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HOSPITALIZATION CHARACTERISTICS OF PARKINSON'S DISEASE INPATIENTS IN THE UNITED STATES: A NATIONWIDE ANALYSIS

by

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Hospitalization Characteristics of Parkinson's Disease Inpatients in The United States: A Nationwide Analysis

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ABSTRACT

BACKGROUND: Parkinson's Disease (PD) is the second most common neurodegenerative disease found in geriatric patients. It entails heavy burden to patients and governments in terms of high expenditures of medical services, insurance and poor quality of life. The objective of this study was to investigate the hospitalization characteristics of PD inpatients and determine the predictors and their interactive effects on the length of hospital stay (LOS), total charges and in-hospital mortality.

METHOD: This study utilized the Nationwide Inpatient Sample (NIS) for the years 2007 to 2012. The data contained patients' demographic characteristics like age, gender, race, insurance type, and income. Also, the data involved other health variables like types and number of comorbidities, number of procedures, admission types, and type of PD. The SPSS statistical analysis software was used to analyze the NIS data of PD, where all outcomes with p values less than 0.05 were considered significant. Multinomial Logistic Regression and Multiple Linear Regression techniques were used to detect significant predictors of study outcomes.

RESULTS: Descriptive analysis of this study showed the highest incidence of PD in geriatric patients as being White, Males, and patients on Medicare who were primarily emergency admissions. Males were more likely to have both major and extreme loss of function and major and extreme likelihood of dying. The latter was observed even for in-hospital mortality (i.e. higher risk for in hospital mortality). Blacks were seen to have higher odds of loss of function and likelihood of dying. In hospitality mortality didn't reveal the same risk. Length of Stay is seen to decrease over the years 2007 to 2012 – this could possibly be due to improved care and procedures requiring lesser stay in the hospital.

Mortality is also seen to decrease over the same period again possibly due to improved care and procedures. However total costs are on a rising trend indicating the increasing cost per discharge (which has remained same over the years on average) possibly due to the more newer and costly procedures. Advanced age was the main predictor of mortality more than other health predictors confirming the age associated aspects of Parkinson's Disease as has been corroborated by innumerable studies in literature. Mortality is also seen to decrease over the same period (2007-2012) again possibly due to improved care and procedures. Since most of the admissions are through the Emergency Room there exists the possibility of complications leading to mortality.

CONCLUSION: The study revealed several significant results related to hospitalization outcomes of Parkinson's disease patients. Age (65 and above) was observed to be a major hospitalization factor for PD patients and the most significant factor for in hospital mortality. Certain comorbidities (CHF, fluid/electrolyte disorders, metastases, and weight loss) were found to augment the risk of mortality of the PD patients. Although Length of Stay (LOS) is on the decrease over the years of our study yet the median LOS is at least 1 day longer than average most possibly due to age related complications requiring longer hospital stay. Also possibly due to the increased number of procedures the Total Charges per PD patient is seen to be on the increase. This study corroborates the idiopathic nature of the Parkinson's Disease even for the hospitalized patients though the information on LOS and Total Charges could be employed for better resource management of such patients. The results from this study would be highly beneficial to hospital administrators, insurance providers, patients and their caregivers.

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CHAPTER I

INTRODUCTION

1.1 Background of Parkinson's disease

Parkinson disease (PD) is the second most common chronic neurodegenerative disease of elderly patients over 60 years. The occurrence of this disease is significantly related with elderly patients [1, 2].

PD was first clinically categorized by James Parkinson in 1817 based on abnormal neurological syndrome. Indian and Chinese ancients reported the description of this syndrome. Bradykinesia was first explained by Jean-Martin Charcot 50 years ago as the primary feature of this disease. Richer and Meige were involved in clinical studies of PD, where they reported details of the disease at different stages, especially those related to morphological changes and complications. Brissaud believed damage to the sustantia nigra was the main reason for Parkinson disease. Later Tretiakoff, Foix and Nicolesco found the relationship between the midbrain and the disease [3].

Epidemiological reports in the United States reported that there were approximately one million people diagnosed with PD. The incidence of PD increased with age. There were ten for each one hundred thousand of those aged 50-59 years of age, and increased to one hundred twenty persons per one hundred thousand for those aged 80-89 years. There was about a 1% prevalence of PD especially for those aged over 65 years, and 2.5% for those aged 65 years old. However, onset and diagnosis of this disease is starting at from 55 to 65 years of age[4].

There were many poor understandings of the etiology of PD, but the most common opinion was the result of interactions between age, genetics and other risk factors (like environmental conditions). A key to this disease was the histopathological changes due to the degeneration of neurons in the substantia nigra[5]. The development of PD was related to the secretion of 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (or MPTP). This compound was converted by activity of monoamine oxidase (MAO) and converted to 1-methyl-4-phenylpyridinium ion (MPP^+), which is considering to be toxic to neurons[6]. Two main features were believed to be related to the pathophysiology of PD; first, the depigmentation of neuron dopamine, and second, the aggregation of protein synneuclein (Lewy bodies), which determine stages of PD. Accumulations of Lewy bodies in the medulla are associated with the presence of anxiety, depression, and the impairment of smell. Cases of PD progressed into cognitive disorders and behavioral changes after the Lewy bodies increased and spread in the midbrain[7]. PD symptoms, like bradykinesia, significantly increased in intensity with more dopamine depletion, i.e. the loss of about 70-80% of neurons is enough to diagnose a case as PD[8].

In the US, several attempts were made between 1919 and 1930 to isolate the virus inducing PD, and the relation of PD with encephalitis, but all of them failed to approve the link [9]. PD is not considered a serious risk for death, but complications of this disease, like impaired mobility and aspiration pneumonia, cardiovascular incidents, thromboembolism and cerebrovascular disease were the main reason for mortality[10].

1.2 Goals and Objectives

The main objective of this study is to determine the impact of risk factors on the length of stay, total charge, and mortality for PD patients in the United States. The secondary objectives of this study are to determine:

1. Whether the type of comorbidity and number of procedures affect the length of stay of PD patients.
2. Whether the type of comorbidity and number of procedures affect the total charge of PD patients.
3. Whether the type of comorbidity and number of procedures affect the mortality of PD patients.
4. Whether socio-demographic characteristics, type of insurance, and year of admission affect the length of stay of PD patients.
5. Whether socio-demographic characteristics, type of insurance, and year of admission affect the total charge of PD patients.
6. Whether socio-demographic characteristics, type of insurance, and year of admission affect the mortality of PD patients.
7. Whether type of Parkinson affects the length of stay of PD patients.
8. Whether type of Parkinson affects the total charge of PD patients.
9. Whether type of Parkinson affects the mortality of PD patients.
10. Whether interaction of predictors affects the length of stay of PD patients.
11. Whether interaction of predictors affects the total charge of PD patients.
12. Whether interaction of predictors affects the mortality of PD patients.
13. Whether presence of risk factors affects the major and extreme likelihood of dying for PD patients.

14. Whether presence of risk factors affects the major and extreme loss of function for PD patients.

1.3 Research hypotheses

Hypothesis 1: There is significant impact for the type of comorbidities on the length of hospital stay

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 2: There is significant impact for the type of comorbidities on the total charge

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 3: There is significant impact for the type of comorbidities on mortality

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 4: There is significant impact for number of procedures on the length of stay

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 5: There is significant impact for number of procedures on total charge

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 6: There is significant impact for socio-demographic characteristics on the length of stay

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 7: There is significant impact for socio-demographic characteristics on the total charge

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 8: There is significant impact for socio-demographic characteristics on the mortality

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 9: There is significant impact for type of insurance on the length of stay

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 10: There is significant impact for type of insurance on total charge

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 11: There is significant impact for type of insurance on mortality

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 12: There is significant impact for year of admission on length of stay

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 13: There is significant impact for year of admission on total charge

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 14: There is significant impact for year of admission on mortality

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 15: There is significant impact for type of Parkinson on length of stay

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 16: There is significant impact for type of Parkinson on total charge

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 17: There is significant impact for type of Parkinson on mortality

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 18: There is significant impact for predictors' interaction on length of stay

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 19: There is significant impact for predictors' interaction on total charge

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 20: There is significant impact for predictors' interaction on mortality

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 21: There is significant impact for predictors on major and extreme likelihood of dying

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

Hypothesis 22: There is significant impact for predictors on major and extreme loss of function

Null Hypothesis: H0 = H1

Alternative Hypothesis: H0 ≠ H1

1.4 Statement of the problem

Parkinson disease is the second most common neurodegenerative disease in the United States. Limited options for reducing the progression of PD caused increased in burden of complaints with high charges to the patients and payers. The US Census Bureau estimated that the number of PD patients will double in 2040 from the 630,000 they found in 2010 with the rising number of elderly patients who consume the efforts and economy of the government on one side and reduce the quality of life of patients and their families on another side[11]. And, the burden of fees and incidence of PD are going to increase from

$14 billion in 2010. That number is higher by $8.1 billion than expenses for non-PD patients. The indirect costs of PD patients were also estimated to be $6.3 billion, due to loss of employment. T PD is not death causative disease, but it is associated with several fatal comorbidities which represented the real threats to patients' lives, especially in United States[10].

1.5 Definition of terms

The terms used in this study are defined in Table 1.

Table 1 Definitions of terms

Term	Definition
Symptoms	Any physical or mental disorder related to a disease
Diagnosis	Examining and identification of an illness depending on the symptoms and other clinical measurements
Health	Free from illness or diseases
Disorder	Abnormality of the physical or mental status
Medication	Drugs used for special medical conditions
Depression	Feelings of severe despondency with lack of energy and normal activities
Anxiety	Feeling of worry and nervousness toward something
Bradykinesia	Slowness of initiation of voluntary movement with progressive reduction in speed and amplitude or repetitive actions

1.6 Importance of the study

PD is a common irreversible neurodegenerative disorder of elderly patients. Information about and methods of controlling the disorder were insufficient to save patients' lives and economic resources. Several studies agreed the mortality due to PD with complications[12]. The disease is more often connected to elderly patients, which increases the burden of healthcare due to the increased incidence of chronic diseases which may worsen the health status of patients. In the Unites States, PD was considered the fourteenth most frequent cause of death in 2013. Previous study was studied 25,196 PD patients and found a 4.3% percent change from 2012 to 2013, with higher mortality in males than females, and White races than others. PD patients in the United States were suffering a poor quality of life due to paying a lot of money for health care services, and second of high incidence of deaths because of the complications[13].

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

Parkinson disease is a progressive neurodegenerative disorder that affects elderly patients. No treatment has yet been approved for stopping or minimizing the progression of PD. Concurrent diseases may modify the plan for therapy and may be more complicated and cause bradykinesia. Pharmacological medications may worsen the non-motor symptoms which affect the quality of life[14,15]. Unsuccessful therapy plans, controlling the symptoms, the quality of healthcare services and loss of hope cause patient dissatisfaction. Therefore, several types of therapy were added in trying to improve the patient's quality of life, including non-pharmacological therapy[16].

2.2 Reasons of PD and dementia

There are several reasons contributing to the incidence of PD and dementia: [17,18]

1. **Genetics**. One of most important reasons for PD and dementia induced by PD is the genetic factor; the mutation of glucocrobrosidase enzyme. Genetics also plays a role in the cognitive impairment, where changes in apolipoprotein E allelic 4 induce changes in the structures related to memory.
2. **Structural brain lesions**. These include Cryptococcus, neurosyphilis, injury, posttraumatic, toxic substances (e.g. carbon monoxide), metabolic disorders (e.g. phenylketonuria, xanthomatosis), secondary Fahr's syndrome, hydrocephalus, intracranial tumors, and Wilsonian acquired hepatocerbral degeneration.

3. **Drug induced**. Antipsychotics (e.g. haloperidol, chlorpromazine), atypical antipsychotics (olanzapine and risperidone) reserpine, methyldopa, cinnarizine, verapamil, metoclopramide can contribute to PD complications.
4. **Psychogenic.** This referred to the physical illness induced by the mental and emotional sickness.

2.3 Diagnosis

Three steps must be followed in the diagnosis of PD. [17]

1) **Diagnosis of Parkinson syndrome**: which involved bradykensia, with one of the following; muscular rigidity, 4-6 Hz rest tremor, or postural instability.
2) **Exclusion criteria for Parkinson disease**: History of the strokes, head injury, and encephalitis, or the presence of oculogyric crises, neuroleptic treatment, cerebellar signs, unilateral features after three years, early severe autonomic involvement, cerebral tumors, negative response of high dose of levodopa, and 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) exposure.
3) **Supportive information of PD:** Three or more of following; unilateral onset, rest tremor, progressive disorder, levodopa response (more than 5 years), hyposmia, visual hallucinations, therapy course of 10 years or more.

2.4 Differentiation between PD and other syndromes

1- There are several disorders often confused with PD and dementia.[17] **Vascular Parkinsonism**: Parkinsonian symptoms can be observed in lower body areas and

limbs. These symptoms are spasticity, hemiparesis, and pseudobulbar palsy. Tremors at rest are rare.

2- **Drug induced Parkinsonism**: Several medications induce PD and cause postural tremors. The disorders induced by drugs are orolingual dyskinesia, tardive dyskinesia, dystonia, or akathisia.

3- **Tremor disorders (or essential tremors)**: With these kinds of tremors, there were no signs and symptoms of PD or any significant abnormality.

4- **Dementia with Lewy bodies**: These types of tremor are accompanied by dementia and the majority of patients are elderly with concurrent problems of cognition and have hallucinations, behavior disorders, and sensitivity to drugs.

5- **Multiple system atrophy**: This is one of the common causes of degenerative Parkinsonism with advanced age patients. Several symptoms accompany this type of disease like generalized hyperreflexia.

6- **Progressive supranuclear palsy (or Richardson syndrome)**: This syndrome is often confused with PD. It includes symmetric akinetic-rigid syndrome, and impairments of gait and balance with occurrence of falls in the first year of symptoms. Tremors are infrequent with the patients of this syndrome. Other symptoms of this type of disorder are vertical gaze supranuclear palsy, pseudobulbar symptoms, retrocollis, frontalis muscle, and eyes opening wide.

7- **Fragile X-tremor ataxia syndrome:** This is more obviously found in patients older than 50 years of age and men due to abnormality of genes. The symptoms of this syndrome are ataxia, postural tremors, Dysautonomia, and cognitive impairment.

2.5 Symptoms of PD

There are two types of symptoms of PD, motor and non-motor. Motor symptoms involve bradykinesia, tremor, rigidity, postural and gait impairment. Bradykinesia refers to slow movement, especially with lower muscle groups. Tremor can be observed in lower limbs, jaw and tongue. Rigidity of muscles is found the limbs and neck. Other symptoms include postural and gait impairment with falls and short heavy steps; non-motor symptoms involving neuropsychiatric (apathy, anxiety, depression, hallucinations, cognitive impairment and mood disorders); Dysautonomia (orthostatic hypotension, constipation, urinary dysfunction, sexual dysfunction, sweating, and swallowing problems); sleep disorders (insomnia, restless leg disorders, excessive daytime sleeping, limbs night movements); sensory dysfunction (loss of sense of smell, visual recognition impairment, decrease visual motion, and difficulty of color discrimination); pain; and fatigue[17,19].

There was a link found between the severity of non-motor symptoms and low measures of a patient's quality of life, cost of therapy, length of stay, and number of hospital admissions. Non-motor symptoms were often related to mortality and comorbidities[20].

2.6 Detection for the risk factors of PD and dementia induced by PD

There are several tools for the detection and diagnosis of PD and dementia .[21]

1) Tremor dominant group: where failing in neuropsychological tests of planning, memory, and other functions.

2) Akinetic-rigid-postural instability: failing in visual perception and semantic fluency.

Where lower levels of dopamine contributed in affecting the motor, emotional and cognitive impairments. Therefore, some medications like levodopa may affect the dopamine but no improvement in cognitive performance[22].

2.7 Complications and severity of PD

There are several complications of PD that are considered major causes of mortality.

1) Dementia is the major complication of PD influencing comorbidities and mortality. Dementia increases costs of therapy and health services to PD patients by approximately three times over those without[23]. Reid et al., found that the incidence of dementia was about 83% in all PD patients. They also reported that dementia was most common among patients over 75 years of age by approximately five times than those who were younger[20]. Demographic characteristics also impacted the incidence of dementia induced by PD; for example, the incidence of dementia was lower in those patients with higher education levels[24]. Risk factors for dementia included patients being older than 75 years, having a diagnosis of PD for more than 10 years, impairments of semantic fluency, genetic factors, low levels of education, postural instability, and a Unified Parkinson's Disease Rating Scale (UPDRS) score of more than 24 points[25,26].
2) The cognitive impairment incidence varies in severity and incidence among PD patients. Genetic factors were often the cause.

Therefore, screening and evaluation were needed to detect the incidence and risk factors[25].

3) Dysarthria, the abnormality of speech with hypophonia, poor voice quality, hypoprsodia, and festinations, often accompanied PD; especially in the idiopathic type of PD[27].

2.8 Risk factors of PD

1) Gender contributed to the high incidence of PD and its symptoms. A higher incidence of PD was observed with males than females with non-motor symptoms, except when depression was present[28].
2) Race played a role in the distribution and severity of PD among US populations. Blacks and Asians had lower incidence of PD than in Whites[29].
3) Age significantly increased the incidence of PD, where those aged equal to or older than 85 had the highest incidence of PD [30-33].
4) Region played a role in the incidence of PD among US patients. Willis et al., found that urban citizens had a higher incidence of PD than those in rural areas, and Midwest and north eastern higher than other regions[29].
5) A previous study showed that the incidence of PD is higher in the year 2000 than 2005[29]. The incidence of PD appeared to be different among these years based on developments made in the quality of health services.
6) The type of Parkinsonism was different in incidence among US patients; with a smaller number of patients having a secondary type of PD than primary[34].

2.9 Global prevalence of PD

PD is the second most common neurodegenerative disorder after Alzheimer's disease. Globally, 1% of those over 55 years and 3% of those over 70 years received a PD diagnosis. The age of onset for PD was about 80% for those aged between 40 and 70 years old and 5% for those aged younger than 40 years. Juvenile onset of PD is misdiagnosis for the advance aged PD[35,36].

2.10 Common comorbidities of PD

Psychiatric disorders are considered main comorbidities for 90% of PD patients. The presence of at least one psychiatric disorder was often found with PD patients. The common psychiatric disorders that accompanied PD are noted below.

1- **Depression**. The main abnormalities of PD patients' behavior involved low mood, frustration, sadness and embarrassment. Depression occurred in 20-90% of PD patients. About 50% of PD patients were diagnosed with major depression disorder. This type of depression was not related to family history [37,38].

2- **Anxiety**. Generalized anxiety, panic disorders, and social phobias were found in about 40% of PD patients. Anxiety was aggravated due to motor fluctuation induced by medications, which contributed to severe panic attacks[37].

3- **Cognitive impairment**. Impairment ranged from mild cognitive impairments to dementia. About 25 to 40% of PD patients developed dementia. The main impairments were impairments of memory, executive functions, attention, speaking fluency, and mental flexibility[36].

4- **Psychosis**. The incidence of psychosis with PD patients was found to be 20%. Symptoms like hallucinations and delusions were noted in more than 50% of PD patients[39].

5- **Apathy**. Apathy is associated with depression and cognitive impairment. The incidence is about 25% in PD patients[37].

6- **Cardiovascular and chronic comorbidities**. Hypertension (29-34%), diabetes mellitus type 2 (15%), hyperlipidemia (14%), and atrial fibrillation (7%) were frequent comorbidities[40].

7- **Other comorbidities**. The incidence of fatigue (47%), back problems (36%), arthritis (34.3%), cataracts (23.9%), urinary tract infection (7%), urinary incontinence (11.3%), sleep disturbances (63%), and sensory symptoms (63%) were also noted in PD patients[40,41].

2.11 Mortality of PD

A high incidence of mortality was found in patients with PD[42]. Males had higher incidence of mortality than females by two times[43]. Significantly higher incidences of mortality induced by PD were noted for those with advanced age, especially those older than 80 years. There was no significant impact found for smoking on the incidence of mortality[44].

2.12 Research gaps

Many studies noted the incidence, risk factors, mortality rates, and comorbidities, but several gaps exist for most of them affecting their results validity and generalizations.

First, most of these studies relied on the diagnosis of physicians, where misdiagnosis was considered a main gap, especially if those physicians were unable to differentiate the PD from other similar syndromes. Another problem found in the literature was in the selection of PD patients, as most of these studies depended on a small number of patients, using different types of selection criteria which some of them considered a bias. Another gap that most of PD patients were admitted in same or other hospitals with different registration number and different therapy which affected the validity of results because of repetitions. Several variables were recommended to be involved like scales of assessment, clinical findings (laboratory data), and signs/symptoms of PD. There is deficiency in information and results for the impact of genetics and variations among races and countries. These studies will cost high amount to support the researchers, labs and conducting of researches. The other risk factors like those related with diagnosis were not involved in the NIS data which unable to generalize the final outcomes. Finally, the cost or total charges of health services are varying among the studies depending on quality of service, type of hospital, and medications dispensed. Although all studies, including the US studies, mentioned several outcomes related to total charges, comorbidities and mortality, but none predicted the impact of cofactors and the interactions of predictors on the final outcomes, which will be performed in this study.

2.13 Summary

Several studies revealed the improvement of PD patients' health status after using new diagnostic tools, annual screenings, and new strategies of therapy plans like non-pharmacological and pharmacological methods. These tools contributed to reducing the

total charges, the length of hospital stay, and mortality rates. Proper diagnosis of PD and detection risk factors, especially the preventable types, may contribute to controlling the disease, and then minimizing the PD patients' complaints, total charges, lengths of stay, number of hospital admissions, and improvement in quality of life.

CHAPTER III

MATERIAL AND METHODS

3.1 Nationwide inpatient sample data

The data for the present study was obtained from Nationwide Inpatient Sample (NIS). NIS is the most common website related to hospital inpatient stays. This database is commonly used by most clinical researchers to detect and predict the influences of information on the research outcomes. Information within this database includes patients' information, hospital characteristics, and insurance type for different diseases at different years of admissions.

3.2 Data and methods

For this study, datasets obtained related to Parkinson disease. The total visits of Parkinson disease patients totaled 361,662 cases from the years 2007 to 2012 from 1,050 hospitals in forty-four States. The NIS data included information related to patients' health status, financial status, hospital information, and other non-clinical data. Information collected for this study included: primary and secondary types of Parkinson disease, number of procedures and chronic diseases, admission and discharge status, patient's socio-demographic characteristics, patient's type of insurance, mortality incidence, length of hospital stays, and total charges of care.

The NIS database contains several things related to inpatient stays like total charges paid by insurance companies, and which types of insurance (i.e., Medicare, Medicaid, private insurance, and others). Based on the hypotheses of this study, the mortality, total charge and length of stay are considered dependent variables, while patients' information, hospital information, insurance and the year of admission considered are independent variables. SPSS was used to analyze the collected NIS data. All results with p values of less than 0.05 were considered as significant. Multinomial logistic regression was used to determine the predictors of mortality, while multiple linear regressions (dummy method) was used to determine the predictors of total charge and length of stay. Dummy method is specific analysis to determine the effects of subgroups on the numerical dependent variables in linear regression. This because using the variables as it is will not disclose the relationships between the subgroups and the outcomes, it is related with the type of group only. Dummy variables involved either presence or absence which coded by 0 and 1, where 0 referred to the absence while 1 to the presence of variables. To give example, presence of a comorbidity will be coded as 1 while absence of the comorbidity be coded as 0. The main limitation of dummy method is that using of several variables will reduce the strength of association because linear regression is depended on the type and strength of the numerical variables. Thus, in present study the dummy variables range is 0 to 1 only which reduced the R square of the model and/or the strength of variables contribution for the final model.

3.3 Data variables, research questions, statistical analysis procedures

The NIS data used in this study covered the patients from years 2007 to 2012. The variables involved in the present study to achieve the objectives are illustrated in Tale 2.

Table 2 Data variables used for the analysis

Study variables	Original variables in NIS	Variables description
AGE	AGE	Age in years; Numerical Variable
MORTALITY	DIED	Patient did not die during hospitalization (DIED=0); Patient died during hospitalization (DIED=1), Categorical (binary) Variable
GENDER	FEMALE	Gender of patient FEMALE = 1 is Female; FEMALE= 0 is Male; Categorical (binary) Variable
TOTAL CHARGE	TOTCHG	Total charges, Numerical Variable
RACE	RACE	1 = White, 2 = Black, 3 = Hispanic, 4 = Asian/Pacific, 5 = Native Am., 6 = Other; Categorical Variable
INSURANCE TYPE	PAY1	1=Medicare, 2=Medicaid, 3=Private insurance,4=Self-pay,5=No charge,6=Other; Categorical Variable
NUMBER OF PROCDURES	NPR	The number of procedures performed while patient was hospitalized; Numerical Variable
SOCIO_ ECONOMIC STATUS	ZIPINC_QRTL	Median household income for patient's ZIP Code, 1=0-25th percentile, 2=26th -50th percentile (median), 3=51st – 75th percentile, 4=76th – 100th percentile; Categorical Variable

Table Continues

Study variables	Original variables in NIS	Variables description
COMORBIDITIES	CM_AIDS, CM_ALCOHOL, CM_ANEMDEF, CM_ARTH, CM_BLDLOSS, CM_CHF, CM_CHRNLUNG, CM_COAG, CM_DEPRESS, CM_DM, CM_DMCX, CM_DRUG, CM_HTN_C, CM_HYPOTHY, CM_LIVER, CM_LYMPH, CM_LYTES, CM_METS, CM_NEURO, CM_OBESE, CM_PARA, CM_PERIVASC, CM_PSYCH, CM_PULMCIRC, CM_RENLFAIL, CM_TUMOR, CM_ULCER, CM_VALVE, CM_WGHTLOSS	Acquired immune deficiency syndrome, alcohol abuse, deficiency anemias, rheumatoid arthritis/collagen vascular diseases, chronic blood loss anemia, congestive heart failure, chronic pulmonary disease, coagulopathy, depression, diabetes uncomplicated, diabetes with chronic complications, drug abuse, hypertension , hypothyroidism, liver disease, lymphoma, fluid and electrolyte disorders, metastatic cancer, other neurological disorders, obesity, paralysis, peripheral vascular disorders, psychoses, pulmonary circulation disorders, renal failure, solid tumor without metastasis, peptic ulcer disease excluding bleeding, valvular disease, weight loss; Categorical variable
LENGTH OF STAY	LOS	The number of days patient was hospitalized; Numerical Variable
Risk of Mortality Subclass	APRDRG_Risk_Mortality	No class specified, minor likelihood of dying, moderate likelihood of dying, major likelihood of dying, extreme likelihood of dying; Categorical variable
Severity of Illness Subclass	APRDRG_Severity	No class specified, minor loss of function, moderate loss of function, major loss of function, extreme loss of function; Categorical variable

Table Continues

Study variables	Original variables in NIS	Variables description
Admission type	ATYPE	Emergency, urgent, elective, newborn, delivery, trauma, other; Categorical variable
Length of Stay Level	DS_LOS_L	Very low (less than 5% of patients), low (5 - 25% of patients), medium (25 - 75% of patients), high (75 - 95% of patients), very high (greater than 95% of patients); Categorical variable
Number of chronic conditions	NCHRONIC	Number of chronic conditions; Numerical variable
Type of Parkinson	332.0, 332.1	Primary and secondary; Categorical variable

3.4 Study hypotheses and statistical tests

In order to answer the research questions, 22 hypotheses were tested by using different statistical tests. All research questions, hypotheses, outcomes, independent variables, and statistical tests are illustrated in Table 3.

Table 3 Study hypotheses, research questions and appropriate statistical tests

Research questions	Hypotheses	Independent variables	Outcomes variables	Inferential statistical analysis
Do type of comorbidities significantly affect length of stay?	Hypothesis 1	All comorbidities	Length of stay	Multiple linear regression
Do type of comorbidities significantly affect total of charge?	Hypothesis 2	All comorbidities	Total charge	Multiple linear regression
Do types of comorbidities significantly affect the mortality?	Hypothesis 3	All comorbidities	Mortality	Multinomial logistic regression

Table Continues

Research questions	Hypotheses	Independent variables	Outcomes variables	Inferential statistical analysis
Do numbers of procedures significantly affect the length of stay?	Hypothesis 4	Number of procedures	Length of stay	Simple Linear regression
Do numbers of procedures significantly affect the total charge?	Hypothesis 5	Number of procedures	Total charge	Simple Linear regression
Do gender, race, age & Socioeconomic status significantly affect length of stay?	Hypothesis 6	Gender, race, age, and income	length of stay	Multiple linear regression
Do gender, race, age & socioeconomic status significantly affect the total charge	Hypothesis 7	Gender, race, age, and income	Total charge	Multiple linear regression
Do gender, race, age & socioeconomic status significantly affect the mortality?	Hypothesis 8	Gender, race, age, and income	Mortality	Multinomial logistic regression
Do types of insurance significantly affect the length of stay?	Hypothesis 9	Type of insurance	Length of stay	Multiple linear regression
Do types of insurance significantly affect the total charge?	Hypothesis 10	Type of insurance	Total charge	Multiple linear regression
Do types of insurance significantly affect the mortality?	Hypothesis 11	Type of insurance	Mortality	Multinomial logistic regression
Do year of admission significantly affect the length of stay?	Hypothesis 12	Year of admission	Length of stay	Multiple linear regression
Do year of admission significantly affect the total charge?	Hypothesis 13	Year of admission	Total charge	Multiple linear regression

Table Continues

Research questions	Hypotheses	Independent variables	Outcomes variables	Inferential statistical analysis
Do year of admission significantly affect the mortality?	Hypothesis 14	Year of admission	Mortality	Simple Logistic regression
Does type of Parkinson significantly affect the length of stay?	Hypothesis 15	Type of Parkinson	Length of stay	Multiple linear regression
Does type of Parkinson significantly affect the total charge?	Hypothesis 16	Type of Parkinson	Total charge	Multiple linear regression
Does type of Parkinson significantly affect the mortality?	Hypothesis 17	Type of Parkinson	Mortality	Simple Logistic regression
Do interactions of predictors significantly affect the length of stay?	Hypothesis 18	Predictor's interactions	Length of stay	Multiple linear regression
Do interactions of predictors significantly affect the total charge?	Hypothesis 19	Predictor's interactions	Total charge	Multiple linear regression
Do interactions of predictors significantly affect the mortality?	Hypothesis 20	Predictor's interactions	Mortality	Simple Logistic regression
Do previous risk factors significantly affect the major and extreme likelihood of dying?	Hypothesis 21	All risk factors	Major and extreme likelihood of dying	Multinomial logistic regression
Do previous risk factors significantly affect the major and extreme loss of function?	Hypothesis 22	All risk factors	Major and extreme loss of function	Multinomial logistic regression

Extraction of patients' information related to Parkinson disease of the NIS database, was achieved after reviewing 361,662 entries between 2007 and 2012. Analysis of the data and discussion of results follow in the next chapter.

CHAPTER IV

RESULTS AND ANALYSIS

4.1 Introduction

This chapter includes the detailed results of the descriptive and statistical analysis. Statistical Package for the Social Sciences (SPSS) version 22 was used to analyze the NIS dataset from the years 2007 to 2012, which included 361,662 patients with Parkinson disease. ICD-9-CM codes for Parkinson disease (332.0 and 332.1) were used to analyze data. All results with p values less than 0.05 were considered significant.

4.2 Patients demographic characteristics and health information

4.2.1 Age

The age of patients was divided into four groups; 65-74 years, 75-84 years, and 85 years and older. The incidence of patients with Parkinson disease was highest for patients in the age range of 75-84 by 41.6%, while the lowest rate was found in those aged less than 65 years, as shown in Table 4.

Table 4 Patients age groups

Age categories	Frequency	Percent
<65	42974	11.9
65-74	82886	22.9
75-84	150401	41.6
≥85	85341	23.6
Total	361602	100.0

	Missing	60	.0
	Total	361662	100.0

4.2.2 Race

White patients had highest incidence (70.7%) of Parkinson disease than others, while Native American had 0.4%, as shown in Table 5.

Table 5 Patients race groups

Race		Frequency	Percent
	White	255807	70.7
	Black	20266	5.6
	Hispanic	20961	5.8
	Asian or Pacific Islander	6825	1.9
	Native American	1487	.4
	Other	7512	2.1
	Total	312858	86.5
Missing	System	48804	13.5
Total		361662	100.0

4.2.3 Gender

Males had higher incidence of Parkinson disease than females (at 54.1% vs. 45.88%), as shown in Table 6.

Table 6 Incidence of Parkinson disease between genders

Gender		Frequency	Percent
	Male	195641	54.10
	Female	165937	45.88
	Total	361578	100.0
Missing	System	84	.02
Total		361662	100.0

4.2.4 Health insurance

Medicare was the main form of health insurance, and had the highest incidence by 86.4%, as shown in Table 7.

Table 7 Parkinson disease and health insurance

Health insurance		Frequency	Percent
	Medicare	312594	86.4
	Medicaid	10661	2.9
	Private including HMO	31326	8.7
	Self-pay	2089	.6
	No charge	266	.1
	Other	4195	1.2
	Total	361131	99.9
Missing	System	531	.1
Total		361662	100.0

4.2.5 Patients' comorbidities

The highest incidence of comorbidities for Parkinson patients was other neurological disorders by 85.29% followed by hypertension (61.71%), while lowest were reported as being peptic ulcer disease and acquired immune deficiency syndrome (0.04% each), as shown in Table 8.

Table 8 Patients' comorbidities

	Comorbidities	Frequency	Percent
1.	Other neurological disorders	308454	85.29
2.	Hypertension (combine uncomplicated and complicated)	223168	61.71
3.	Fluid and electrolyte disorders	105121	29.07
4.	Diabetes, uncomplicated	83096	22.98
5.	Deficiency anemias	77981	21.56

6. Chronic pulmonary disease	71422	19.75
7. Hypothyroidism	61676	17.05
8. Depression	57307	15.85

Table continued

Comorbidities	Frequency	Percent
9. Renal failure	50722	14.03
10. Congestive heart failure	49888	13.79
11. Psychoses	29415	8.13
12. Peripheral vascular disorders	25165	6.96
13. Weight loss	22823	6.31
14. Obesity	18492	5.11
15. Valvular disease	18252	5.05
16. Diabetes with chronic complications	18120	5.01
17. Coagulopathy	14767	4.08
18. Paralysis	11447	3.17
19. Rheumatoid arthritis/collagen vascular diseases	9191	2.54
20. Pulmonary circulation disorders	7603	2.10
21. Solid tumor without metastasis	7329	2.03
22. Alcohol abuse	4959	1.37
23. Chronic blood loss anemia	4435	1.23
24. Liver disease	4179	1.16
25. Metastatic cancer	4058	1.12
26. Lymphoma	2653	0.73
27. Drug abuse	2579	0.71
28. Acquired immune deficiency syndrome	146	0.04
29. Peptic ulcer disease excluding bleeding	127	0.04

4.2.6 Mortality

About 3.5% of all Parkinson disease patients died during hospitalization, as shown in Figure 4.

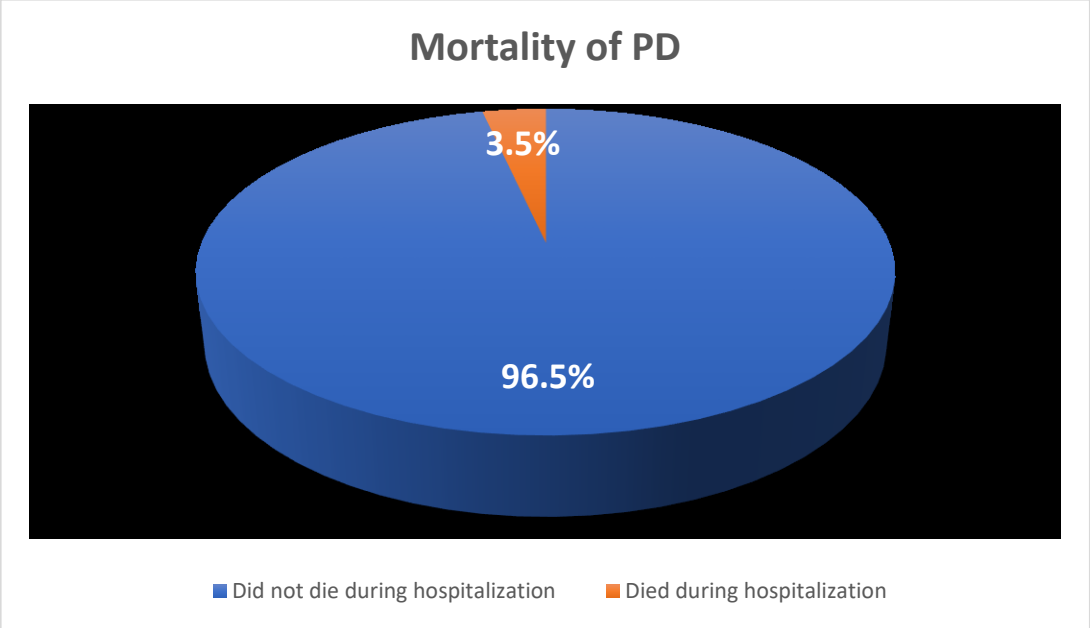

Figure 1 Mortality of the Parkinson patients

4.2.7 Length of stay and total charge

The mean (±SD) length of stay for patients with Parkinson disease was 5.89 (±7.116) days. The mean (±SD) total charge was $35044.96 (±$47081.41), as shown in Table 10.

Table 9 Measures of length of hospital stay and total charge

Parameters	Mean	Median	± SD	Skewness	Kurtosis

Length of hospital stay (days)	5.89	4.00	7.116	12.715	405.033
Total charge ($)	35044.96	21965.00	47081.41	8.706	203.113

4.2.8 Risk of mortality subclass

The incidence of Parkinson disease patients with moderate likelihood of dying were the highest by 50.6%, followed by major (26.6%), minor (14.5%), and extreme (8.3%), as shown in Table 11.

Table 10 Risk of mortality subclass of Parkinson disease patients

Subclass	Frequency	Percent
No class specified	112	.03
Minor likelihood of dying	52489	14.5
Moderate likelihood of dying	182970	50.6
Major likelihood of dying	96041	26.6
Extreme likelihood of dying	30050	8.3
Total	361662	100.0

4.2.9 Severity of illness subclass

The incidence of Parkinson disease patients with moderate loss of function was the highest by 44.9%, followed by major (41.1%), extreme loss (9.4%) and minor loss (4.6%), as shown in Table 12.

Table 11 Severity of illness subclass of Parkinson disease patients

Subclass	Frequency	Percent

No class specified	112	.03
Minor loss of function	16755	4.6
Moderate loss of function	162343	44.9
Major loss of function	148494	41.1
Extreme loss of function	33958	9.4
Total	361662	100.0

4.2.10 Length of stay level

The length of hospital stay was classified into five levels; very low, low, medium, high and very high. The highest incidence among these levels was observed with high incidence, by 7.7%, followed by medium (6.3%), very high (1.8%), low (0.4%) and very low (0.8%). However, the majority of patients' data were missed, as shown in Table 13.

Table 12 Length of stay levels with Parkinson disease

Length of stay levels		Frequency	Percent
	Very low (less than 5% of patients)	460	.1
	Low (5 - 25% of patients)	1425	.4
	Medium (25 - 75% of patients)	22924	6.3
	High (75 - 95% of patients)	27906	7.7
	Very high (greater than 95% of patients)	6418	1.8
	Total	59133	16.4
Missing	System	302529	83.6
Total		361662	100.0

4.2.11 Mortality level

The six levels of mortality are extremely low, very low, low, medium, high and very high. The highest incidence mortality was noted to be 7.1%, followed by medium (6.6%), very high (2.1%), low (0.30%), extremely low (0.23%) and very low (0.05%). However, the majority of patients' data were missed, as shown in Table 14.

Table 13 Mortality levels of Parkinson disease patients

Mortality levels	Frequency	Percent

	Extremely low - excluded from percentile calculation (mortality probability less than .0001)	833	.23
	Very low (less than 5% of patients)	171	.05
	Low (5 - 25% of patients)	1050	.30
	Medium (25 - 75% of patients)	23753	6.6
	High (75 - 95% of patients)	25564	7.1
	Very high (greater than 95% of patients)	7764	2.1
	Total	59135	16.4
Missing	System	302527	83.6
Total		361662	100.0

4.2.12 Disease staging: resource demand level

There were four levels of resource demand; low, medium, high and very high. The most frequent incidence occurred at the medium level, by 7.7%, followed by high (7.3%), very high (1.1%) and low (0.16%). However, the majority of patients' data were missed, as shown in Table 15.

Table 14 Resource of demand levels of Parkinson disease patients

Resource of demand levels		Frequency	Percent
	Low (5 - 25% of patients)	572	.2
	Medium (25 - 75% of patients)	27971	7.7
	High (75 - 95% of patients)	26539	7.3
	Very high (greater than 95% of patients)	4051	1.1
	Total	59133	16.4
Missing	System	302529	83.6
Total		361662	100.0

4.2.13 Median household income

The four levels of median household income noted in this study are 0-25th percentile, 26th to 50th percentile, 51st to 75th percentile, and 76th to 100th percentile. The 0-25th percentile showed the highest incidence of PD by 25.8%, followed by 26th to 50th percentile (at 25.5%), 51st to 75th percentile (at 23.9%) and 76th to 100th percentile (at 23%), as shown in Table 16.

Table 15 Median household income of Parkinson disease patients

Levels of household income		Frequency	Percent
	0-25th percentile	93244	25.8
	26th to 50th percentile	92195	25.5
	51st to 75th percentile	86409	23.9
	76th to 100th percentile	83065	23.0
	Total	354913	98.1
Missing	System	6749	1.9
Total		361662	100.0

Table continue

4.2.14 Admission type

The six types of admissions into hospitals are emergency, urgent, elective, newborn, delivery, and trauma. The highest incidence of admissions was emergency by 49.2%, followed by elective (12.7%) and urgent (12.6%), with the lowest incidence being within the others category, as shown in Table 17.

Table 16 Admission types of Parkinson disease patients

Admission types		Frequency	Percent
	Emergency	177990	49.2
	Urgent	45665	12.6
	Elective	46054	12.7
	Others	881	.25
	Trauma	124	.03
	Total	270714	74.9
Missing	System	90948	25.1
Total		361662	100.0

4.2.15 Mortality during the years 2007 to 2012

The incidence of mortality for Parkinson disease patients during hospitalization from the 2007 to 2012 is depicted in Figure 6. It showed that incidence of mortality decreased to the lowest level in 2012.

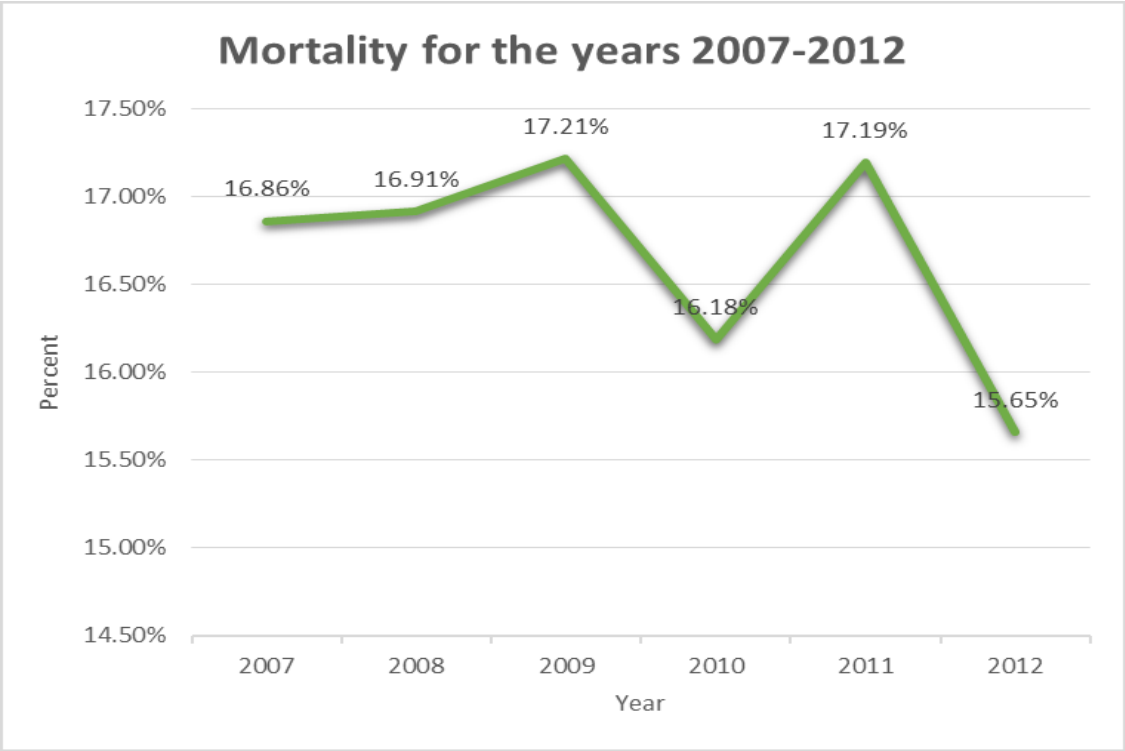

Figure 2 Mortality for the years 2007-2012

4.2.16 Average total charge during the years 2007 to 2012

The average total charge by US dollars for Parkinson disease patients from 2007 to 2012 is depicted in Figure 7. It showed the charges of hospitalization increased to the highest in 2012.

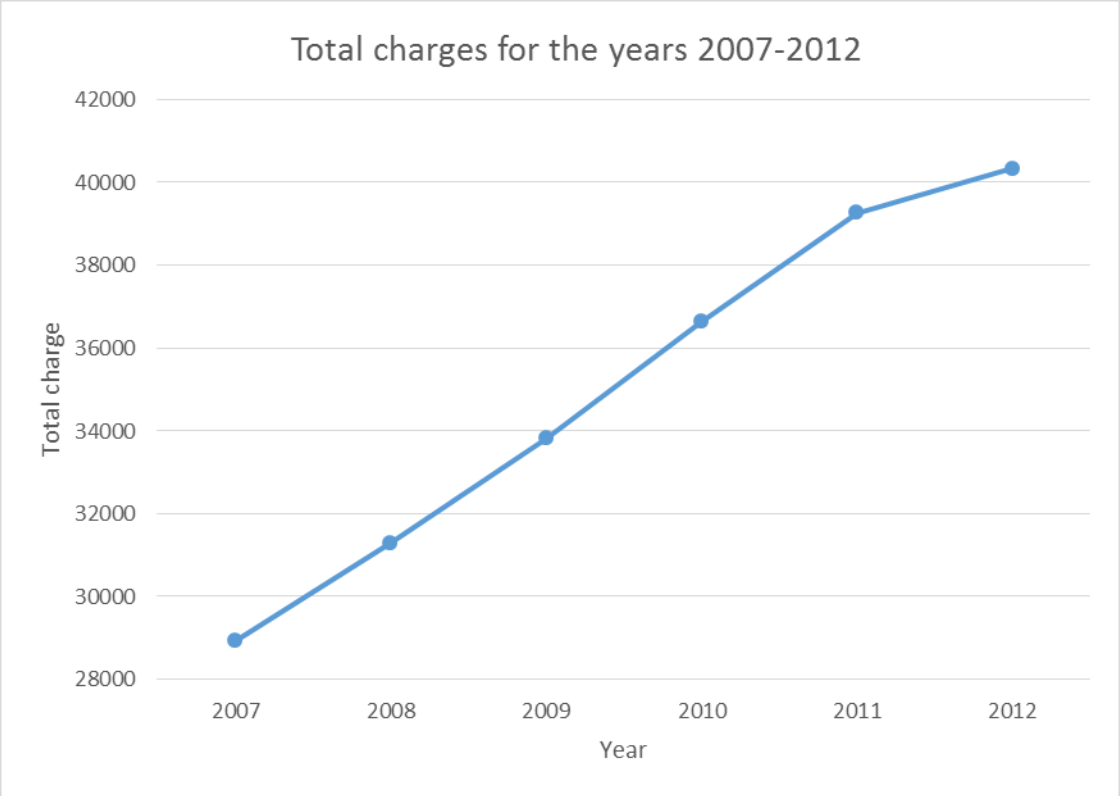

Figure 3 Total charges for the years 2007-2012

For median total charges during the years 2007 to 2012, the highest incidence occurred in 2012, and the lowest in 2007, as shown in Figure 8

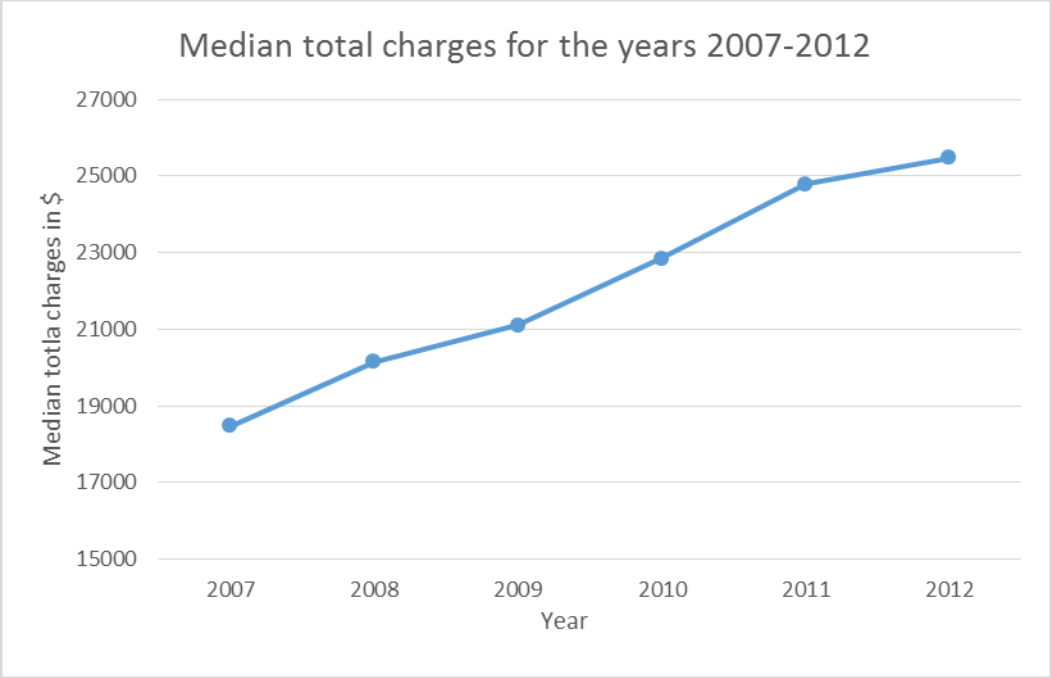

Figure 4 Median total charges for the years 2007-2012

4.2.17 Discharge of Parkinson disease patients during the years 2007-2012

The total of discharge costs for Parkinson disease patients was highest in 2011, with the lowest occurring in 2012, as shown in Figure 9.

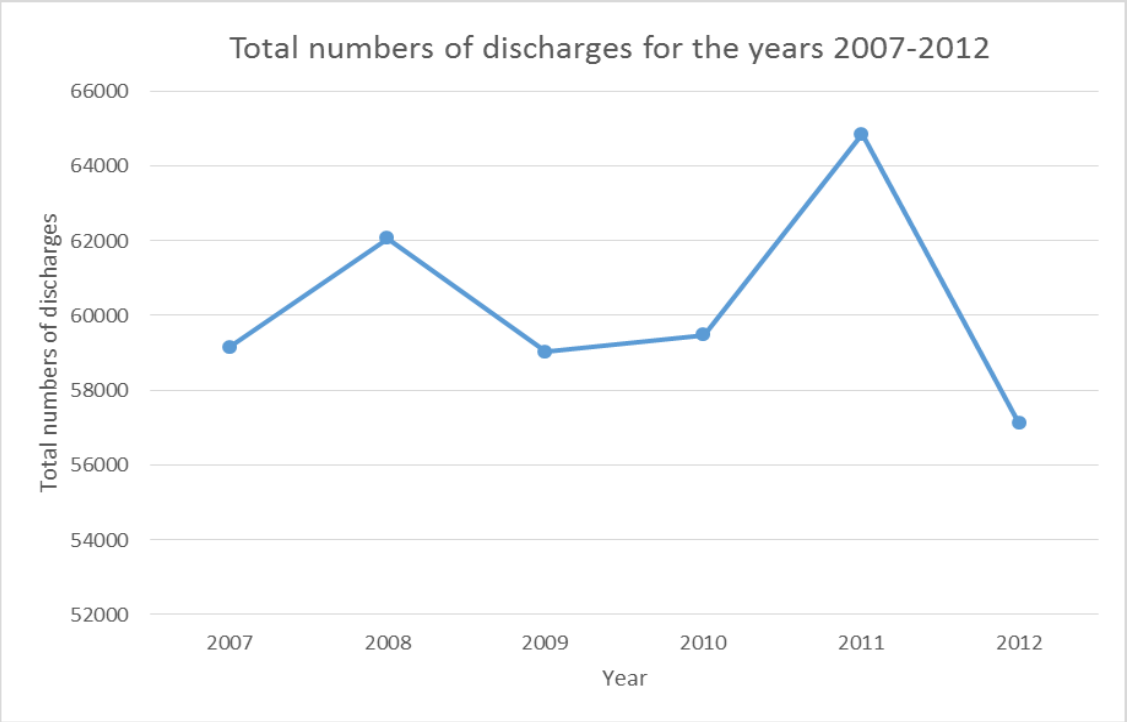

Figure 5 Total numbers of discharges for the years 2007-2012

4.2.18 Average length of stay during the years 2007 to 2012

The average length of stay during the years 2007 to 2012 is shown in Figure 10. The average length of stay decreased to the lowest incidence at 2012.

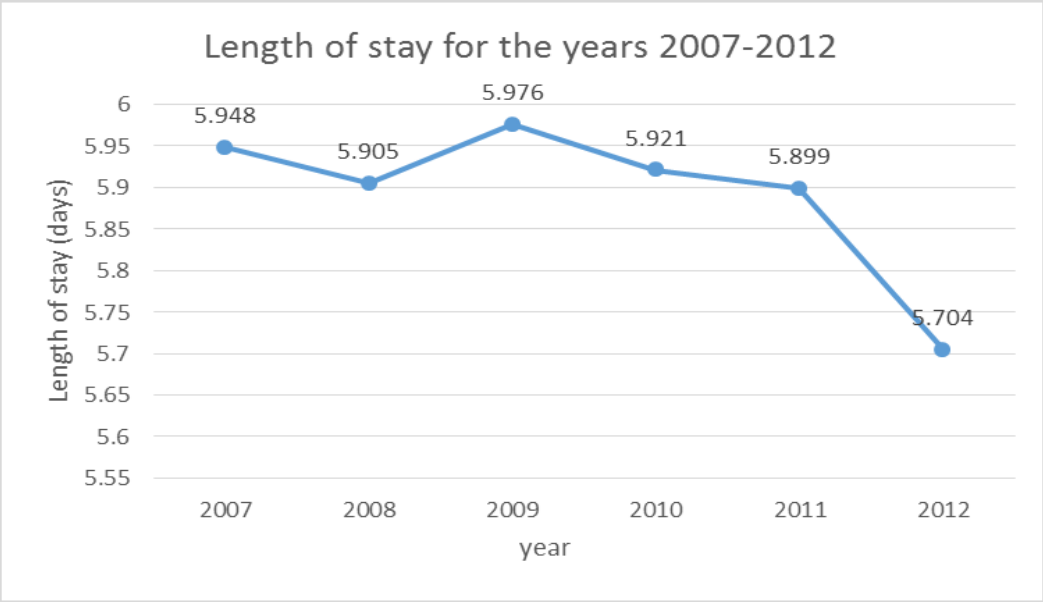

Figure 6 Length of stay for the years 2007-2012

4.3 Predictors of study outcomes

4.3.1 Comorbidities with length of hospital stay (Hypothesis 1)

In order to predict the comorbidities that affected the length of hospital stay for Parkinson disease patients, several assumptions were made to determine the final model of outcomes. The assumptions for each model will be mentioned first then final model. The dummy method and linear regression model were used to determine the predictors.

Assumption 1, dependent variables should be continuous: The length of hospital stay is continuous.

Assumption 2, two or more independent variables (numerical, ordinal, or categorical): Comorbidities involved in this model were categorical, either by their presence or absence when using the dummy method.

Assumption 3, independence of observations or independence of residuals: The value of the Durbin-Watson test for the length of hospital stay must range between 1 and 3, or be near to 2 to be accepted. It was 1.769 which is considered an accepted value.

Assumption 4, linear relationship between the dependent and independent variable(s): There was linearity between the dependent and independent variables based on significant correlations.

Assumption 5, data must show homoscedasticity: Results indicated that the dots along a scatterplot are homogenous and the same in distance along the linear fit line, as shown in the figure below. This assumption is accepted.

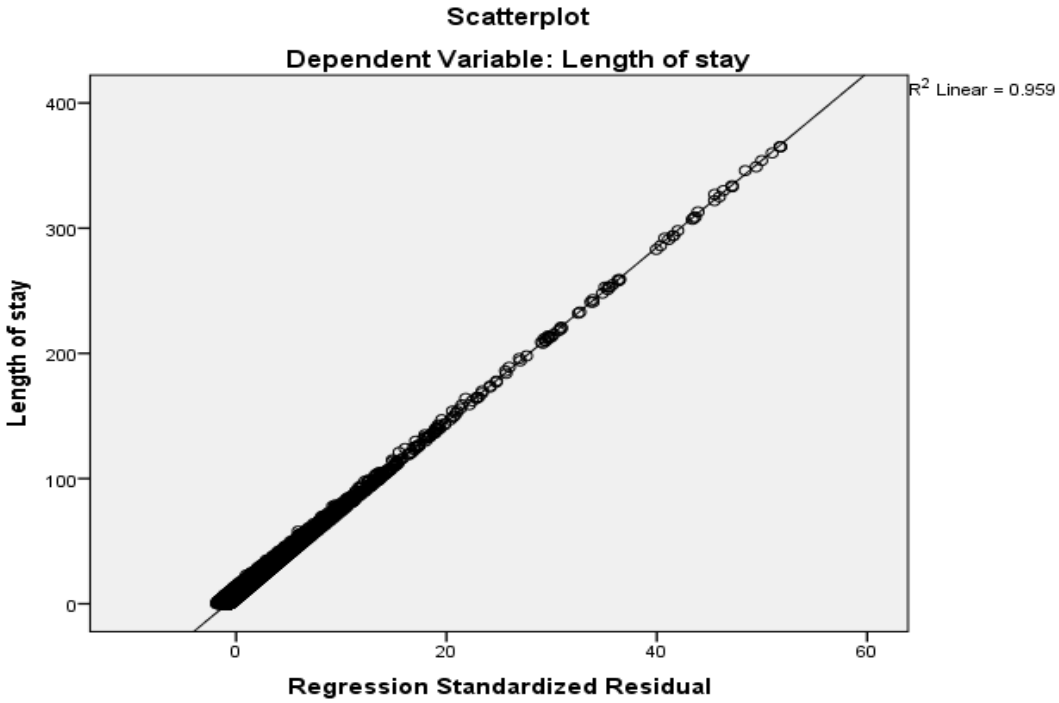

Figure 1 Homoscedasticity of Length of hospital stay

Assumption 6, data must not show multicollinearity: Using collinearity diagnostics, the VIF results must be less than 2 and will be ideal when close to 1. All results of VIF were less than 2, thus this assumption is accepted.

Assumption 7, no significant outliers: These are defined as residuals that have a much larger absolute value than the rest, for example, having values three or more standard deviations from the mean of the residuals. Using of Cook's distance (4/n, must be equals 0.00001) to measure the outliers of the model. i.e. determine the outliers for all variables in same time which is differ than simple outlier's detection methods. In this step, the outliers for the subjects with presence of other variables affected must be close to the fit line. There were 11861 cases which were considered outliers which were later excluded from the regression model.

Assumption 8, the residuals must be normally distributed: The residuals of length of stay were normally distributed, as shown in Figure 8 above.

After accepting all assumptions for the length of stay, the final model for the comorbidities of Parkinson disease is shown in Table 18. The length of hospital stay is positively significant, and highest, weight loss by 2.362 days coming in next, followed by paralysis (1.213 days), fluid and electrolyte disorders (0.797 days), congestive heart failure (0.710 days), drug abuse (0.574 days), other neurological disorders (0.572 days), coagulopathy (0.546 days), and others. Comorbidities that showed a lower length of stay than normal cases were those who had rheumatoid arthritis/collagen vascular diseases by -0437 days, followed by solid tumor without metastasis (-0.243 days), liver disease (-0.365 days), lymphoma (-0.363 days) and others. The comorbidities with the highest positively contributed to the longer hospital stay compared to others; weight loss (beta =0.136) and fluid/ electrolyte disorders (beta =0.089), deficiency anemia (beta = 0.080) and congestive heart failure (beta =0.060) were the highest respectively.

The length of hospital stay = 3.932 + .792 (Deficiency anemias) - .437 (Rheumatoid arthritis/collagen vascular diseases) + .303 (Chronic blood loss anemia) + .710 (congestive heart failure) + .230 (Chronic pulmonary disease) + .546 (Coagulopathy) - .107 (depression) + .192 (Diabetes with chronic complications) + .574 (Drug abuse) + .067 (Hypertension) - .052 (Hypothyroidism) - .365 (Liver disease) - .363 (Lymphoma) + .797 (Fluid and electrolyte disorders) + .572 (Other neurological disorders) - .071 (Obesity) + 1.213 (Paralysis) - .079 (Peripheral vascular disorders) + .345 (Psychoses) + .466 (Pulmonary circulation disorders) - .243 (Solid tumor without metastasis) + 2.362 (Weight loss)

Table 11 Comorbidities of Parkinson disease patients with length of hospital stay

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	3.932		189.97	<0.001		
Deficiency anemias	.792	.080	47.247	<0.001	.937	1.067
Rheumatoid arthritis/collagen vascular diseases	-.437	-.017	-10.21	<0.001	.998	1.002
Chronic blood loss anemia	.303	.008	4.813	<0.001	.997	1.003
Congestive heart failure	.710	.060	35.371	<0.001	.935	1.070
Chronic pulmonary disease	.230	.023	13.542	<0.001	.971	1.030
Coagulopathy	.546	.026	15.678	<0.001	.982	1.018
Depression	-.107	-.010	-5.874	<0.001	.992	1.008
Diabetes with chronic complications	.192	.010	6.028	<0.001	.939	1.064
Drug abuse	.574	.010	6.204	<0.001	.989	1.011
Hypertension	.067	.008	4.865	<0.001	.967	1.034
Hypothyroidism	-.052	-.005	-2.956	.003	.991	1.009
Liver disease	-.365	-.009	-5.454	<0.001	.981	1.019
Lymphoma	-.363	-.007	-4.353	<0.001	.999	1.001
Fluid and electrolyte disorders	.797	.089	53.279	<0.001	.960	1.042
Other neurological disorders	.572	.050	30.282	<0.001	.981	1.019
Obesity	-.071	-.004	-2.288	.022	.973	1.028
Paralysis	1.213	.050	30.625	<0.001	.998	1.002
Peripheral vascular disorders	-.079	-.005	-2.966	.003	.979	1.021
Psychoses	.345	.023	13.947	<0.001	.986	1.014
Pulmonary circulation disorders	.466	.016	9.495	<0.001	.960	1.042
Solid tumor without metastasis	-.243	-.008	-5.039	<0.001	.998	1.002
Weight loss	2.362	.136	81.695	<0.001	.975	1.026

Multiple linear regression: R = 0.239 (adjust R^2=0.057), df (29), p <0.001

4.3.2 Comorbidities with total charges (Hypothesis 2)

Assumption 1, dependent variables should be continuous: The total charge was continuous.

Assumption 2, two or more independent variables (numerical, ordinal, or categorical): Comorbidities involved in this model were categorical, either by their presence or absence when using the dummy method.

Assumption 3, independence of observations or independence of residuals: . The value of the Durbin-Watson test for the total charge must range between 1 and 3, or be near to 2 to be accepted. The value of Durbin-Watson test for the total charge was 1.640 which considered as accepted value

Assumption 4, linear relationship between the dependent and independent variable(s): The results showed linearity between the dependent and independent variables based on significant correlations.

Assumption 5, data must show homoscedasticity: Results indicated that the dots along a scatterplot were homogenous and the same in distance along the linear fit line, as shown in the figure below. This assumption is accepted.

Assumption 6, data must not show multicollinearity: Using collinearity diagnostics, the VIF results must be less than 2 and will be ideal when close. All results of VIF were less than 2, thus this assumption is accepted.

Assumption 7, no significant outliers: The cut point for the outliers while using Cook's distance is (4/n), which equals to 0.00001. There were 5679 cases that were considered as outliers and later excluded from the regression model.

Assumption 8, the residuals must be normally distributed: The residuals of length of stay were normally distributed.

After accepting all assumptions for total charges, the final model for the total charges and the comorbidities of Parkinson disease patients is shown in Table 16.

The comorbidity with highest costs for Parkinson disease patients was found in those with peptic ulcer disease ($11198.2), followed by weight loss ($11084.1), acquired immune deficiency syndrome ($10505.5), coagulopathy ($7660.7), paralysis ($4818.4), deficiency anemia ($4696.9) and others. Those patients who had a lower total charge than in normal cases were patients with drug abuse ($-2895.4), rheumatoid arthritis ($-2770.4), alcohol abuse ($-2347), and others. The comorbidity with the highest positive contribution to the total charges was weight loss (beta = .099), followed by deficiency anemia (beta =.074), coagulopathy (beta =.055), fluid and electrolyte imbalance (beta =. 044), and others.

The total charges = 25353.2 (constant) + 10505.2 (Acquired immune deficiency syndrome) - 2347.0 (Alcohol abuse) + 4696.9 (Deficiency anemias) -2770.4 (Rheumatoid arthritis/collagen vascular diseases) + 3063.8(Chronic blood loss anemia) + 405.7 (Congestive heart failure) + 1199.7 (Chronic pulmonary disease) + 7660.7 (Coagulopathy) -1815.1 (Depression) -2895.4 (Drug abuse) + 1285.2 (Hypertension) -1096.2 (Hypothyroidism) + 1090.3 (Liver disease) -1861.8 (Lymphoma) + 2505.6 (Fluid and electrolyte disorders)+ 1261.1 (Metastatic cancer) + 772.1 (Other neurological disorders) + 2819.3 (Obesity) + 4818.4 (Paralysis) + 1086.6 (Peripheral vascular disorders) -980.257 (Psychoses) + 4209.6 (Pulmonary circulation disorders) + 666.5 (Renal failure) -2230.8 Solid tumor without metastasis) + 11198.2 (Peptic ulcer disease excluding bleeding) + 500.6 (Valvular disease) +11084.1 (Weight loss).

Table 18 Comorbidities of Parkinson disease patients with total charges

	B	Beta	t	Sig.	Toler-ance	VIF
(Constant)	25353.2		187.0	.000		
Acquired immune deficiency syndrome	10505.5	.004	2.2	.029	1.000	1.000
Alcohol abuse	-2347.0	-.010	-5.8	.000	.973	1.028
Deficiency anemias	4696.9	.074	42.6	.000	.939	1.065
Rheumatoid arthritis/collagen vascular diseases	-2770.4	-.017	-9.8	.000	.998	1.002
Chronic blood loss anemia	3063.8	.012	7.3	.000	.997	1.003
Congestive heart failure	405.7	.005	3.1	.002	.937	1.068
Chronic pulmonary disease	1199.7	.018	10.8	.000	.971	1.029
Coagulopathy	7660.7	.055	32.5	.000	.987	1.013
Depression	-1815.1	-.026	-15.2	.000	.992	1.008
Drug abuse	-2895.4	-.009	-5.2	.000	.982	1.018
Hypertension	1285.2	.024	14.1	.000	.967	1.034
Hypothyroidism	-1096.2	-.016	-9.4	.000	.992	1.008
Liver disease	1090.3	.004	2.4	.016	.985	1.016
Lymphoma	-1861.8	-.006	-3.3	.001	.999	1.001
Fluid and electrolyte disorders	2505.6	.044	25.5	.000	.962	1.040
Metastatic cancer	1261.1	.005	2.8	.004	.998	1.002
Other neurological disorders	772.1	.011	6.3	.000	.982	1.019
Obesity	2819.3	.023	13.8	.000	.974	1.027
Paralysis	4818.4	.031	18.6	.000	.999	1.002
Peripheral vascular disorders	1086.6	.010	6.1	.000	.981	1.019
Psychoses	-980.257	-.010	-6.0	.000	.986	1.015
Pulmonary circulation disorders	4209.6	.022	12.9	.000	.962	1.040
Renal failure	666.5	.009	5.0	.000	.917	1.091
Solid tumor without metastasis	-2230.8	-.012	-7.0	.000	.998	1.002
Peptic ulcer disease excluding bleeding	11198.2	.004	2.2	.028	1.000	1.000
Valvular disease	500.6	.004	2.4	.015	.956	1.046
Weight loss	11084.1	.099	57.9	.000	.976	1.024

Multiple linear regression: R = 0.176 (adjust R^2=0.031), df (29), p <0.001

4.3.3 Number of procedures with length of stay (Hypothesis 3)

For the independence of observations or independence of residuals, the value of the Durbin-Watson test for the overall score of length of stay is 1.640 which is considered an accepted value. For the multicollinearity, the VIF value is equal to 1.

Table 20 shows a significant positive relationship between the hospital of length stay and the number of procedures, where the hospital of length stay increased by .933 days when the number of procedures increased.

Table 19 Relationship between number of procedure and length of stay

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	4.763		349.258	.000		
Number of procedures on this record	.933	.247	153.160	.000	1.000	1.000

Linear regression: R = 0.213 (adjust R^2 = .045), df (1), p <0.001

4.3.4 Number of procedures with total charge (Hypothesis 4)

For the independence of observations or independence of residuals, the value of the Durbin-Watson test for the total charge is 1.575. For the multicollinearity, the VIF value is equal to 1.

Table 21 shows a significant positive relationship between the total charge and the number of procedures, where the total charge increases by $12738.1 when the number of procedures increased.

Table 20 Relationship between number of procedure and total charge

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	19614.3		242.80	.000		
Number of procedures on this record	12738.1	.509	353.04	.000	1.000	1.000

Linear regression: R = .509 (adjust R^2 = .260), df (1), p <0.001

4.3.5 Mortality and comorbidities (Hypothesis 5)

Six assumptions were checked to approve the results of the multinomial logistic regression model.

Assumption 1: The dependent variable must be nominal. The mortality is nominal. This assumption is accepted

Assumption 2: The independent variables are continuous, ordinal, or nominal; comorbidities are nominal. This assumption is accepted.

Assumption 3: Independence of observation. All subjects of dependent variables were different. This assumption is accepted.

Assumption 4: No outliers. Eight subjects were considered outliers, and those were excluded later.

As for the impact of comorbidities of Parkinson disease patients to the mortality rate, only the significant results were illustrated in Table 22. Metastatic cancer showed the highest comorbidity, with mortality ratio equal to 2.17 times (170%) higher than the mortality of patients without metastatic cancer, followed by fluid and electrolyte disorders (OR = 2.04 times, 104%), weight loss (OR = 1.85 times, 85%), congestive heart failure (OR = 1.83 times, 83%), coagulopathy (OR= 1.62 times, 62%), solid tumor without

metastasis (OR = 1.5 times, 50%), renal failure (OR = 1.46 times, 46%), pulmonary circulation disorder (OR = 1.35, 35%) and others.

Mortality = -2.938 (Constant) - -.606 (Congestive heart failure) -.156(Chronic pulmonary disease) -.481(Coagulopathy) -.212 (Liver disease) -.711(Fluid and electrolyte disorders) -.776 (Metastatic cancer) -.057 (Other neurological disorders) -.159 (Paralysis) -.300 (Pulmonary circulation disorders) -.377 (Renal failure) -.403 (Solid tumor without metastasis) Solid tumor without metastasis -.617 (Weight loss).

Table 21 Impact of comorbidities of Parkinson disease patients on the mortality

		B	Wald	df	Sig.	Exp (B)	95% CI for Exp(B)	
							Lower Bound	Upper Bound
Intercept		-2.938	16.40	1	.000			
Congestive heart failure	No	-.606	714.96	1	.000	.545	.522	.570
	Yes	0	.	0	.	.	.	.
Chronic pulmonary disease	No	-.156	49.95	1	.000	.855	.819	.893
	Yes	0	.	0	.	.	.	.
Coagulopathy	No	-.481	179.90	1	.000	.618	.576	.663
	Yes	0	.	0	.	.	.	.
Liver disease	No	-.212	7.796	1	.005	.809	.697	.939
	Yes	0	.	0	.	.	.	.
Fluid and electrolyte disorders	No	-.711	1418.3	1	.000	.491	.473	.510
	Yes	0	.	0	.	.	.	.
Metastatic cancer	No	-.776	164.3	1	.000	.460	.409	.518
	Yes	0	.	0	.	.	.	.
Other neurological disorders	No	-.057	4.073	1	.044	.945	.894	.998
	Yes	0	.	0	.	.	.	.
Paralysis	No	-.159	10.85	1	.001	.853	.776	.938
	Yes	0	.	0	.	.	.	.
Pulmonary circulation disorders	No	-.300	35.3	1	.000	.741	.671	.818
	Yes	0	.	0	.	.	.	.
Renal failure	No	-.377	241.1	1	.000	.686	.654	.719
	Yes	0	.	0	.	.	.	.
Solid tumor without metastasis	No	-.403	57.3	1	.000	.668	.602	.742
	Yes	0	.	0	.	.	.	.
Weight loss	No	-.617	481.93	1	.000	.540	.511	.570
	Yes	0	.	0	.	.	.	.

Multinomial logistic regression. Model of fitting: $\chi^2 = 4953.87$, $p < 0.001$. The reference category is: did not die during hospitalization

4.3.6 graphic characteristics and length of hospital stay (Hypothesis 6)

For the independence of observations or independence of residuals, the value of the Durbin-Watson test for the overall score for length of stay is 1.770 which is considered an accepted value. For the multicollinearity, the VIF values are less than 2.

No significant impact was found for gender on the length of hospital stay. All ages significantly affected the length of hospital stay, where those aged less than 65 years had longer lengths of hospital stay than other ages by 0.428 days, followed by those aged 65-74 years (0.154 days) and 75-84 years (0.116 days). Race affected the length of hospital stay. Asian or Pacific Islander patients had the longest stay by 1.223 days, followed by blacks (1.156 days), others (0.95 days), and Hispanics (0.609 days). Income was significantly associated with length of hospital stay, where those with income that ranged in the 76th to 100th percentile had the highest length of stay by -0.177 (days) which is higher than those in the 51st to 75th percentile (-0.288 days) and the 26th to 50th percentile (-0.298 days). Blacks showed the highest influence (beta = 0.037) with length of hospital stay, followed by Asian or Pacific Islander (beta = 0.023), Hispanics (beta = 0.02), while the income showed lower influence to the length of hospital stay, as shown in Table 23.

Length of hospital stay = 5.816 (constant) - .032 (female) + .428 (age less than 65 years) + .154 (Age 65-74 years) + .116 (Age75-84 years) + 1.156 (Black) + .609 (Hispanic) + 1.223 (Asian or Pacific Islander) + .950 (Other race) - .298 (76th to 100th percentile) -.288 51st to 75th percentile) -.177 (76th to 100th percentile).

Table 22 Relationships between the demographic characteristics and length of stay

Length of hospital stay	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	5.798					
Female	-.032	-.002	-1.333	.183	.994	1.006
Age less than 65 years	.428	.019	10.146	.000	.749	1.336
Age 65-74 years	.154	.009	4.444	.000	.654	1.529
Age 75-84 years	.116	.008	3.800	.000	.618	1.618
Black	1.156	.037	22.268	.000	.979	1.022
Hispanic	.609	.020	11.952	.000	.986	1.014
Asian or Pacific Islander	1.223	.023	14.033	.000	.993	1.007
Native American	.168	.002	.909	.363	.997	1.003
Other	.950	.019	11.449	.000	.996	1.004
26th to 50th percentile	-.298	-.018	-9.141	.000	.691	1.448
51st to 75th percentile	-.288	-.017	-8.679	.000	.697	1.435
76th to 100th percentile	-.177	-.010	-5.237	.000	.694	1.442

Multiple linear regression. R= .057 (adjusted R^2 = 0.003), df(12), p<0.001.
References; White (race), ≥85 years (age), 0-25th percentile (income).

4.3.7 Demographic characteristics and total charge (Hypothesis 7)

For the independence of observations or independence of residuals, the value of the Durbin-Watson test for the total charges is 1.683 which is considered an accepted value. For the multicollinearity, the VIF values are less than 2.

Gender is a significant predictor for the total charge, where females had lower charges than males by $-2502.9. All ages were significantly related to total charge; however, those aged less than 65 years had the highest charges by $7558.0, followed by those aged 65-74 years ($6336.0) and 75-84 ($3044.7). Race was significantly related with total charges of Parkinson disease patients, except for the Native Americans. Asian or Pacific Islander had the highest charges by $22136.6, followed by Hispanics ($16136.9), others ($11576.8), and Blacks ($5469.7). Income is significantly related with the total charges, where those

with income 76th to 100th percentile got highest charges by $10462.0, followed by 51st to 75th percentile (5841.7) and 26th to 50th percentile ($1822.8). Patients in the 76th to 100th percentile income showed the highest contribution (beta = .093), followed by Hispanic (beta= .08), Asian Pacific and Islander (beta= .063), Age 65-74 years (beta = .057), and others, as shown in Table 24.

Total charges = 26477.4 (Constant) -2502.9 (female) +7558.0 (Age less than 65 years) + 6336.0 (Age 65-74 years) +3044.7 (Age 75-84 years) + 5469.7 (Black) + 16136.9 (Hispanic) +22136.6 (Asian or Pacific Islander) +11576.7 (other) + 1822.8 (26th to 50th percentile) + 5841.7 (51st to 75th percentile) + 10462.1(76th to 100th percentile)

Table 23 Relationships between the demographic characteristics and total charges

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	26477.4		116.57	.000		
Female	-2502.9	-.026	-15.92	.000	.994	1.006
Age less than 65 years	7558.0	.052	27.09	.000	.749	1.335
Age 65-74 years	6336.0	.057	27.58	.000	.654	1.528
Age 75-84 years	3044.7	.032	15.11	.000	.619	1.616
Black	5469.7	.027	15.92	.000	.979	1.022
Hispanic	16136.9	.080	47.71	.000	.986	1.014
Asian or Pacific Islander	22136.6	.063	37.62	.000	.994	1.006
Native American	-538.7	-.001	-0.44	.660	.997	1.003
Other	11576.7	.035	21.13	.000	.996	1.004
26th to 50th percentile	1822.8	.017	8.48	.000	.693	1.444
51st to 75th percentile	5841.7	.053	26.66	.000	.700	1.429
76th to 100th percentile	10462.1	.093	46.84	.000	.698	1.433

Multiple linear regression. R= .147 (adjusted R^2 = 0.022), df(112), p<0.001. References; male (gender), White (race), ≥85 years (age), 0-25th percentile (income).

4.3.8 Demographic characteristics and mortality (Hypothesis 8)

Males had a higher incidence of mortality than females by 1.245 times (24.5%). The age, income, and race of Parkinson disease patients are significant predictors of mortality. Those aged equal to or elder than 85 years had the higher indigence of death by 3.92 times (292%), 2.53 times (153%), and 1.48 times (48%) than those < 65 years, 65-74 years and 75-84 years respectively. Asian or Pacific Islanders had higher mortality rates than Whites by 1.155 times (15.5%) and 1.532 times (53.2%) respectively. Although the income significantly affected mortality, there were no significant results when comparing the types of incomes, as shown in Table 25.

Mortality = -2.983 (Constant) + .220 (female) -1.367 (age < 65 years) -.926 (age 65-74 years) -.394 (age 75-84 years) + .144 (other) + .427 (Asian or Pacific Islander).

Table 12 Association between demographic characteristics and mortality of Parkinson disease patients

	B	Wald	df	Sig.	Exp (B)	95% CI for Exp(B)	
						Lower Bound	Upper Bound
Intercept	-2.983	12498.9	1	.000			
Male	.220	121.98	1	.000	1.246	1.198	1.296
Female (ref.)	0	.	0	.	.	.	.
Age < 65 years	-1.367	849.34	1	.000	.255	.232	.279
Age 65-74 years	-.926	930.39	1	.000	.396	.373	.420
Age 75-84 years	-.394	320.09	1	.000	.674	.646	.704
Age ≥ 85 years(ref.)	0	.	0	.	.	.	.
Other	.144	5.31	1	.021	1.155	1.022	1.306
Black	.001	0.00	1	.989	1.001	.921	1.087
Hispanic	.034	0.70	1	.404	1.034	.956	1.119
Asian or Pacific Islander	.427	58.57	1	.000	1.532	1.373	1.709
Native American	-.032	0.04	1	.836	.968	.716	1.310
White(ref.)	0	.	0	.	.	.	.
76th to 100th percentile	.033	1.45	1	.228	1.034	.979	1.091
26th to 50th percentile	-.021	0.54	1	.461	.980	.927	1.035
51st to 75th percentile	-.049	3.04	1	.082	.952	.900	1.006
0-25th percentile (ref.)	0	.	0	.	.	.	.

4.3.9 Relationship between type of insurance and length of stay (Hypothesis 9)

For the independence of observations or independence of residuals, the value of the Durbin-Watson test for the length of stay is 1.766 which is considered as accepted value. For the multicollinearity, the VIF values are less than 2.

Medicaid, private including HMO, self-pay and other insurance were significantly related to length of stay by 2.285, -.466, .364, and -.384 days respectively. The results indicate that some insurances affected the hospital stay either positively or negatively, as shown in Table 26.

Table 25 Relationship between type of insurance and length of stay

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	5.869		462.290	.000		
Medicaid	2.285	.054	32.605	.000	.996	1.004
Private including HMO	-.466	-.018	-11.075	.000	.995	1.005
Self-pay	.364	.004	2.336	.020	.999	1.001
No charge	.187	.001	.430	.667	1.000	1.000
Other insurance	-.384	-.006	-3.476	.001	.998	1.002

Multiple linear regression: R = 0.059 (adjust R^2 = .003), df (5), p <0.001
Reference: Medicare

4.3.10 Relationship between type of insurance and total charge (Hypothesis 10)

For the independence of observations or independence of residuals, the value of the Durbin-Watson test for the overall score of length of stay is 1.638 which is considered an accepted value. For the multicollinearity, the VIF values are less than 2.

Medicaid, private insurance, including HMO and others significantly affected the total charge by $8758.4, $3087, and $-2652.8 respectively. Medicaid was the highest

impact contributed for the total charges (beta = 0.03), followed by private including HMO (eta = 0.02), while other insurance negatively affected the total charges of patients (beta = -0.01), as shown in Table 27.

Table 26 Relationship between type of insurance and total charge

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	34556.77		407.59	.000		
Medicaid	8758.35	0.03	18.79	.000	.996	1.004
Private including HMO	3087.03	0.02	10.94	.000	.995	1.005
Self-pay	-983.34	0.00	-0.95	.344	.999	1.001
No charge	379.27	0.00	0.13	.896	1.000	1.000
Other insurance	-2652.83	-0.01	-3.62	.000	.998	1.002

Multiple linear regression: R = 0.036 (adjust R^2 = .001), df (5), p <0.001
Reference: Medicare

4.3.11 Relationship between type of insurance and mortality (Hypothesis 11)

Other insurance and self-pay showed the highest mortality incidence by 2.1 times (110%) and 1.58 times (58%) than in Medicare, while the mortality is lower with Medicaid by 1.25 times and 25% (OR = 0.80) than in Medicare, as shown in Table 28.

Table 27 Association between type of insurance and mortality of Parkinson disease patients

	B	Wald	df	Sig.	Exp (B)	95% CI for Exp(B)	
						Lower Bound	Upper Bound
Intercept	-3.335	115396.8	1	.000			
Other	.744	146.422	1	.000	2.10	1.865	2.373
Medicaid	-.219	13.444	1	.000	.80	.714	.903
Private including HMO	.006	.034	1	.853	1.01	.944	1.072
Self-pay	.454	21.481	1	.000	1.58	1.300	1.909
No charge	.366	1.657	1	.198	1.44	.826	2.519
Medicare (ref.)	0	.	0	.	.	.	.

Logistic regression. Model Fitting: χ^2= 156.2, df(5), p<0.001.

The reference category is: did not die during hospitalization

4.3.12 Relationship between the year and total charge (Hypothesis 12)

For the independence of observations or independence of residuals, the value of the Durbin-Watson test for the overall total charges is 1.648 which is considered an accepted value. For the multicollinearity, the VIF values are less than 2.

There is a significant relationship between the years and total charges, where highest charges observed with 2012 ($11413.6), followed by 2011 ($10331.4), 2010 ($7709.1), 2009 ($4884.4), and 2008 ($2365.9), as shown in Table 29.

Table 13 Association between the year and total charge

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	28922.6		148.6	.000		
year2008	2365.9	.019	8.7	.000	.588	1.700
year2009	4884.4	.038	17.8	.000	.597	1.676
year2010	7709.1	.061	28.0	.000	.596	1.677
year2011	10331.4	.084	38.4	.000	.581	1.721
year2012	11413.6	.088	41.1	.000	.604	1.655

Multiple linear regression. R = 0.087 (adjust R^2 = .008), df (5), p <0.001, Reference 2007

4.3.13 Relationship between the year and length of stay (Hypothesis 13)

For the independence of observations or independence of residuals, the value of the Durbin-Watson test for the overall length of stay is 1.764 which is considered an accepted value. For the multicollinearity, the VIF values are less than 2.

The length of hospital stay decreased with the years, where length of stay was reduced by -.244 days, -.049 days, -.028 days, .028 days and -.043 days from years

2012-2008 respectively. However, length of stay obviously reduced to the lowest at 2012, as shown in Table 30.

Table 29 Association between the year and length of stay

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	5.948		203.283	.000		
year2008	-.043	-.002	-1.054	.292	.589	1.698
year2009	.028	.001	.678	.498	.598	1.672
year2010	-.028	-.001	-.669	.504	.597	1.676
year2011	-.049	-.003	-1.206	.228	.581	1.721
year2012	-.244	-.013	-5.849	.000	.604	1.655

Multiple linear regression. R = 0.012 (adjust R^2 = .001), df (5), p <0.001. Reference 2007

4.3.14 Relationship between the year and mortality (Hypothesis 14)

The incidence of mortality was reduced in 2011 by 1.08 times (8%) compared to incidence of mortality at 2007. However, no significant results for other years, as shown in Table 31.

Table 30 Association between the year and mortality of Parkinson disease patients

	B	Wald	df	Sig.	Exp (B)	95% CI for Exp(B)	
						Lower Bound	Upper Bound
Intercept	-3.292	22143.3	1	.000			
2012	-.040	1.606	1	.205	.960	.902	1.022
2008	-.046	2.161	1	.142	.955	.898	1.015
2009	.024	.584	1	.445	1.024	.963	1.089
2010	-.048	2.318	1	.128	.953	.896	1.014
2011	-.074	5.627	1	.018	.929	.874	.987
2007 (ref.)	0	.	0	.	.	.	.

Logistic regression. Model Fitting: χ^2= 13.184, df(5), p= 0.022.
The reference category is: did not die during hospitalization

4.3.15 Relationship between type of Parkinson and mortality (Hypothesis 15)

Primary Parkinson disease showed a higher incidence of mortality by 2.3 times (130%) than secondary type, as shown in Table 32.

Table 31 Association between the type of Parkinson disease and mortality

	B	Wald	df	Sig.	Exp (B)	95% CI for Exp(B)	
						Lower Bound	Upper Bound
Intercept	-4.149	1389.7	1	.000			
Primary	.834	55.83	1	.000	2.303	1.851	2.867
Secondary (ref.)	0	.	0	.	.	.	.

Logistic regression. Model Fitting: χ^2= 73.917, df(1), p <0.001.
The reference category is: did not die during hospitalization

4.3.16 Relationship between length of stay and type of Parkinson (Hypothesis 16)

For the independence of observations or independence of residuals, the value of the Durbin-Watson test for the length of stay is 1.765 which considered an accepted value. For the multicollinearity, the VIF value equals to 1, as shown in Table 28.

The length of hospital stay increased with secondary type of Parkinson disease by 3.688 days compared to primary, as shown in Table 33.

Table 32 Relationship between length of stay and type of Parkinson

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	5.840		490.8	.000		
Secondary	3.688	.062	37.465	.000	1.000	1.000

Multiple linear regression: R = 0.062 (adjust R^2 = .004), df (1), p <0.001
Reference: Primary type of Parkinson

4.3.17 Relationship between total charges and type of Parkinson (Hypothesis 17)

For the independence of observations or independence of residuals, the value of the Durbin-Watson test for the total charge is 1.636 which is considered an accepted value. For the multicollinearity, the VIF value equals to 1, as shown in Table 29.

The total charges increased with secondary types of Parkinson by $6726.9 compared to primary, as shown in Table 34.

Table 33 Relationship between total charge and type of Parkinson

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	34947.7		439.48	.000		
Secondary	6726.9	.017	10.18	.000	1.000	1.000

Multiple linear regression: R = 0.017 (adjust R^2 = .001), df (1), p <0.001
Reference: Primary type of Parkinson

4.3.18 Length of stay predictors and interactions (Hypothesis 18)

For the independence of observations or independence of residuals, the value of the Durbin-Watson test for the overall length of stay is 1.778 which is considered an accepted value. For the multicollinearity, the VIF value equals to 1, as shown in Table 30.

In terms of length of hospital stay, secondary types of Parkinson showed a longer length of stay by 3.173 days, followed by weight loss (3.004 days), paralysis (1.865 days), Medicaid (1.832 days), and drug abuse (1.345 days). The predictors which reduced the length of hospital stay were highest in year 2012 by -.399 days, followed by private insurance (-.354 days), and other insurance (-.300 days). As contributors to the overall length of stay, the number of procedures (beta = .227) and weight loss (beta = .106) were noted most frequently, as shown in Table 35.

Table 34 Predictors of hospital of length stay of Parkinson disease patients

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	3.129					
Deficiency anemias	.717	.042	23.563	.000	.931	1.074
Congestive heart failure	.806	.039	21.678	.000	.900	1.111
Coagulopathy	.471	.014	7.797	.000	.972	1.028
Drug abuse	1.345	.016	9.492	.000	.987	1.013
Fluid and electrolyte disorders	.794	.051	29.021	.000	.955	1.047
Other neurological disorders	.392	.020	10.994	.000	.932	1.073
Paralysis	1.865	.047	26.847	.000	.987	1.014
Psychoses	.409	.016	9.087	.000	.958	1.044
Pulmonary circulation disorders	.708	.015	8.487	.000	.972	1.029
Weight loss	3.004	.106	60.311	.000	.960	1.042
Number of chronic conditions	.098	.041	21.376	.000	.816	1.225
Number of procedures on this record	.846	.227	129.34	.000	.963	1.039
Black	.677	.022	12.728	.000	.971	1.030
Hispanic	.287	.010	5.476	.000	.979	1.021
Asian or Pacific Islander	.560	.011	6.224	.000	.986	1.014
Other	.548	.011	6.528	.000	.993	1.007
26th to 50th percentile	-.294	-.018	-8.716	.000	.688	1.454
51st to 75th percentile	-.289	-.017	-8.444	.000	.693	1.442
76th to 100th percentile	-.271	-.016	-7.770	.000	.688	1.453
Medicaid	1.832	.044	25.092	.000	.968	1.033
Private including HMO	-.354	-.014	-8.097	.000	.981	1.019
Self-pay	.425	.005	2.642	.008	.996	1.004
Other insurance	-.300	-.005	-2.652	.008	.996	1.004
Secondary	3.713	.063	35.423	.000	.927	1.079
Year 2012	-.399	-.022	-12.759	.000	.992	1.008

Multiple linear regression: R = 0.321 (adjust R^2 = .103), df (25), p <0.001. Reference: Primary Parkinson, White, Medicare, 0-25th percentile, no comorbidities, and 2007. For the interactions of most affected predictors with race, primary Parkinsonism of

Secondary PD for Asians or Pacific Islanders were the most impactful factor for the longest length of stay by 9.97 days, followed by other races who had weight loss (7.197 days), and other races with drug abuse (5.966 days). For the highest contributed factor for the final model of interactions on the length of stay, Whites who had weight loss was the

largest factor (beta = .115), followed by Hispanics with weight loss (beta = .049), Whites with paralysis, and Whites with Medicaid (beta = .045 each), as shown in Table 36.

Table 35 Predictors interaction with race impact on the hospital of length stay of Parkinson disease patients

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	5.325					
White*drug abuse	1.100	.011	6.617	.000	.992	1.008
Black*drug abuse	-.255	-.001	-.585	.558	.970	1.031
Hispanic*drug abuse	1.583	.005	2.908	.004	.980	1.021
Asian*drug abuse	2.735	.003	1.828	.067	.997	1.003
Other*drug abuse	5.966	.009	5.687	.000	.990	1.010
White*Paralysis	2.262	.045	27.176	.000	.992	1.008
Black*Paralysis	1.624	.013	7.905	.000	.946	1.057
Hispanic*Paralysis	2.622	.018	10.896	.000	.960	1.041
Asian*Paralysis	2.088	.010	6.176	.000	.937	1.068
Other*Paralysis	3.639	.014	8.516	.000	.963	1.038
White * Weight loss	4.029	.115	69.962	.000	.983	1.017
Black* Weight loss	4.044	.040	23.510	.000	.920	1.087
Hispanic* Weight loss	5.425	.049	29.007	.000	.933	1.072
Asian* Weight loss	3.990	.024	13.911	.000	.906	1.103
Other*Weight loss	7.197	.039	23.204	.000	.934	1.071
Secondary *White	3.083	.043	25.896	.000	.993	1.007
Secondary*Black	3.917	.022	13.130	.000	.965	1.036
Secondary*Hispanic	4.027	.015	9.162	.000	.981	1.020
Secondary*Other	4.899	.012	7.147	.000	.985	1.015
Secondary*Asian	9.974	.020	12.025	.000	.990	1.010
Medicaid*White	2.748	.045	26.844	.000	.947	1.056
Medicare*White	.096	.007	3.357	.001	.699	1.430
Medicaid*Black	2.523	.021	12.723	.000	.945	1.059
Medicare*Black	1.048	.031	16.747	.000	.774	1.291
Medicaid*Hispanic	1.660	.016	9.544	.000	.962	1.040
Medicare*Hispanic	.503	.015	8.187	.000	.803	1.246
Medicaid*Asian	2.403	.015	8.724	.000	.967	1.035
Medicare*Asian	.985	.017	9.371	.000	.833	1.201
Medicaid*Other	.858	.004	2.660	.008	.974	1.027
Medicare*Other	.720	.013	7.384	.000	.866	1.155

4.3.19 Total charges predictors and interactions (Hypothesis 19)

For the independence of observations or independence of residuals, the value of the Durbin-Watson test for the total charges is 1.644 which considered as accepted value. For the multicollinearity, the VIF value equals to 1, as shown in Table 28.

The predictors for the highest total charges was observed to be Asian or Pacific Islanders ($19387.9); followed by Hispanics ($14005.7), weight loss ($13281.9), number of procedures ($12443.7), and others. Females had lower total charges than males by $-1232.3. The number of procedures was observed to be a contributing factor for the total charge model (beta = .487), then weight loss and Hispanics (beta = 0.068 each), and income at the 76th to 100th percentile (beta = .065), and others, as shown in Table 37.

Table 36 Predictors of total charges of Parkinson disease patients

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	2998.16					
Deficiency anemias	4033.78	.034	21.70	.000	.931	1.074
Congestive heart failure	3943.35	.028	17.33	.000	.895	1.118
Chronic pulmonary disease	2040.30	.017	10.44	.000	.910	1.099
Coagulopathy	9111.05	.038	24.65	.000	.969	1.032
Fluid and electrolyte disorders	5345.78	.050	32.00	.000	.952	1.051
Obesity	699.45	.003	2.05	.040	.926	1.079
Paralysis	8148.66	.029	19.10	.000	.985	1.015
Pulmonary circulation disorders	4781.88	.015	9.39	.000	.971	1.030
Weight loss	13281.92	.068	43.33	.000	.958	1.044
Female	-1232.34	-.013	-8.18	.000	.983	1.017
Number of chronic conditions	578.81	.035	19.64	.000	.738	1.355
Number of procedures on this record	12443.65	.487	311.20	.000	.959	1.043
Less than 65 years	3499.83	.023	12.00	.000	.615	1.626
Age 65-74 years	2649.32	.023	11.93	.000	.632	1.582
Age75-84 years	989.13	.010	5.13	.000	.614	1.629
Black	1902.39	.009	5.84	.000	.969	1.032
Hispanic	14005.65	.068	43.57	.000	.978	1.022
Asian or Pacific Islander	19387.87	.053	34.55	.000	.986	1.015
Other	7824.22	.024	15.29	.000	.993	1.007

Table continued

26th to 50th percentile	1287.19	.012	6.28	.000	.689	1.451
51st to 75th percentile	4933.02	.043	23.59	.000	.695	1.439
76th to 100th percentile	7568.51	.065	35.37	.000	.689	1.452
Medicaid	4709.21	.017	10.16	.000	.887	1.127
Private including HMO	802.41	.005	2.86	.004	.895	1.118
year2009	1035.57	.008	4.40	.000	.634	1.576
year2010	3374.46	.028	14.33	.000	.632	1.582
year2011	5259.22	.044	22.72	.000	.614	1.629
year2012	6203.51	.050	25.91	.000	.631	1.584
Secondary	7274.32	.018	11.65	.000	.983	1.017

Multiple linear regression: R = .549 (adjust R^2 = .301), df (29), p <0.001. Reference: Primary Parkinson, White, Medicare, 0-25th percentile, age ≥ 85 years, male, no comorbidities, and 2007.

Coagulopathy for Asians or Pacific Islanders showed the highest total charges by $29665.5, followed by other races with weight loss ($29310.1), Asians with weight loss ($28973.3), Hispanics with weight loss ($28348.3), and others. The predictors contributing to the final model of the total charges, the number of procedures for Whites showed the highest rate (beta = .421), followed by the number of procedures for Hispanics (beta = .197), the number of procedures for Blacks (beta = .142), the number of procedures for Asian or Pacific Islanders (beta = .133), and the number of procedures for other races (beta = .199), as shown in Table 38.

Table 14 Predictors' interaction impact on total charges of Parkinson disease patients

	B	Beta	t	Sig.	Tolerance	VIF
(Constant)	20252.4					
Coagulopathy*White	11115.5	.040	27.40	.000	.986	1.014
Coagulopathy*Black	10040.5	.011	7.20	.000	.965	1.036
Coagulopathy*Hispanic	19373.3	.021	14.40	.000	.961	1.041
Coagulopathy*Asian	29665.5	.019	12.90	.000	.958	1.044
Coagulopathy*Others	24864.3	.015	10.47	.000	.960	1.041

Table continued

White*Paralysis	7143.2	.021	14.69	.000	.996	1.004
Black* Paralysis	8495.2	.010	7.15	.000	.973	1.028
Hispanic* Paralysis	17424.0	.018	12.46	.000	.974	1.026
Others* Paralysis	15472.4	.009	6.29	.000	.979	1.021
White* Weight loss	14167.1	.061	41.90	.000	.978	1.022
Black* Weight loss	12623.6	.019	12.51	.000	.928	1.078
Hispanic* Weight loss	28348.3	.038	25.65	.000	.941	1.063
Asian* Weight loss	28973.3	.026	17.11	.000	.929	1.076
Others* Weight loss	29310.1	.024	16.21	.000	.937	1.068
No.of procedures*White	11743.6	.421	286.29	.000	.957	1.045
No.of procedures*Black	12484.3	.142	92.90	.000	.884	1.131
No.of procedures*Hispanic	16297.9	.197	129.48	.000	.897	1.115
No.of procedures*Asian	18337.3	.133	87.58	.000	.900	1.111
No.of procedures*Others	14540.8	.119	77.96	.000	.893	1.120
Secondary*White	6215.8	.013	8.95	.000	.999	1.001
Secondary *Black	8149.2	.007	4.74	.000	.991	1.009
Secondary*Hispanic	14066.9	.008	5.43	.000	.996	1.004
Secondary *Asian	16635.7	.005	3.37	.001	.996	1.004

4.3.20 Mortality predictors and interactions (Hypothesis 20)

The highest impact on mortality was observed to be age, where those aged 85 years and above had significantly higher incidence of mortality than patients aged less than 65, 65-74, and 75-84 years by 4.74 times (374%), 2.47 times (147%) and 1.48 times (48%), respectively. Patients with metastasis showed a higher incidence of mortality by 2.23 times (123%) than those without. Fluid and electrolyte balance prompted higher incidence of mortality for patients by 1.9 times (90%) than those without. Congestive heart failure is the third highest reason of mortality by 1.78 times (78%). Those with weight loss got 1.96 times (69%) higher incidence of mortality, and followed by others, as shown in Table 39.

Table 38 Predictors of mortality of Parkinson disease patients

		B	Wald	df	Sig.	Exp (B)	95%CI Exp(B)	
							Lower	Upper
Intercept		1.209	20.35	1	.000			
No. of chronic diseases		-.049	145.27	1	.000	.952	.944	.959
No. of procedures		.163	1799.6	1	.000	1.177	1.168	1.186
Congestive heart failure	No	-.576	503.16	1	.000	.562	.534	.591
	Yes (ref.)	0	.	0	.	.	.	.
Chronic pulmonary disease	No	-.221	77.17	1	.000	.802	.763	.842
	Yes (ref.)	0	.	0	.	.	.	.
Coagulopathy	No	-.394	101.10	1	.000	.674	.624	.728
	Yes (ref.)	0	.	0	.	.	.	.
Liver disease	No	-.407	25.02	1	.000	.665	.567	.781
	Yes (ref.)	0	.	0	.	.	.	.
Fluid and electrolyte balance	No	-.641	946.04	1	.000	.527	.506	.549
	Yes (ref.)	0	.	0	.	.	.	.
Metastasis	No	-.801	143.43	1	.000	.449	.394	.512
	Yes (ref.)	0	.	0	.	.	.	.
Neurological disorders	No	.093	8.68	1	.003	1.097	1.032	1.167
	Yes (ref.)	0	.	0	.	.	.	.
Paralysis	No	-.187	12.17	1	.000	.830	.747	.921
	Yes(ref.)	0	.	0	.	.	.	.
Pulmonary circulation disorders	No	-.272	25.45	1	.000	.762	.685	.847
	Yes (ref.)	0	.	0	.	.	.	.
Renal failure	No	-.296	120.13	1	.000	.744	.705	.784
	Yes (ref.)	0	.	0	.	.	.	.
Solid tumor without metastasis	No	-.341	32.90	1	.000	.711	.633	.799
	Yes (ref.)	0	.	0	.	.	.	.
Weight loss	No	-.523	288.13	1	.000	.593	.558	.630
	Yes (ref.)	0	.	0	.	.	.	.
Gender	Male	.179	74.000	1	.000	1.196	1.148	1.245
	female(ref.)	0	.	0	.	.	.	.
Age (years)	< 65	-1.56	905.75	1	.000	.211	.191	.233
	65-74	-.904	831.60	1	.000	.405	.381	.431
	75-84	-.395	292.35	1	.000	.674	.644	.705
	≥ 85 (ref.)	0	.	0	.	.	.	.
White	No	-.078	9.691	1	.002	.925	.881	.972
	Yes (ref.)	0	.	0	.	.	.	.
Asian or Pacific Islander	No	-.365	32.732	1	.000	.694	.612	.786
	Yes (ref.)	0	.	0	.	.	.	.

Table continued

Other	No	-.138	4.021	1	.045	.871	.761	.997
	Yes(ref.)	0	.	0	.	.	.	.
Medicare	No	.526	246.80	1	.000	1.692	1.584	1.806
	Yes (ref.)	0	.	0	.	.	.	.
Medicaid	No	.177	5.820	1	.016	1.193	1.034	1.377
	Yes (ref.)	0	.	0	.	.	.	.
Self-pay	No	-.437	15.260	1	.000	.646	.518	.804
	Yes (ref.)	0	.	0	.	.	.	.
2011 year	No	.071	8.072	1	.004	1.074	1.022	1.128
	Yes (ref.)	0	.	0	.	.	.	.
Type of Parkinson	Primary	.656	25.86	1	.000	1.926	1.496	2.480
	Secondary(ref.)	0	.	0	.	.	.	.

Multinomial logistic regression. Model Fitting: χ^2= 6535.662, df(26), p <0.001.
The reference category is: did not die during hospitalization.

The highest incidence of mortality due to the presence of CHF for those aged equal or elder than 85 years old by 6.33 times (533%), 4 times (300%), 2.49 times (149%), 1.7 times (70%), 2.91 times (191%), 2.07 times (107%), and 1.27 times (27%) for those with absence and presence of CHF, and aged less than 65 years old, 65-74 years, 75-84 years and equals and elder than 85 years respectively.

The highest incidence of mortality due to the presence of fluid/electrolyte disorders for those aged equal or elder than 85 years old by 8.33 times (733%), 2.65 times (165%), 4.98 times (398%), 1.9 times (90%), 2.85 times (185%), 1.31 times (31%), and 1.86 times (86%) for those with absence and presence of fluid/electrolyte disorders, and aged less than 65 years old, 65-74 years, 75-84 years and equals and elder than 85 years respectively.

Highest incidence of mortality due to the presence of metastasis for those aged equal or elder than 85 years old by 8.2 times (720%), 1.55 times (55%), 5 times (400%), 1.83 times (83%), 2.99 times (199%), 1.28 times (28%), and 2.03 times (103%) for those with absence and presence of metastasis, and aged less than 65 years old, 65-74 years, 75-84 years and equals and elder than 85 years respectively.

Highest incidence of mortality due to presence of weight loss for those aged equal or elder than 85 years old by 7.52 times (652%), 2.43 times (143%), 4.74 times (374%), 1.6 times (60%), 2.81 times (181%), 1.17 times (17%), and 1.87 times (87%) for those with absence and presence of weight loss, and aged less than 65 years old, 65-74 years, 75-84 years and equals and elder than 85 years respectively, as shown in Table 40.

Table 39 Predictors' interaction impact on the mortality of Parkinson disease patients

	B	Wald	df	Sig.	Exp (B)	95% CI for Exp(B)	
						Lower Bound	Upper Bound
Intercept†	-2.472	7254.50	1	.000			
No CHF * <65 yrs	-1.844	1227.85	1	.000	.158	.143	.175
CHF * <65 yrs	-1.388	1274.03	1	.000	.250	.231	.269
No CHF * 65-74 yrs	-.914	768.06	1	.000	.401	.376	.428
CHF * 65-74 yrs	-.532	243.11	1	.000	.587	.549	.628
No CHF * 75-84 yrs	-1.067	87.99	1	.000	.344	.275	.430
CHF * 75-84 yrs	-.729	138.76	1	.000	.483	.428	.545
No CHF * ≥ 85 yrs	-.236	34.02	1	.000	.790	.729	.855
CHF * ≥ 85 yrs	0	.	0	.	.	.	.
Intercept‡	-2.508	12604.8	1	.000			
No fluid/electrolyte*<65 yrs	-2.119	1235.59	1	.000	.120	.107	.135
Fluid/electrolyte*<65 yrs	-.975	233.75	1	.000	.377	.333	.427
No fluid/electrolyte*65-74yrs	-1.605	1684.3	1	.000	.201	.186	.217
Fluid /electrolyte * 65-74 yrs	-.640	244.90	1	.000	.527	.487	.571
No fluid/electrolyte*75-84yrs	-1.047	1287.99	1	.000	.351	.332	.372
Fluid /electrolyte * 75-84 yrs	-.272	81.92	1	.000	.762	.718	.808
No fluid/electrolyte* ≥ 85 yrs	-.622	412.06	1	.000	.537	.505	.570
Fluid/electrolyte * ≥ 85 yrs	0	.	0	.	.	.	.

Table continued

Intercept§	-2.179	319.998	1	.000			
No metastasis * <65 yrs	-2.101	266.04	1	.000	.122	.095	.157
Metastasis * <65 yrs	-.439	3.894	1	.048	.645	.417	.997
No metastasis * 65-75 yrs	-1.607	167.68	1	.000	.200	.157	.256
Metastasis * 65-75 yrs	-.607	11.32	1	.001	.545	.383	.776
No metastasis * 76-84 yrs	-1.096	79.96	1	.000	.334	.263	.425
Metastasis * 76-84 yrs	-.249	2.79	1	.095	.780	.582	1.044
No metastasis * ≥ 85 yrs	-.709	33.36	1	.000	.492	.387	.626
Metastasis ≥ 85 yrs	0	.	0	.	.	.	.
Intercept ¥	-2.313	2683.4	1	.000			
No weight loss * <65 yrs	-2.016	1042.76	1	.000	.133	.118	.150
Weight loss * <65 yrs	-.887	51.82	1	.000	.412	.324	.525
No weight loss * 65-75 yrs	-1.555	918.01	1	.000	.211	.191	.234
Weight loss * 65-75 yrs	-.468	37.351	1	.000	.626	.539	.728
No weight loss *76-84 yrs	-1.032	481.63	1	.000	.356	.325	.391
Weight loss *76-84 yrs	-.157	7.31	1	.007	.854	.762	.958
No weight loss *≥ 85 yrs	-.625	172.81	1	.000	.535	.488	.588
Weight loss *≥ 85 yrs	0	.	0	.	.	.	.

Multinomial logistic regression.
† χ^2= 2627.92, df(7), p<0.001, ‡ χ^2= 3624.43, df(7), p<0.001, § χ^2= 2064.93, df(7), p<0.001
¥ χ^2= 2685.58, df(7), p<0.001

4.3.21 Risk of mortality and severity of illness

There were five subclasses for risk of mortality; no class specified, minor likelihood of dying, moderate likelihood of dying, major likelihood of dying, and extreme likelihood of dying. Results of these variables showed a moderate likelihood of dying got the highest incidence by 50.6%, followed by major likelihood of dying (26.6%), and others, as shown in Table 41.

Table 40 Subclasses for risk of mortality

	Frequency	Percent
No class specified	112	.03
Minor likelihood of dying	52489	14.5
Moderate likelihood of dying	182970	50.6
Major likelihood of dying	96041	26.6
Extreme likelihood of dying	30050	8.3
Total	361662	100.0

For severity of illness five subclasses were involved; no class specified, minor loss of function, moderate loss of function, major loss of function and extreme loss of function. The highest incidence of severity of illness was observed with a moderate loss of function by 44.9%, followed by major loss of function (41.1%), as shown in Table 42.

Table 41 Subclasses for severity of illness

	Frequency	Percent
No class specified	112	.03
Minor loss of function	16755	4.6
Moderate loss of function	162343	44.9
Major loss of function	148494	41.1
Extreme loss of function	33958	9.4
Total	361662	100.0

4.3.22 Predictors of major and extreme likelihood of dying (Hypothesis 21)

As the most affected predictors of a major likelihood of dying, age was the most influential predictor where higher incidence observed for those aged equal or elder than 85 years old by 20.83 times (1983%), 7.14 times (614%), and 2.26 times (126%) than those aged 65-74, 75-84 and ≥ 85 years respectively. Emergency admission is considered a second major predictor to the major likelihood of dying by 3.7 times (270%), 2.30 times (130%), 1.88 times (88%), and 1.34 times (34%) higher than elective, delivery, trauma and urgent admissions, respectively. Black race patients had the highest incidence of dying by 1.584 times (58.4%) compared to White patients. The major likelihood of dying category was observed to be highest in 2011 by 1.576 times (57.6%), followed by 2009 (1.406 times, 40.6%), 2010 (1.367 times, 36.7%), 2008 (1.177 times, 17.7%) compared with 2007. And, no charge showed a higher incidence of a major likelihood of dying by

1.66 times (66%) than Medicare, followed by self-pay (1.56 times, 56%), private insurance including HMOs (1.40 times, 40%), and others (1.25 times, 25%).

For the extreme likelihood of dying, age also played an important role, where there was a higher incidence in those aged equal and elder than 85 years by 38.46 times (3746%); followed by 8.33 times (733%), and 2.46 times (146%) for those aged < 65, 65-74 and 75-84 years, respectively. The incidence of extreme likelihood of dying is higher in 2011 by 2.565 times (156.5%) than in 2007, followed by 2.107 times (110.7%), 2.055 times (105.5%), and 1.287 times (28.7%) for the years 2010, 2009, and 2008, respectively. Emergency admission showed the highest incidence of an extreme likelihood of dying by 6.54 times (554%) than in elective, followed by trauma (4.72 times, 372%), delivery (1.96 times, 96%), and urgent (1.74 times, 74%). Males had a higher incidence of an extreme of likelihood of dying by 1.594 times (59.4%). Blacks had higher incidence than Whites by 1.624 times (62.4%), as shown in Table 43.

Table 42 Predictors of major and extreme likelihood of dying

			B	Wald	df	Sig.	Exp(B)	95% CI for Exp(B)	
								Lower Bound	Upper Bound
Major likelihood of dying	Intercept		2.019	968.809	1	.000			
	NPR		.141	1017.37	1	.000	1.151	1.141	1.161
	Parkinson type	Primary	-.105	3.488	1	.062	.900	.807	1.005
		Secondary	0	.	0	.	.	.	.
	Age (years)	< 65	-3.036	8898.44	1	.000	.048	.045	.051
		65-74	-1.964	5148.98	1	.000	.140	.133	.148
		75-84	-.813	909.035	1	.000	.443	.421	.468
		≥ 85	0	.	0	.	.	.	.
	Race	Other	-.180	14.267	1	.000	.835	.760	.917
		Black	.460	218.835	1	.000	1.584	1.491	1.684
		Hispanic	-.083	6.380	1	.012	.921	.864	.982
		Asian or Pacific Islander	-.214	9.543	1	.002	.807	.705	.925
		Native American	.010	.009	1	.924	1.010	.823	1.240
		White	0	.	0	.	.	.	.
	Income	76th to100th percentile	-.315	206.064	1	.000	.730	.699	.762
		26th to 50th percentile	-.100	22.760	1	.000	.905	.869	.943
		51st to 75th percentile	-.195	82.738	1	.000	.823	.789	.858
		0-25th percentile	0	.	0	.	.	.	.
	Year	2008	.163	41.472	1	.000	1.177	1.120	1.237
		2009	.340	182.150	1	.000	1.406	1.338	1.477
		2010	.313	157.189	1	.000	1.367	1.302	1.436
		2011	.455	345.772	1	.000	1.576	1.502	1.653

		2007	0	.	0	.	.	.	.
	Gender	Male	.290	360.244	1	.000	1.336	1.296	1.376
		Female	0	.	0	.	.	.	.
	Insurance	Other	-.221	12.040	1	.001	.801	.707	.908
		Medicaid	-.057	1.635	1	.201	.945	.865	1.031
		Private including HMO	-.336	173.582	1	.000	.714	.679	.751
		Self-pay	-.443	26.368	1	.000	.642	.542	.760
		No charge	-.508	6.092	1	.014	.602	.402	.901
		Medicare	0	.	0	.	.	.	.
	Type of admission	Urgent	-.289	184.892	1	.000	.749	.719	.781
		Elective	-1.310	4259.96	1	.000	.270	.259	.281
		Delivery	-.835	39.321	1	.000	.434	.334	.563
		Trauma	-.634	3.893	1	.048	.531	.283	.996
		Emergency	0	.	0	.	.	.	.
Extreme likelihood of dying	Intercept		.270	8.286	1	.004			
	NPR		.350	5189.43	1	.000	1.419	1.405	1.432
	Parkinson type	Primary	-.096	1.327	1	.249	.908	.771	1.070
		Secondary	0	.	0	.	.	.	.
	Age (years)	< 65	-3.654	5828.81	1	.000	.026	.024	.028
		65-74	-2.119	4053.68	1	.000	.120	.113	.128
		75-84	-.902	847.640	1	.000	.406	.382	.431
		≥ 85	0	.	0	.	.	.	.
	Race	Other	-.022	.129	1	.719	.978	.866	1.104
		Black	.485	151.531	1	.000	1.624	1.503	1.754
		Hispanic	.021	.254	1	.615	1.022	.940	1.110
		Asian or Pacific Islander	.047	.299	1	.585	1.048	.886	1.240
		Native American	-.251	2.677	1	.102	.778	.575	1.051
		White	0	.	0	.	.	.	.
	Income	76th to100th percentile	-.301	110.349	1	.000	.740	.699	.783
		26th to 50th percentile	-.146	27.158	1	.000	.864	.818	.913
		51st to 75th percentile	-.201	50.048	1	.000	.818	.774	.865
		0-25th percentile	0	.	0	.	.	.	.
	Year	2008	.252	47.035	1	.000	1.287	1.198	1.383
		2009	.720	414.265	1	.000	2.055	1.917	2.202
		2010	.745	456.028	1	.000	2.107	1.967	2.256
		2011	.942	765.253	1	.000	2.565	2.399	2.742
		2007	0	.	0	.	.	.	.
	Gender	Male	.466	527.902	1	.000	1.594	1.532	1.658
		Female	0	.	0	.	.	.	.
	Insurance	Other	-.056	.387	1	.534	.945	.791	1.129
		Medicaid	.069	.994	1	.319	1.071	.936	1.226
		Private including HMO	-.329	76.141	1	.000	.720	.668	.775
		Self-pay	-.187	2.306	1	.129	.829	.651	1.056
		No charge	-.392	1.556	1	.212	.675	.365	1.251
		Medicare	0	.	0	.	.	.	.
	Type of admission	Urgent	-.553	369.964	1	.000	.575	.543	.608
		Elective	-1.880	3507.65	1	.000	.153	.143	.162
		Delivery	-.671	17.300	1	.000	.511	.372	.701
		Trauma	-1.550	6.022	1	.014	.212	.062	.732
		Emergency	0	.	0	.	.	.	.

Multinomial logistic regression. Model Fitting: χ^2= 23369.9, df(112), p <0.001.

4.3.23 Predictors of major and extreme loss of function (Hypothesis 22)

Age was considered a stronger predictor of a major loss of function for those aged equal or elder than 85 years old than patients aged <65, 65-74, and 75-84 years by 3.06 times (206%), 1.96 times (96%), and 1.36 times (36%), respectively. For type of admission, patients with an emergency admission type had a higher incidence than delivery, urgent, and other by 1.09 times (9%), 2.92 times (192%), and 1.86 times (86%), respectively. Patients admitted to hospital in 2011 had the highest incidence of major loss of function by 1.448 times (44.8%), followed by years 2009 (1.319 times, 31.9%), 2010 (1.217 times, 27.1%), and 2008 (1.089 times, 8.9%). Primary Parkinson disease had higher incidence than secondary types by 1.41 times (41%). Black patients had higher incidence than White by 1.405 times (40.5%), while Whites had higher incidence than Hispanics by 1.31 times (31%), Asian or Pacific Islanders by 1.57 times (57%), and others by 1.44 times (44%).

For extreme loss of function, patients aged equal or elder than 85 years had higher incidence than those aged less than 65, 65-74, and 75-84 years by 3.98 times (298%), 2.37 times (137%), and 1.51 times (51%), respectively. The number of procedures significantly affected the incidence of extreme loss of function by 1.455 times (45.5%). Patients admitted in 2011 had higher incidence of extreme loss of function by 2.536 times (153.6%) than in 2007, followed by those in 2009 (2.048 times, 104.8%), 2010 (1.985 times, 98.5%), and 1.257 times (25.7%). Emergency admissions showed the highest incidence of extreme loss of function over urgent, elective, and delivery by 1.4 times (40%), 5.26 times (426%), and 2.43 times (143%), respectively. No charge insurance type had the highest incidence of extreme loss of function by 1.9 times (90%) over Medicare, followed by self-pay (1.42

times, 42%), private insurance including HMOs (1.39 times, 39%), and other (1.28 times, 28%), while Medicaid had higher incidence than Medicare by 1.311 times (31.1%). Males had higher incidence of extreme loss of function by 1.331 times (33.1%) than females. The number of procedures affected extreme loss of function by 1.455 times (45.5%), as shown in Tale 44.

Table 43 Predictors of major and extreme loss of function

			B	Wald	df	Sig.	Exp(B)	95% CI for Exp(B)	
								Lower Bound	Upper Bound
Major loss of function	Intercept		3.215	882.20	1	.000			
	NPR		.077	120.97	1	.000	1.080	1.065	1.095
	Parkinson type	Primary	-.345	11.969	1	.001	.708	.583	.861
		Secondary	0	.	0	.	.	.	.
	Age (years)	< 65	-1.118	723.91	1	.000	.327	.301	.355
		65-74	-.673	364.55	1	.000	.510	.476	.547
		75-84	-.306	86.968	1	.000	.737	.691	.786
		≥ 85	0	.	0	.	.	.	.
	Race	Other	-.362	30.717	1	.000	.696	.613	.791
		Black	.340	43.063	1	.000	1.405	1.269	1.555
		Hispanic	-.272	33.567	1	.000	.762	.695	.835
		Asian or Pacific Islander	-.451	22.499	1	.000	.637	.529	.768
		Native American	.111	.442	1	.506	1.117	.806	1.550
		White	0	.	0	.	.	.	.
	Income	76th to100th percentile	-.309	90.650	1	.000	.734	.689	.782
		26th to 50th percentile	-.113	12.866	1	.000	.893	.839	.950
		51st to 75th percentile	-.198	38.148	1	.000	.820	.770	.874
		0-25th percentile	0	.	0	.	.	.	.
	Year	2008	.086	5.629	1	.018	1.089	1.015	1.169
		2009	.277	56.739	1	.000	1.319	1.227	1.417
		2010	.240	44.035	1	.000	1.271	1.184	1.365
		2011	.370	107.73	1	.000	1.448	1.350	1.553
		2007	0	.	0	.	.	.	.
	Gender	Male	.080	12.69	1	.000	1.084	1.037	1.133
		Female	0	.	0	.	.	.	.
	Insurance	Other	-.257	8.163	1	.004	.774	.649	.923
		Medicaid	.160	4.789	1	.029	1.174	1.017	1.355
		Private including HMO	-.359	95.97	1	.000	.698	.650	.750
		Self-pay	-.481	16.18	1	.000	.618	.489	.782
		No charge	-.538	3.740	1	.053	.584	.338	1.007
		Medicare	0	.	0	.	.	.	.
	Type of admission	Other	-.089	7.24	1	.007	.914	.857	.976
		Urgent	-1.070	1568.54	1	.000	.343	.325	.362
		Delivery	-.619	13.59	1	.000	.539	.388	.748
		Emergency	0	.	0	.	.	.	.
Extreme loss of function	Intercept		1.030	69.07	1	.000			
	NPR		.375	2611.6	1	.000	1.455	1.434	1.476
	Parkinson type	Primary	-.485	18.268	1	.000	.616	.493	.769
		Secondary	0	.	0	.	.	.	.
	Age (years)	< 65	-1.381	760.82	1	.000	.251	.228	.277
		65-74	-.863	459.10	1	.000	.422	.390	.456
		75-84	-.412	127.17	1	.000	.662	.617	.712

		≥ 85	0	.	0	.	.	.	.
	Race	Other	-.140	3.331	1	.068	.869	.748	1.010
		Black	.540	90.26	1	.000	1.716	1.535	1.919
		Hispanic	-.061	1.264	1	.261	.941	.846	1.046
		Asian or Pacific Islander	-.110	1.032	1	.310	.895	.724	1.108
		Native American	-.094	.224	1	.636	.910	.616	1.344
		White	0	.	0	.	.	.	.
	Income	76th to100th percentile	-.279	55.43	1	.000	.756	.703	.814
		26th to 50th percentile	-.142	15.05	1	.000	.867	.807	.932
		51st to 75th percentile	-.173	21.62	1	.000	.841	.782	.905
		0-25th percentile	0	.	0	.	.	.	.
	Year	2008	.228	26.203	1	.000	1.257	1.151	1.372
		2009	.717	262.82	1	.000	2.048	1.878	2.233
		2010	.686	246.94	1	.000	1.985	1.822	2.162
		2011	.931	475.82	1	.000	2.536	2.333	2.757
		2007	0	.	0	.	.	.	.
	Gender	Male	.286	118.31	1	.000	1.331	1.264	1.401
		Female	0	.	0	.	.	.	.
	Insurance	Other	-.248	4.861	1	.027	.781	.626	.973
		Medicaid	.271	9.880	1	.002	1.311	1.107	1.552
		Private including HMO	-.330	53.19	1	.000	.719	.658	.786
		Self-pay	-.351	5.583	1	.018	.704	.526	.942
		No charge	-.643	2.980	1	.084	.526	.253	1.091
		Medicare	0	.	0	.	.	.	.
	Type of admission	Urgent	-.336	76.824	1	.000	.714	.663	.770
		Elective	-1.662	2210.14	1	.000	.190	.177	.203
		Delivery	-.889	19.64	1	.000	.411	.278	.609
		Emergency	0	.	0	.	.	.	.

Multinomial logistic regression. Model Fitting: χ^2= 23369.91, df(112), p <0.001.

CHAPTER V

DISCUSSION AND LIMITATION

5.1 Discussion

This study was conducted to highlight the main outcomes associated with patients of Parkinson disease admitted at hospitals in the United States. The aim of the study was to find the impact of patients' socio-demographic characteristics and medical information as predictors on their length of hospital stay, total charges and mortality due to their Parkinson disease. This study also revealed the predictors' interactions with the main outcomes, which could highlight about necessary needs for revisions in the therapy plan in order to minimize the cost of health services and incidence of mortality, and improve the quality of life.

This data was collected from NIS and involved 361,662 patients with PD from the years 2007 to 2012. The highest incidence of PD was observed to occur in males (54.1%), whites (70.7%), ages 75-84 years (41.6%), and with Medicare insurance (86.4%). There were significant relationships between the PD and the type of comorbidity, where the highest incidence was observed with those patients who had other neurological problems by 85.29%, followed by hypertension (61.71%), fluid and electrolyte disorders (29.07%), diabetes mellitus (22.98%), deficiency anemia (21.56%), and others (Table 8). Hypertension, diabetes, and depression showed the highest incidence as reported by Mithal et al. which supported the results of this study; however, their study involved only

PD outpatients [45]. Incidence of mortality reported by Sharma et al., was 1% only which is lower than mortality of present study (3.5%) as in Table 9, this could be due to their study involved PD patients got surgery admitted only for the years 2006-2010[46].

The mean hospital length of stay for the present study was 5.89 days. The value was similar to the findings obtained by Mukherjee et al., where the length of stay was approximately 5 days[47]. The mean and median of total charges for the current study was $35044 and $21965, respectively, which is similar to the value ($28400) by Mukherjee et al., [47] and median total charges by Eskandar et al ($14300)[48]; however, there was variation in the cost of hospitalization among the results for this study and previous studies, which can be attributed to the information for the years involved. Moderate risk of mortality was most frequent among PD patients admitted by approximately half (Table 11). Moderate severity of illness showed the highest incidence compared to others, while cumulative percentages of major and extreme severity was noted in more than half of PD admitted patients (Table 12). The high level was the most common length of stay compared to others by about 10% (Table 13). High levels of mortality occurred most often, by approximately 10% compared to other levels (Table 14). For the disease staging, high was the most resource of demand levels by approximately 10% (Table 15). The median household income showed almost similar incidences among the categories, however highest incidences observed with those small percentiles (Table 16). Emergency type showed the highest incidences by almost half of patients than others (Table 17).

There were steady increments in the total charges of health service plan from the year 2007 until 2012 (Figure 4). The increment is expected as normal because; the patients got older with more severity of PD, increase in the expenditures for the therapy plan for

PD, increase in the number of patients have PD. This result is harmonized with findings and opinion of Tagliati & Connolly that the cost for the patients with PD got higher in total charges with follow-up years compared with the total charges of other diseases[49]. The incidence of mortality is reduced with the long therapy durations (figure 3) due to the enhancements in the health procedures like doing the deep brain stimulation (DBS) which is more successful nowadays than pharmacotherapy and implementation of developed health services to minimize the incidence of mortality[50]. However, the fluctuation in incidence of mortality is attributed for the using of medications like Levodopa which showed improvements only in the first five years of therapy[51]. The average lengths of hospital stay was reduced to the minimum at 2012 compared with previous years (Figure 7) due to implementing new strategies for reducing the hospital costs. This is done by determining for reasons of hospitalization like number of and type of complication especially related with geriatrics that affected the lengths of hospital stay[52,53].

Several comorbidities significantly affected the length of hospital stay due to their influences on the progression of PD and quality of life, which increased the number of hospital admissions[54,55]. A study conducted by Braga et al. about the effects of comorbidities on the multiple admissions, all neurological disease, infections (urinary tract, pulmonary, serious infections), tumors, urological disorders, trauma, and cardiovascular diseases (myocardial infarction) significantly related with admissions of PD patients[56]. Other comorbidities where also predicted by Lubomski et al., where they found that psychiatric illness, gastrointestinal disorders, hypotension, pneumonia, anemia, neoplasia, and adverse drug events showed significant relation with length of stay. Some of their significant results showed lower incidence for reasons of admissions of PD

patients[57], which supported the significant results of present study (Table 18). Number of procedures significantly correlated with the length of stay (Table 20) due to increase in surgical and minor procedures as reported by Braga et al.[56]. Comorbidities elevated the total charges of PD patients to high levels (Table 19), where those on early diagnosis are paying higher than those without PD, while PD patients with advanced stages of disease paying six or seven times higher than normal patients[59,60]. The doing or surgical procedures like deep brain stimulation, were also added other charges to the PD patients[61]. This result is in line with the outcomes of present study, where the increase in the number of procedures of PD patients increased the total charges (Table 21).

Present study revealed the association between the comorbidities and mortality, where metastatic cancer, fluid and electrolyte disorders, weight loss, congestive heart failure tumors renal failure and other diseases showed high incidence of deaths (Table 22). Increase the number and severity of comorbidities were contributed for the high incidence of mortality, but this incidence is highest with patients of PD.

Several variables were considered as significant predictors for length of hospital stay. Females showed lower incidence of hospital stay than males and this possibly due to the severity of PD found higher with males than females. Those with younger ages got higher length of hospital stay than others. Differences among races in the length of hospital stay. Finally the type of median for house incomes significantly related with the length of hospital stay where those with higher incomes got higher length of hospital stay. The findings about the length of hospital stay was supported by previous studies about the effects of PD and comorbidities on hospital of stay[46,57,62]. Since the total charges depend on the length of hospital stay[47], then the patients with higher length of hospital stay got

the higher total charges. For example, females got lower length of hospital stay, and then they got lower total charges. Asian or Pacific Islander patients got highest length of stay so they got highest total charges than other races. Patients with higher incomes got higher total charges because their length of stay was higher, and this supports the results of present study (Table 24). Other reasons of more length of hospital stay like failure of therapy, comorbidities and therapeutic misadventures[63,64].

For the predictors of mortalities depending the demographic characteristics, significant association for race and mortality induced by PD, where the Asian or Pacific got highest incidence of mortality than other races. This result showed the significant relationship between the race and mortality which also approved this opinion by a study conducted by Lanska DJ, where the researcher found that Whites are more susceptible to the mortality than Blacks[65], which supported the results of present study. PD is age-dependent disease therefore age is significant predictor of mortality in several studies[44]. Present study showed PD patients aged older than 85 years were the highest incidence of mortality than other ages. PD male patients showed incidence of mortality than females (Table 25). This result is similar to opinion reported by Rist et al., where the risks of mortality is higher by two times than in females[67] and the survival is higher with females than males after years of therapy[68].

Type of health insurance also contributed for higher length of hospital stay and total charges (Tables 26 & 27). There were significant influences for the Medicare, Medicaid, self-pay, and other insurance types on length of hospital stay, total charges and mortality. This result is harmonized with findings of Noyes et al. that PD patients are using

more expenditures supported by Medicare[69], however very few studies explored the influence for type of insurance on the length of hospital stay, total charges and mortality.

There was a significant relationship for the type of PD on the length of hospital stay. This outcome is supported by Lubomski et al., the secondary of hospital stay was higher with secondary than primary[57]. Therefore, the total charges of secondary found be higher than primary (Tables 33 & 34). Although the PD is not the disease with more mortality, significant higher incidence of mortality observed with primary than in secondary (Table 32). Unfortunately, very few published studies which involved the comparison between primary and secondary types of PD in terms of mortality, length of hospital stay and total charges.

After performing the prediction of socio-demographic characteristics, years, types of insurance and other, collection of all significant predictors to compare the influence among them to on the length of stay, total charges and mortality.

Number of procedures (like deep brain stimulation) and other comorbidities (like weight loss) showed the highest lengths of hospital stay. The weight loss significantly and positively affected the length of stay due to the malnutrition caused by other diseases[70]. In conclusion for the predictors of length of hospital stay, the comorbidities and number of procedures were the most affected factors than socio-demographic predictors (Table 35). Significant effects found for the interactions of predictors like race with comorbidities, type of PD, and insurance type. Outcomes with highest lengths of hospital stay were observed for interactions comorbidities with demographic characteristics than interactions of demographic characteristics (Table 36).

Number of procedures and other comorbidities (like weight loss) showed highest effects on the total charges (Tale 37). Yang and Chen reported that the number of procedures and surgical therapy are more charging than pharmacotherapy and other medical services[61]. High level income and Hispanic race patients got higher total charges than other predictors. In conclusion the medical factors (like comorbidities and number of procedures) and socio-demographic factors were contributed for high total charges. Interaction of predictors showed high contribution for high total charges. Significant impact found for the interaction of medical variables like number of procedures with socio-demographic characteristics like race (Table 38).

Age is the main risk factor of mortality of PD patients, which is the evidence that this disease is significantly related with patients' age[66]. Present study revealed that the main predictor for the mortality of PD patients was the age. Other serious disease like metastasis, fluid/electrolyte deficiency, congestive heart failure, and weight loss were the highest associated with mortality (Table 39). Therefore, the age is the main interacting factor used for the interaction with other predictors to determine the cumulative effects on the mortality of PD patients. The interaction of comorbidities like metastasis, CHF, fluid/electrolyte deficiency and weight loss with advanced age like ≥ 85 years showed the highest mortality than patients with younger ages or without comorbidities (Table 40).

The novelty of present study is that several predictors of PD patients were measured after performing their interaction to detect the effect on the length of hospital stay, total charges and mortality. However scanty number of studies highlighted the effect of interaction of predictors especially between the comorbidities and patients' socio-demographic characteristics.

5.2 Study limitations

The main limitations of this study are related to the secondary data downloaded from NIS. There was missing in information about the patients' medical history for all diseases. Moreover, some of that information was essential to this study regarding the diagnosis and treatment of PD, the stages of PD, the age of onset of the PD, the duration of therapy, the type of medications and doses, and dates of surgical procedures. Other complications like dementia were also missing, and important to determining the severity of Parkinson disease.

CHAPTER VI

CONCLUSION AND FURTURE RESEARCH

6.1 Study summary

This study analyzed the hospitalization characteristics of Parkinson's inpatients in the US and determined the main predictors and their interactions with length of hospital stay, total charges, and mortality. The outcomes of the study related not only to patients' health status, but also to their financial status, quality of life, and mortality. These outcomes were influenced by patients' socio-demographic characteristics and medical information. Two types of independent variables involved in this study were patients' socio-demographic characteristics and health variables. The socio-demographic characteristics evaluated were age, gender, race, the year of admission, type of insurance, and income. The patients' health information involved comorbidities, admission type, number of procedures, number of comorbidities, and type of Parkinson disease. The total number of patients who had Parkinson disease was 361,662 over six years, from 2007 to 2012. Multiple linear regression and multinomial logistic regression were used to achieve the objectives of present study.

Descriptive analysis showed the highest incidence of PD patients were elderly, equal or older than 85 years; White; male; had Medicare insurance; and had a household income median within the 0-25th percentile. For patient's health outcomes highest incidence were in emergency admission, neurological and hypertension comorbidities, major and extreme likelihoods of dying, major and extreme loss of function, high and very

high lengths of stay, high and very high mortality levels, and high and very high staging disease levels.

Logistic regression and multiple linear regression were used to determine the predictors of length of hospital stay, total charges and mortality. The number of procedures and comorbidities, like weight loss, were the main predictors affecting length of hospital stay and the total charges, and were higher than patients' socio-demographic predictors. Age was the main predictor for the mortality of PD patients and was higher than medical predictors. Metastasis is more comorbidity related with mortality followed by fluid and electrolyte disorders, congestive heart failure and weight loss.

This study revealed the influence of interactions between predictors of the study main outcomes. Race with a weight loss comorbidity was considered a main risk for a longer hospital stay. Race with a number of procedures, was the main risk for higher total cost. Interactions of age with comorbidities (CHF, fluid/electrolyte disorders, metastasis, and weight loss) was the main risk of mortality.

An overarching conclusion of this study is that several steps need to be taken for patients admitted for treatment of Parkinson disease to reduce the length of their hospital stay, their total charges and to minimize their mortality rate. There is need to review the therapy guidelines of Parkinson disease, controlling of comorbidities, and managing the preventable predictors to decease the burden of therapy in terms of cost, quality of life and mortality of Parkinson disease in United States.

6.2 Future research

The future work for this study is to conduct a longitudinal cohort study to analyze details on serious complications for PD patients, such as dementia and cognition. Other variables like laboratory and screening could be considered as fundamental to support the results of that study. Finally doing intervention studies, by implementing educational programs for patients and healthcare professionals about the serious effects of Parkinson disease on patients and society would be important to enhance awareness of this disease. Clinical trials needed to determine the clinical complications and comorbidities taken in consideration the patients demographic characteristics.

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