.

Tests used to diagnose type 1 and type 2 diabetes include glycated hemoglobin (A1C) test, random blood sugar test, and fasting blood sugar test. A1C reading of 6.5% or more on two separate occasions is diagnostic for diabetes, a random blood sugar sample of 200 mg/dl or above is suggestive of diabetes, and a fasting blood sugar measurement of 126 mg/dl or higher on separate occasions is diagnostic for diabetes.

Healthy eating and physical activity are used as a first line treatment for all types of diabetes. Type 1 diabetes is treated in addition to healthy treatment and physical activity by frequent monitoring of blood sugar and insulin injections. In addition to the above, type 2 diabetes is treated with oral hypoglycemic medications.

Pancreatic transplantation is used in some cases of type 1 diabetes and bariatric surgery is used for treatment of some type 2 diabetic patients who have body mass index of 35 or higher.

1.1 Importance of the study and Significance

Diabetes mellitus is one of the most dangerous chronic diseases in Western countries. According to the International Diabetes Federation, 366 million people had DM in 2011, with estimates reaching 552 million by 2030; diabetes was the cause of 4.6 million deaths in this same year ***(IDF, 2011)***. These figures with increasing trends, along with the associated direct and indirect healthcare expenditure would place the problem of DM among the most important public health issues in most countries.

The number of diabetic patients has increased by three folds in the last 30 years, and the problem is bound to continue to increase. In 2011 there were 24 million people who had diabetes up from 18 million in 2008. The Center for Disease Control (CDC) predicts that by the year 2050 one of every three people will have diabetes.

Compared to the general population, patients with DM have higher general mortality rates, and are at higher risk for CVD incidence and complications. The recent decrease in diabetes-related mortality attributed to better primary and secondary prevention, is however counteracted by the negative impacts of the global epidemics of obesity and sedentary

lifestyle, in addition to the increased life expectancy ***(Abi Khalil et al, 2012)***. Therefore, the study of the risk factors, including the social determinants of the disease ***(Abeyta et al, 2012)***, would help in mitigating the complications and reducing the deaths among patients with DM through fostering the preventive endeavors among those patients.

1.2 Limitations

Lack of the knowledge of the amount of time spent by the research subjects on activities, due to self-reporting limitations, introduces a bias that can limit the results gathered and concluded by some studies. Also observational data collection has a Proportional Attribute Risk (PAR)%, which is a lower risk, as low as the risk found in normal non-exposed subjects ***(Rockhill et al., 1998; Nelson et al., 2010)***.

As certain factors may cluster within people, and certain interventions are not risk factors specific, meaning that they can affect multiple risk factors at once, not just the targeted risk factor so instead of looking at the benefit of certain intervention on an individual level, PAR% can be helpful in assessing the benefits of them on a population level ***(Nelson et al., 2010)***. PAR% assumes there is no relation between risk

factors and the population exposed; it also looks at “association between the exposure and disease and the prevalence of the exposure in the population” ***(Narayan et al., 1999)***.

Another observation to keep in mind is that the normal distribution of cardiovascular protective life style factors is a bell shaped one, and is the same as the normal distribution observed in studies of clinical data ***(Khaw et al., 2008; van Dam et al., 2008; Nechuta et al., 2010; Stamler et al., 1999)***. That leads to the conclusion that people can reduce their cardiovascular risk by increasing the prevalence of protective lifestyle risk factors ***(Capewell and Lloyd-Jones, 2010; Pell et al., 2008; Franco et al., 2011)***.

Studies have shown that ethnic differences can influence the survival rate and that is mostly due to different modifiable and preventable rick factors. The control of rick factors involved with cardiovascular disease will eventually lead to the improvement in the individual’s health status, which in turn will ultimately lead to a reduction in the ethnic differences ***(Nietert et al., 2006)***.

A thorough study and understanding of the trends in Diabetes Mellitus (DM) mortality and morbidity over time is an important clue to identify the underlying causes of their relative weight in disease etiology, complications, and death. The prevalence and mortality trends demonstrate a considerable variability across countries. Research confirmed the roles of major risk factors in the trends in DM morbidity and mortality worldwide. However, the relative contribution of these identified factors in different countries is complex.

Chapter II

II. Literature Review

2.1 All-cause mortality risk among diabetics

There is a close association between early mortality and diabetes due to its complications like infectious diseases, cancers and degenerative diseases. It was found that on average an elderly with diabetes and no history of vascular problems die 6 years earlier than those without diabetes (Doll et al., 2004). More than third of years lost to diabetes is contributed to nonvascular disease (the emerging risk factors collaboration, 2010).

Both studies done by (barr et al., 2009; selvvin et al., 2010) showed that the increased blood sugar demonstrated by the increase in both HbA1c and fasting blood sugar is highly associated with vascular and nonvascular premature mortality.

Mean fasting blood glucose of 104.5 mg/dL was associated with a 1.19 odds ratio (OR) for all-cause mortality (1.05-1.35, P <0.05) ***(Selvin et***

al., 2010). The OR ratio for mortality was 1.61 (1.35-2.25) when the fasting blood glucose was 113 mg/dL (equivalent to an A1c of 6.1%).

Even patients with new onset hyperglycemia (NOH), which is defined as a fasting blood glucose >125 mg/dL or a random blood glucose >199 mg/dL in non-diabetic individuals, even in them the risk of mortality was found to be critically higher when compared to non diabetic patients, a study found that non diabetic patients with NOH had 3 fold higher ICU admissions and 5 fold higher hospital mortality rate when compared to adults with diabetes (Umpierrez et al., 2002).

A study on Spanish adults done between 1998 and 2004 found the mortality risk to be more by 2.5 to 3 times in patients with high blood sugar in both diagnosed and undiagnosed diabetes, when compared with individuals with normal blood sugar levels. The increased risk is demonstrated in Figure 1 ***(Valdés et al, 2009)***.

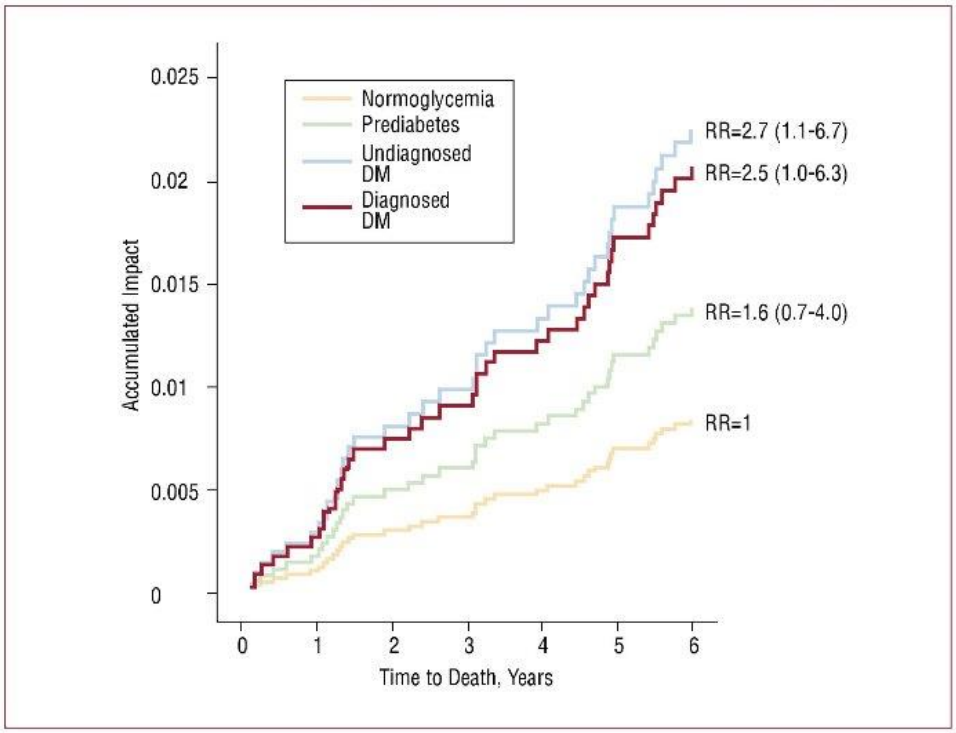

Figure 1: Accumulated all-cause mortality curve with normoglycemia, pre-diabetes, undiagnosed DM, and diagnosed DM. Source: Valdes et al, 2009

Multiple studies showed that the high blood sugar in non-diabetic patients caused a significant increase in hospital mortality in comparison to diabetic patients (Falciglia et al., 2009; Cheung 2008). As may these studies suggest that high blood glucose level indicates the severity of systemic injury but that alone is not a good marker because diabetic patients suffer from varying levels of insulin insufficiency which causes the higher levels of blood sugar which in turn is not a good indicator of injury instead its more

of an indication of longer duration of diabetes and less β cell function (for type 2 diabetes) ***(Tayek and Tayek, 2012)***.

Gender was studied also as a predictive factor for mortality risk in diabetic patient. Some studies found that men have lower mortality risk than women when it comes to cardiovascular mortality especially in the third decade of age which some explained by women lower care adherence and provision and by the diabetes disease itself ***(Howard et al., 1998)***. Also another observation was that diabetic men have a comparable survival improvement as those found in non-diabetic men; women didn't have that same survival improvement ***(Jansson et al., 2010; Gu et al., 1999; Gregg et al., 2007).*** In the contrary, other studies found that women have lower mortality rate than in men ***(de Fine Olivarius et al., 1997; Gu et al., 1998)***, and still others found no sex differences ***(Fox et al., 2004; Dale et al., 2008)***.

A lead-time bias was identified when comparing diabetic subjects through the decades, which have been found to have influence on the analysis of the results ***(Jansson et al., 2010)***.

Other than gender other factors were found to affect mortality risk like accompanying smoking or physical inactivity, in fact it was found in a study conducted on American population that "mortality rates could be decreased by 15.3, 16.4, and 7.5%, respectively, if the following risk factors were eliminated: having an A1C of ≥8%, physical inactivity, or current smoking" ***(Nelson et al., 2010).***

It was found that most of the diabetes related mortality rate is principally from type 1 diabetes worldwide, the main cause of mortality comes from renal disease specially in the first two decades of life and it's incidence is in decline, followed by the cardiovascular disease (CVD) which also dominates later in life which has sustained its incidence unchanged ***(Nishimura et al., 2001; Deckert et al., 1978; Christlieb et al., 1981; Dorman et al., 1984; Pambianco et al., 2006)***.

It was found that being male with type 1 diabetes would predispose you to have a higher mortality rate due to non diabetes related death complications in comparison to women who are prone to have more diabetes related death causes; African American with type 1 diabetes also were found to have higher mortality rates from diabetes related complications ***(Secrest et al., 2010)***. In light of such observations and many

others it is generally stated that preventing acute and chronic complications is pivotal for the treatment plan of patients with type-1 diabetes.

The inclusion of the presence or absence of diabetes in death certificates in recent years have aided greatly in cohort studies, it has helped in the comparison of data obtained from them to previous studies and showed similar observations “in regard to prevalence of diabetes at death, distribution of causes of death among diabetic decedents, risk of death for persons with diabetes relative to persons without diabetes, and age- and sex-specific trends in risk of death” ***(Tierney et al., 2001)***, and the inclusion of the presence or absence of diabetes in death certificates may aid in the preventive efforts to lower the incidence diabetic mortality and of specific diabetic related diseases.

Physical activity and exercise were studied and found to have great effect on the mortality risk in patients with diabetes, a study on diabetic women with regular exercise found that the relative risk of CVD was 0.54 (95% CI 0.39–0.76); while diabetic men with low levels of physical activity

had a relative risk of 1.7 (95% CI 1.2–2.3) ***(Hu et al., 2001., Wei et al. (2000)***.

The effect of tobacco smoking on the diabetes mortality was examined and studies found a strong association between smoking and the increase in the CVD and that by quitting diabetic patient improve their risk of development of such diseases ***(Al-Delaimy et al., 2002)***.

It is widely accepted that moderate glycemic control is crucial for preventing the development of diabetes related complications and slowing the progression of it too. Several studies have concluded that an A1c level of ≥8% was associated with higher all-cause mortality risk complications ***(UK Prospective Diabetes Study [UKPDS] Group, 1998; Saydah et al., 2009; Nelson et al., 2010)***. But recent studies have proven the aggressive approach to lowering blood glucose levels patients with type 2 diabetes to be controversial, as it has shown to cause an increase in mortality ***(Gerstein et al., 2008; Adler et al., 2009)***.

Although a number of meta-analysis showed a "15% relative reduction in non-fatal myocardial infarctions" ***(Ray et al., 2009; Turnbull et al., 2009; Kelly et al., 2009)***, the Action to Control Cardiovascular Risk in

Diabetes (ACCORD) trial found that the benefits of intensive treatment was accompanied by an increase in diabetes related mortality and that it didn't have significant improvement on microvascular complication related to diabetes although aggressive sugar level control cause the reduction in microalbuminurea. Non the less when only high quality studies were considered the reduction in non-fatal MI and microalbuminurea was not considered significant and it was also accompanied with an increase in the risk of CHD.

Another meta-analysis was done and it showed that diabetes type 2 did not have benefit of aggressive treatment on all-cause mortality and CVD mortality ***(Boussageon et al., 2011)***.

A cohort study done on patients with type 2 Diabetes who had cardiac autonomic neuropathy (CAN) found that intensive glycemic control did not produce better effect on all cause and cardiovascular mortality when compared with standard glycemic control although the presence of CAN was associated with three folds higher mortality when compared with type 2 Diabetes patients who didn't have CAN, it was shown to be a strong predictor of silent ischemia and subsequent cardiovascular complications

(Pop-Busui et al., 2010; Young et al., 2009; ACCORD cohort; Detection of Ischemia in Asymptomatic Diabetics (DIAD) study).

Its not an easy task to diagnose CAN but recent studies have shown that a subset of diabetic patients –both type 1 and type 2- with subclinical CAN who are at risk of increased mortality can be identified using both Heart Rate Variability (HRV) and QTI measurements which both are easily obtained using standard ECG ***(Pfeifer et al., 1984; Pop-Busui et al., 2010; Lykke et al., 2008)***.

Diabetes was found to be associate with mortality from nephropathy causing renal disease, fatty liver disease causing digestive problems, impairment of immunity causing various infectious diseases, and nephropathy causing trauma and injuries which is also caused by eye disease and low blood sugar ***(The Emerging Risk Factors Collaboration, 2011; Angulo, 2002; Jawa et al., 2004; The Emerging Risk Factors Collaboration, 2011)***.

2.2 Diabetes and increased risk for CVD

Cardiovascular complications of diabetes like coronary artery disease (CAD) has the worst health outcome among other diabetes complications; Hypertension is another example of cardiovascular complication of

diabetes and increased morbidity and mortality have been shown in patients with both systemic hypertension and diabetes, even more a study done on individuals with type 2 diabetes and normal blood pressure found increased left ventricular diastolic dysfunction prevalence (LVDD) ***(Danbauchi et al., 2005; Palmieri et al., 2001; Hildebrandt et al., 2005; Aigbe et al. 2012)***.

The Center for Disease Control (CDC) has classified Diabetes as major risk for developing Cardiovascular disease as it was documented to be a strong independent risk factor on both males and females, Diabetic patients developing cardiovascular disease develop worse scenarios when compared with patients who are not diabetic ***(Wilson, 1998; Wilson et al., 1998; McGill and McMahan, 1998; Brezinka and Padmos, 1994; Geiss et al., 1995; CDC, 2008).***

Several studies have looked at the relationship and effect of the presence of metabolic syndrome on Diabetes related mortality. Diabetes alone has a threefold increase in the risk of developing of cardiovascular disease and adding metabolic syndrome didn't add a significant increase to

cardiovascular related mortality with no age groups difference in these findings ***(Church et al., 2009; Hu et al., 2004; Malik et al., 2004; Tong et al. 2007; Alexander et al. 2003; Hunt et al. 2004; Cull et al. 2007)***.

Although diabetes can cause heart failure on its own as an indepindant risk factor it also causes an increase in the prevelance of coronary artery disease (CAD) which in turn causes an increase in mortality due to congestive heart failure (CHF) ***(Pocock et al., 2006; MacDonald et al., 2008; He et al., 2001)***.

Studies found that Insulin treatment has a markedly bad effect on macrovascular disease; it was found to cause an increase in mortality in patients with congestive heart failure (CHF) diabetic patients and a decrease in left ventricular ejection fraction (LVEF) all when compared with non insulin treated diabetic patients ***(Ehl et al., 2011; Nichols et al., 2004; Ingelsson et al., 2005; Smooke et al. 2005; Witteles and Fowler 2008; Hildebrandt et al., 2005; Konduracka et al., 2007; Ehl et al., 2011)***.

2.3 Social determinants

Researchers have found a relevant relationship between class and diabetes mortality, diabetic patients coming from higher social class and white collar class seem to benefit from the resources available for them to reduce complications by having access to better quality of treatment; higher social class benefit more of health education to improve their health outcomes by being more accepting to lifestyle behavioral modification like smoking and diet while blue collar or low socioeconomic class tend to be more resistance towards such behaviors ***(Koskinen et al., 1996; Richmond et al., 1993; Aarva, 1995; Pill et al., 1995; Dorman et al., 1985; Matsushima et al., 1996)***.

Income has been clearly identified as a factor affecting survival, a number of Canadian studies have been done where healthcare is provided for all. Although everybody has access to the same healthcare system but the fact was that patients from low-income did not benefit from advanced and more complex diabetes care that patients with higher income have access to. Mortality in middle age groups (30-46) have been affected more by the income factor by widening of the mortality rate, in comparison with older age groups which didn't show much differences in health outcome

between high and low income patients ***(Mackenbach et al., 2003; Mackenbach et al., 2008; Wilkins et al., 2002***; ***Grant et al., 2004; Lipscombe et al. 2010)***.

Gender is another factor affecting diabetes and its outcomes, although studies have found that in general there is a reduction in mortality in the general population in the last two decades, females benefited less from this trend, in a study it was shown that females actually may have an increase in diabetes related mortality. In a cohort of studies females had 50% more fatal coronary heart disease and 50% worse outcome after a myocardial infarction when compared to males. In another retrospect study, diabetic patients with abnormal stress myocardial perfusion imaging, woman had worse outcome than men. It is widely acceptable now that women seem to have higher risk than men for cardiovascular disease and both symptomatic as well as asymptomatic women are at greater risk of developing cardiovascular complications ***(Tandon et al., 2012; Gregg et al., 2007; Preis et al., 2009; Ford et al., 2007; Huxley et al., 2006; Mukamal et al., 2001; Graham et al., 2003; Giri et al., 2002; Mosca et al., 2011)***.

Overweight and obesity are another possible determinant related to socio-economic factors. Although cardiovascular disease is major cause for mortality in type 1 Diabetes patients the problem gets more complicated when you add the weight factor to the disease, which comes naturally or as a side effect of insulin therapy ***(Stadler et al., 2006; Flegal et al., 2005; Pambianco et al., 2006; Freedman et al., 2006)***.

In contrast another study pointed out an increase in mortality found with leanness associated with type 1 diabetes, thus recommending on focusing the attention on associated risk factors such as blood pressure and lipids ***(Conway et al., 2009)***.

2.4 Preventive measures

Blood sugar control is key in lowering micro and macro vascular complications in diabetic patients, and although the ACCORD trial have shown an increase in death rate related to type 2 diabetes due to intensive glycemic control, several other studies, like Action in Diabetes and Vascular Disease: Preterax and Diamicron Modified Release Controlled Evaluation (ADVANCE) and Veterans Affairs Diabetes Trial (VADT), have shown no change in the mortality rate in fact intensive glycemic control have shown a

decrease in both myocardial infarction and mortality incidences ***(Gerstein et al., 2008; Patel et al., 2008; Duckworth et al., 2009; Holman et al., 2008)***.

Hypoglycemia is another studied effect of intensive glycemic control; with its increased incidence it can affect negatively the response to subsequent episodes of hypoglycemia due to its autonomic and hormonal impairment. Hypoglycemia can cause sudden cardiac death by reducing the threshold for malignant arrhythmias and causing cardiac autonomic neuropathy (CAN), although that theory of increased cardiac arrhythmias and sudden death was attributed to CAN in the ACCORD Trial and it concluded that patients with type 2 diabetes were not at an increased risk due to intensive glycemic control ***(Van den Berghe et al., 2006; Finfer et al., 2009; Adler et al., 2009; Pop-Busui et al. 2010)***.

Blood pressure and lipids levels control have been studied extensively and their positive effect have been documented. The use of lipid lowering medications like Statin have shown to bring the mortality rate in diabetic older patients to the same level of non diabetic patients of the same age group irrespective of their cardiovascular condition of blood

glucose levels, therefor establishing Statin as a crucial part of diabetes management (***Snow et al., 2003; Vijan and Hayward, 2004; Olafsdottir et al. 2011)***.

Studies have shown that obesity (BMI 30-<35 kg/m2) was not associated with increased mortality rate in diabetic patients but sever obesity (defined as a BMI ≥31.1 kg/m^2 for men and ≥32.3 kg/m^2 for women) -in addition to age and male sex and low physical activities were associated with CHD ad increased mortality in diabetic patients ***(Ford and DeStefano, 1991; (Jerant and Franks, 2012)***.

Several studies have demonstrated the protective effect of dietary fibers in the general population and with diabetic patients both type 1 and type 2 diabetes patients, studies have found that diet rich in fibers like bran and grains have a protective association with cardiovascular disease mortality in diabetic patients. Other studies have shown also a reduction in all-cause mortality in diabetic patients with no cardiovascular disease with no clear differences between the source of the dietary fiber and whether it was total, soluble or insoluble fiber ***(Schoenaker et al., 2012; Streppel et***

al., 2008; He et al., 2010; Streppel et al., 2008; Park et al. 2011; Pereira et al., 2004).

A diet high in saturated fatty acids has shown a strong association with cardiovascular disease in a number of studies, a cross sectional study showed an increase of the risk of developing cardiovascular disease in children and young adolescence, in addition, a meta-analysis was done on 11 cohort studies showed that replacing saturated fatty acids with polyunsaturated fatty acids causes a reduction on cardiovascular disease development risk; some other studies showed that the type of fat consumed in the diet of diabetic patients has no effect cardiovascular disease risk but those studies were criticized with lack of power ***(Schoenaker et al., 2012; (Øverby et al., 2007; Mozaffarian et al., 2010; Jakobsen et al., 2009; Prineas et al., 1982)***.

A British study was done on group of older men aged 52 to 74, the results showed that diabetic patients had higher death rate of coronary heart disease higher than non diabetic patients, approximately nine times more likely, even higher than patients with angina only; in addition, it was found that diabetic patients had a lesser chance of surviving the first heart

attack and they had similar death rate to those found in patients with myocardial infarction. These finding were attributed to the high blood sugar effect on the blood, which causes thrombus formation and ultimately coronary heart disease ***(Wannamethee et al., 2004; Mittinen et al., 1998; Beckman et al., 2002)***.

This and other studies have proved the importance of predictive measurements and ultimately preventive measures; several studies have looked into coronary artery calcium (CAC) and have found that it have a good independent value in predicting all cause death risk; CAC and the use of vascular imaging can be great tools in both predicting and preventing death in diabetic patients ***(Agarwal et al. 2011)***.

In a study done on a population with no cardiovascular disease, the coronary heart disease risk was more by 6.84 (95% CI 2.93-15.99) in patients with coronary artery calcium (CAC) of 300 or more. Another study done on 903 diabetic patients, who had Coronary artery calcium imaging, found an increase in mortality risk in those with higher CAC. Both these studies have concluded to the same result as found in another study which compared diabetic patients with CAC of 0-9 with diabetic patients with CAC

of 10 or more, the study found that patients with diabetes and higher levels of CAC were males hypertensive and older in age. These three studies have ascertained the importance role of CAC as a risk predictor for the increased risk of cardiovascular mortality related to diabetes ***(Detrano et al., 2008; Raggi et al. 2004; Agarwal et al., 2011)***.

Atherosclerotic imaging has shown that diabetic patients with no coronary heart disease symptoms and non-diabetic patients with coronary heart disease have the same extent of calcifications ***(Mielke et al., 2001; Hoff et al., 2003)***.

While these finding have emphasized the importance of aggressive therapy towards those diabetic patients with high CAC scores and high risk for atherosclerosis, another recent study have doubted the benefits of aggressive therapy in which it was found to be harmful and not helpful ***(Gerstein et al., 2008)***.

The fact that patients with diabetes have higher concentration of C-Reactive Protein (CRP), when compared with non-diabetic patients, is well studied and documented. The high CRP is an indication of the inflammatory process involved with atherosclerosis patients ***(King et al., 2003;***

Wannamethee et al., 2004; Aronson et al., 2004; Vu et al., 2005; Malik et al., 2005; Friedman et al., 2005; de Rekeneire et al., 2006; Soinio et al., 2006). CRP was the focus of a number of studies to prove the predictive value of it, the fact that most these studies were cross sectional done on data collected from clinics made the results reliability questionable ***(Pai et al., 2004; Friedman et al., 2005; Vu et al., 2005; Malik et al., 2005; King et al., 2003; Schulze et al., 2004)***. In addition to that results of studies done on non-diabetic patients were not promising either ***(Wilson et al., 2005; Cook et al., 2006; Cook, 2007; Sattar et al., 2007)***.

Them main predictor of mortality in diabetic patients is microalbuminurea. An Italian study done on patients with type 2 diabetes studied the relationship between CRP as predictor of 5-year mortality and found it to be comparable to that of microalbuminurea and 5-year mortality. A diabetic patient with a CRP of 3 mg/l or more was at a greater risk of death. Another factor the researcher studied was Albumin Excretion Rate (AER) and found that both CRP and AER were good predictors of 5-year mortality risk ***(Bruno et al., 2009)***.

On the other hand a study showed that CRP measurement had a very limited benefit as a predictor on the 5-year survival and that even in elderly non-diabetic patients, CRP had limited predictive value beyond a 3-year survival period ***(Sattar et al., 2007)***.

The association between CRP and mortality was studied in diabetic subjects aged 45-64 and another study looked at the association between CRP and cardiovascular complications in diabetic patients, both studies found CRP to have a strong independent predictive role in cardiovascular mortality in that an increase CRP of 3 gm/l or more is associated with 64% increase in cardiovascular mortality ***(Soinio et al., 2006; Schulze et al., 2004; Bruno et al., 2009)***.

Furthermore ***(Bruno et al., 2009)*** found that an increase in CRP is associated with elevation of all mortality risk and cardiovascular mortality risk by 51% and 44% respectively. But in contrast a study done of patients 65 years and older found no association between elevated CRP levels and both all-cause mortality and cardiovascular mortality ***(Wilson et al., 2005)***. A study has shown the association between fibrinogen and death and a subsequent study suggested that this fibrinogen related death is CRP

mediated ***(Bruno et al. 2005; Bruno et al.' 2009)***. Another study was conducted on patients with atherosclerosis, most of them had diabetes and the researcher found that the A1C and CRP both were elevated and that both had caused subsequent cardiovascular complications ***(Schillinger et al., 2003)***.

Researchers have looked into other predictor and factors influencing cardiovascular risk, a number of studies have looked at the role of Growth-Differentiation Factor-15 (GDF-15) and have found that it is, like CRP, can indicate inflammation and that it is a strong predictor of mortality even after adjusting for other factors, for example age; the higher risk was positively associated with age, male sex and diabetes, and to be inversely associated with blood lipid levels like LDL and HDL ***(Daniels et al., 2011; Lind et al., 2009; Wollert et al., 2007; Daniels et al., 2011)***.

(Brown et al., 2002) studied older women with high GDF-15 who developed cardiovascular complications in the progress of their condition, when compared to a control group; he also found a strong positive relationship with CRP. Also ***(Lind et al., 2009)*** studied the association of the manifestation of cardiovascular disease and GDF-15. In another study

studied the fact that GDF-15 was found to be elevated with no cardiovascular disease and which subsequently develops, led to the strong suggestion that GDF-15 plays a role in the pathophysiology of the development of cardiovascular disease ***(Daniels et al., 2011)***.

The Division of Diabetes Translation at the Centers for Disease Control and Prevention (CDC) devised a conceptual model for prevention shown in Figure 2 ***(Martin et al, 2007)***.

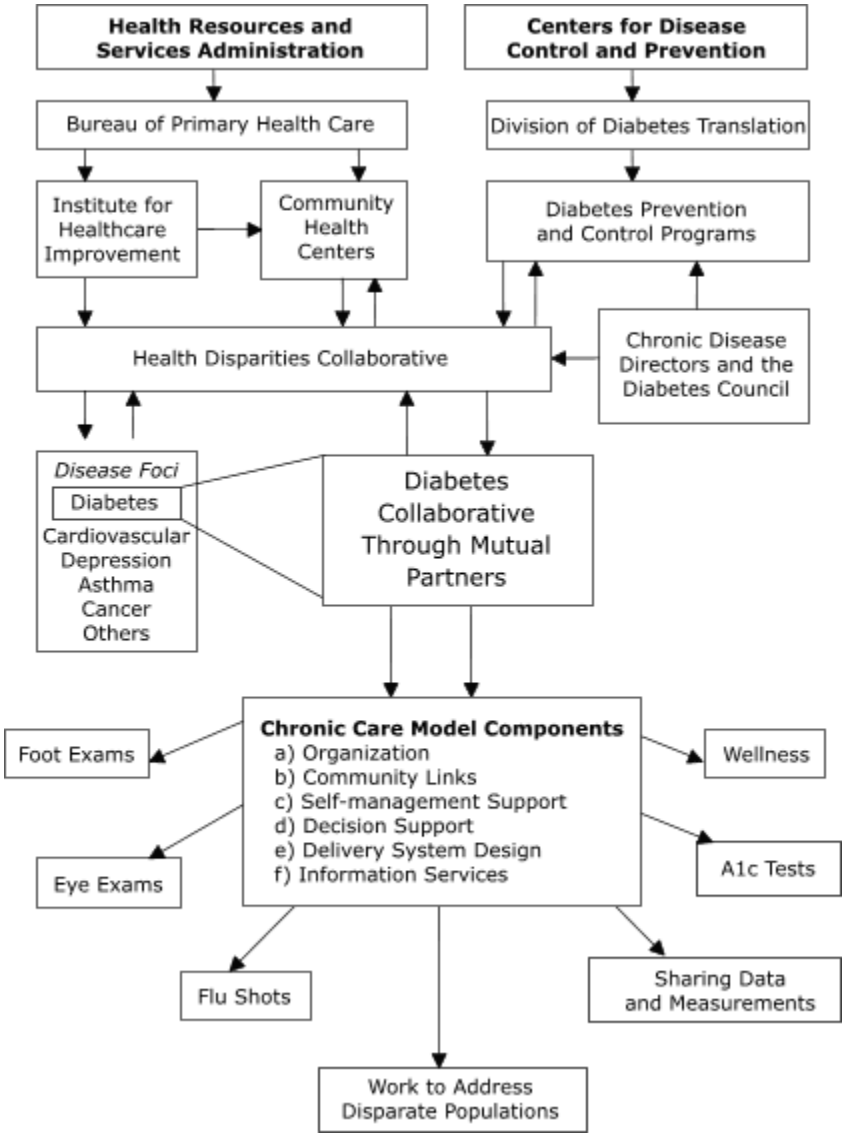

Figure 2: Conceptual model for mutual diabetes mellitus prevention and treatment. Source: Martin et al, 2007

2.5 Prediction models

Although the Framingham Risk Score and other cardiovascular risk prediction models, all have lower significance as predictive measures in older patients, still the effort spent studying risk in older individuals is very

important. In light of that, in addition to studying of the effect of diabetes on mortality, studying the various levels of functioning will provide a better assessment of the risk of mortality. And that in effect will help target resources to those with the highest risk ***(Kannel and D'Agostino, 1995)***.

A research was conducted to study the functional impairment and mortality in older patients with diabetes. After adjusting for various risk factors, an increase in mortality of less than 1.5 times was reported which was similar to findings of most studies done on older individuals with diabetes ***(Barnett et al., 2006; Gulliford and Charlton, 2009; Barnett et al., 2010; Hubbard et al., 2010)***. Even after adjustment for demographic, socio-economic, behavioral and health status, several studies have shown that functional decline in older diabetic individuals is associated with an increase in mortality risk, which led to the suggestion that comorbidities has an additive role in such increase ***(Otiniano et al., 2003; Carnethon et al., 2010; (Li et al., 2011)***.

A Scottish study showed that dental disease is a strong predictor of higher mortality in general. It was advised to perform more experimental

studies to show the benefit of dental disease prevention and treatment can affect and improve mortality risks ***(Watt et al., 2012)***.

Models can be used to prioritize challenging health issues for example the two dimensions of the diamond model can utilize the magnitude and the trends of rates to help make policy decisions and their priorities. Taiwan used the diamond model to help prioritize health resources for 30 causes of death, the diamond model was used to visually show the data collected to the public and policy makers and prioritized data that would help in decision making ***(Tsung-Hsueh et al, 2011)***. The model is shown in Figure 3.

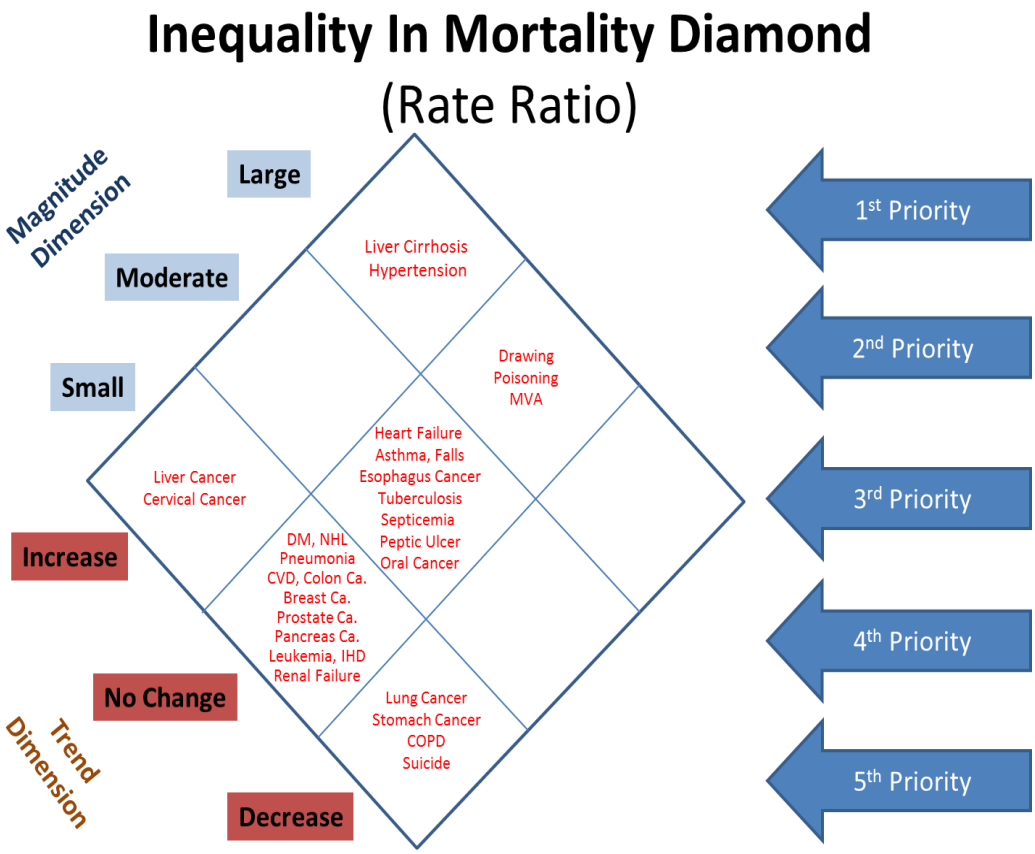

Figure 3: The diamond model. Source: Tsung-Hsueh et al, 2011

A number of studies have looked at the red blood cell distribution width (RDW) and it relation to cardiovascular disease. It was found that RDW is an independent predictor for cardiovascular disease adverse outcome. Higher RDW is associated with increased all-cause mortality, cardiovascular disease and cancer mortality ***(Perkins, 2003; (Felker et al., 2007; Tonelli et al., 2008; Daniels et al. 2011)***.

A study looked at sleep disturbances as a public health issue and found that the treatment of the cause can prevent death prematurely, as it is known that sleep disturbance can cause mortality through causing diabetes and hypertension for example. Younger men suffering from sleep disturbances can lead to higher mortality rates, and although woman reported lower mortality risk, still had higher incidences of diabetes and hypertension ***(Rod et al. 2010; Cappuccio et al., 2010)***.

Chapter III

III. Research Methodology

3.1 Goal

The main goal of the study is to contribute to the understanding of the role of various risk factors in the incidence of deaths among adult patients with DM and to identify emerging trends. This would help in preventing or delaying mortality from DM and increasing the life expectancy of those patients with diabetes through modification of the identified factors.

3.2 Objectives

1. Identification of the risk factors associated with DM mortality;
2. Classifying these factors according to their amenability to preventive measures;
3. Measuring the relative contribution of each of the factors in the prediction of mortality.

3.3 Hypothesis

Null Hypothesis.

H_0: There are no differences in diabetic adults living status and death rate in the demographic factors.

H_0: There are no differences in diabetic adults living status and death rate in the socioeconomic factors.

H_0: There are no differences in diabetic adults living status and death rate in the medical factors.

H_0: There are no differences in diabetic adults living status and death rate in the health care factors.

Alternatives Hypothesis.

H_1: There are differences in diabetic adults living status and death rate in the demographic factors.

H_1: There are differences in diabetic adults living status and death rate in the socioeconomic factors.

H_1: There are differences in diabetic adults living status and death rate in the medical factors.

H_1: There are differences in diabetic adults living status and death rate in the health care factors.

3.4 Study Design

The study was a secondary data analysis of existing patient records (record-based). It was based on the Nationwide Inpatient Sample (NIS). NIS is a set of longitudinal hospital inpatient databases included in the Healthcare Cost and Utilization Project (HCUP). The HCUP family of health care databases and related software tools and products is made possible by a Federal-State-Industry partnership sponsored by the Agency for Healthcare Research and Quality (AHRQ).

The HCUP's objectives are to 1) create and enhance a powerful source of national, state, and all-payer health care data; 2) produce a broad set of software tools and products to facilitate the use of HCUP and other administrative data; 3) enrich a collaborative partnership with statewide data organizations aimed at increasing the quality and use of health care data; and, 4) conduct and translate research to inform decision making and improve health care delivery.

The HCUP databases bring together the data collection efforts of State data organizations, hospital associations, private data organizations, and the Federal government to create a national information resource of

patient-level health care data. It includes the largest collection of longitudinal hospital care data in the United States, with all-payer, encounter-level information beginning in 1988. These databases enable research on a broad range of health policy issues, including cost and quality of health services, medical practice patterns, access to health care programs, and outcomes of treatments at the national, State, and local market levels.

The Nationwide Inpatient Sample (NIS) is the largest all-payer inpatient care database in the United States, containing data on more than seven million hospital stays from approximately 1,000 hospitals. Its large sample size is ideal for developing national and regional estimates and enables analyses of rare conditions, uncommon treatments, and special populations.

Data element descriptions explain how the data element is coded in the HCUP databases, what the uniform values are, and State-specific coding practices. The descriptions are cumulative across all states and years of NIS data from 1988 to the current data year. However, not all data elements in

the NIS are uniformly coded across states. In addition, not all data elements in the NIS are available from every state.

The current study was based on the NIS data during the period 2007 to 2010 inclusive. The analysis included only adult population (18 years age or older). My primary outcomes of interest were the mortality (dead/alive) or (living status of adult diabetic subjects) measured as the percentage or rate of dead diabetic among all the adults' diabetic patients.

Ethical Consideration:

- All patient identifiers were removed and individuals included in the research were anonymous.
- An online course on data security required by NIS was completed before having access to the data.

The risk factors that we investigated as predictors of death were classified into the following categories:

1. Personal characteristics: such as age, sex, race;
2. Socio-economic factors: such as residence and income;

3. Medical factors: such as admission type (emergency vs outpatient), diagnosis (principal and others), stage of disease, co-morbidities, elective versus no-elective admission, etc.

4. Healthcare-related factors: such as stratum of hospital, Length of Stay (LOS), procedures, payers, hospital charges, disposition.

We performed a descriptive (means and proportions/percentage) and bivariate analyses (chi-square and t-test) where appropriate to compare patient characteristics, LOS, and death rates between the two living status. The chi square test was applied to compare dichotomous and categorical variables such as gender, admission type, etc., and the t-test to compare continuous variables with normal distribution such as age, or a suitable non-parametric test in case this condition cannot be assumed. Using these tests, I obtained 95% confidence intervals (CIs), p values, and odds ratios (ORs). Following initial descriptive statistics, bivariate analysis I did a regression models to evaluate the crude association between each potential predictor variable and all outcomes of interest. Then, a hierarchical generalized linear modeling (HGLM) approach was used to assess the odds of changing death rate and LOS over time, controlling for

changes in patient demographic and clinical variables. Predictors found to be significant at $p \leq 0.2$ in the bivariate analyses were considered for inclusion in the hierarchical multivariate modeling. Predictors were considered statistically significant in the final model with a p-value ≤ 0.05.

Chapter IV

IV. Results

4.1 Descriptive statistics and bivariate analysis

Sample description

Table 1: Distribution of study sample by calendar years

	Frequency	Percent
2007	107955	24.6
2008	110194	25.1
2009	107301	24.5
2010	113388	25.8
Total	438838	100

Table 1 shows the sample size was almost the same in the selected four years (2007-2010). The sample size ranged from lowest in 2008 with 107301 subjects included to the highest in 2010 with 113338 subjects included in the study.

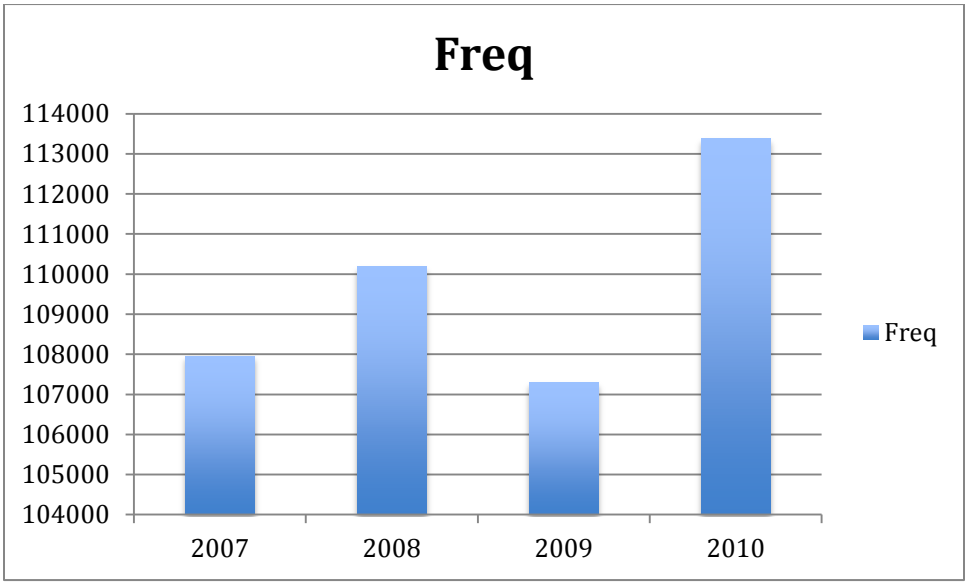

Figure 4: Distribution of the study sample by calendar years

Descriptive statistics, proportions, and diabetes death rate comparison by different factors (Year included, gender, race, income, insurance, location, origin of admission…etc.

Table 2: comparison of the diabetes death rates in the study sample by calendar years

	Status		Death rate /100	95% CI	X^2 (p-value)
	Alive	Dead			
2007	107098	840	0.78	0.73 - 0.83	
2008	109341	782	0.71	0.66 - 0.76	
2009	106542	711	0.66	0.62 - 0.71	
2010	112596	734	0.65	0.60 - 0.70	16.266 df=3, (0.001)*
Total	435577	3067	0.70	0.67 - 0.72	

Table 2 shows the proportion of diabetic alive and dead and the death rate by year of inclusion. The chi-square test shows a statistical significant difference in the death between the years at alpha (P<0.05). We can see that the death rate decreased over the years from the highest in 2007 to the lowest in 2010.

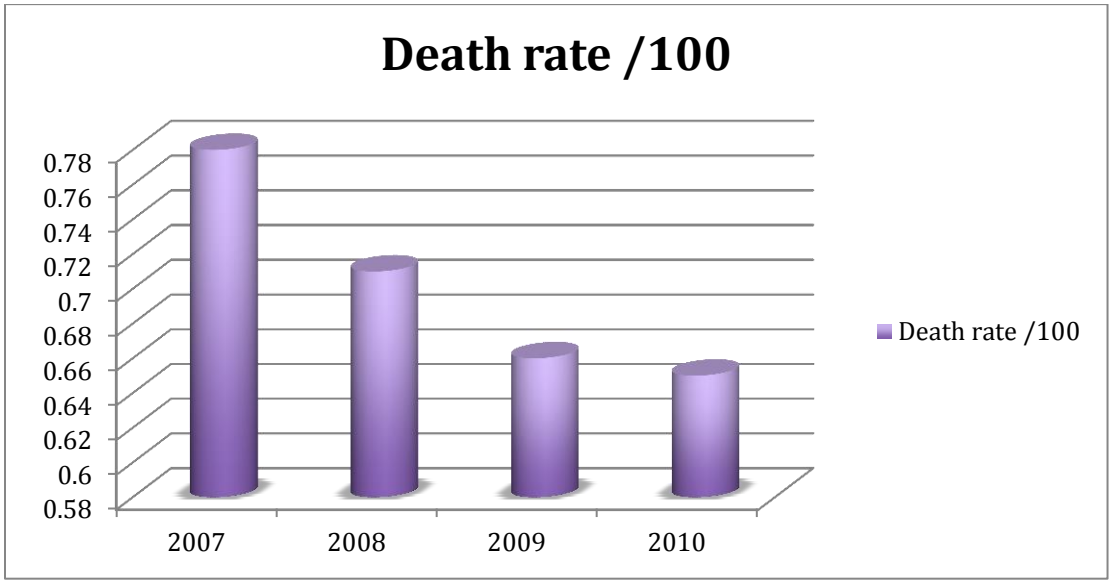

Figure 5: Comparison of the diabetes death rates in the study sample by calendar years.

Table 3: Comparison of the diabetes death rates in the study samples by gender

Gender	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
Male	227419	99.28	1633	0.71		
Female	207350	99.31	1434	0.69	1.07	0.301

Table 3 shows the proportion of diabetic alive and dead and the death rate by gender. The chi-square test shows no statistical significant difference in the death rate between the male and female at alpha (P>0.05).

Table 4: Comparison of the diabetes death rates in the study sample by race

Race (uniform)	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
White	192113	99.24	1462	0.76		
Black	96499	99.34	645	0.66		
Hispanic	50758	99.39	312	0.61		
Asian or Pacific Islander	6504	99.16	55	0.84		
Native American	3415	99.53	16	0.47		
Other	10766	99.03	105	0.97	29.79	0.000

Table 4 shows the proportion of diabetic alive and dead and the death rate by race. The chi-square test shows a statistical significant difference in the death rate between the different races at alpha (P<0.05). The death rate distribution shows that others have the highest death rate followed by Asian or pacific islanders while Native Americans show the lower death rate.

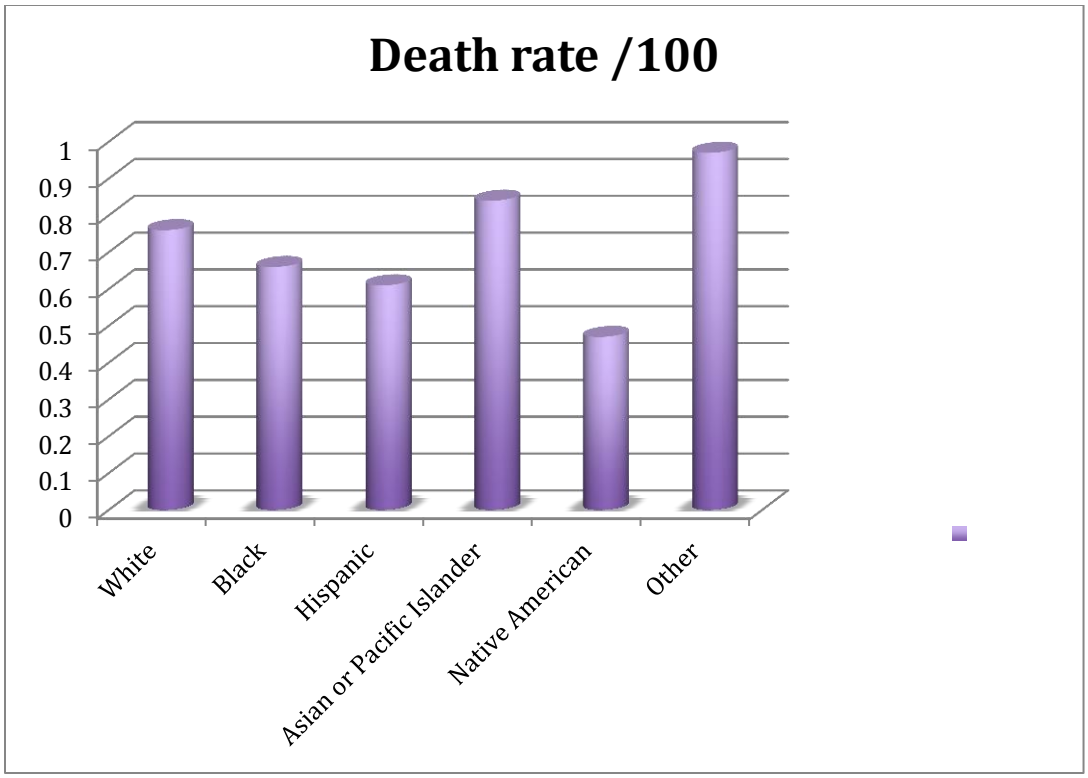

Figure 6: Comparison of the diabetes death rates in the study sample by race.

Table 5: Comparison of the diabetes death rates in the study sample by income

Median household income national Quartile for patient ZIP Code	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
0-25th percentile	156500	99.29	1120	0.71		
26th to 50th percentile (median)	113111	99.33	759	0.67		
51st to 75th percentile	88561	99.36	573	0.64		
76th to 100th percentile	64563	99.19	527	0.81	17.54	0.001

Table 5 shows the proportion of diabetic alive and dead and the death rate by their income. The chi-square test shows a statistical significant difference in the death rate between the different income groups ($P<0.05$). Subjects in the 76-100th percentile

had the highest death rate while subjects in the 51-75th percentile had the lowest death rate.

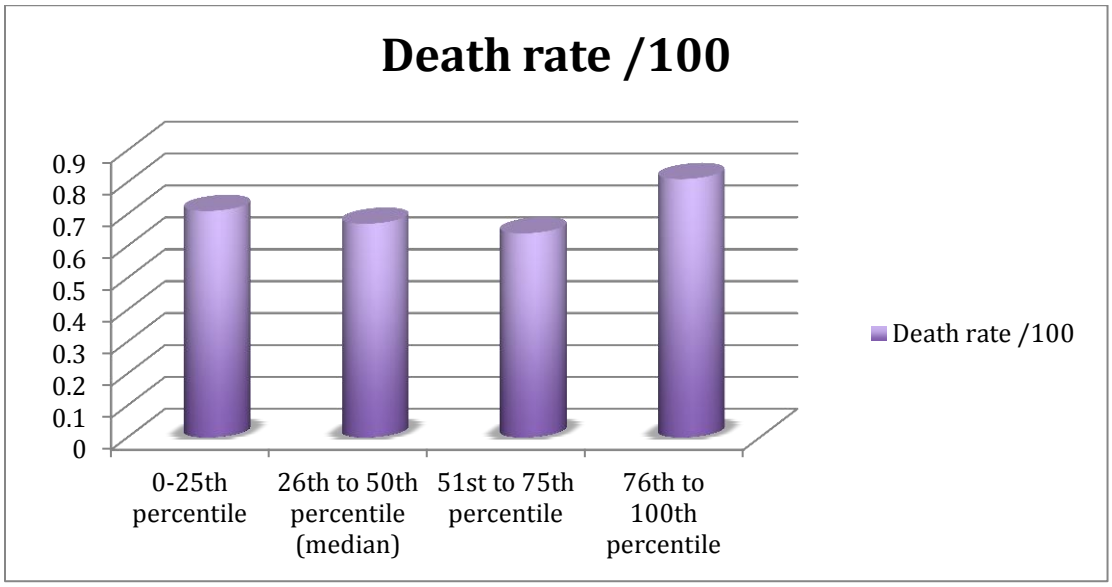

Figure 7: Comparison of the diabetes death rates in the study sample by income

Table 6: Comparison the diabetes death rates in the study sample by insurance

	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
Primary expected payer (uniform)						
Medicare	178814	98.85	2089	1.15		
Medicaid	81421	99.61	315	0.39		
Private insurance	108199	99.59	442	0.41		
Self-pay	45117	99.74	117	0.26		
No charge	4384	99.75	11	0.25		
Other	16460	99.48	86	0.52	936.88	0.000
Secondary expected payer (uniform)						
Medicare	24203	98.88	274	1.12		
Medicaid	44230	99.06	419	0.94		
Private insurance	37646	98.68	504	1.32		
Self-pay	23310	99.55	105	0.45		
No charge	1001	99.60	4	0.40		
Other	6497	99.16	55	0.84	123.88	0.000

Table 6 shows the proportion of diabetic alive and dead and the death rate by insurance. First the primary expected payers were compared in the death rate by using chi-square test that showed a statistical significant difference in the death rate between the different insurance plans at alpha ($P<0.05$). Medicare showed the highest death rate, which is expected due to the higher older age of the participants. While those with no charge or self-pay insurance plan subjects had the lowest death rate. Then we checked the secondary expected payers and compared the diabetes death rate by using chi-square test which showed a statistical significant difference in the death between the different insurance plans at alpha ($P<0.05$). Medicare also showed the highest death rate, which is expected due to the higher older age of the participants. Also those with no charge or self-pay insurance plan subjects had the lowest diabetes death rate.

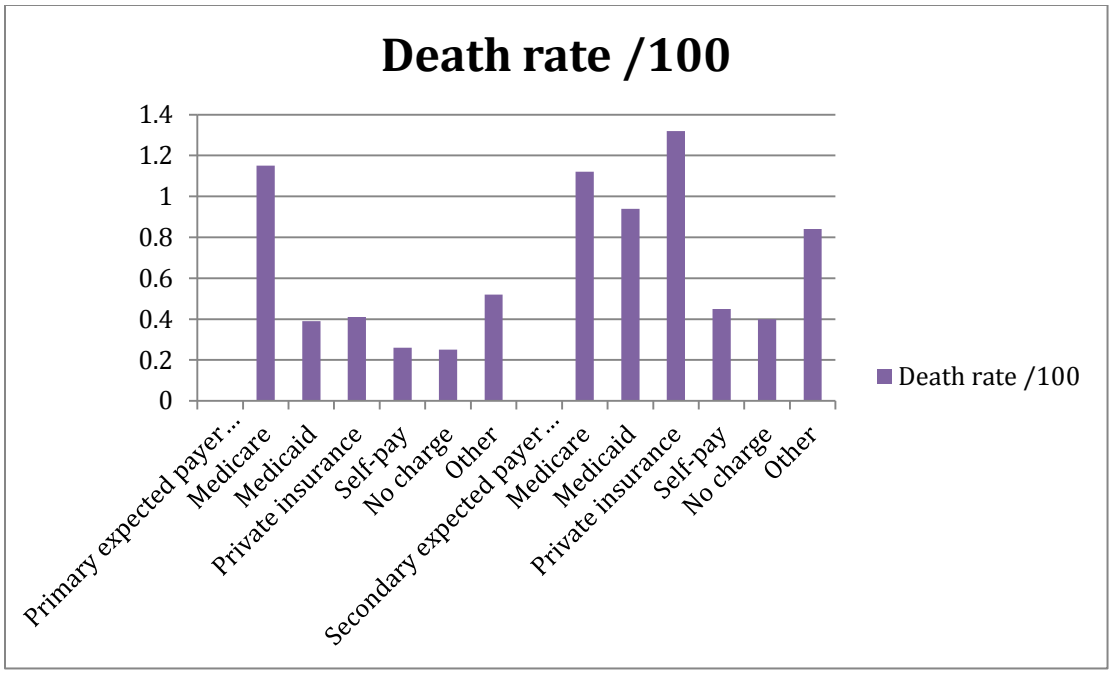

Figure 8: Comparison of the diabetes death rates of the study sample by insurance

Table 7: Comparison of the diabetes death rates in the study sample by patient location

Patient Location: NCHS Urban-Rural Code (V2006)	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
"Central" counties of metro areas of >=1 million population	140704	99.30	986	0.70		
"Fringe" counties of metro areas of >=1 million population	91370	99.35	602	0.65		
Counties in metro areas of 250,000-999,999 population	77748	99.26	576	0.74		
Counties in metro areas of 50,000-249,999 population	36594	99.35	239	0.65		
Micropolitan counties	47749	99.22	373	0.78		
Not metropolitan or micropolitan counties	30407	99.29	216	0.71	9.49	0.091

Table 7 shows the proportion of diabetic alive and dead and the death rate by their location. The chi-square test showed that there is no statistical significant difference in the death rate between the different locations (P>0.05).

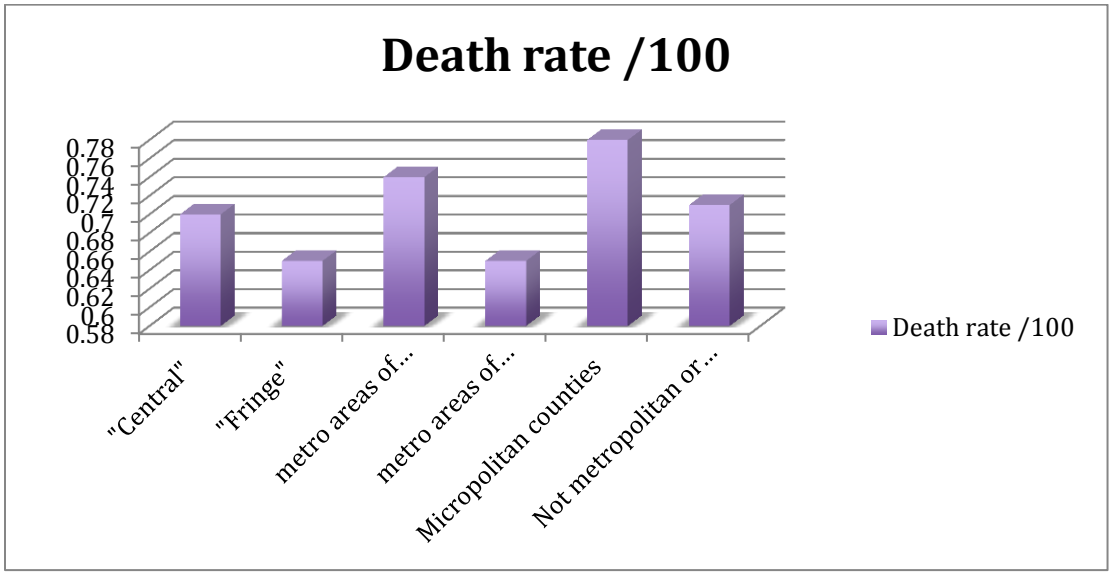

Figure 9: Comparison of the diabetes death rates in the study sample by patient location

Table 8: Comparison of the diabetes death rates in the study sample by point of origin for admission

Point of origin for admission or visit, UB-04 standard coding	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
Missing	185459	99.25	1400	0.75		
Non-health care facility point of origin	78215	99.39	477	0.61		
Clinic	6415	99.50	32	0.50		
Transfer from a hospital (different facility)	8381	98.58	121	1.42		
For non-newborn admissions (ATYPE ne 4): Transfer from a skilled Nursing Facility (SNF) or Intermediate Care Facility (ICF)	2617	97.58	65	2.42		
For newborn admissions (ATYPE = 4) beginning October 2007: Born inside this hospital	1693	98.89	19	1.11		
For non-newborn admissions (ATYPE ne 4): Transfer from another health care facility	152159	99.39	937	0.61		
For newborn admissions (ATYPE = 4) beginning October 2007: Born outside of this hospital	141	100.00	0	0.00		
Emergency room	1	100.00	0	0.00		
Court/law enforcement	1	100.00	0	0.00		
Transfer from another Home Health Agency	452	97.20	13	2.80		
Readmission to Same Home Health Agency	31	93.94	2	6.06		
Transfer from one distinct unit of the hospital to another distinct unit of the same hospital resulting in a separate claim to the payer	12	92.31	1	7.69	273.58	0.000

$$ Test result not valid

Table 8 shows the proportion of diabetic alive and dead and the death rate by their origin of admission. The chi-square test showed a statistical significant difference in the death rate between the different admission origins at alpha ($P<0.05$). The Subjects admitted from Readmission to Same Home Health Agency and those

transferred from one distinct unit of the hospital to another distinct unit of the same hospital resulting in a separate claim to the payer had the highest diabetes death rate of 6-7%. Those from emergency or from court or law enforcement had no death at all.

Table 9: Comparison of the diabetes death rates in the study sample by admission source

Admission source (uniform)	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
Emergency department	127302	99.31	885	0.69		
Another hospital	4258	97.80	96	2.20		
Other health facility including long-term care	2356	98.13	45	1.87		
Court/Law enforcement	165	100.00	0	0.00		
Routine including births and other sources	49946	99.28	364	0.72	172.4	0.000

Table 9 shows the proportion of diabetic alive and dead and the death rate by their source of admission. The chi-square test showed a statistical significant difference in the death rate between the different sources of admission at alpha ($P<0.05$). The Subjects admitted from another hospital had the highest diabetes death rate of 2.2% followed by those admitted from other health care facilities including long-term care with 1.87%. Those from court or law enforcement had no death at all.

Table 10: Comparison of the diabetes death rates in the study sample by admission source (according to UB-92 standard coding)

Admission source (UB-92 standard coding)	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
Missing	307253	99.33	2069	0.67		
Physician referral	29312	99.14	255	0.86		
Outpatient or Clinic	2550	99.49	13	0.51		
HMO	147	100.00	0	0.00		
Transfer from an acute care hospital	2861	97.71	67	2.29		
Transfer from a skilled nursing facility	757	97.18	22	2.82		
Transfer from another health care facility	660	98.51	10	1.49		
Emergency room	91890	99.32	631	0.68		
Court/Law enforcement	68	100.00	0	0.00		
Transfer from a rural primary care hospital	14	100.00	0	0.00		
Transfer from one distinct unit of the hospital to another distinct unit of the same hospital resulting in a separate claim to the payer	65	100.00	0	0.00	182.49	0.000

Table 10 shows the proportion of diabetic alive and dead and the death rate by their source of admission (UB-92 standard coding). The chi-square test showed a statistical significant difference in the death rate between the different sources of admission at alpha ($P<0.05$). The Subjects admitted from acute care hospital or skilled nursing facility or another health care facility had the highest diabetes death rate of 2.29, 2.82, and 1.49 respectively. Those from court or law enforcement transfer from rural primary care hospital, or those Transfer from one distinct unit of the hospital to another distinct unit of the same hospital resulting in a separate claim to the payer had no death at all.

Table 11: Comparison of the diabetes death rates in the study sample by admission type

Admission type	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
Emergency	279422	99.36	1794	0.64		
Urgent	67410	99.20	545	0.80		
Elective	42056	99.14	366	0.86		
Trauma Center	6	85.71	1	14.29	61.08	0.000

Table 11 shows the proportion of diabetic alive and dead and the death rate by their admission type. The chi-square test showed a statistical significant difference in the death rate between the different admission types at alpha (P<0.05). The Subjects admitted from trauma center had the highest diabetes death rate of 14%, followed by those admitted from delivery and elective 0.86%.

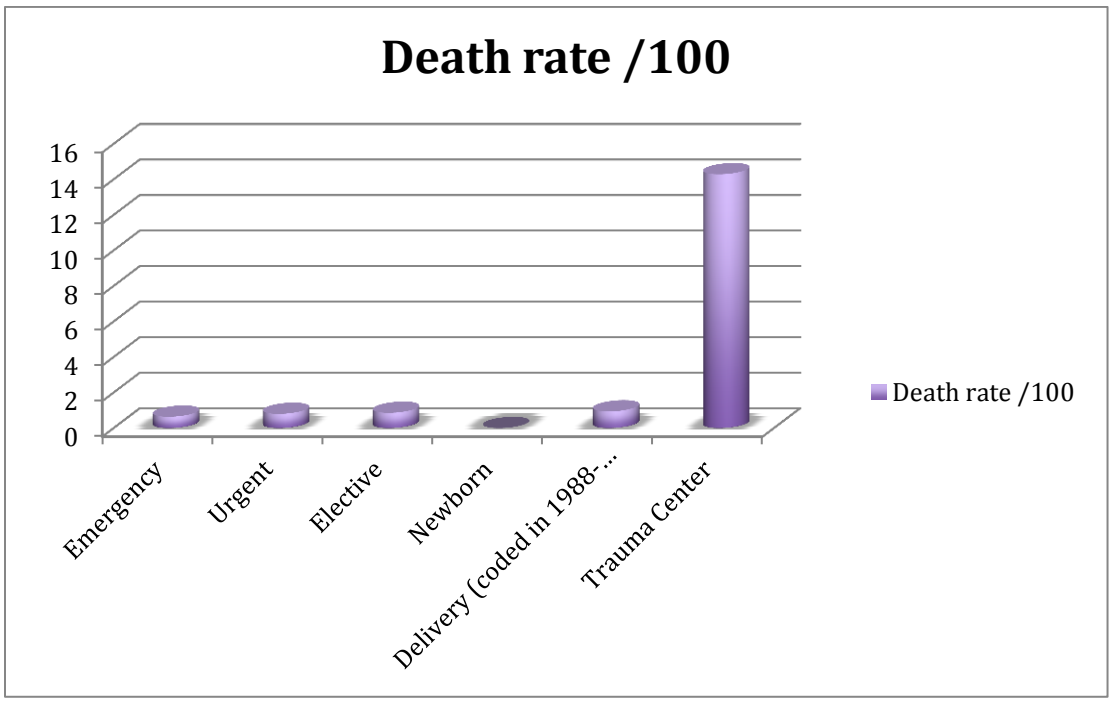

Figure 10: Comparison of the diabetes death rates in the study sample by admission type

Table 12: Comparison of the diabetes death rates in the study sample by weekday/end admission

Admission day is a weekend	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
Admitted Monday-Friday	339452	99.29	2416	0.71		
Admitted Saturday-Sunday	96121	99.33	651	0.67	1.26	0.263

Table 12 shows the proportion of diabetic alive and dead and the death rate by their day of admission. The chi-square test showed that there was no statistical significant difference in the death rate between the different day of admission at alpha (P>0.05). The Subjects admitted on weekday were no different from these admitted on weekend in their death rate.

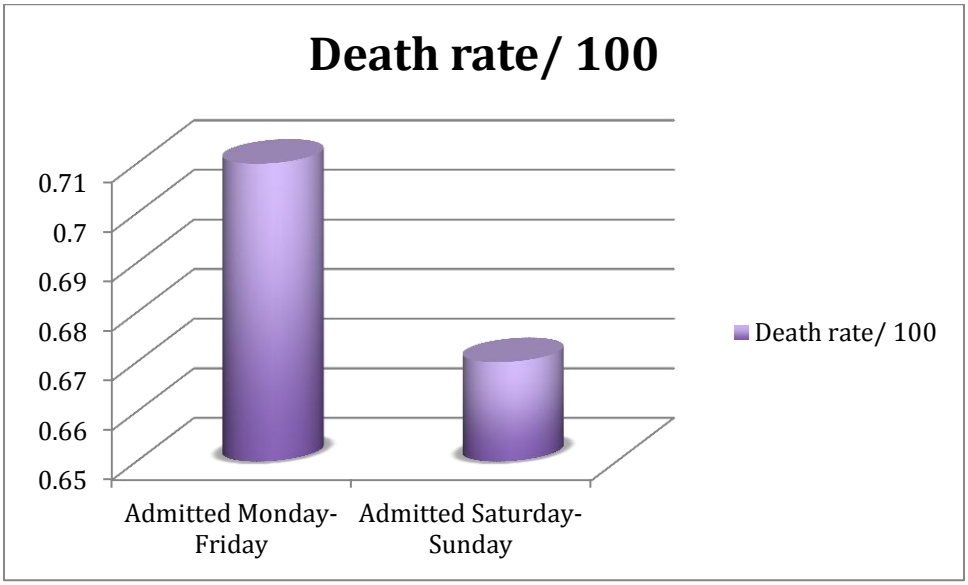

Figure 11: Comparison of the diabetes death rates in the study sample by weekday/end admission

Table 13: Comparison of the diabetes death rates in the study sample by quarter of discharge

	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
Discharge quarter (uniform values):						
First quarter (Jan - Mar)	110213	99.19	895	0.81		
Second quarter (Apr - Jun)	107757	99.36	693	0.64		
Third quarter (Jul - Sep)	108934	99.37	690	0.63		
Fourth quarter (Oct - Dec)	107946	99.28	786	0.72	32.29	0.000
Discharge quarter (as received from source):						
First quarter (Jan - Mar)	110407	99.19	897	0.81		
Second quarter (Apr - Jun)	107965	99.36	693	0.64		
Third quarter (Jul - Sep)	109126	99.37	692	0.63		
Fourth quarter (Oct - Dec)	107352	99.28	782	0.72	32.57	0.000

Table 13 shows the proportion of diabetic alive and dead and the death rate by their quarter of discharge. The chi-square test showed that there was a statistical significant difference in the death rate between the different quarters of discharge at alpha ($P<0.05$). The Subjects discharged in the first quarter (Winter) had the highest diabetic death rate 0.81%. While those discharged in the third quarter (Summer) had the lowest diabetic death rate 0.63%.

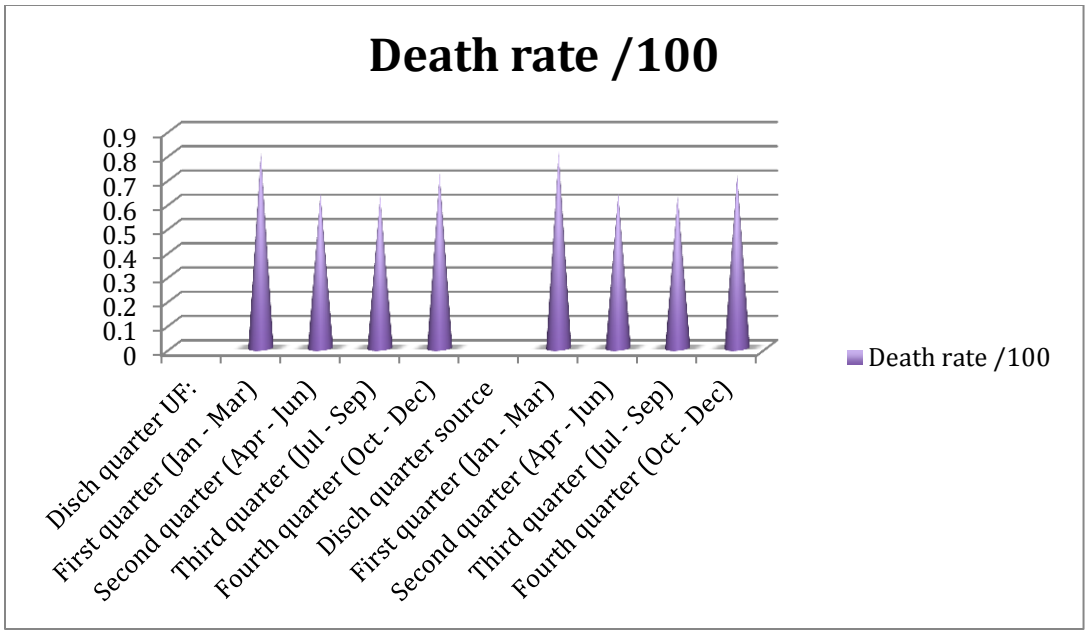

Figure 12: Comparison of the diabetes death rates in the study sample by quarter of discharge

Table 14: Comparison of diabetes death rates in the study sample by diagnosis

	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
ICD-9 CODE						
250.00	11458	99.68	37	0.32		
250.01	5595	99.91	5	0.09		
250.02	37566	99.68	121	0.32		
250.03	4577	99.85	7	0.15		
250.10	3032	99.15	26	0.85		
250.11	4500	99.84	7	0.16		
250.12	30793	99.27	228	0.73		
250.13	79403	99.73	212	0.27		
250.20	4807	98.61	68	1.39		
250.21	454	99.56	2	0.44		
250.22	8192	98.95	87	1.05		
250.23	1010	99.31	7	0.69		
250.30	1131	94.17	70	5.83		
250.31	193	94.15	12	5.85		
250.32	762	93.96	49	6.04		
250.33	743	92.41	61	7.59		
250.40	9582	98.16	180	1.84		
250.41	1925	99.38	12	0.62		
250.42	4483	98.94	48	1.06		
250.43	1108	99.28	8	0.72		
250.50	415	100.00	0	0.00		
250.51	102	100.00	0	0.00		
250.52	617	100.00	0	0.00		
250.53	120	100.00	0	0.00		
250.60	30837	99.61	120	0.39		
250.61	6652	99.88	8	0.12		
250.62	18892	99.71	55	0.29		
250.63	5984	99.80	12	0.20		
250.70	23858	97.85	525	2.15		
250.71	1301	98.94	14	1.06		
250.72	8165	98.47	127	1.53		
250.73	778	99.23	6	0.77		
250.80	84540	99.13	744	0.87		
250.81	6323	99.57	27	0.43		
250.82	27428	99.42	161	0.58		
250.83	3647	99.70	11	0.30		
250.90	747	99.87	1	0.13		
250.91	147	100.00	0	0.00		
250.92	3102	99.74	8	0.26		
250.93	608	99.84	1	0.16	3097.23	0.000

Table 15: IDC-9 code description

ICD-9 CODE	ICD-9 CODE DESCRIBTION
250.00	DIABETES MELLITUS WITHOUT MENTION OF COMPLICATION, TYPE II OR UNSPECIFIED TYPE, NOT STATED AS UNCONTROLLED
250.01	DIABETES MELLITUS WITHOUT MENTION OF COMPLICATION, TYPE I (JUVENILE TYPE), NOT STATED AS UNCONTROLLED
250.02	DIABETES MELLITUS WITHOUT MENTION OF COMPLICATION, TYPE II OR UNSPECIFIED TYPE, UNCONTROLLED
250.03	DIABETES MELLITUS WITHOUT MENTION OF COMPLICATION, TYPE I (JUVENILE TYPE) UNCONTROLLED
250.10	DIABETES WITH KETOASIDOSIS, TYPE II OR UNSPECIFIED TYPE, NOT STATED AS CONTROLLED
250.11	DIABETES WITH KETOASIDOSIS, TYPE I (JUVENILE TYPE), NOT STATED AS UNCONTROLLED
250.12	DIABETES WITH KETOASIDOSIS, TYPE II OR UNSPECIFIED TYPE, UNCONTROLLED
250.13	DIBETES WITH KETOASIDOSIS, TYPE I (JUVENILE TYPE), UNCONTROLLED
250.20	DIABETES WITH HYPEROSMOLARITY, TYPE II OR UNSPECIFIED TYPE, NOT STASTED AS UNCONTROLLED
250.21	DIABETES WITH HYPEROSMOLARITY, TYPE I (JUVENILE TYPE), NOT STATED AS UNCONTROLLED
250.22	DIABETES WITH HYPEROSMOLARITY, TYPE II OR UNSPECIFIED TYPE, UNCONTROLLED
250.23	DIABETES WITH HYPEROSMOLARITY, TYPE I (JUVENILE TYPE), UNCONTROLLED
250.30	DIABETES WITH OTHER COMA, TYPE II OR UNSPECIFIED TYPE, NOT STSTED AS CONTROLLED
250.31	DIABETES WITH OTHER COMA, TYPE I (JUVENILE TYPE), NOT STATED AS UNCONTROLLED
250.32	DIABETES WITH OTHER COMA, TYPE II OR UNSPECIFIED TYPE, UNCONTROLLED
250.33	DIABETES WITH OTHER COMA, TYPE I (JUVENILE TYPE), UNCONTROLLED
250.40	DIABETES WITH RENAL MANIFESTATION, TYPE II OR UNSPECIFIED TYPE, NOT STATED AS UNCONTROLLED
250.41	DIABETES WITH RENAL MANIFESTATION, TYPE I (JUVENILE TYPE), NOT STSTED AS UNCONTROLLED
250.42	DIABETES WITH RENAL MANIFESTATION, TYPE II OR UNSPECIFIED TYPE, UNCONTROLLED
250.43	DIABETES WITH RENAL MANIFESTATION, TYPE I (JUVENILE TYPE), UNCONTROLLED
250.50	DIABETES WITH OPHTHALMIC MANIFESTATION, TYPE II OR UNSPECIFIED TYPE, NOT STATED AS UNCONTROLLED

250.51	DIABETES WITH OPHTHALMIC MANIFESTATION, TYPE I (JUVENILE TYPE), NOT STATED AS UNCONTROLLED
250.52	DIABETES WITH OPHTHALMIC MANIFESTATION, TYPE II OR UNSPECIFIED, UNCONTROLLED
250.53	DIABETES WITH OPHTHALMIC MANIFESTATION, TYPE I (JUVENILE TYPE), UNCONTROLLED
250.60	DIABETES WITH NEUROLOGICAL MANIFESTATION, TYPE II OR UNSPECIFIED TYPE, NOT STATED AS UNCONTROLLED
250.61	DIABETES WITH NEUROLOGICAL MANIFESTATION, TYPE I (JUVENILE TYPE), NOT STATED AS UNCONTROLLED
250.62	DIABETES WITH NEUROLOGICAL MANIFESTATION, TYPE II OR UNSPECIFIED TYPE, UNCONTROLLED
250.63	DIABETES WITH NEUROLOGICAL MANIFESTATION, TYPE I (JUVENILE TYPE), UNCONTROLLED
250.70	DIABETES WITH PERIPHERAL CIRCULATORY DISORDERS, TYPE II OR UNSPECIFIED TYPE, NOT STATED AS UNCONTROLLED
250.71	DIABETES WITH PERIPHERAL CIRCULATORY DISORDERS, TYPE I (JUVENILE TYPE, NOT STATED AS UNCONTROLLED
250.72	DIABETES WITH PERIPHERAL CIRCULATORY DISORDERS, TYPE II OR UNSPECIFIED TYPE, UNCONTROLLED
250.73	DIABETES WITH PERIPHERAL CIRCULATORY DISORDERS, TYPE I (JUVENILE TYPE, UNCONTROLLED
250.80	DIABETES WITH OTHER SPECIFIED MANIFISTATION, TYPE II OR UNSPECIFIED TYPE, NOT STATED AS UNCONTROLLED
250.81	DIABETES WITH OTHER SPECIFIED MANIFISTATION, TYPE I (JUVENILE TYPE), NOT STATED AS UNCONTROLLED
250.82	DIABETES WITH OTHER SPECIFIED MANIFISTATION, TYPE II OR UNSPECIFIED TYPE, UNCONTROLLED
250.83	DIABETES WITH OTHER SPECIFIED MANIFISTATION, TYPE I (JUVENILE TYPE), UNCONTROLLED
250.90	DIABETES WITH OTHER UNSPECIFIED COMPLICATION, TYPE II OR UNSPECIFIED TYPE, NOT STATED AS UNCONTROLLED
250.91	DIABETES WITH OTHER UNSPECIFIED COMPLICATION, TYPE I (JUVENILE TYPE), NOT STATED AS UNCONTROLLED
250.92	DIABETES WITH OTHER UNSPECIFIED COMPLICATION, TYPE II OR UNSPECIFIED TYPE, UNCONTROLLED
250.93	DIABETES WITH OTHER UNSPECIFIED COMPLICATION, TYPE I (JUVENILE TYPE), UNCONTROLLED

Table 14 shows the proportion of diabetic alive and dead and the death rate by their diagnosis. The chi-square test showed that there was a statistical significant difference in the death rate between the different accompanying diagnoses at alpha ($P<0.05$). The Subjects diagnosed with 250.33 (DIABETES WITH OTHER COMA, TYPE I (JUVENILE TYPE), UNCONTROLLED) had the highest diabetic death rate 7.59%.

Table 16: Comparison of the diabetes death rates in the study sample by major diagnosis categories (MDC)

Major Diagnostic Category (MDC)	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
MDC appropriate for the date of discharge:						
(0) PRINCIPAL DX CAN NOT BE ASSIGNED TO MDC	1908	98.20	35	1.80		
(1) DISEASES & DISORDERS OF THE NERVOUS SYSTEM	62011	99.69	192	0.31		
(2) DISEASES & DISORDERS OF THE EYE	1249	100.00	0	0.00		
(5) DISEASES & DISORDERS OF THE CIRCULATORY SYSTEM	33846	98.07	665	1.93		
(10) ENDOCRINE, NUTRITIONAL & METABOLIC DISEASES & DISORDERS	319512	99.40	1928	0.60		
(11) DISEASES & DISORDERS OF THE KIDNEY & URINARY TRACT	17051	98.57	247	1.43	1106.67	0.000
MDC, version 24						
(0) PRINCIPAL DX CAN NOT BE ASSIGNED TO MDC	21	100.00	0	0.00		
(1) DISEASES & DISORDERS OF THE NERVOUS SYSTEM	62362	99.69	195	0.31		
(2) DISEASES & DISORDERS OF THE EYE	1254	100.00	0	0.00		
(5) DISEASES & DISORDERS OF THE CIRCULATORY SYSTEM	34102	98.07	672	1.93		
(10) ENDOCRINE, NUTRITIONAL & METABOLIC DISEASES & DISORDERS	320741	99.40	1952	0.60		
(11) DISEASES & DISORDERS OF THE KIDNEY & URINARY TRACT	17097	98.57	248	1.43	1080.69	0.000

Table 16 shows the proportion of diabetic alive and dead and the death rate by major diagnostic categories (MDC). First the MDC for the date of discharge were compared in the death rate by using chi-square test that shows a statistical significant difference in the death between the different MDC at alpha (P<0.05). Category 5 (DISEASES & DISORDERS OF THE CIRCULATORY SYSTEM) showed the highest death rate 1.93%. While those in category 2 (DISEASES & DISORDERS OF THE EYE) had no death at all. Then we checked the MDC V24 and compared the diabetes death rate by using chi-square test, which showed a statistical significant difference in the death between the different MDC (P<0.05). Category 5 shows the highest death rate 1.93%. While those in category 2 had no death at all

Table 17: Comparison of the diabetes death rates in the study sample by Diagnosis Related Group (DRG)

All Patient Refined DRG	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
Risk of Mortality Subclass						
No class specified	28	100.00	0	0.00		
Minor likelihood of dying	191499	99.96	82	0.04		
Moderate likelihood of dying	160397	99.79	341	0.21		
Major likelihood of dying	71922	98.63	997	1.37		
Extreme likelihood of dying	11731	87.69	1647	12.31	28187.95	0.000
Severity of Illness Subclass						
No class specified	28	100.00	0	0.00		
Minor loss of function (includes cases with no comorbidity or complications)	68813	99.93	46	0.07		
Moderate loss of function	188726	99.88	235	0.12		
Major loss of function	152531	99.43	880	0.57		
Extreme loss of function	25479	93.04	1906	6.96	16791.35	0.000

Table 17 shows the proportion of diabetic alive and dead and the death rate by the Diagnosis Related Group appropriate for the date of discharge (DRG). First at the risk of Mortality Subclass the subjects were compared in the death rate by using chi-square test that showed a statistical significant difference in the death between the different DRGs at alpha ($P<0.05$). The group with extreme likelihood of dying showed the highest death rate 12.31%, while those in no specific class had no death at all. Then we looked at the Severity of Illness Subclass and compared the diabetes death rate by using chi-square test, which showed a statistical significant difference in the death between the different DRGs ($P<0.05$). The group with extreme loss of function shows the highest death rate 6.96%, while those in no specific class had no death at all.

Table 18: Comparison of the diabetes death rates in the study sample by co-morbid conditions

AHRQ comorbidity measure	Status				X^2 Test	p-value
	Alive		Dead			
	No.	%	No.	%		
Acquired immune deficiency syndrome						
0-NO	434413	99.30	3054	0.70		
1-YES	1164	98.90	13	1.10	2.79	0.095
Alcohol abuse						
0-NO	419089	99.29	2987	0.71		
1-YES	16488	99.52	80	0.48	11.61	0.001
Deficiency anemias						
0-NO	346796	99.34	2292	0.66		
1-YES	88781	99.13	775	0.87	44.76	0.000
Rheumatoid /collagen vascular diseases						
0-NO	429379	99.30	3019	0.70		
1-YES	6198	99.23	48	0.77	0.44	0.508
Chronic blood loss anemia						
0-NO	432970	99.30	3037	0.70		
1-YES	2607	98.86	30	1.14	7.35	0.007
Congestive heart failure						
0-NO	386610	99.47	2073	0.53		
1-YES	48967	98.01	994	1.99	1352.10	0.000
Chronic pulmonary disease						
0-NO	379734	99.34	2522	0.66		
1-YES	55843	99.03	545	0.97	66.60	0.000
Coagulopathy						
0-NO	425723	99.35	2769	0.65		
1-YES	9854	97.06	298	2.94	748.48	0.000
Depression						
0-NO	388457	99.26	2896	0.74		
1-YES	47120	99.64	171	0.36	87.02	0.000
Drug abuse						
0-NO	415349	99.28	3008	0.72		
1-YES	20228	99.71	59	0.29	51.09	0.000
Hypertension						
0-NO	187777	99.31	1305	0.69		
1-YES	247800	99.29	1762	0.71	0.39	0.532
Hypothyroidism						
0-NO	396582	99.30	2786	0.70		
1-YES	38995	99.28	281	0.72	0.16	0.685
Liver disease						
0-NO	422378	99.31	2937	0.69		
1-YES	13199	99.02	130	0.98	15.10	0.000
Lymphoma						
0-NO	434130	99.30	3042	0.70		
1-YES	1447	98.30	25	1.70	21.24	0.000
Fluid and electrolyte disorders						
0-NO	263873	99.44	1480	0.56		
1-YES	171704	99.08	1587	0.92	193.57	0.000

Metastatic cancer						
0-NO	432495	99.33	2927	0.67		
1-YES	3082	95.65	140	4.35	621.43	0.000
Other neurological disorders						
0-NO	407814	99.35	2659	0.65		
1-YES	27763	98.55	408	1.45	243.31	0.000
Obesity						
0-NO	384717	99.28	2800	0.72		
1-YES	50860	99.48	267	0.52	26.11	0.000
Paralysis						
0-NO	428294	99.32	2936	0.68		
1-YES	7283	98.23	131	1.77	123.83	0.000
Peripheral vascular disorders						
0-NO	384557	99.39	2358	0.61		
1-YES	51020	98.63	709	1.37	380.75	0.000
Psychoses						
0-NO	410113	99.29	2948	0.71		
1-YES	25464	99.53	119	0.47	21.43	0.000
Pulmonary circulation disorders						
0-NO	430119	99.33	2882	0.67		
1-YES	5458	96.72	185	3.28	547.71	0.000
Renal failure						
0-NO	342809	99.49	1756	0.51		
1-YES	92768	98.61	1311	1.39	831.55	0.000
Solid tumor without metastasis						
0-NO	431328	99.31	2975	0.69		
1-YES	4249	97.88	92	2.12	127.35	0.000
Peptic ulcer disease excluding bleeding						
0-NO	435431	99.30	3065	0.70		
1-YES	146	98.65	2	1.35	Fisher	0.277
Valvular disease						
0-NO	424857	99.32	2912	0.68		
1-YES	10720	98.57	155	1.43	84.68	0.000
Weight loss						
0-NO	419429	99.38	2626	0.62		
1-YES	16148	97.34	441	2.66	953.15	0.000

Table 18 shows the proportion of diabetic alive and dead and the death rate by co morbid conditions. We compared the diabetic death rate in different conditions using chi-square test, which showed that there was no statistical significant difference in the death rate in diabetic subjects with AIDS, rheumatoid or vascular disease, hypertension, hypothyroidism, and peptic ulcer diseases at alpha ($P>0.05$). And it showed statistical

significant increase in death rate among diabetic with the other co-morbid conditions at alpha (P<0.05) as it shows in table 18.

4.2 Bivariate analysis for the continuous variables

Table 19: Comparison of the age of diabetes patients according to living status

	Status												Difference		t	p
	Alive						Dead									
	N	Mean	SD	Median	Qrtl1	Qrtl3	N	Mean	SD	Median	Qrtl1	Qrtl3	Mean	SE		
Age in years at admission	435335	51.98	20.36	53.00	38.00	67.00	3067	67.73	15.77	70.00	57.00	80.00	-15.75	0.29	-55.00	0.000

Table 19 shows the mean age of diabetic alive and dead and the mean difference. We compared the age of diabetic alive and dead using t-test, which showed that there is a statistical significant difference in the age of diabetic subjects alive or dead at alpha (P<0.05). We can see from the analysis that the diabetic subjects who died were older in average by about 15 years.

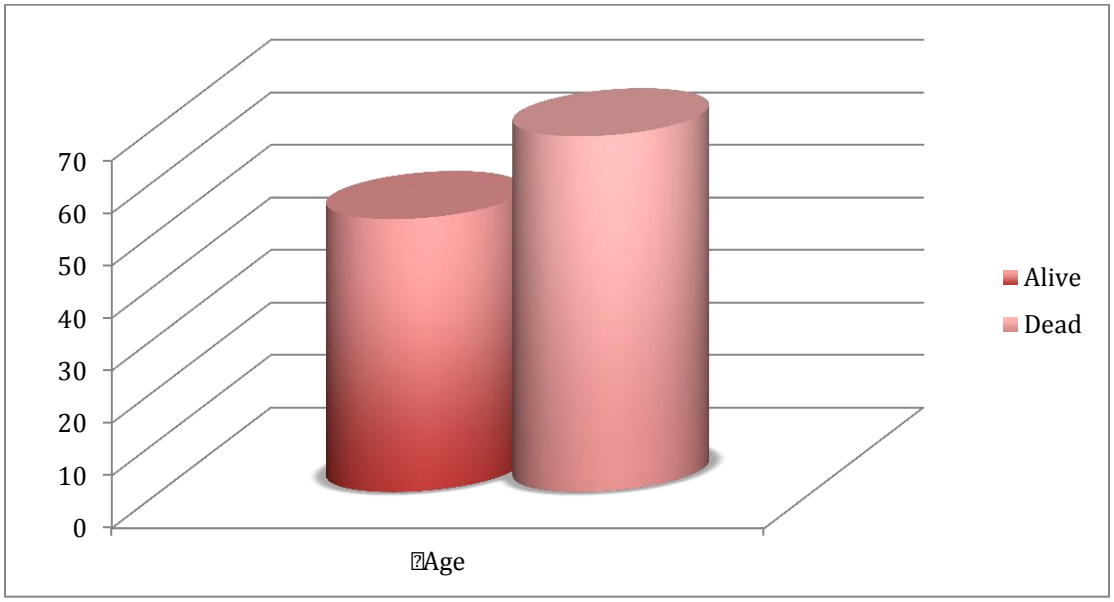

Figure 13: Comparison of the age of diabetes patients according to living status

Table 20: Comparison of the weight at discharge of diabetes patients according to living status

	Status												Difference		t	p
	Alive						Dead									
	N	Mean	SD	Median	Qrtl1	Qrtl3	N	Mean	SD	Median	Qrtl1	Qrtl3	Mean	SE		
Weight to discharges in the universe for national estimates of total charge in 2000.	435577	4.97	0.58	4.97	4.69	5.32	3067	4.96	0.55	4.95	4.68	5.32	0.01	0.01	0.96	0.336

Table 20 shows the mean weight of diabetic patient alive and dead and the mean difference at discharge. We compared the weight of diabetic patients alive and dead using t-test, which showed that there is no statistical significant difference in the weight of diabetic subjects alive or dead at alpha (P>0.05).

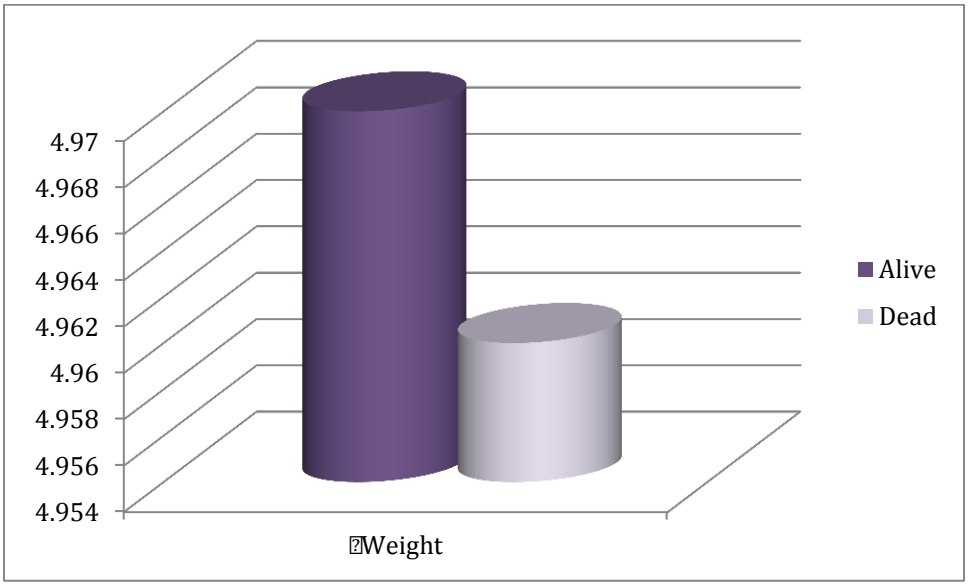

Figure 14: Comparison of the weight at discharges of diabetes patients according to living status

Table 21: Comparison of the length of stay at the hospital of diabetes patients according to living status

	Status												Difference		t	p
	Alive						Dead									
	N	Mean	SD	Median	Qrtl 1	Qrtl3	N	Mean	SD	Median	Qrtl 1	Qrtl 3	Mean	SE		
Length of stay (cleaned)	435547	4.88	6.16	3.00	2.00	6.00	3065	12.86	20.05	7.00	3.00	16.00	-7.98	0.36	-22.04	0.0000
Length of stay (as from source)	434750	4.91	10.20	3.00	2.00	6.00	3066	13.45	32.40	7.00	3.00	16.00	-8.55	0.59	-14.60	0.0000

Table 21 shows the mean length of stay (LOS) in a hospital of diabetic alive and dead and the mean difference. We compared the LOS of diabetic alive and dead using t-test, which showed that there is statistical significant difference in the LOS of diabetic subjects alive or dead at alpha (P<0.05). We can see from the analysis that the diabetic subjects who died had longer stays in average by about 7 days.

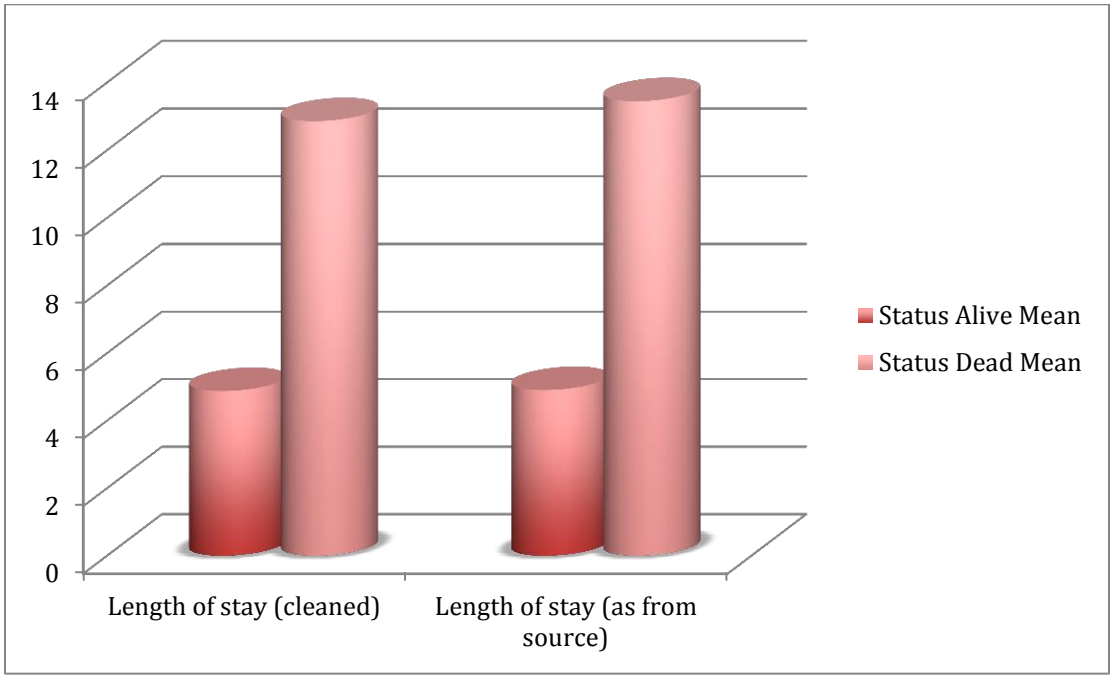

Figure 15: Comparison of the length of stay of diabetes patients at a hospital according to living status

Table 22: Comparison of the number of diagnosis, E-code and procedure among diabetes patients according to living status

	Status												Difference		t	p
	Alive						Dead									
	N	Mean	SD	Median	Qrtl 1	Qrtl 3	N	Mean	SD	Median	Qrtl 1	Qrtl 3	Mean	SE		
No. of diagnoses on this record	435577	9.62	5.01	9.00	6.00	13.00	3067	14.12	6.03	14.00	9.00	18.00	-4.50	0.11	-41.21	0.000
No. of E codes on record	435577	0.16	0.51	0.00	0.00	0.00	3067	0.27	0.67	0.00	0.00	0.00	-0.12	0.01	-9.71	0.000
No. of procedures on record	435577	1.05	1.83	0.00	0.00	1.00	3067	4.08	3.92	3.00	1.00	6.00	-3.03	0.07	-42.74	0.000

Table 22 shows the mean number of diagnosis, e-codes, and procedures of diabetic patients alive and dead and the mean difference. We compared the age of diabetic patients alive and dead using t-test, which showed that there is statistical significant difference in the number of diagnosis, e-codes, and procedures of diabetic subjects alive or dead at alpha ($P<0.05$). We can see from the analysis that the diabetic subjects who died had higher number of diagnosis, e-codes, and procedures in average by about 4.5, 0.12, and 3.03 respectively.

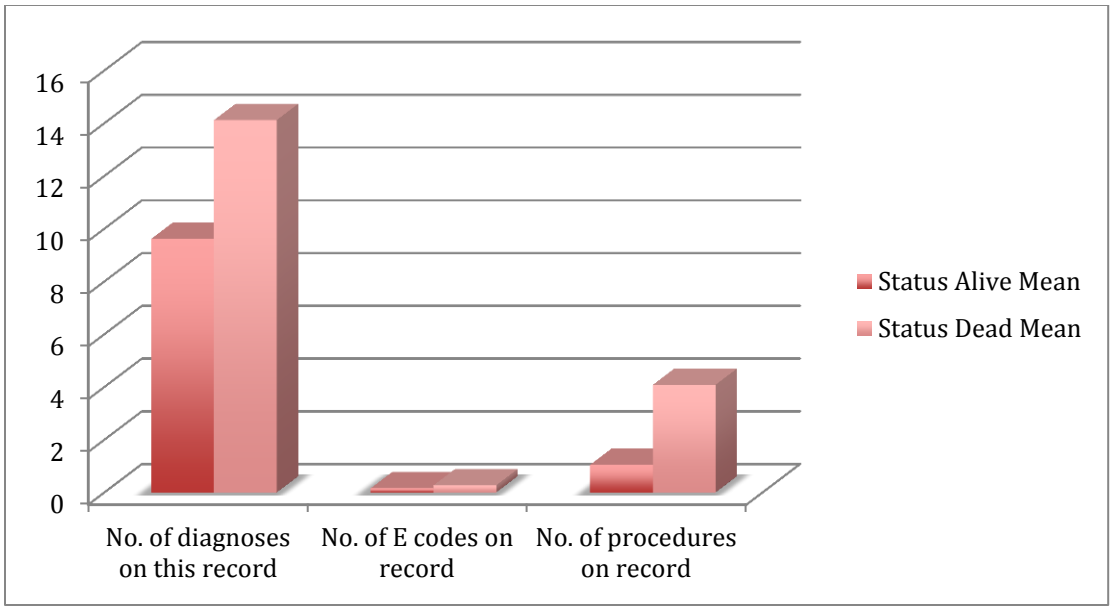

Figure 16: Comparison of the number of diagnosis, E-code and procedures among diabetes patients according to living status

Table 23: Comparison of the number of days from admission to procedure among diabetes patients according to living status

	Alive				Dead				Difference			
	N	Mean	SD	Median	N	Mean	SD	Median	Mean	SE	t	p
No. of days from admission to:												
Procedure on Nervous System	163180	2.57	4.17	1.00	2241	5.33	8.96	2.00	-2.76	0.19	-14.57	0.000
Procedure on Endocrine System	85661	3.29	4.85	2.00	1823	5.95	9.11	3.00	-2.66	0.21	-12.42	0.000
Procedure on Eye	51429	4.04	5.86	2.00	1521	6.69	9.28	4.00	-2.65	0.24	-11.06	0.000
Procedure on Ear	32030	4.80	6.78	3.00	1221	7.96	10.86	5.00	-3.16	0.31	-10.09	0.000
Procedure on Nose, Mouth, and Pharynx	20487	5.54	7.83	3.00	1002	8.86	12.22	5.00	-3.33	0.39	-8.53	0.000
Procedure on Respiratory System	13714	6.24	8.17	4.00	800	9.81	11.71	7.00	-3.57	0.42	-8.51	0.000
Procedure on Cardiovascular System	7422	7.00	8.93	4.00	531	12.11	15.06	8.00	-5.11	0.66	-7.73	0.000
Procedure on Hemic and Lymphatic System	5085	7.85	10.44	5.00	430	12.85	14.90	8.00	-5.00	0.73	-6.82	0.000
Procedure on Digestive System	3313	8.50	10.82	6.00	327	13.10	14.81	9.00	-4.59	0.84	-5.47	0.000
Procedure on Urinary System	2282	9.49	11.69	6.00	268	12.94	18.22	9.00	-3.46	1.14	-3.03	0.003
Procedure on Male Genital Organs	1471	10.49	12.57	7.00	199	14.35	15.37	10.00	-3.87	1.14	-3.40	0.001
Obstetrical Procedures	987	11.30	14.05	7.00	146	14.84	15.24	10.00	-3.53	1.34	-2.64	0.009
Obstetrical Procedures	691	12.45	15.25	8.00	102	16.63	18.39	13.00	-4.18	1.91	-2.19	0.031
Procedure on Musculoskeletal System	490	13.76	14.68	10.00	86	20.76	20.38	15.50	-7.00	2.30	-3.05	0.003
Procedure on Integumentary System	350	14.62	15.20	11.00	71	20.54	28.66	15.00	-5.92	3.50	-1.69	0.095

Table 23 shows the mean number of days from admission to procedures of diabetic alive and dead and the mean difference. We compared the number of days from admission to procedures of diabetic alive and dead using t-test, which showed that there is statistical significant difference in the number of days from admission to procedures of diabetic subjects alive or dead at alpha (P<0.05). We can see from the analysis that the diabetic subjects who died had higher number of days from admission to procedures on all procedures up to the musculoskeletal system procedures, when in procedures on Integumentary system they show no statistical significant difference.

Table 24: Comparison of the number of total charges among diabetes patients according to living status

	Status												Difference		t	p
	Alive						Dead									
	N	Mean	SD	Median	Qrtl1	Qrtl3	N	Mean	SD	Median	Qrtl1	Qrtl3	Mean	SE		
Total charges (cleaned)	428165	27625.49	42169.18	15523.00	8738.00	29599.00	2977	92700.15	138992.56	44666.00	17582.50	109108.00	-65074.65	801.52	-25.54	0.000
Total charges (as from source)	427587	27679.37	43097.03	15528.61	8737.81	29616.47	2984	98104.70	181025.00	44747.00	17645.85	110263.75	-70425.3	3314.547	-21.25	0.000

Table 24 shows the mean charges of diabetic alive and dead and the mean difference. We compared the charges of diabetic alive and dead using t-test, which showed that there is statistical significant difference in the charges of diabetic subjects alive or dead at alpha (P<0.05). We can see from the analysis that the diabetic subjects who died had higher charges in average by about 25.

Table 25: Comparison of the number of all patient refined Diagnosis Related Group (DRG) among diabetes patients according to living status

	Status												Difference		t	p
	Alive						Dead									
	N	Mean	SD	Median	Qrtl1	Qrtl3	N	Mean	SD	Median	Qrtl1	Qrtl3	Mean	SE		
All Patient Refined DRG	435577	354.20	151.03	420.00	314.00	420.00	3067	359.48	162.05	420.00	305.00	420.00	-5.28	2.935	-1.80	0.072
All Patient Refined DRG: Severity of Illness Subclass	435577	2.31	0.80	2.00	2.00	3.00	3067	3.51	0.70	4.00	3.00	4.00	-1.21	0.01	-94.65	0.000

Table 25 shows the mean number of patient Diagnosis Related Group (DRG) of diabetic alive and dead and the mean difference. We compared the number of patient (DRG) s of diabetic alive and dead using t-test, which showed that there is no statistical significant difference in the number of patient (DRG) s of diabetic subjects alive or dead at alpha (P>0.05). We compared the number of patient (DRG) s with severe illness of diabetic alive and dead using t-test, which showed that there is statistical significant difference in the number of patient (DRG) s with severe illness of diabetic subjects alive or dead at alpha (P>0.05).

Table 26: Comparison of the number of median household income among diabetes patients according to living status

	Status												Difference		t	p
	Alive						Dead									
	N	Mean	SD	Median	Qrtl1	Qrtl3	N	Mean	SD	Median	Qrtl1	Qrtl3	Mean	SE		
Median household income national quartile for patient ZIP Code	422735	2.14	1.08	2.00	1.00	3.00	2979	2.17	1.12	2.00	1.00	3.00	-0.03	0.02	-1.24	0.215

Table 26 shows the mean number of median household income of diabetic alive and dead and the mean difference. We compared the number of median household income of diabetic alive and dead using t-test, which shows that there is no statistical significant difference in the number of median household income of diabetic subjects alive or dead at alpha (P>0.05).

4.3 Multivariate Analysis

Table 27: Hierarchal logistic regression analysis - Categorical Variable Coding for Reference Groups

Variables	Code	Parameter coding				
		(1)	(2)	(3)	(4)	(5)
Patient Location: NCHS Urban-Rural Code (V2006)	1	1	0	0	0	0
	2	0	1	0	0	0
	3	0	0	1	0	0
	4	0	0	0	1	0
	5	0	0	0	0	1
Reference	6	0	0	0	0	0
Primary expected payer (uniform)	1	1	0	0	0	0
	2	0	1	0	0	0
	3	0	0	1	0	0
	4	0	0	0	1	0
	5	0	0	0	0	1
Reference	6	0	0	0	0	0
Secondary expected payer (uniform)	1	1	0	0	0	0
	2	0	1	0	0	0
	3	0	0	1	0	0
	4	0	0	0	1	0
	5	0	0	0	0	1
Reference	6	0	0	0	0	0
Race (uniform)	1	1	0	0	0	0
	2	0	1	0	0	0
	3	0	0	1	0	0
	4	0	0	0	1	0
	5	0	0	0	0	1
Reference	6	0	0	0	0	0
Admission type ***Reference***	1	0	0	0	0	
	2	1	0	0	0	
	3	0	1	0	0	
	4	0	0	1	0	
	5	0	0	0	1	
Discharge quarter (as received from source)	1	1	0	0		
	2	0	1	0		
	3	0	0	1		
Reference	4	0	0	0		

Model 1: Demographics characteristics

Table 28: Logistic regression model predicting living status from demographic variables

	Wald	*df*	P	OR	95.0% CI	
					Upper	Lower
Age	144.854	1	0	1.044	1.037	1.052
Constant	778.939	1	0	0.001		
Nagelkerke R Square: 0.046						
Hosmer and Lemeshow Test: p=0.267						
Tests of Model Coefficients: p<0.001						

In Table 28 I performed a logistic regression model to predict the living status of diabetic patients from demographic variables age, gender, race. We found that the model showed that the global test was statistically significant (Likelihood Ratio Chi square p<0.001). We found that for every one-year increase in age, we expect to see a 4% increase in the odds of being at high risk for death. This relationship was statistically the only significant relation among the demographic factors. According to the R square this model only explains 4% of the variability of the living status of the diabetic subjects.

Model 2: Socio-economic variables

Table 29: Logistic regression model predicting living status from Sociao-economic variables

	Wald	*df*	P	OR	95.0% CI	
					Upper	Lower
AGE	355.833	1	0.000	1.04	1.04	1.05
TOTAL CHARGE	848.469	1	0.000	1.00	1.00	1.00
PL_NCHS2006	20.364	5	0.001			
PL_NCHS2006(1)	4.896	1	0.027	0.77	0.60	0.97
PL_NCHS2006(2)	11.7	1	0.001	0.65	0.51	0.83
PL_NCHS2006(3)	1.725	1	0.189	0.84	0.65	1.09
PL_NCHS2006(4)	2.147	1	0.143	0.80	0.60	1.08
PL_NCHS2006(5)	0.003	1	0.957	0.99	0.76	1.30
Constant	1521.73	1	0.000	0.00		
Nagelkerke R Square: 0.097						
Hosmer and Lemeshow Test: p=0.001						
Tests of Model Coefficients: p<0.001						

Table 30: Patient location classification used in Table 29

Variable	Description	Value	Value Description
PL_NCHS2006	Patient Location: NCHS Urban-Rural Code, 2006	1	"Central" counties of metro areas of >=1 million population
		2	"Fringe" counties of metro areas of >=1 million population
		3	Counties in metro areas of 250,000-999,999 population
		4	Counties in metro areas of 50,000-249,999 population
		5	Micropolitan counties
		6	Not metropolitan or micropolitan counties
		.	Missing

In Table 29 I performed a logistic regression model to predict the living status of diabetic patients from Socio-economic variables. We found that the model showed the global test was statistically significant (Likelihood Ratio Chi square p<0.001). We found that for every one-year increase in age, we expect to see a 4% increase in the odds of

being at high risk for death. This relationship was statistically significant at alpha ($P<0.05$). The total charge variable was significant predictor of the living status of diabetic patients at alpha ($P<0.05$). Location of residence was also a social significance predictor of living status of diabetic patients. According to the R square this model only explains 9% of the variability of the living status of the diabetic subjects.

Model 3: Health/disease factors

Table 31: Logistical regression model predicting living status according to Health/disease factors

	Wald	*df*	P	OR	95.0% CI	
					Upper	Lower
AGE	55.721	1	0.000	1.02	1.01	1.02
TOTAL CHARGE	1.248	1	0.264	1.00	1.00	1.00
Patient Location	35.604	5	0.000			
Patient Location (1)	14.902	1	0.000	0.61	0.47	0.78
Patient Location (2)	27.227	1	0.000	0.50	0.39	0.65
Patient Location (3)	13.487	1	0.000	0.60	0.46	0.79
Patient Location (4)	5.903	1	0.015	0.68	0.50	0.93
Patient Location (5)	2.058	1	0.151	0.81	0.61	1.08
Number of diagnoses on this record	14.488	1	0.000	0.97	0.95	0.99
Number of procedures on this record	196.402	1	0.000	1.18	1.15	1.21
All Patient Refined DRG: Risk of Mortality Subclass Mortality	466.385	1	0.000	4.23	3.71	4.82
All Patient Refined DRG: Severity of Illness Subclass	60.722	1	0.000	1.82	1.57	2.12
Comorbidities:						
ALCOHOL	2.735	1	0.098	0.62	0.35	1.09
ANEMDEF	15.966	1	0.000	0.73	0.62	0.85
BLDLOSS	4.189	1	0.041	0.42	0.18	0.96
CHF	7.403	1	0.007	1.22	1.06	1.41
COAG	2.825	1	0.093	1.23	0.97	1.57
DEPRESS	9.596	1	0.002	0.64	0.48	0.85
DMCX	14.222	1	0.000	0.70	0.58	0.84
LYTES	4.005	1	0.045	0.87	0.76	1.00
METS	35.021	1	0.000	2.65	1.92	3.65
NEURO	4.474	1	0.034	1.23	1.02	1.49
PERIVASC	6.364	1	0.012	0.81	0.68	0.95
PULMCIRC	5.091	1	0.024	1.38	1.04	1.82
TUMOR	6.856	1	0.009	1.62	1.13	2.33
WGHTLOSS	8.001	1	0.005	1.31	1.09	1.59
Constant	1579.099	1	0.000	0.00		
Nagelkerke R Square: 0.311						
Hosmer and Lemeshow Test: p=0.196						
Tests of Model Coefficients: p<0.001						

In Table 31 I performed a logistic regression model to predict the living status of diabetic patients adjusting for Socio-economic and health/disease variables. We found that the model showed the global test was statistically significant (Likelihood Ratio Chi square $p<0.001$). We found that for every one-year increase in age, we expect to see a 2% increase in the odds of being at high risk for death. This relationship was statistically significant at alpha ($P<0.05$). The total charge variable was significant predictor of the living status of diabetic patients at alpha ($P<0.05$). Location of residence also was statistical significant predictor of living status of diabetic patients. The number of diagnosis, procedures, Diagnosis Related Group Risk Mortality, Diagnosis Related Group Risk severity, and the addition of co-morbid condition was statistical significant predictor of living status of diabetic patients. According to the R square this model only explains 31% of the variability of the living status of the diabetic subjects.

Model 4: Health care variables

Table 32: Logistical regression model prediction living status according to Health care variables

	Wald	*df*	P	OR	95.0% CI	
					Upper	Lower
AGE	59.147	1	0.000	1.02	1.02	1.03
TOTCHG	8.924	1	0.003	1.00	1.00	1.00
Patient Location	36.177	5	0.000	1.00		
Patient Location (1)	14.08	1	0.000	0.62	0.48	0.79
Patient Location (2)	27.675	1	0.000	0.50	0.38	0.65
Patient Location (3)	13.664	1	0.000	0.60	0.45	0.79
Patient Location (4)	5.769	1	0.016	0.68	0.50	0.93
Patient Location (5)	2.014	1	0.156	0.81	0.61	1.08
Number of Diagnoses	13.031	1	0.000	0.97	0.96	0.99
Number of Procedures	206.892	1	0.000	1.19	1.16	1.22
All Patient Refined DRGs_Risk_Mortality	465.53	1	0.000	4.23	3.71	4.82
All Patient Refined DRGs_Severity	63.27	1	0.000	1.85	1.59	2.15
Co-morbidities:						
ALCOHOL	3	1	0.083	0.60	0.34	1.07
ANEMDEF	17.186	1	0.000	0.72	0.62	0.84
BLDLOSS	4.318	1	0.038	0.41	0.18	0.95
CHF	7.849	1	0.005	1.23	1.06	1.42
COAG	2.578	1	0.108	1.22	0.96	1.56
DEPRESS	9.815	1	0.002	0.63	0.48	0.84
DMCX	14.016	1	0.000	0.70	0.59	0.85
LYTES	4.307	1	0.038	0.86	0.75	0.99
METS	34.876	1	0.000	2.65	1.92	3.66
NEURO	4.417	1	0.036	1.23	1.01	1.49
PERIVASC	7.067	1	0.008	0.80	0.67	0.94
PULMCIRC	5.324	1	0.021	1.39	1.05	1.83
TUMOR	7.435	1	0.006	1.66	1.15	2.38
WGHTLOSS	10.452	1	0.001	1.37	1.13	1.66
Discharge Quarter	13.074	3	0.004	1.00		
Discharge Quarter (1)	1.273	1	0.259	1.11	0.93	1.32
Discharge Quarter (2)	4.294	1	0.038	0.82	0.68	0.99
Discharge Quarter (3)	2.621	1	0.105	0.86	0.71	1.03
LOS	10.516	1	0.001	0.99	0.98	1.00
Constant	1502.109	1	0.000	0.00		
Nagelkerke R Square: 0.312						
Hosmer and Lemeshow Test: p=0.095						
Tests of Model Coefficients: p<0.001						

Table 33 Discharge quarter data used in table 32

Variable	Description	Value	Value Description
DQTR	Discharge quarter	1	First quarter (Jan - Mar)
		2	Second quarter (Apr - Jun)
		3	Third quarter (Jul - Sep)
		4	Fourth quarter (Oct - Dec)
		0	Missing or invalid

In Table 32 I performed a logistic regression model to predict the living status of diabetic patients adjusting for from Socio-economic and health/disease variables. We found that the model showed that the global test was statistically significant (Likelihood Ratio Chi square $p<0.001$). We found that for every one-year increase in age, we expect to see a 2% increase in the odds of being at high risk for death. This relationship was statistically significant at alpha ($P<0.05$). The total charge variable was significant predictor of the living status of diabetic patients at alpha ($P<0.05$). Location of residence also was statistical significant predictor of living status of diabetic patients. The number of diagnosis, procedures, Diagnosis Related Group Risk Mortality, Diagnosis Related Group Risk severity, discharge quarter, LOS, and the addition of co-morbid condition was statistical significant predictor of living status of diabetic patients. According to the R square this model only explains 31% of the variability of the living status of the diabetic subjects. We found that the subjects residing in areas 1,2,3,4 are at least 38 % less likely to be dead compared to those residing in area 6 and these relationships are statistically significant at alpha ($P<0.05$). Addition of 1 procedure has 19% more increase

in the odds of being in the dead diabetic category and this relationship is statistically significant at alpha ($P<0.05$). Patient with higher Risk of Mortality DRG's have 4 times higher odds of being in the dead diabetic group category. The discharge quarter was also a positive statically significant predictor of diabetic living status with those in group 2 have 18% decrease odds of being in the dead diabetic group compared to those in group 4 (the reference group).

Chapter V

V. Discussion

This research shows that there is an association between some but not all of the cardiovascular diseases with Diabetes Mellitus death rate. This can agree with some of the results by barr et al., 2009; selvvin et al., 2010) where they showed that the increased blood sugar is highly associated with vascular and nonvascular premature mortality.

This study, as with previous studies show that cardiovascular complications of diabetes like coronary artery disease (CAD) cause an increase in diabetic mortality. It also agrees with previous studies where an increased morbidity and mortality have been shown in patients with both systemic hypertension and diabetes ***(Danbauchi et al., 2005; Palmieri et al., 2001; Hildebrandt et al., 2005; Aigbe et al. 2012)***.

The results of the degree of the effect of each of the risk factors have varied in their significance but their predictive values have agreed mostly closely with the previous literature.

Death rate has been decreasing over the years; also the disease and risk factors affect both males and females very similarly. In comparison,

gender as a risk factor affecting diabetes and its outcomes has shown in previous studies to have a reduction in mortality in the general population in the last two decades, females benefited less from this trend, in a study it was shown that females actually may have an increase in diabetes related mortality. In a cohort of studies females had 50% more fatal coronary heart disease and 50% worse outcome after a myocardial infarction when compared to males. In another retrospect study, diabetic patients with abnormal stress myocardial perfusion imaging, woman had worse outcome than men. Generally astudies have agreed that women seem to have higher risk than men for cardiovascular disease and both symptomatic as well as asymptomatic women are at greater risk of developing cardiovascular complications ***(Tandon et al., 2012; Gregg et al., 2007; Preis et al., 2009; Ford et al., 2007; Huxley et al., 2006; Mukamal et al., 2001; Graham et al., 2003; Giri et al., 2002; Mosca et al., 2011)***.

The regression model showed the additive effect of several risk factors on the odds of death in diabetic subjects, in contrast other previous studies didn't find the addition of metabolic syndrome to diabetes to be significant in the death rate ***(Church et al., 2009; Hu et al., 2004; Malik et***

al., 2004; Tong et al. 2007; Alexander et al. 2003; Hunt et al. 2004; Cull et al. 2007).

This study agrees with previous studies that found that dibateic caused death rate due to heart failure is higer ***(Pocock et al., 2006; MacDonald et al., 2008; He et al., 2001)***.

Patients who died were generally 15 years older; also race showed a variation in death rate, others and native Americans had the highest and the lowest death rates respectively.

When I performed a logistic regression model analysis to predict the living status of the diabetic patients from the demographic variables, I found that age had the only significant relationship with the odds of risk of death. For every one year increase in the age we expect to see a 4% increase in the odds of being at high risk of death. According to the R square this only explains 4% of the variability of the living status of the diabetic subjects.

Income data showed a statistical significant difference in the death rate between different income groups. Subjects in the 76^{th} to 100^{th} percentile had the highest death rate while subjects in the 51^{st} to 75^{th}

percentile had the lowest rate. In contrast studies have found that mortality in middle age groups (30-46) have been affected more by the income factor by widening of the mortality rate, in comparison with older age groups which didn't show much differences in health outcome between high and low income patients ***(Mackenbach et al., 2003; Mackenbach et al., 2008; Wilkins et al., 2002***; ***Grant et al., 2004; Lipscombe et al. 2010)***.

Comparing death rates in the study sample by insurance showed a statistical significant difference in the death rate between different insurance plans for the primary expected payer. The highest death rate was associated with Medicare, which is expected due to the older age of participants while no charge or self-pay plans subjects had the lowest death rate. The same findings were observed for the secondary expected payer.

Analyzing the number of total charges for diabetic patients showed that patients who died a higher bill by $65074.65.

Patient's residence had no statistical significance on death rate.

When incorporating socioeconomic factors to the demographic into the regression model it was found that total charge and patient location of residence were significant in predicting of the living status of diabetic patients.

Subjects residing in central and fringe counties of metro areas as well as counties in metro areas with population counts more than 50000 were found to be at least 38% less likely to be dead compared to those residing in a non micro or metropolitan areas.

Looking at the admission data showed that the origin of admission, the admission source, the type of admission, and the time of admission all were statistically significant in affecting death rate in diabetic subjects.

For example, data showed that subjects admitted from another hospital had the highest death rate of 2.2% followed by those admitted from other health care facilities including long term care with 1.87%.

Trauma centers admission had a death rate of 14% while electives had 0.86%.

Studying the accompanying diagnosis data, the major diagnosis categories (MDC) s, and the diagnosis related groups (DRG) s data in addition to comorbid conditions all showed a statistically significant increase in diabetic subjects death rate.

Analysis showed that the more disease, e codes, and procedures the patient had in his hospital chart the higher the risk of death by 4.5, 0.12, 3.03 respectively.

Data also showed that staying at the hospital longer before any procedure had a significant impact on the risk of death.

Regression model found that the addition of 1 procedure has a 19% increase in the odds of being in the dead diabetic category. With each increase in the risk of mortality DRG score there is a 4 times the odds of being dead.

Patients discharged in the April – June quarter had 18% less odds of being in the dead diabetic group; in addition to that, the length of stay analysis showed a statistical significance. Diabetic subjects who died had longer stays in average by 7 days.

Patients discharged in the winter had the highest diabetic death rate of 0.81% while those discharged in the summer had the lowest of 0.63%.

This study results for the death rate differences between genders showed that male and female have the same risk and rate of death from diabetes. This contradict the finding of previous studies of *Howard et al., 1998,* Jansson et al., 2010; Gu et al., 1999; Gregg et al., 2007 where they showed that men have lower mortality risk than women when it comes to cardiovascular mortality but they explained that by the women's lower care adherence and provision and by the diabetes disease itself. In the other

hand *de Fine Olivarius et al., 1997; Gu et al., 1998* found that women have lower mortality rate than in men. Other studies *Fox et al., 2004; Dale et al., 2008* confirm our finding and found no sex differences.

Ray et al., 2009; Turnbull et al., 2009; Kelly et al., 2009; Boussageon et al., 2011 found that there were no benefits of intensive treatment and that it was accompanied by an increase in diabetes related mortality and it didn't have significant improvement on micro-vascular complication. This study showed that different treatment approaches and drug classes as significant predictors of mortality in the crude relationship but when controlled for it did show the same effect.

Similar results were found showing that with different diagnosis there is an increase in mortality rate among diabetic patients as seen in Tables 14, 16, 17 and 18, similar to *the Emerging Risk Factors Collaboration, 2011; Angulo, 2002; Jawa et al., 2004)* which showed that Diabetes was found to be associate with mortality from nephropathy causing renal disease, fatty liver disease causing digestive problems, impairment of immunity causing various infectious diseases, and nephropathy causing

trauma and injuries which is also caused by eye disease and low blood sugar.

Studies by Koskinen et al., 1996; Richmond et al., 1993; Aarva, 1995; Pill et al., 1995; Dorman et al., 1985; Matsushima et al., 1996 found that income and social class have effects on the mortality and death rate of diabetic patients. This study also confirms these findings showing the higher death rate among the lower income. This relationship is also reflected by the location of living of the included subjects. Also when we looked at the insurance plans and the primary and secondary payers we found similar results confirming that lower socioeconomic status is associated with higher risk of mortality and death rate. This can be explained by having access to better quality of treatment; higher social class benefit more of health education to improve their health outcomes by being more accepting to lifestyle behavioral modification like smoking and diet. In contrast blue collar or low socioeconomic class tend to be more resistance towards such behaviors. Mackenbach et al., 2003; Mackenbach et al., 2008; Wilkins et al., 2002; Grant et al., 2004; Lipscombe et al. 2010

Previously socio-economic factors like overweight and obesity were found to cause an increase in the complication, death rate, and mortality of diabetic patients (Stadler et al., 2006; Flegal et al., 2005; Pambianco et al., 2006; Freedman et al., 2006). This study has found similar results confirming the association of higher mortality with overweight and obese population. Ford and DeStefano, 1991; Jerant and Franks, 2012 found in their studies higher mortality was associated with only sever obesity but not overweight subjects.

In contrast another study pointed out an increase in mortality found with leanness associated with type 1 diabetes, thus recommending on focusing the attention on associated risk factors such as blood pressure and lipids ***(Conway et al., 2009)***.

The results of the regression model showed multiple factors as significant predictors of the living status of the diabetic subjects. These factors can be used and targeted to improve the mortality rate. The results of the model confirm and agree with previous studies by Barnett et al., 2006; Gulliford and Charlton, 2009; Barnett et al., 2010; Hubbard et al., 2010. They found that after adjustment for demographic, socio-economic,

behavioral, and health status, death in diabetic individuals is associated with an increase in death rate, which also suggest that comorbidities and the risk factors have an additive role in such increase (Otiniano et al., 2003; Carnethon et al., 2010; (Li et al., 2011).

Strengths:

1. Big sample size big data set.
2. Longitudinal with record from several years.
3. The possibilities to study risk factors individually and together to examine the additive effect.

Limitations:

1. The study was limited to the available variables
2. Limited ability to study the preventive measures
3. We have no control group.

Chapter VI

VI. Summary and Conclusion

6.1 Summery and Conclusion

The study was a secondary data analysis of existing patient data (record-based). It was based on the Nationwide Inpatient Sample (NIS). My research has studies the risk factors involved in causing and affecting the death rate in patients with diabetes mellitus. The results of the degree of the effect of each the risk factors have varied in their significance but their predictive values have agreed mostly closely with the previous literature. Looking closely at the data shows that death rate have been decreasing over the years. And that disease and risk factors affect both males and females very similarly. Age was looked at the data showed that patient who died of diabetes mellitus were generally older by 15 years. Studying race showed a variation in death rate, others and Native Americans being the highest and lowest in death rate respectively. Income, and finances had a predictable impact on death rate in diabetic patient.

Looking at admission data showed that the origin of admission, the admission source, the type of admission, and the time of admission all were

statically significant in affecting death rate in diabetic patients. Patients who stayed longer at the hospital had higher death rate.

Studying the accompanying diagnosis and The Major Diagnostic Category appropriate for the date of discharge (MDC), The Diagnosis Related Group (DRG) appropriate for the date of discharge, and co-morbid conditions the patient is suffering from in addition to diabetes, all had statistically significant increase in death rate. Data showed that the more diseases, e-codes and procedure in the diabetic patient's chart the higher the death rate. Data showed also that staying at the hospital longer before any procedure had a significant impact on the death rate among diabetic patients.

Logistical regression models showed that demographic factors, namely age, gender and race player a statistically significant role in predicting the living status among diabetic patents. Socio-economic variables also had a statically significant role in predicting the living status, as did studying the health care factors revealed.

Health care factors like length of stay at the hospital and the number of procedure done in addition to weather the procedure was elective or not,

all played a predictive role in determining the living status of diabetic patients.

The study shows the different risk factors for mortality in the adult diabetic patients. The study showed demographic, socioeconomic, and health care conditions risk factors. The crude analysis showed the individual effect of each factor and the prediction model showed how these factors play in the existence and controlling of the other factors.

6.2 Future Research and Recommendation

The study was based on the Nationwide Inpatient Sample (NIS) data, which had very valuable variables but also had some missing or unfilled data or had broad worded variables like when the variable 'others' were used. Replacing and filling the gaps in the data will lead to more precise predictions. The help of the health workers in completing the gaps and performing a more through gathering of information will aid also.

The addition of more variables to the information gathering process will aid also in the increasing the predictive power of existing ones. Training the health care workers on recognizing various factors affecting the progression of diabetes mellitus and its complications will aid in early discovery and prevention of them. The workflow of admission can benefit from a

predictive modeling sheet to include current proven factors and future variables and factors (Risk Assessment Screening).

Studying and implementing ways to educate patients on preventive measures can help add to the body of research.

6.3 Closing Statement

This study confirmed and added to the body of knowledge about the risk factors for the mortality of diabetic patients. It also shines the light on the most important factors to plan preventive measures that can modify these risk factors.

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Appendices

Appendix A: List of abbreviations and acronyms

ADVANCE	Action in Diabetes and Vascular Disease: Preterax and Diamicron Modified Release Controlled Evaluation
ACCORD	Action to Control Cardiovascular Risk in Diabetes
AHRQ	Agency for Healthcare Research and Quality
AER	Albumin Excretion Rate
BMI	Body Mass Index
CHARM	Candesartan in Heart Failure: Assessment of Reduction in Mortality and Morbidity
CH	Carbohydrates
CAN	Cardiac Autonomic Neuropathy
CV	Cardiovascular
CVD	Cardiovascular Disease
CARE	Cholesterol and Recurrent Events
CBC	Complete Blood Count

CI	Confidence Interval
CAC	Coronary Artery Calcium
CHD	Coronary Heart Disease
CRP	C-Reactive Protein
DIAD	Detection of Ischemia in Asymptomatic Diabetics
DM	Diabetes Mellitus
GDF-15	Growth-Differentiation Factor-15
HR	Hazard Ratio
HCUP	Healthcare Cost and Utilization Project
HRV	Heart Rate Variability
HGLM	Hierarchical Generalized Linear Modeling
ICU	Intensive Care Unit
INT	Intensive Glycemia Therapy
IDF	International Diabetes Federation
LOS	Length of Stay

MUFA	Monounsaturated Fatty Acids
NIS	Nationwide Inpatient Sample
NOH	New Onset Hyperglycemia
OR	Odds Ratio
PUFA	Polyunsaturated Fatty Acids
PAR	Proportional Attributable Risk
RDW	Red Blood Cell Distribution Width
RR	Relative Risk
SFA	Saturated Fatty Acids
STD	Standard Glycemia Therapy
UKPDS	UK Prospective Diabetes Study
VADT	Veterans Affairs Diabetes Trial