



# RUTGERS

**ANALYSIS OF ALZHEIMER'S DISEASE INPATIENTS IN  
THE UNITED STATES**

**By**

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## Abstract

**Background:** Alzheimer's disease (AD) is the commonest dementia, which has no recognized cure. It causes deterioration as it advances, and ultimately results in death. AD was primarily defined by German psychiatric specialist and neuropathologist, Alois Alzheimer. Frequently, AD Alzheimer's disease is diagnosed in persons above the age of 65 years, even though the less common early-onset of the disease can happen. It is anticipated that more than 3 million individuals aged 85 and more will have Alzheimer's. 33% of Americans over age 85 are burdened with the disease while 5.3 million Americans are living with Alzheimer's disease. Unless a cure is found, close to 16 million Americans will have the disease by 2050. Alzheimer's is one of the most expensive diseases. The impact of the disease in the U.S. is the main objective of this study. To study this impact, the length of stay, mortality, and cost will be studied in terms of different patient characteristics and hospital contexts.

**Method:** This study's main objective was to find the influence of patient characteristics and hospital contexts on three outcomes, namely; length of stay, mortality, and costs. To achieve this objective, The Nationwide Inpatient Sample (NIS) was analyzed after using a filtering method to get a net sample size of 698,170 entries. The sample was obtained for statistical analysis for the six-year period covering 2007-2012. Descriptive and inferential statistic analysis were conducted in order to answer the research questions. Descriptive analysis includes frequencies, mean, and median. Inferential analysis includes multiple and logistic regression and qui-square models were utilized to test the significance of the relationships between independent and dependent variables of the study.

**Results:** Some of the important results found in this study were: 1. The patient characteristics including the age and gender are a highly risk factor of the incidence of Alzheimer's disease while the race is not a significant risk factor. 2. Alzheimer's patients who were admitted to the hospital with psychosis on average stayed 2.20 days longer than those without psychosis ( $p < .001$ ). 3. Alzheimer's patients who were admitted to the hospital with normal pressure hydrocephalus on average were charged \$4569.03 more than those without with normal pressure hydrocephalus ( $p < .001$ ). 4. Alzheimer's patients on average were billed \$11,895.48 more per procedure performed ( $p < .001$ ). 5. Alzheimer's patients who were admitted to the hospital with diabetes were .92 times as likely to die as those without diabetes (not statistically significant). 6. The age group 65 and less has a length of stay of 1.6 more than other patients on other age groups.

**Keywords:** Alzheimer's disease, Inpatients, clinical factors, Length of stay, Mortality, Total charge, Statistical analysis.

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# **CHAPTER I**

## **INTRODUCTION**

### **1.1 Background of Alzheimer's Disease**

Alzheimer's disease (AD) is the commonest dementia, which has no recognized cure. It causes deterioration as it advances, and ultimately results in death. AD was primarily defined by German psychiatric specialist and neuropathologist, Alois Alzheimer (Wei, Visweswaran, and Cooper, 370-375). Frequently, AD Alzheimer's disease is diagnosed in persons above the age of 65 years, even though the less common early-onset of the disease can happen. About 27 million individuals across the world had Alzheimer's disease in 2006. Alzheimer's disease is forecasted to affect one in eighty-five persons across the globe by 2050. Though Alzheimer's disease develops in a different way for each person, there are numerous common warning signs. Early symptoms are frequently incorrectly considered age-associated concerns, or signs of stress. In early phases, the commonest symptom is the failure to remember recent incidents, referred to as temporary memory loss (Brennan, 160-168). When Alzheimer's disease is suspected, the diagnosis is normally proved with tests that assess performance and thinking capabilities, a scan of the brain when on hand; nevertheless, assessment of brain tissue is necessary for an ultimate diagnosis.

With the advancement of Alzheimer's disease, symptoms could encompass problems with language, temper swings, bewilderment, petulance, aggression, and lasting memory loss. With the declination of the health of individuals, they frequently isolate themselves from family and community. Progressively, bodily roles are lost, finally

causing death. Given that AD is not the same for every patient, predicting the manner in which it will affect an individual patient is difficult. Alzheimer's disease advances for an unidentified and inconsistent quantity of time prior to becoming completely evident and it can progress undetected for a long time. Typically, the life expectancy subsequent to diagnosis is roughly 7 years (Epstein et al., 125-129). Less than three percent of people live over fourteen years past diagnosis. Alzheimer's disease is categorized in the group of neurodegenerative disorders where the origin and development are not adequately comprehended; it is linked to plaques and tangles in the brain. Present treatments only assist with the warning signs symptoms of disease. By the close of 2012, over 1000 medical experiments had been carried out to test different compounds in Alzheimer's disease.

Psychological stimulation, diet, and physical activity indicate some known approaches that impede cognitive symptoms (although not brain pathology) in fit older people, though there is no convincing proof backing an effect. Since Alzheimer's disease is incurable and chronic, the sick people progressively depend on others for help (Alzheimer's Association, 158). The task of the major caregiver is frequently carried out by the partner or a close relations associate. AD is recognized for exerting a great weight on caregivers; the forces could be extensive, entailing social, emotional, physical, and financial components of the caregiver's existence. In developed nations, Alzheimer's disease is among the most expensive diseases to the community.

About 25% of individuals with Alzheimer's disease as well have other chronic diseases like heart failure, diabetes, and osteoarthritis. The Primary Care Practitioner ought to diagnose comorbid illnesses and manage them on time and professionally. In trying to ascribe changes in operation to the unhinging sickness, a person has to be watchful for the

existence of new health states like thyroid disease, which could occur as weight decrease or increase. Moreover, people have to be watchful of known health states like badly compensated cardiac problem, which could affirm itself with an alteration in the conduct (Mangialasche et al., 702-716). Evaluation of the patient's health situation ought to encompass acquiring information concerning the individual through formed patient and caregiver interrogations. The engagement of relatives and other care providers in collecting a record, and carrying out an assessment to recognize co-morbid health conditions is fundamental, and the application of other medical and social service experts, (psychologists, caseworkers, or care directors) or an interdisciplinary concern group is vital to establish the degree of suitable care and build up the remedial design. The family denotes an outstanding source of knowledge concerning a patient's baseline rate of operation. This will help the Primary Care Practitioner in establishing whether there is a severe medical state over and above AD.

The Primary Care Practitioner ought to ask for information from the care provider concerning any other health care obtained. Concentration has to be offered to present medications both stipulated and non-stipulated, which could deteriorate cognitive, behavioral, or psychiatric conducts linked to AD. Other health conditions and medications ought to be established, documented in the patient's register, and integrated into suitable care arrangements (Nordhus, Sivertsen, and Pallesen, 521-528). Hallucination, or a heightened confusional condition, is more common in people diagnosed with AD in addition to other dementias as compared to non-demented older grown-ups. AD is an urgent health condition since it is frequently an indication of a severe causal medical illness, demanding wide-ranging assessment to establish the underlying basis so that quick

corrective achievement can be carried out. Delirium in individuals with AD could occur with agitation or other alterations in the conduct. The Primary Care Practitioner ought to be attentive to such severe conduct alterations as a cause for further health assessment. It is vital to monitor for signs and symptoms that could signify the existence of other comorbid disease conditions.

Reversible grounds have to be hunted when a patient shows swift cognitive weakening. For instance, if the care provider states anorexia or decrease in weight exceeding 2kg or five percent of the individual's body weight over the past three to six months, this ought to elicit a dietary review. The Mini Nutritional Assessment (MNA) that is also obtainable in a condensed form, in addition to the measurement of the plasma albumin is a means of assessing the necessity of intervention (Jackson et al. 258-266). The patient ought to be checked for health challenges like colon cancer, in addition to dejection and medication unfavorable impacts. A nonspecific symptom like excess drowsiness could be a sign of medication impact or contagion, in addition to the outcome of dementia-associated interruption of the standard sleep-wake sequence.

Over eighty percent of AD patients encounter some kind of behavioral indications like nervousness, agitation, and tedium through the development of the disease. Behavioral indications turn problematic when they are the basis of considerable grief (for patient and care provider), failure of practical ability, or risk of impairment to the patient or others. Such indications offer the most challenging factor of care provision and frequently precipitate institutionalization (Schneider et al., 1525-1538). Nevertheless, cautious assessment and management could delay the requirement for institutionalization. Patients and families will provide their Primary Care Practitioner with a scope of behavioral

symptoms that frequently fluctuate with time, and there is a broad array of capabilities to endure or deal with these behaviors. The management of behavioral signs demand developing early, appropriate, and individualized care objectives and arrangements that ought to be regularly re-assessed. Unexpected inception of behavioral indications demand assessment for health basis, encompassing pain, medication impacts, contagion, and cardiopulmonary illness.

Once the prospective concerns are tackled, evaluation ought to concentrate on the rate, severity, and duration of some conducts in addition to care provider's stress and coping policies. This will permit perfect detection of noteworthy or hazardous conducts and their causes, suitable prioritization of interventions, and advancement of targeted backing and educational policies for care providers. Behavioral indications have a tendency of clustering into four sub syndromes: hyper (agitated) conducts, psychopathy, emotional conducts, and indifference. Violence and agitation have been demonstrated to be linked to pain in patients with dementedness. Standardized devices could be employed by Primary Care Practitioners or hospital employees to collect information on behavioral indications from the care providers and assess the success on interventions with time (Docksai, 12-13). Care providers could help at home through maintaining a log of troubling conducts that encompass the rate at which they happen, in addition to policies that are triumphant in transforming or restricting the symptoms.

It is significant for medical care experts to be responsive to signs of emotional problems linked to AD and to enhance early intervention since depression has an impact in as many as half of AD patients residing in the society. Undesirable results associated with depression encompass early nursing home position, higher physical hostility towards

care providers, augmented care provider misery, burden, and high mortality. Discussion with and recommendation to a professional, for instance a psychiatrist, is necessary if the presentation or account of depression is uncharacteristic or intricate. Since directing evaluation checks for depression to AD patients is frequently difficult and patients could be incapable of describing their symptoms to the care provider, collecting information from the members of family turns particularly imperative. Signs of depression in AD could appear similar to symptoms of hysteria, apathy, and psychopathy (Shan, 32-38).

Temper symptoms, which could wax and diminish, might encompass irritability, nervousness, and advanced functional diminution. Dread, suspicion, and illusions could be found in about 30% of AD patients with depression. Thus, it is significant for the provider to mull over depressive disorder in the differential diagnosis with the occurrence of behavioral symptoms. Successful diagnosis and management of depression in AD demands understanding of the connection involving the depression, task, and cognition of the patient. A decrease in operation but not cognition normally precedes the initial occurrence of depression. Key modifications in the patient's setting could trigger depression though the patient could be incapable of expressing the perturbation because of cognitive loss. A major possible cause is elder abuse where the patient cannot vocally convey the information of the abuse, though the ensuing conduct appears as depression. With the progression of AD, collateral data from the care provider turns out to be critical to diagnose, manage, follow the course of patients' depression, and examine patients' suicidal likelihood (Grossi et al., 515-522).

Because AD does not have cure and progressively makes individuals unable to tend for their requirements, provision of care fundamentally is the treatment and has to be

cautiously handled over the development of the sickness. In the early and restrained phases, alterations to the living setting and way of life can raise patient protection and decrease caregiver burden. Instances of such adjustments are the devotion to basic practices, the introduction of security locks, the marking of household items to prompt the individual with the disease, and the application of customized daily life items. Patients could as well turn out to be helpless of taking food by themselves thus need food in small bits or pureed (Butte and Shah, 352-353). In case swallowing disorders arise, the application of feeding tubes could be necessitated. In such instances, the health efficaciousness and moral principles of continuing feeding is a significant deliberation of the care providers and members of family. The utilization of physical moderation is seldom specified in any phase of the disease, though there are conditions when they are essential to avert harm to the individual with Alzheimer's disease or their care providers. Other health issues that could appear with the advancement of the disease include oral and dental illnesses, undernourishment, hygiene problems, and eye infection to mention a few.

Effective management and early diagnosis of AD can prevent the occurrence of other health issues while professional treatment is required when they occur. In the course of the final phases of AD, management is based on mitigating uneasiness till death. Recent studies in the United States indicate that individuals whose care providers had a sensible comprehension of the prognosis and medical difficulties of late dementia were probable of receiving insistent treatment close to the end of life. Early phases of AD are hard to diagnose. An unequivocal diagnosis is normally achieved the moment cognitive deterioration compromises everyday existence endeavors, though the individual could still be residing separately. Symptoms usually progress from minor cognitive challenges like

memory loss via increasing phases of disorders, eradicating any likelihood of independent living, particularly in the late phases of the Disease. Life expectancy of the people with AD is decreased. The average life expectancy after diagnosis is about 7 years; less than three percent of individuals exist over 14 years (Iacono et al., 521-533).

Disease aspects considerably linked to decreased existence are an augmented asperity of cognitive deterioration, reduced practical intensity, record of falls, and interruptions in the neurological assessment. Other issues like heart diseases, diabetes, or accounts of alcoholism are as well associated with reduced survival. Though an early age of onset indicates higher survival, life expectancy is mainly decreased when judged against the healthy population amid the ones that are younger. Males are known to have a less favorable existence prognosis as compared to females (Citron, 387-398). AD is known to be the primary cause of death in seventy percent of all instances; pneumonia and dehydration signify the most common instant reasons behind death. Dementia, and particularly in the case of AD, could be amid the most costly sicknesses for communities in the United Kingdom and the US, whereas the outlays in other nations like Argentina are as well high and increasing. The costs will possibly rise with the ageing of the community, making it a significant social challenge.

Alzheimer's disease-linked economic effects encompass direct health costs like treatment home care, direct nonmedical expenses like in-home daycare, and other expenses associated with lost productiveness of both the sick person and care provider. The costs differ between researchers, though dementia outlays across the globe have been computed to about 160 billion dollars, while outlays of AD in the US could be approximately 100 billion dollars every year. The highest origin of outlay for communities is the lasting care

by the medical experts and mainly institutionalization, which corresponds to about 70% of the total expenses for community. The outlay of residing at home is as well very high, particularly when informal outlays for the family, like the time for the provision of care and the lost income for the patient and care provider, are considered. Outlays rise with the rigorousness of dementia and the existence of behavioral disruptions, and are associated with the augmented care provision time needed for physical care (Marchesi, 1762-1767). Thus, any management that delays cognitive worsening holds up institutionalization or decreases care provider's hours will have financial gains. Economic assessments of present treatments and early diagnosis have indicated positive outcomes.

The partner or a close family member frequently handles the function of the major care provider. AD is recognized for laying an enormous weight on care provider which encompasses social, emotional, physical, or financial features. Individuals with Alzheimer's disease and their family members normally favor care at home. This alternative also hinders or eradicates the requirement for more specialized and expensive levels of care; nonetheless, 70% of nursing home dwellers have dementias. Dementia care providers are at a risk of elevated levels of bodily and psychological disorders (Thies and Bleiler, 208-245). Aspects linked to higher psychosocial challenges of the major care providers encompass having an affected individual at home, the caregiver being a partner, involving conducts of the sick person like depression, behavioral disorders, delirium, sleep difficulties, or walking troubles and social segregation.

Among the initial concerns for a recently diagnosed patient is the accuracy of the diagnosis (Lichtenberg 42-56). It is vital to certify a diagnosis and be sure of its correctness. On the contrary, the thought of a misdiagnosis must not be employed as a means of

vacillating and evading treatment for any health problem. However, it is wise to make an effort of confirming a diagnosis through processes like searching for second views, seeking advice from professionals, going for more medical examinations, and studying information concerning the health problem, in this case Alzheimer's disease. Misdiagnosis could and does arise and is sensibly widespread with inaccuracy levels rating from 1.5% in cancer biopsies to 25-45% misdiagnosis level in emergency or care at Intensive Care Unit. Studies of patients demonstrate a possibility of having a misdiagnosis to vary from 9% to 45%; approximately half of the individuals that are told they have AD could in reality have other kinds of dementia that generate related symptoms. This leads to misdiagnosis being among the common kinds of medical errors (Lichtenberg 42-56). Some of the explanations as to why misdiagnosis could happen encompass mistakes by physicians, lab tests, and consultants.

Concerning monetary challenges, family care providers frequently forego time from work to use more than 40 hours each week thus the monetary value of caring for the patients is high. Some studies affirm that the total cost of providing care for a sick person range between 18,000 dollars and 77,500 dollars per annum in the US. Cognitive behavioral treatment and the instructions of management policies either independently or as a large number have shown their efficacy in boosting mental health of care providers. Clinical Decision Support Systems (CDSS) signify useful tools that aid doctors in the course of different operations like early diagnosis, treatment, and supervision of patients (Sperling et al. 280-292). Clinical Decision Support Systems must address multidisciplinary, varied, dissipate medical information, and decision criteria. In cases of such operations, Knowledge Engineering (KE) methods and semantic technologies are

very suitable since they back the incorporation of heterogeneous knowledge, the manifestation of rich and clear representations for knowledge accumulation, and the utilization of logic analysis for the creation of new knowledge. In this dissertation, Alzheimer's disease's risk factors will be studied and statistically analyzed to find out, in particular, the factors that influence the AD inpatients in the community hospitals across the united states.

## **1.2 Goal and Objectives**

The overall goal of the research is to find out the factors associated with AD patients in terms of length of stay, mortality, and costs in different kinds of clinical settings across the United States. Particularly, the objectives are to determine:

1. What clinical factors, such as number and types of comorbidities and procedures, affect the length of stay.
2. What clinical factors, such as number and types of comorbidities and procedures, affect the cost.
3. What clinical factors, such as number and types of comorbidities and procedures, affect the mortality.
4. Whether length of stay, mortality, and costs differ with race, age, or socio-economic status.
5. Whether there are differences in length of stay, mortality, and costs across the various regions of the US
6. Whether there are differences in length of stay, mortality, and costs amongst the various types of hospital settings - rural/urban/hospital (non-teaching vs. teaching).

7. Whether there are differences in length of stay, mortality, and cost with various types of health insurances – Medicare, Medicaid, self-insured, uninsured.

### **1.3 Research Hypotheses:**

**Hypothesis 1:** There are statistically significant associations between the number and types of comorbidities and procedures in length of stay.

Null Hypothesis:  $H_0 = H_1$

Alternative Hypothesis:  $H_0 \neq H_1$

**Hypothesis 2:** There are statistically significant associations between the number and types of comorbidities and procedures in costs of Alzheimer's disease inpatients.

Null Hypothesis:  $H_0 = H_1$

Alternative Hypothesis:  $H_0 \neq H_1$

**Hypothesis 3:** There are statistically significant associations between the number and types of comorbidities and procedures in mortality.

Null Hypothesis:  $H_0 = H_1$

Alternative Hypothesis:  $H_0 \neq H_1$

**Hypothesis 4:** There are statistically significant differences in length of stay, mortality, and costs of Alzheimer's disease patients with regards to race, age, or socioeconomic status.

Null Hypothesis:  $H_0 = H_1$

Alternative Hypothesis:  $H_0 \neq H_1$

**Hypothesis 5:** There are statistically significant differences in length of stay, mortality, and costs of Alzheimer's disease patients across the various regions of the US.

Null Hypothesis:  $H_0 = H_1$

Alternative Hypothesis:  $H_0 \neq H_1$

**Hypothesis 6:** There are statistically significant differences in length of stay, mortality, and costs of Alzheimer's disease patients amongst the different types of hospital settings – rural, urban non-teaching, urban teaching hospital.

Null Hypothesis:  $H_0 = H_1$

Alternative Hypothesis:  $H_0 \neq H_1$

**Hypothesis 7:** There are statistically significant differences in length of stay, mortality, and costs of Alzheimer's disease patients amongst the different types of health insurance – Medicare, Medicaid, Private, and self-pay.

Null Hypothesis:  $H_0 = H_1$

Alternative Hypothesis:  $H_0 \neq H_1$

#### **1.4 Statement of the Problem**

An approximated 5 million American residents had Alzheimer's disease by the start of 2014, encompassing 200,000 people with an age of less than 65 years that have younger-onset AD. About 65 percent of American adults residing with AD are females; out of five million individuals aged sixty-five years and above with AD in the US, 3.5 million are female while 1.5 million are male (Kalaria, 812-826). The number of individuals with AD and other dementias is anticipated to rise rapidly in the coming years with the aging of the baby boom cohort. By the close of 2049, the rate of infection for individuals aged 65 years

and above might increase almost threefold, to nearly 16 million, blocking the advancement of health breakthroughs to prevent, delay, or impede the disease.

Alzheimer's disease has turned out to be a great problem in the developed nations where developments in health have lengthened the population existence. The social and economic effects of AD are immense and efforts to reduce the effects are still being investigated.

### **1.5 Definition of Terms:**

The terms, which are used in the study, are defined in the Table 1.

| Term            | Definition                                                                                                  |
|-----------------|-------------------------------------------------------------------------------------------------------------|
| Dementia        | Mental weakening of organic or practical cause                                                              |
| Symptoms        | Any feeling or alteration in physical function that a patient experiences and is linked to a given sickness |
| Memory loss     | Partial or full loss of the power of keeping and remembering past experiences                               |
| Diagnosis       | The detection of the nature and origin of a sickness mostly arrived at by studying the symptoms             |
| Health          | The condition of being without bodily or psychological sickness, infirmity, or malfunction                  |
| Life expectancy | An anticipated time to exist as computed on the foundation of arithmetical probabilities                    |
| Disorder        | A physical state in which there is an interruption of normal performance                                    |

|                           |                                                                                                                                                                                                                       |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Caregiver/ Care provider  | An individual who takes the responsibility of attending to the requirements of a patient                                                                                                                              |
| Primary Care Practitioner | An individual who assists in recognizing, precluding, or treating ill health                                                                                                                                          |
| Medication                | Something that treats, precludes, or eases the symptoms of sickness                                                                                                                                                   |
| Anorexia                  | An extended disorder of eating because of the loss of desire for food                                                                                                                                                 |
| Intervention              | Care given to improve a condition (particularly health processes or applications meant to alleviate sickness or injury)                                                                                               |
| Institutionalization      | Being admitted to a health institution                                                                                                                                                                                |
| Depression                | Sad sentiments of somberness                                                                                                                                                                                          |
| Semantic technologies     | Programming progressions where implication is stored disjointedly from data and content; the division offers fluidity to investigations and systems functions that are not present in standard Information Technology |
| Knowledge engineering     | The practice employed to develop a professional system                                                                                                                                                                |

Table 1: Terms and their definitions that are used in the introduction

## **1.6 Importance of the study**

AD was the sixth leading cause of death in 2015 and the fifth leading cause of death for those age 65 and older (CDC: Alzheimer's disease: 84,767). In addition, Alzheimer's disease accounts for up to 80 percent of all dementia cases. However, researchers have established that two nervous illnesses (Lewy body and Pick's diseases), which were initially wrongly diagnosed as AD, are turning out to be key causes of dementia. Over 500,000 adults die every year due to AD; therefore, if AD was eradicated, half a million lives could be saved every year (Epstein et al. 125-129). Deaths from AD rose to 68% from 2000 to 2010 whereas deaths caused by other key diseases reduced. AD is the only cause of death amid the top ten in the US that cannot be precluded or cured. Early diagnosis of AD allows individuals with dementia and their relatives to seek assistance in comprehending and aligning to the diagnosis and to plan in a suitable manner. This could encompass generating lawful and monetary arrangements, variations to the living preparations, and discovering concerning assistance and services that will boost the quality of life for individuals with dementia, their relatives, and pals.

## **CHAPTER II**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

Alzheimer's disease is a progressive and irreversible disorder of the brain that affects thinking skills, memory and the ability of individuals to carry out simple tasks. The first symptoms of the disease in most individuals usually appear in the mid-60s (Brill 10). Experts have noted that close to five million Americans might have the disease. Alzheimer's disease also commonly referred to, as AD is also known as the forgetting disease. The symptoms deteriorate over time and eventually lead to death because of brain damage. Alzheimer's disease affects the brain, which acts as the main control center of the human body. The brain controls such things as feelings, senses (which include smell, touch, taste, and hearing), speech, memory, breathing, and mobility. When AD attacks the brain, an individual may lose the ability to function (Brill 11). This chapter is a literature review exploring and analyzing Alzheimer's patients' characteristics in the United States.

#### **2.2 Dementia**

Dementia is a global term that is used for those diseases and conditions that are associated with a decline or loss of memory or other mental attributes that impairs an individual's ability to perform their daily activities (Moore 57). It results from the damage to the nerve cells in the brain, referred to as neurons. Because of the damage so caused, neurons are unable to function normally, and this condition could easily lead to the death of the neurons. If this happens, memory is ultimately lost and so is a slack in behavior and ability to think clearly. Further, owing to the damage caused to neurons by Alzheimer's

disease, an individual loses the capacity to perform basic bodily functions such as swallowing and walking among others (Alzheimer's Association 8). The patients in the final stages of this disease are bedridden and require maximum care and attention throughout the day and night. This means that Alzheimer's is a deadly disease (Prasher 5).

Physicians have always defined dementia based on the criterion available in the Statistical and Diagnostic Manual of Mental Disorders. American Psychiatric Association in 1993 launched DSM fifth edition (DSM-5), which added dementia among the diagnostic categories of major and mild precognitive disorders. To qualify for DSM-5 criteria for major neurocognitive disorders, a person must show evidence of significant cognitive decline (for instance, diminishing memory, language or learning). Also, the cognitive decline must affect the independence of everyday tasks (for example, assistance the patient will need to be assisted with complex tasks such as paying bills or handling medications).

For both major and mild neurocognitive disorders, DSM-5 has instructed physicians to be specific as to whether the condition is attributed to the AD, frontotemporal lobar degeneration, Lewy body disease or a variety of other conditions. There are various conceivable reasons for the advancement of dementia. In some cases, dementia grows all alone and does not exist together with different conditions, for example, on account of Alzheimer's disease. Different times, dementia is created by a hidden condition that prompts brain weakness. Sometimes, dementia is created by a response to a solution or as an aftereffect of a contamination (Lillrank, Christine, and Pat 62). There are distinctive sorts of dementias, and they are regularly arranged by variables that they share. For example, which range of the brain is influenced or on the off chance that they are dynamic or reversible with treatment. Dynamic dementias are not reversible, and they turn out to be

more regrettable over the long period. Samples of conditions that cause dynamic dementia include:

- i. Alzheimer's disease. This is the most well-known condition that causes dementia in grown-ups beyond 65 years old. Manifestations of Dementia for the most part grow after the age of 60. However, there are a few sorts of Alzheimer's disease that can have an early onset, typically because of a blemished quality (Lillrank, Christine, & Pat 57).
- ii. Lewy body dementia. Give or take 20 percent of people with dementia are influenced by Lewy body dementia. Lewy bodies are clusters of protein that grow in the brain are more normal compared to the other types.
- iii. Vascular dementia. This is the second and most regular type of dementia after AD. It happens as an aftereffect of brain harm that is brought about by issues in the supply routes that prompt the heart and mind. It can likewise grow as a consequence of a heart valve contamination or hemorrhagic strokes.
- iv. Frontotemporal dementia. This kind of dementia is less regular, for the most part creating at a more youthful age than Alzheimer's disease. Side effects typically grow between the ages of 40 and 70. It alludes to a gathering of sicknesses that prompt the degeneration of nerve cells in both the worldly and frontal mind projections. The reason is obscure.
- v. Huntington's illness. This infection is acquired and brings about squandering of the nerve cells in the mind and spinal line. Side effects grow in the 30's and 40's, and in the long run advancement to serious dementia.

- vi. Dementia pugilistic: Additionally, alluded to as endless traumatic encephalopathy, it is the aftereffect of head injury that happens over and over again, for example, the sort that boxers experience. It is otherwise called boxer's dementia. Indications may not create for quite a long while after the injury happened.
- vii. Creutzfeldt-Jakob Disease. Despite the fact that this sort of mind issue is uncommon, notwithstanding, it is deadly. It by and large creates with no notice, and there are no danger components for it. A few cases have been connected to heredity, and others have been connected to introduction to the unhealthy mind.

The other classification of dementia is not dynamic and can be turned around with proper treatment. Reasons for reversible dementia include:

- i. Scatters of the insusceptible framework and contaminations: Fever and different side effects that happen as a consequence of the body battling a contamination can prompt the advancement of dementia. Cases of diseases that can bring about incorporate dementia meningitis, encephalitis, Lyme Disease, syphilis and leukemia (Hammond 14).
- ii. Metabolic issue and endocrine variations from the norm: Included in this rundown are hypoglycemia, thyroid issues, anomalous sodium and calcium levels and a dishonorable ingestion of vitamin B-12 (Hammond 14).
- iii. Wholesome lacks: These incorporate inadequacies, for example, lack of hydration, low levels of vitamin B-1 (thiamin), and vitamins B-6 and B-12 insufficiencies.
- iv. Drug associations: Dementia may grow as an aftereffect of a response to a solution itself or because of a medication connection between a few prescriptions.

- v. Subdural hematomas: At the point when draining happens between the surface of the mind and its external covering, these hematomas can create.
- vi. Mind tumors: Despite the fact that it is not basic, dementia can happen as a consequence of a brain tumor.
- vii. Lacking oxygen: Heart assault, asthma that is serious, carbon monoxide harming, being at a high elevation, strangulation, soporific overdose, constant lung issues and heart conditions can all deny the brain (Hammond, 15).

Dementia has a slippery onset ordinarily portrayed by a beginning unobtrusive decrease in one or more subjective capacities including memory and thinking. Since the systems, that connection dementia-related brain harm to the outflow of dementia indications are not completely comprehended, a version of dementia is regularly imagined as the postponement of the clinical onset of the disease as opposed to a moderating or shirking of the advancement of the fundamental neuropathology. A typical five year postpone in the time of onset would have a tendency to lessen populace commonness by 50%, subsequently extraordinarily diminishing its effect in the overall public (Dickerson and Alireza, 247).

### **2.3 Importance of Early Diagnosis**

Early diagnosis of AD is significant as it could permit the AD patients to have a lively task in the judgment making and arranging for the future while relatives can edify themselves concerning the sickness and discover successful ways of interrelating with the people with AD.

Modifications in memory and thinking capability could be extremely perturbing. Numerous dissimilar diseases and conditions could bring about symptoms of dementia. Some of these diseases and conditions are curable and reversible, encompassing contagion, depression, drug side-effects, or dietary deficiencies. The earlier the origin of dementia symptoms is recognized, the earlier the management can start. Requesting a physician to test any symptoms and discover the origin of symptoms can create reprieve to individuals and their relatives. There is proof that the presently accessible medications for AD could be more helpful if provided early in the disease progression. These drugs could assist to sustain everyday operation and quality of life, in addition to stabilizing cognitive decline in a number of individuals. Nevertheless, they cannot assist everybody and are not a cure. Early diagnosis gives room for quick access to drugs and medical consideration. Obtaining a diagnosis could also assist in the handling of other symptoms that could go along with the early phases of dementia, for instance, depression and peevishness. In addition, assessing administration of other health conditions is vital as memory challenges could meddle with an individual recalling to take significant drugs like the ones for high blood pressure, heart problems, and diabetes (Epstein et al. 125-129).

## **2.4 Symptoms of the Alzheimer's Disease**

In the early stages, expanding distraction or gentle disarray may be the primary manifestations of Alzheimer's disease that you take note. Over the long period, the disease denies patients greater amounts of their memories, particularly late recollections. The rate at which side effects compound changes from individual to individual (Lu and Juergen, 29).

On the off chance that you have Alzheimer's, you may be the first to notice that you are having irregular trouble recollecting things and arranging your musings. On the other hand, you may not perceive that not anything is right, notwithstanding when changes are perceptible to your relatives, close companions or collaborators (Lu and Juergen, 30).

Brain changes connected with Alzheimer's disease lead to developing issue with:

1. Memory

Everybody has incidental memory slips. It is typical to forget about where you put your keys or overlook the name of a colleague. The memory misfortune connected with Alzheimer's disease continues and intensifies, influencing your capacity at work and home (Harris 49). Individuals with Alzheimer's may:

- a) Rehash proclamations and inquiries again and again, not understanding that they've posed the question some time recently
- b) Disregard discussions, arrangements or occasions, and not recall them later
- c) Routinely lose belonging, frequently placing them in strange areas
- d) In the end overlook the names of relatives and regular items

2. Bewilderment and misjudging spatial relationships

Individuals with Alzheimer's disease may lose their feeling of what day it is, the season, where they are or even their momentum life circumstances. Alzheimer's may additionally upset your mind's capacity to translate what you see, making it hard to comprehend your environment. Inevitably, these issues may prompt become mixed up in well-known spots (Harris, 52).

3. Talking and Writing

Those with Alzheimer's may experience difficulty discovering the right words to distinguish articles, express musings or participate in discussions. Over the long period, the capacity to peruse and composer likewise decays (Green, 16).

#### 4. Thinking and Reasoning

Alzheimer's Disease causes trouble thinking and considering, particularly about dynamic ideas like numbers. It might be trying to oversee funds, equalization checkbooks, and stay informed regarding bills and pays them on time. These challenges may advance the failure to perceive and manage numbers.

#### 5. Settling on judgments and choices

Reacting successfully to ordinary issues, for example, nourishment smoldering on the stove or sudden driving circumstances turns out to be progressively difficult (Green, 16).

#### 6. Arranging and performing commonplace undertakings

When routine exercises that oblige consecutive steps, for example, arranging and cooking a feast or playing a most loved diversion, turn into a battle as the Disease advances. In the long run, individuals with cutting edge Alzheimer's may overlook how to perform essential undertakings, for example, dressing and showering.

#### 7. Changes in identity and conduct

Brain changes that happen with Alzheimer's disease can influence the way you act and how you feel. Individuals with Alzheimer's may encounter:

- a) Misery
- b) Nervousness
- c) Social withdrawal

- d) Emotional Episodes
- e) Doubt in others
- f) Crabbiness and forcefulness
- g) Changes in resting propensities
- h) Meandering
- i) Loss of restraints
- j) Hallucinations, for example, thinking something has been stolen

Numerous vital abilities are not lost until late in the infection. These incorporate the capacity to peruse, move and sing, appreciate old music, participate in artworks and distractions, tell stories and think back. This is on account of data; aptitudes and propensities adapted ahead of schedule in life are among the last capacities to be lost as the infection advances. Exploiting these capacities can permit you to keep on having triumphs and keep up a high caliber of life notwithstanding when you are into the moderate period of the illness.

At the point when an individual has manifestations of dementia, a doctor must lead tests to recognize the hidden brain disease or other condition that is creating side effects. Diverse sorts of dementia are connected with unmistakable side effect examples and brain variations from the norm. Expanding proof from long period observational and dissection studies demonstrates that numerous individuals with dementia, particularly those in the more established age gatherings, have mind irregularities connected with more than one kind of dementia. This is called blended dementia.

A few conditions bring about manifestations that copy dementia yet that, dissimilar to dementia, may be turned around with treatment. An examination of 39 articles portraying

5,620 individuals with dementia-like manifestations reported that 9 percent had side effects that were mirroring dementia and conceivably reversible. Primary reasons for these indications are gloom, ridiculousness, and reactions from medicines, thyroid issues, certain vitamin lacks and extreme utilization of liquor. Interestingly, Alzheimer's disease and different dementias cannot be turned around with current medications.

## **2.5 Alzheimer's Stages**

Alzheimer's disease develops gradually and systematically deteriorates through the span of quite a while. It inevitably influences most ranges of the brain, incorporating those essential in memory, considering, judgment, dialect, critical thinking, identity and development (Ali, 117). There are five stages connected with Alzheimer's disease: preclinical Alzheimer's disease, Mild Dementia, Mild Cognitive Impairment (MCI), moderate dementia, and severe dementia . Dementia portrays a gathering of manifestations influencing scholarly and social capacities extremely enough to meddle with every day working (FCARF 1).

### **2.5.1 Preclinical Alzheimer's disease**

AD disease starts much sooner than any manifestations get to be obvious. This stage is called preclinical Alzheimer's disease (Ali, 118). No indications will be seen amid this stage. This phase of Alzheimer's can keep going for quite a long time, potentially even decades. Despite the fact that you won't see any progressions, new imaging innovations can now distinguish stores of amyloid beta that have been connected with AD disease. The

capacity to identify these early stores may be particularly essential as new medicines are created for Alzheimer's infection (FCARF, 1).

### **2.5.2 Mild Cognitive Impairment (MCI)**

Individuals with MCI have gentle changes in their memory and speculation capacity. These progressions are not sufficiently huge to influence work or connections yet. Individuals with MCI may have memory slips in terms of data that is normally effortlessly recollected, for example, discussions, late occasions or arrangements. Individuals with MCI might likewise experience difficulty judging the measure of the time required for an errand, or they may experience issues accurately judging the number or grouping of steps expected to finish an undertaking. The capacity to make steady choices can get to be harder for individuals with MCI (Ali, 118).

Not everybody with a gentle intellectual disability suffers from Alzheimer's disease. Sometimes, MCI is because of melancholy or an interim medicinal intricacy. The same methodology used to recognize preclinical Alzheimer's disease can help figure out if MCI is because of Alzheimer's infection or something else.

### **2.5.3 Mild Dementia**

Alzheimer's disease is frequently analyzed in the mellow dementia stage when it turns out to be clear to family and specialists that a man is experiencing critical difficulty with memory and considering.

In the mild Alzheimer's stage, individuals may encounter:

- Memory misfortune for late occasions. People may have an especially hard time recalling recently learned data and over and again ask the same inquiry.
- The trouble with critical thinking, complex errands, and sound judgments. Arranging a family occasion or adjusting a checkbook may get to be overpowering. Numerous individuals experience absences of foresight, for example, when settling on monetary choices (Ali 119).
- Changes in identity. Individuals may get to be curbed or withdrawn — particularly in socially awkward circumstances — or show strange fractiousness or resentment. Diminished consideration compass and lessened inspiration to finish errands likewise are basic.
- Trouble arranging and communicating contemplations. Discovering the right words to portray questions or plain

#### **2.5.4 Moderate Dementia**

In this stage, individuals get more confused and tend to forget quite often and, therefore, need help with daily chores and self-care (Snyder 19). Individuals with moderate dementia may:

- Exhibit deteriorating judgment and increasing confusion
- Experience increased and prolonged memory loss
- Require help with their daily chores
- Exhibit significant changes in personality and behavior

#### **2.5.5 Severe Dementia**

In the severe (late) phase of Alzheimer's, mental capacity keeps on declining and the disease has a developing effect on development and physical capabilities (Snyder 21). In serious Alzheimer's, individuals for the most part:

- Lose the capacity to impart lucidly. An individual can no more talk or talk rationally, despite the fact that he or she might periodically say words or expressions.
- Oblige every day help with personal consideration. This incorporates complete help with eating, dressing, utilizing the restroom and all other daily self-consideration undertakings (Snyder, 21).
- Experience a decrease in physical capacities. Gradually, one fails to stroll without help, and then not able to hold up the head without backing. Muscles may get to be unbending and reflexes unusual. Inevitably, a man loses the capacity to swallow and to control bladder and gut capacities (Ali, 121).

## **2.6 Alzheimer's Risk Factors**

Studies to identify risk factors with potential for intervention for Alzheimer's may be somehow arbitrarily categorized into three general categories. These are case-control studies of Alzheimer's disease. Typically it is inclusive of cases identified through receipt of healthcare at a clinic or other medical facility; longitudinal studies of Alzheimer's disease, often conducted as large-scale population studies of disease incidence. Also, it contains randomized clinical trials with the occurrence of AD disease as the primary outcome, as distinguished from randomized trials of treatments for persons already

diagnosed with the disease (Grossberg and Sanjeev, 6). The following critical factors have been identified for the disease.

### **2.6.1 Age**

Expanding age is the main danger element for Alzheimer's. Alzheimer's is not a piece of typical maturing, but rather your danger increments significantly after you achieve age 65. About a large portion of those, more established than age 85 have Alzheimer's. Individuals with uncommon hereditary changes that essentially ensure they will build up Alzheimer's start encountering side effects as ahead of schedule as their 30s (Gogia & Nirek, 53).

### **2.6.2 Family History and Hereditary Qualities**

Your danger of building up Alzheimer's gives off an impression of being to some degree higher if a first-degree relative — your guardian or kin — has the Disease. Researchers have distinguished uncommon changes (transformations) in three qualities that ensure a man who acquires them will create Alzheimer's. In any case, these changes represent fewer than 5 percent of Alzheimer's disease (Fisher, 211).

Most hereditary systems of Alzheimer's among families remain unexplained. The most grounded danger quality scientists have discovered so far is apolipoprotein e4 (APOE e4). Other risk qualities have been distinguished yet not definitively affirmed.

### **2.6.3 Sex**

Women may be more probable than are men to add to Alzheimer's disease to a limited extent because they live more (Feher, 51). In fact, women are 2.5 times more likely than men to provide on duty care 24 hours a day in the late stage of the disease.

#### **2.6.4 Mild Cognitive Impairment**

Individuals with gentle Mild Cognitive Impairment (MCI) have memory issues or different indications of psychological decay that are more terrible than may be normal for their age, yet not sufficiently extreme to be analyzed as dementia.

Those with MCI have an expanded danger — yet not sureness — of later creating dementia. Making a move to add to a sound way of life and procedures to make up for memory misfortune at this stage may help postpone or keep the movement to dementia.

#### **2.6.5 Past Head Injury**

Individuals who have had an extreme head injury or rehashed head injury seem to have a more serious danger of Alzheimer's infection (Gogia and Nirek, 54).

#### **2.6.6 Way of Life and Heart Wellbeing**

There is no way of life component that has been indisputably demonstrated to diminish your danger of Alzheimer's sickness. On the other hand, some proof proposes that the same variables that put you in danger of coronary illness likewise may build the chance that you will suffer from Alzheimer's. These include:

- a) Absence of activity
- b) Smoking
- c) Hypertension
- d) High blood cholesterol
- e) Hoisted homocysteine levels
- f) Inadequately controlled diabetes
- g) An eating routine ailing in leafy foods

These danger variables are likewise connected to vascular dementia, a kind of dementia brought on by harmed veins in the brain. Working with your medicinal services group on an arrangement to control these variables will help ensure your heart — and might likewise help decrease your danger of Alzheimer's illness and vascular dementia.

### **2.6.7 Long Lasting Learning and Social Engagement**

Studies have discovered a relationship between long-lasting inclusions in rationally and socially empowering exercises and lessened the danger of Alzheimer's disease (Gogia and Nirek 56). Variables that may decrease your danger of Alzheimer's include:

- a) Larger amounts of formal training
- b) A fortifying occupation
- c) Rationally difficult relaxation exercises, for example, perusing, playing recreations or playing a musical instrument

We cannot control some risk factors for the disease, such as age and hereditary profile. Be that as it may, researchers are mulling over various different elements that could have any effect. Examination recommends that a certain way of life variables may help to lessen the danger of subjective decrease and Alzheimer's infection. These may include a nutritious eating regimen, exercise, social engagement, and rationally fortifying interests. Researchers are researching the relationship between psychological decay and coronary illness, hypertension, diabetes, and stoutness. Understanding these connections and testing them in clinical trials will help us comprehend whether lessening danger elements for these maladies may help with Alzheimer's also.

The present concentrate on modifiable danger elements is defended by their capability to be focused on avoidance. Be that as it may, non-modifiable danger variables (age, sexual

orientation, and hereditary elements) are additionally imperative. Although at present hereditary components cannot be altered they may be utilized to distinguish those at the higher danger that may be focused on subgroup aversion programs.

## **2.7 Alzheimer's Disease comorbidities:**

Comorbidity can be simply defined as co-occurrence of two or more diseases during the treatment of a certain health condition. Comorbidity poses significant medical challenges as it results in additional health problems. Alzheimer's disease is one of the medical conditions with high comorbidity. According to AMC (1), successful treatment of Alzheimer's disease must entail an approach to the patient's memory as well as the comorbidities. Comorbidity of Alzheimer's diseases takes two forms: psychiatric and non-psychiatric comorbidity. Psychiatric comorbidity is where Alzheimer's disease results into some cognitive conditions resulting in psychiatric conditions. Depression, agitation, anxiety, and psychosis are among the psychiatric conditions that co-occur with Alzheimer's disease. Non-psychiatric comorbidity of Alzheimer's disease is whereby patients of Alzheimer's disease develop medical conditions that affect them in non-cognitive ways.

Depression is one of the comorbidities of Alzheimer's disease (Moretti et al. 338). According to Holtzer (2083), between 30 and 50 percent of patients with Alzheimer's disease also suffer from depression. Depression is a mental disorder characterized by loss of pleasure, depressed moods, decreased energy, feeling of low self-worth, and poor concentration among other symptoms (WHO 6). These symptoms, even though they do not appear to be serious, significantly affect the patients' ability to go on with their daily

lives. In the extreme conditions, patients suffering from depression become a danger to themselves or others. As WHO explains, there are over 3000 suicides every day that are associated with depression.

Psychosis is also a prevalent comorbidity of Alzheimer's disease. According to Madhusoodanan and Ting (1) over 41 percent of patients with Alzheimer's disease suffer from psychosis. Psychosis is a medical condition which affects the patients' mental state impairing one's emotions and thought. Once emotions and thoughts are impaired, patients lose contact with the external reality. Alzheimer's disease affects the neurocognitive functioning. Eventually, the patients develop behavioral and psychological disorders. Psychosis is one of the behavioral and psychological conditions that develop as a result of dysfunction in the neurocognitive systems. One of the main symptoms of psychosis is hallucination. Patients of Alzheimer's disease commonly develop hallucinations due to the co-occurrence of psychosis and Alzheimer's disease.

Alzheimer's disease is also associated with the prevalence of normal pressure hydrocephalus. Golomb et al (780) posits that patients with normal pressure hydrocephalus also suffer from dementia which is caused by Alzheimer's disease. Normal pressure hydrocephalus is a medical condition that causes intellectual and motor impairment. Even though some symptoms of normal pressure hydrocephalus and Alzheimer disease intersect, normal pressure hydrocephalus has some additional symptoms that affect the patients' physical abilities. Some of the psychological and behavioral symptoms of the two diseases are similar. For instance, they both cause memory loss, difficulties in reasoning and behavioral and mood changes. However,

normal pressure hydrocephalus causes serious problems to the patients when they develop symptoms such as walking difficulties, physical weakness, and unsteadiness.

Alzheimer's disease has also been associated with the occurrence of cardiovascular disease. Stampfer (221) explains that most of the symptoms of Alzheimer's disease are also visible among patients with cardiovascular disease. In this case, there is the comorbidity of Alzheimer's disease and cardiovascular disease, but the cardiovascular disease is the base disease. Cardiovascular is a disease that affects heart and blood vessels. As a result, the patients develop blood flow problems, which result in resultant conditions. Normal functioning of the brain requires uninterrupted supply of blood and oxygen to the brain. Once one suffers from cardiovascular disease, the supply of blood and oxygen is interrupted resulting brain dysfunction. It is the brain dysfunction that results in Alzheimer's disease. Cognitive dysfunction is among the symptoms of Alzheimer's disease that are evident in patients with cardiovascular disease. During the advanced stages of cardiovascular disease, patients develop cognitive problems which affect their cognitive abilities.

There is a correlation between pulmonary disease and Alzheimer's disease. In this case, the pulmonary disease serves as the base disease which results in the development of Alzheimer's disease. Pulmonary disease is a condition of the lungs where proper flow of air into and out of the lungs is interrupted. As Ebner (1) posits, the relationship between pulmonary diseases and Alzheimer's disease cannot be ignored. As earlier stated, proper functioning of the brain is dependent on the flow of oxygen into the brain; hence, dysfunction in the pulmonary systems will definitely result in brain disorders which result in Alzheimer's disease.

Alzheimer's disease is also linked to chronic medical conditions such as diabetes and high blood pressure. For patients with diabetes, several mechanisms result in the development of Alzheimer's disease, mainly because of the interruption of brain functioning. The flow of insulin into the brain is important for proper brain functioning. However, in patients suffering from diabetes, there is insufficient flow of insulin to the brain resulting in brain dysfunction which causes Alzheimer's disease. In the case of high blood pressure, patients develop blood-brain barrier disruption in the brain capillaries resulting in the dysfunction of the supply of crucial nutrient such as glucose causing poor brain functioning.

## **2.8 Alzheimer's Patients Globally**

Recently, Alzheimer's Disease International (ADI), published a report indicating the prevalence rates of Alzheimer's around the globe. This report of 2009 was extracted from a systematic review of 154 studies undertaken around the world as well as United Nations Population projections spanning up to the year 2050. This report estimated that by 2010, there would be 36 million Alzheimer's' patients globally, with this number projected to double every two decades to 66 million by 2030 and to 115 million by 2050.

The Key findings of this report included the following:

- 58% of those affected lived in low and middle wage nations, underlining the high effect of the condition in those areas. Additionally, mindfulness is low, wellbeing and social consideration are ineffectively created and social insurance is constrained.
- Population aging is the fundamental driver of anticipated increments.

- It was accepted that age-particular prevalence would stay consistent. This presumption is tested by late proof proposing an unobtrusive late decrease in dementia pervasiveness in some higher salary nations (HIC). However, there exists an increment in predominance in China, likely connected to late changes in populace wellbeing, especially introduction to cardiovascular danger components.
- Since population aging is happening at an extraordinarily quick rate in center pay nations, the heft of the increment in numbers through to 2050 will happen in those districts. By 2050, 71% of those with dementia would be living in what areas of now lower and middle-income nations.

### **2.8.1 The Global Impact of Dementia 2013–2050**

Although high-wage countries, including the G8, have borne the brunt of the dementia pestilence, this is a worldwide marvel. The vast majority of dementia lives in low and center salary nations, and a large portion of the emotional increments in numbers influenced, through to 2050, will happen in those districts. In a soul of universal participation and solidarity, we ask the G8 governments to support intergovernmental activity to make dementia a worldwide need. Vitally, this must incorporate opening up access to the determination. All nations worldwide are falling flat in this fundamental goal. Activity to address this issue ought to be adjusted, as a need, with an examination to enhance treatment alternatives and nature of the consideration.

Since 2009, the worldwide confirmation base has extended. The extension is especially with another methodical survey of the pervasiveness of dementia in China<sup>3</sup> containing 75 studies, most distributed in Chinese dialect diaries. The other seven studies

are from five sub-Saharan African nations, where beforehand stand out a study from Nigeria had been accessible. The G8 Dementia Summit held in the year 2013 gives a convenient chance to reassess and redesign confirm on the scale and the dispersion of the worldwide dementia pestilence. This is specifically in its effect on more created (G8, G20, OECD and 'high salary' nations) and less grew 'low and center wage' nations. For the present overperiod, we did a constrained survey, concentrating on the new proof rising out of China and the sub-Saharan African areas, and connected the new commonness extends to the most recent.

Around the world, about 44 million individuals have Alzheimer's or a related dementia (ADI). Just 1-in-4 individuals suffering from Alzheimer's disease have been analyzed. Alzheimer's and dementia is most fundamental in Western Europe followed closely by North America. Alzheimer's is least common in Sub-Saharan Africa. Alzheimer's and different dementias are the top foundations for inabilities in later life

### **2.8.2 The Cost of Alzheimer's Care**

The expense of tending to Alzheimer's patients in the U.S. is assessed to be \$226 billion in 2015. (Alzheimer's Association). The worldwide expense of Alzheimer's and dementia is evaluated to be \$605 billion, which is proportionate to 1% of the whole world's total national output. Medicare and Medicaid are relied upon to pay \$154 billion in 2015 for social insurance; long period administers to individuals with Alzheimer's and different dementias.

Total Cost of Care by Payer for Americans Age 65 and Older with AD and similar dementias: Medicaid \$41 Billion, Medicare \$113 Billion Out of pocket \$44 Billion, Other \$29 Billion.

## **2.9 Alzheimer's in The United States**

The prevalence of Alzheimer's relates to the proportion of the people in a population who suffer from the disease at a stated time. It also helps in understanding the weight of the burden that the disease has on the community and the healthcare system. Incidence, which is the number of newly reported cases every year, is also used to estimate the risk of developing the disease and other dementias for varying age groups. Different studies have provided different estimates on the numbers and percentages of people with Alzheimer's and other dementias. 1-in every nine Americans aged 65 and above have Alzheimer's disease (Alzheimer's Association). At the point when the first influx of children of post-war America achieves age 85 (in 2031), it is anticipated that more than 3 million individuals aged 85 and more established will have Alzheimer's (Alzheimer's Association). 33% of Americans over age 85 are burdened with the disease while 5.3 million Americans are living with Alzheimer's sickness (Michaelis & Mary, 213). Unless a cure is found, close to 16 million Americans will have the sickness by 2050 (Alzheimer's Association).

Alzheimer's disease is the sixth driving reason for death in America (Centers for Disease Control). 1-in-3 seniors bite the dust with Alzheimer's or another sort of dementia. (Centers for Disease Control). Common future after an Alzheimer's determination is 4-to-8 years. In 2014, the 85-years-and-more established populace incorporates around 2 million

individuals with Alzheimer's disease, or 40 % of every other person on earth with Alzheimer's age 65 and more established. By 2050, there could be upwards of 7 million individuals age 85 and more seasoned with Alzheimer's disease. This represents a large portion of (51 percent) out of every other person on earth 65 and more seasoned with Alzheimer's (Alzheimer's Association). Extent of persons who suffer from Alzheimer's Disease in the U.S. by Age: (Alzheimer's Association) 85+ years – 38per cent, 75-84 years, 44 per cent, 65-74 years, 15 per cent, <65 years, 10per cent.

According to a recent study commissioned by the Association of Alzheimer, it was revealed that about 5.3 million American from all ages suffer from AD in 2015 (Alzheimer's Association). This figure incorporates about 5.1 million individuals aged 65 and above and about 0.2 million individuals aged under 65 who have indicated younger-onset Alzheimer's. Further analysis has revealed that:

- a) One in nine individuals age 65 and more seasoned (11 percent) has Alzheimer's disease,
- b) Around 33% of individuals age 85 and more seasoned (32 percent) have Alzheimer's disease, and
- c) Eighty-one percent of individuals who have Alzheimer's disease are age 75 and above.

The evaluated number of people aged 65 and more established with Alzheimer's disease originates from a late study utilizing the most recent information from the 2010 U.S. Registration and the Chicago Health and Aging Project (CHAP). This is a populace based investigation of incessant wellbeing illnesses of more seasoned people. National appraisals of the commonness of all types of dementia are not accessible from CHAP, but rather from other populace-based studies including the Maturing, Demographics, and Memory Study

(ADAMS). Taking into account gauges from ADAMS, 14 percent of individuals age 71 and more developed in the United States have dementia.

Commonness studies, for example, CHAP and ADAMS are planned so that everybody in the study is tried for dementia. Be that as it may, in the group, just about 50% of the individuals who might meet the analytic criteria for different dementias and Alzheimer's disease are determined to have dementia by a physician. Because Alzheimer's disease is under-diagnosed, 50% of the evaluated 5.3 million Americans with Alzheimer's may not have been told by a doctor that they have it.

According to Bairu and Michael, there has been a major surge in the globalization of clinical tests for the AD. The number of clinical surveys being conducted across the world, especially in the developing countries has been fuelled by the need to lower costs, increase speed, and higher quality. By 2008, 80% of marketing applications for drugs and biological approved by the US Drug and Food Administration contained data from US clinical trials conducted outside the USA (47).

The growing number of care centers in the United States demonstrates the increasing awareness of the AD and the measures being taken. By 2012 in the United States, there were an estimated 4,800 grown-up day administrations focuses, 12,200 home wellbeing organizations, 3,700 hospices, 15,700 nursing homes, and 22,200 private consideration groups. Of these, more or less 58,500 regulated, three long period consideration administrations suppliers, around 66% gave mind in private settings (26.8% were nursing homes, and 37.9% were private consideration groups). On the other hand, about 33% gave mind in the home- and group-based settings (8.2% were grown-up day

administrations focuses, 20.9% were home wellbeing organizations, and 6.3% were hospices).

The Centre for Controlling and Preventing disease published a report in 2013 showing the data for mortality from AD in the United States. The key findings in this report showed that:

- a) The death rate for Alzheimer's disease increased by 39% from 2000 through 2010 in the U.S.
- b) Alzheimer's disease is ranked the sixth killer in the United States and is the fifth killer among individuals aged 65 and above. Individuals aged 85 and above have a 5.4 times higher danger of dying from Alzheimer's disease than individuals aged 75–84 years.
- c) The danger of dying from Alzheimer's disease is 26% higher among the non-Hispanic white population compared with non-Hispanic dark population, whereas the Hispanic race has a 30% lower danger than the non-Hispanic white population.
- d) In 2010, among all states and the Locale of Columbia, 31 states demonstrated demise rates from Alzheimer's disease that were over the national rate (25.1).

In 2010, Alzheimer's disease was the hidden reason for an aggregate of 83,494 deaths and was blamed for an extra 26,488 deaths (1). Mortality from Alzheimer's infection has consistently expanded amid the most recent 30 years. Close to 5.4 million individuals in the U.S suffer from Alzheimer's disease (2). The expense of social insurance for individuals with Alzheimer's illness and another dementia was estimated at \$200 billion in 2012. This incorporates \$140 billion dollars in expenses to Medicare and Medicaid and is expected to increase to \$1.1 trillion by 2050 (2).

## **2.10 Alzheimer's Disease Characteristics of Patients in The USA**

Research conducted by Moore found out that the patients who were mostly infected by the disease were older people of age 74 years. The research further indicated that most of the affected patients were non-whites. The mortality rate of the inpatients in the hospital was 5.2% as compared to 3.5 % mortality rate of patients who die due to other Diseases.

In terms of length of stay, the mean length of stay for patients with Alzheimer's disease was 10.4 days as compared to 6 days for inpatients without Alzheimer's disease. The modal period of stay for the inpatients without the Alzheimer's was found to be one day, however, for those with the disease the modal length was three days. Close to 18 percent of the Alzheimer's patients had hospital period of stay more than fifteen days. The study found out that the diagnosis of Alzheimer's disease is associated with long durations in the hospitals. The reasons as to why the inpatients take much time in the hospital are uncertain and can just be speculated. The patients suffering from Alzheimer's disease develop delirium that takes them a long period to recover. Also, many patients with Alzheimer may stay long or not be discharged due to difficulty in finding appropriate placement (Welsh 338).

Concerning the hospital costs, the per capita cost of the hospital for patients with the AD was \$17,542 as compared to the \$13552 for the patients without the disease. The study also compared the mean period of stay in the hospital and the per capita costs of hospitals for the patients. For the inpatients admitted with AD, the result found out that the per capita mean for the patients suffering from the disease was very high. The high cost for the inpatients is often driven by the extended periods of stay in the hospitals.

## **2.11 Research Gaps**

There are several gaps of the literature review that should be put into consideration. Being that the study was conducted at the single hospital, the generalization might be limited. The diagnosis of AD relied on the clinicians who were using various standardized criteria. The clinicians might not have recorded or identified the condition in the chart for some inpatients that could enable quality analysis of the characteristics of the inpatients, specifically, the patients with less complex or milder Alzheimer's disease. Hence, the frequency provided for AD is an underestimate. Also, if Alzheimer's disease were recorded more for patients with complex sensations, then a bias and false association between the disease and high per capita cost and long length of stay would be introduced. The literature was also affected by its reliance on the discharge database. The analysis failed to estimate how critical the ill patients were when they were admitted, and there was a lack of data stating where the patients were before they were admitted to the hospital. Research into the prevention, etiology, and treatment of Alzheimer's disease is at the moment active and promising, and efforts should be accelerated. For instance, over 250 open studies related to AD appear in an online government compendium, National Institutes of Health. There are indications that individuals suffering from Alzheimer's disease will continue to be major research objects in future (Zarit & Ronda, 169).

In the United States, other than the need to find a cure for AD, one of the most compelling reasons for further research is the high number of people with the disease especially given the aging population. This has prompted the federal government to give millions of dollars for Alzheimer's research. Some experts in the fields of neurology and neuropathology, biochemistry, statistics, and public health are being employed to

undertake specialized studies in finding a cure for Alzheimer's. Recent research conducted by the Alzheimer's Association and the National Institute on Aging (NIA) explains the need to pay closer attention to the biomarkers in the human body (Ali, 191). The research on biological markers as contributors to the development of AD is yet to be proven. It involves experimenting with a considerable number of people to reach finally a solid conclusion (Ali, 192).

Although as indicated above there have been much researched into the Alzheimer's disease and its risk factors, there is no study yet looking at a comprehensive insight of the cofactors and the statistical analysis of the dataset available by the NIS. This statistical analysis could provide a comprehensive view of Alzheimer's inpatients in the United States. Therefore, it is proposed in this research study to evaluate the influence of hospital and patient characteristics, on three outcomes namely, the length of stay, mortality and costs.

## **2.12 Summary**

AD patients are always admitted to the hospitals due to various diagnostic problems than the patients without AD. The patients also stay long in hospitals with increased costs. Different studies have found out that most hospitals that employ an intensive program of intervention and early screening of patients, and the duration of stay of patients with Alzheimer's disease are very comparable to that of patients without AD. Early identification of the disease and screening in the hospitals should be evaluated as a way of reducing the duration of stay, and the cost incurred. Patients with Alzheimer's disease can benefit from this since they can spend less time and cost in the hospital, a surrounding that is very hostile and confusing to them.

## **CHAPTER III**

### **MATERIAL AND METHODS**

#### **3.1 Nationwide Inpatient Sample Data:**

The sample data comprises of inpatient hospital stays obtained from the Nationwide (nationwide) Inpatient Sample (NIS). The National Inpatient Sample is the largest nationwide database of hospital inpatient stays. The NIS database is being utilized by researchers and policymakers to identify, track and predict the future trends in health care. The NIS includes sample of inpatients across wide types of patients and hospitals. Patients could be insured or uninsured and include different types of community hospitals, i.e. short term, non-federal, non-rehabilitation hospitals. In addition, it includes more than a hundred clinical and nonclinical data elements.

#### **3.2 Data & Methods:**

In this study, the datasets obtained from the Nationwide Inpatient Sample (NIS) database towards the research's statistical analyses of Alzheimer's Disease. The NIS has data from about eight million hospital stays each year accounting from all discharge data of 1,050 hospitals located in forty-four States, approximating a 20-percent stratified sample of U.S. community hospitals. The NIS contains more than one hundred clinical and nonclinical data elements for each hospital stay. These include:

- ❖ Primary and secondary diagnoses
- ❖ Primary and secondary procedures
- ❖ Admission and discharge status
- ❖ Patient demographics (e.g., gender, age, race, median income for ZIP Code)
- ❖ Expected payment source

- ❖ Total charges
- ❖ Length of stay
- ❖ Hospital characteristics (e.g., ownership, size, teaching status).

Moreover, the NIS is the only national hospital database that contains cost details on all patients encompassing patients covered by Medicare, Medicaid, private insurance, and uninsured. The objectives of interest as mentioned in the objectives and hypotheses above are the length of stay, the mortality and the costs. Using the datasets obtained from the NIS database, descriptive and inferential statistics will be conducted. A multiple regression model will be setup and validated in order to relate the factors associated with the study outcome, the length of stay and the costs. Predictive models such as logistic regression will be employed to decide the risks and ratios for the various issues affecting mortality such as race, age, number and types of procedures and comorbidities.

### **3.3 Data Variables, Research Questions, and Statistical Analysis Procedures**

The NIS data set, on various variables covering the years 2007-2012, were utilized in this study. The required variables to fulfil the statistical analysis are given in **Table 2**.

Table 2: Data Variables used for the Analysis

| Study Variables                                         | Original Variable Name in the NIS Data Set                                                                                         | Variable Description                                                                                                                       |
|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Age</b>                                              | AGE                                                                                                                                | Age in years, Numerical Variable                                                                                                           |
| <b>Mortality</b>                                        | DIED                                                                                                                               | Patient did not die during hospitalization (DIED=0);<br>Patient died during hospitalization (DIED=1), Categorical (binary) Variable        |
| <b>GENDER</b>                                           | FEMALE                                                                                                                             | Gender of patient FEMALE = 1 is Male; FEMALE=0 is female, Categorical (binary) Variable                                                    |
| <b>TOTAL CHARGE</b>                                     | TOTCHG                                                                                                                             | Total charges , Numerical Variable                                                                                                         |
| <b>RACE</b>                                             | RACE                                                                                                                               | 1 = White, 2 = Black, 3 = Hispanic, 4 = Asian/Pacific, 5 = Native Am., 6 = Other, Categorical Variable                                     |
| <b>INSURANCE TYPE</b>                                   | PAY1                                                                                                                               | 1=Medicare, 2=Medicaid, 3=Private insurance,4=Self-pay,5=No charge,6=Other, Categorical Variable                                           |
| <b>NUMBER OF PROCEDURES</b>                             | NPR                                                                                                                                | The number of procedures performed while patient was hospitalized, Numerical Variable                                                      |
| <b>SOCIO_ECONOMIC STATUS (SES)</b>                      | ZIPINC                                                                                                                             | Median household income for patient's ZIP Code, 1=\$1-24,999, 2=\$25,000-34,999, 3=\$35,000-44,999, 4=45,000 or more, Categorical Variable |
| <b>COMORBIDITIES</b>                                    | Comorbidities_Normal_Pressure_Hydrocephalus +<br>Comorbidities_Depression +<br>Comorbidities_Psychosis +<br>Comorbidities_Diabetes | Comorbidities (Normal Pressure Hydrocephalus + Depression + Psychosis + Diabetes, data), Categorical (binary) Variables                    |
| <b>LENGTH OF STAY</b>                                   | LOS                                                                                                                                | The number of days patient was hospitalized, Numerical Variable                                                                            |
| <b>Type of Hospitals (location and teaching status)</b> | HOSP_LOCTEACH                                                                                                                      | Location/teaching status of hospital which are (Rural =1, Urban nonteaching =2, Urban teaching =3)                                         |
| <b>REGION</b>                                           | REGION                                                                                                                             | Four regions are included Northeast = 1, Midwest =2, South = 3, west =4 , Categorical Variable                                             |
| <b>PAY1</b>                                             | INSURANCE TYPE                                                                                                                     | Expected primary payer, uniform: (1) Medicare, (2) Medicaid, (3) private including HMO, (4) self-pay                                       |

### 3.4 Study Hypotheses and Corresponding Statistical Tests

In order to answer the research questions, six hypotheses were tested by using different inferential and descriptive statistical analysis. The research questions and hypotheses, independent and outcome variables, and inferential and descriptive analysis are as given in

**Table 3.**

Table 3: Study Hypotheses and Corresponding Statistical Tests

| Research Question                                                                                         | Hypothesis  | Independent Variables                                               | Outcome Variables | Inferential Analyses                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------|-------------|---------------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Do Type of Comorbidities &amp; Number of Procedures significantly affect Length of Stay(LOS)?</b>      | Hypothesis1 | Normal Pressure Hydrocephalus, Depression, Psychosis, Diabetes, NPR | LOS               | Multi Regression (LOS vs Comorbidities_Normal_Pressure_Hydrocephalus + Comorbidities_Depression + Comorbidities_Psychosis + Comorbidities_Diabetes) + Regression(NPR vs LOS)          |
| <b>Do Type of Comorbidities &amp; Number of Procedures significantly affect total of charge (TOTCHG)?</b> | Hypothesis2 | Normal Pressure Hydrocephalus, Depression, Psychosis, Diabetes, NPR | TOTCHG            | Multiple Regression (TOTCHG VS Comorbidities_Normal_Pressure_Hydrocephalus + Comorbidities_Depression + Comorbidities_Psychosis + Comorbidities_Diabetes) + Regression(NPR vs TOTCHG) |

|                                                                                                   |              |                                                                     |                   |                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------------|--------------|---------------------------------------------------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Do Type of Comorbidities &amp; Number of Procedures significantly affect Mortality(DIED )?</b> | Hypothesis3  | Normal Pressure Hydrocephalus, Depression, Psychosis, Diabetes, NPR | DIED              | Logistic Regression (DIED VS Comorbidities_Normal_Pressure_Hydrocephalus + Comorbidities_Depression + Comorbidities_Psychosis + Comorbidities_Diabetes)<br>+<br>Logistic Regression(NPR vs DIED)             |
| <b>Do Race, Age &amp; Socioeconomic Status significantly affect LOS, TOTCHG &amp; DIED?</b>       | Hypothesis4  | RACE, AGEGRP, ZIPINC                                                | LOS, TOTCHG, DIED | Multi Regression (LOS vs RACE, LOS vs ZIPINC, LOC vs AGEGRP)<br>Multi Regression (TOTCHG vs RACE, TOTCHG vs ZIPINC, TOTCHG vs AGEGRP)<br>Logistic Regression ( DIED vs RACE, DIED vs AGEGRP, DIED vs ZIPINC) |
| <b>Do LOS, TOTCHG &amp; DIED significantly differ with the Geographical Regions?</b>              | Hypothesis5  | REGION                                                              | LOS, TOTCHG, DIED | Multi Regression (LOS vs REGION)<br>Multi Regression (TOTCHG vs REGION)<br>Logistic Regression (DIED vs REGION)<br>Pearson CHI_SQ (DIED vs REGION)                                                           |
| <b>Do LOS, TOTCHG &amp; DIED significantly differ with the Type of Hospital?</b>                  | Hypothesis6  | HOSPTYPE                                                            | LOS, TOTCHG, DIED | Multi Regression (LOS vs HOSPTYPE)<br>Multi Regression (TOTCHG vs HOSPTYPE)<br>Logistic Regression (DIED vs HOSPTYPE)<br>CHI_SQ (DIED vs HOSPTYPE)                                                           |
| <b>Do LOS, TOTCHG &amp; DIED significantly differ with the type of Insurance?</b>                 | Hypothesis 7 | PAY1                                                                | LOS, TOTCHG, DIED | Multi Regression (LOS vs REGION)<br>Multi Regression (TOTCHG vs REGION)<br>Logistic Regression (DIED vs HOSPTYPE)                                                                                            |

### **3.5 Sample Size**

By utilizing the data filtering method on Alzheimer's patients' data from NIS database, a net sample size of 698,170 entries were obtained for statistical analysis for the six-year period covering 2007-2012. Statistical analysis results are provided in the next chapter.

## **CHAPTER IV**

### **RESULTS OF DATA ANALYSIS**

#### **4.1 INTRODUCTION**

In this chapter of this dissertation, statistical analysis has been performed by utilizing different modeling analysis. A sample of 698,170 entries were obtained from NIS dataset and then analyzed after merging the data of the years 2007-2012. Additionally, Descriptive and inferential analysis were performed by using R, version 3.2.3, which is a powerful Statistical programming language in order to answer the research questions indicated in the previous chapter. By using the ICD-9-CM code of Alzheimer's Disease (331.0), the NIS dataset was also queried to obtain the outcomes for Alzheimer's disease for the years 2007-2012.

The patient characteristics and hospital contexts are expected to influence the main outcomes including length of stay, total of charge, and mortality. Patient characteristics and hospital contexts that were consider in this study are given in **Table 4**.

Table 4: Patient characteristics and hospital Context

| Variable                                 | Attributes                           |
|------------------------------------------|--------------------------------------|
| <b>Patient characteristic Variables:</b> |                                      |
| Race                                     | <b>White</b>                         |
|                                          | <b>Black</b>                         |
|                                          | <b>Hispanic</b>                      |
|                                          | <b>Asian</b>                         |
|                                          | <b>Native American</b>               |
| Gender                                   | Male                                 |
|                                          | Female                               |
| Age Groups                               | <b>Less than 65</b>                  |
|                                          | <b>65-74</b>                         |
|                                          | <b>75-84</b>                         |
|                                          | <b>85 and older</b>                  |
| Insurance Type                           | Medicare                             |
|                                          | Medicaid                             |
|                                          | Private                              |
|                                          | Self-pay                             |
| Comorbidities                            | <b>Normal Pressure Hydrocephalus</b> |
|                                          | <b>Depression</b>                    |
|                                          | <b>Psychosis</b>                     |
|                                          | <b>Diabetes</b>                      |
| Patients Income                          | Less than \$39,000                   |
|                                          | \$39,000 - \$47,999                  |
|                                          | \$48,000 – 62,999                    |
|                                          | \$63,000 or more                     |
| <b>Hospital Context Variables:</b>       |                                      |
| Status and Location                      | Rural                                |
|                                          | Urban teaching                       |
|                                          | Urban no-teaching                    |
| Hospital Region                          | <b>Northeast</b>                     |
|                                          | <b>Midwest</b>                       |
|                                          | <b>South</b>                         |
|                                          | <b>West</b>                          |

## 4.2 Results of Descriptive Statistic and Frequencies:

The descriptive statistics and frequencies of both the patient characteristics and hospital context are given in this part of the study. They are part of the analysis that provides an introduction to the inferential analysis where the researcher will test the hypotheses. The tests of the hypotheses to find out the relationships between independent and dependent variables.

### 4.2.1 Patient Characteristics

Patients characteristics are necessary in this study since the objectives are to find out the relationships between these characteristics and other factors. These characteristics including the patients age, patients race, patients gender, patients' health insurance, and comorbidities that the patients have with Alzheimer's disease.

#### 4.2.1.1 Patient Age

The patient age was divided into four groups as given in **Table 5**. The age is a key risk factor for the incidence of Alzheimer's disease. The table indicates that majority of Alzheimer's patients are falling in the group 75-84 while the least number of Alzheimer's incidences were in the age group less than 65.

Table 5: Patients age groups

| Age   | Count  | Percentage |
|-------|--------|------------|
| <65   | 16876  | 2.417%     |
| 65-74 | 77998  | 11.172%    |
| 75-84 | 289039 | 41.4%      |
| >=85  | 314179 | 45%        |

|         |        |        |
|---------|--------|--------|
| Missing | 78     | 0.011% |
| Total   | 698170 | 100%   |

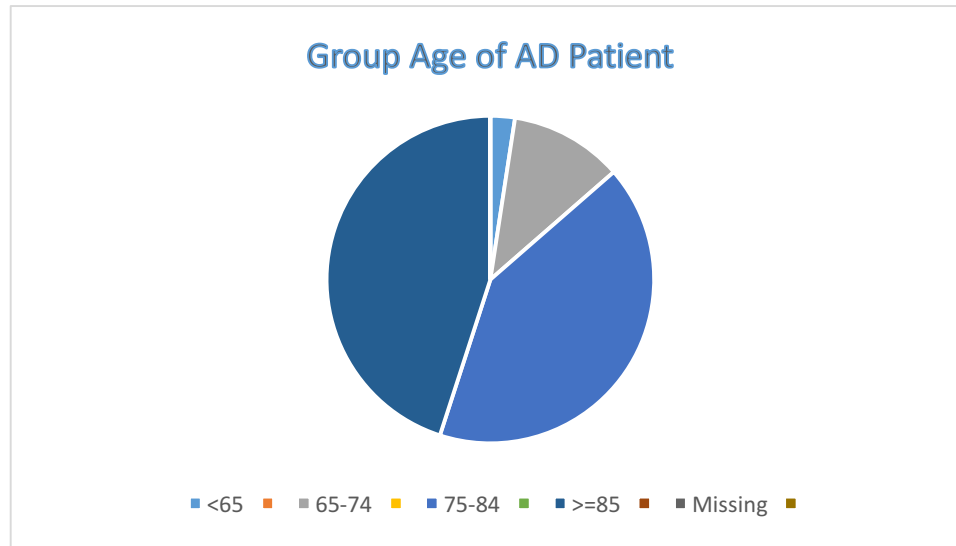


Figure 1: Age Groups of AD Patients

#### 4.2.1.2 Patient Race

The White patients of Alzheimer's disease were 66.37 per cent, however; the Native American were only 2887 with percentage of 0.48. The races and the number of the incidence in the United States are given in **Table 6**.

Table 6: Races incidence of Alzheimer's

| Race                      | Count  | Percentage |
|---------------------------|--------|------------|
| White                     | 463386 | 66.37%     |
| Black                     | 68765  | 9.85%      |
| Hispanic                  | 44903  | 6.43%      |
| Asian or Pacific Islander | 9882   | 1.42%      |
| Native American           | 2887   | 0.41%      |
| Other                     | 15757  | 2.26%      |

|         |        |        |
|---------|--------|--------|
| Missing | 92590  | 13.26% |
| Total   | 698170 | 100%   |

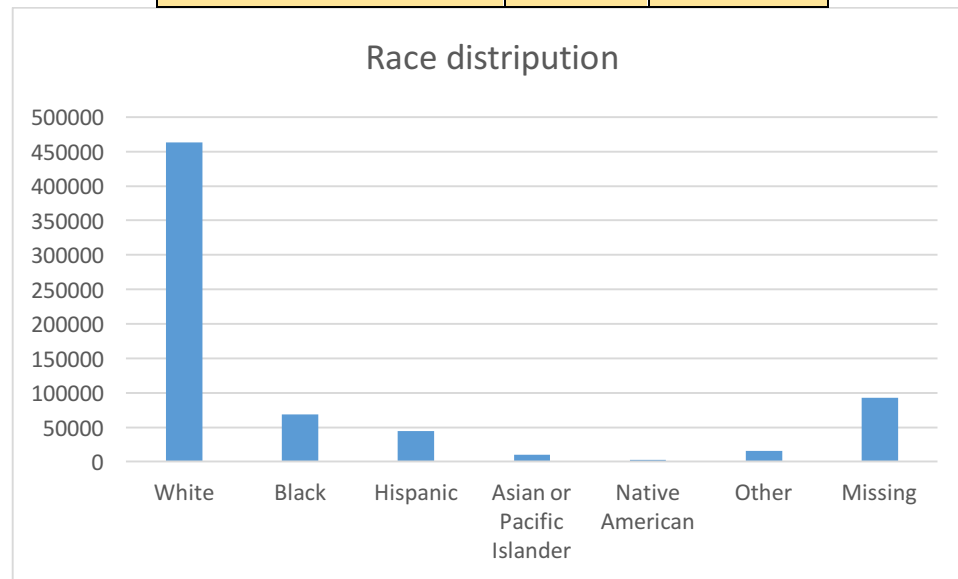


Figure 2: Incidences of Alzheimer's Disease among Races

#### 4.2.1.3 Patient Gender

The Gender of Alzheimer's patients has also an affect of the incidence of AD in the United States as indicated in **Table 7**, females are more likely to have Alzheimer's disease than males. Male patients are almost half the female patients in the period 2007-2012.

Table 7: Patient Gender counts and percentages

| Gender  | Count  | Percentage |
|---------|--------|------------|
| Male    | 251134 | 35.97%     |
| Female  | 446954 | 64.02%     |
| Missing | 82     | 0.01%      |
| Total   | 698170 | 100%       |

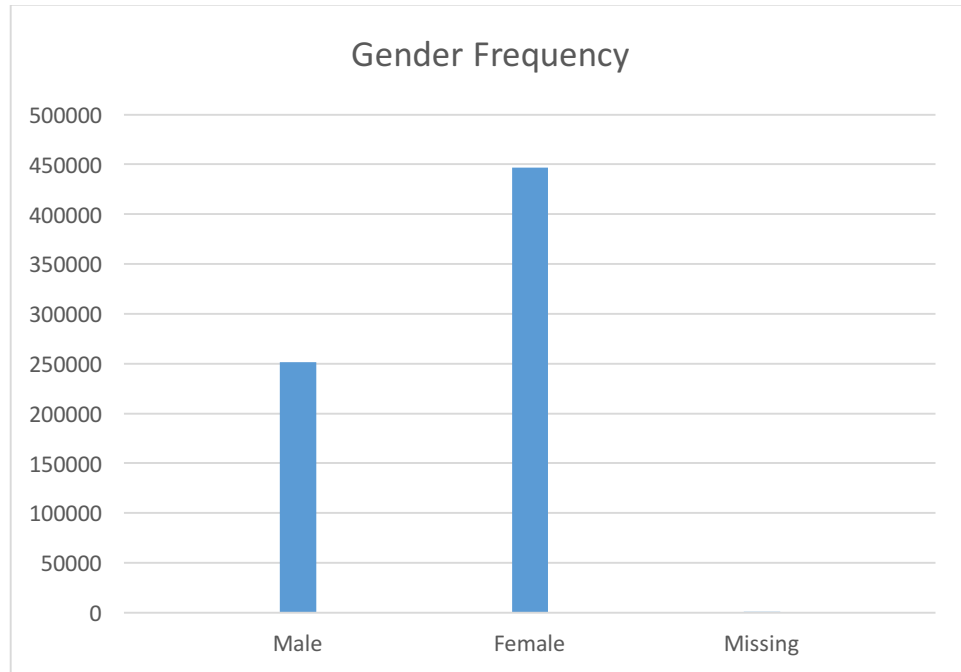


Figure 3: Gender Frequency

#### 4.2.1.4 Patient Health Insurance

The health insurance of Alzheimer’s patients was analyzed as shown in **Table 8**.

Table 8: Health Insurance in the AD sample

| Health Insurance      | Count  | Percentage |
|-----------------------|--------|------------|
| Medicare              | 638027 | 91.39%     |
| Medicaid              | 11293  | 1.62%      |
| Private including HMO | 38421  | 5.5%       |
| Self-pay              | 2731   | 0.39%      |
| No Charge             | 271    | 0.04%      |
| Other                 | 6333   | 0.91%      |
| Missing               | 1094   | 0.16%      |
| Total                 | 698170 | 100%       |

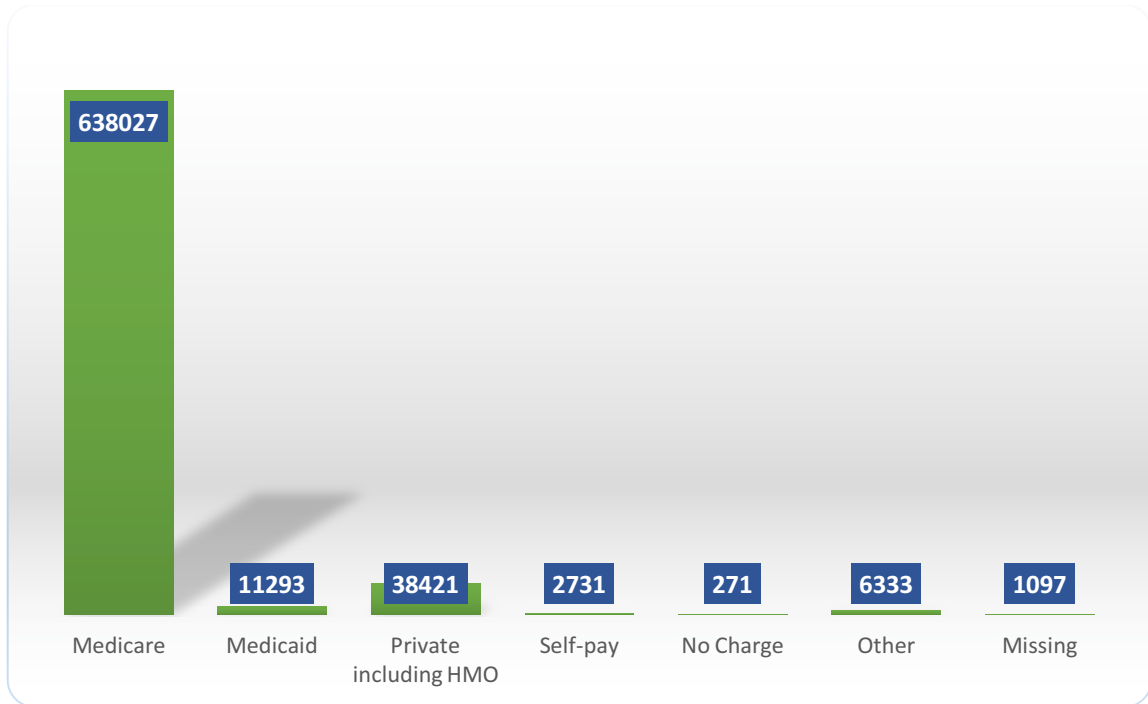


Figure 4: Insurance type of AD patients Frequency

#### 4.2.1.5 Patient Comorbidities

Patients comorbidities include depression, psychosis, hydrocephalus, and diabetes are descriptively analyzed to have a general idea about comorbidities of Alzheimer's disease as given in Table 9.

Table 9: AD comorbidities Counts and Percentages

|   | Comorbidities    | Count  | Percentage |
|---|------------------|--------|------------|
| 1 | Depression       | 82497  | 11.82%     |
|   | No Depression    | 615673 | 88.18%     |
|   | Total            | 698170 | 100%       |
| 2 | Psychosis        | 32228  | 4.62%      |
|   | No Psychosis     | 665942 | 95.38%     |
|   | Total            | 698170 | 100%       |
| 3 | Hydrocephalus    | 3132   | 0.45%      |
|   | No Hydrocephalus | 695038 | 99.55%     |
|   | Total            | 698170 | 100%       |

|   |             |        |        |
|---|-------------|--------|--------|
| 4 | Diabetes    | 180710 | 25.88% |
|   | No Diabetes | 517460 | 74.12% |
|   | Total       | 698170 | 100%   |

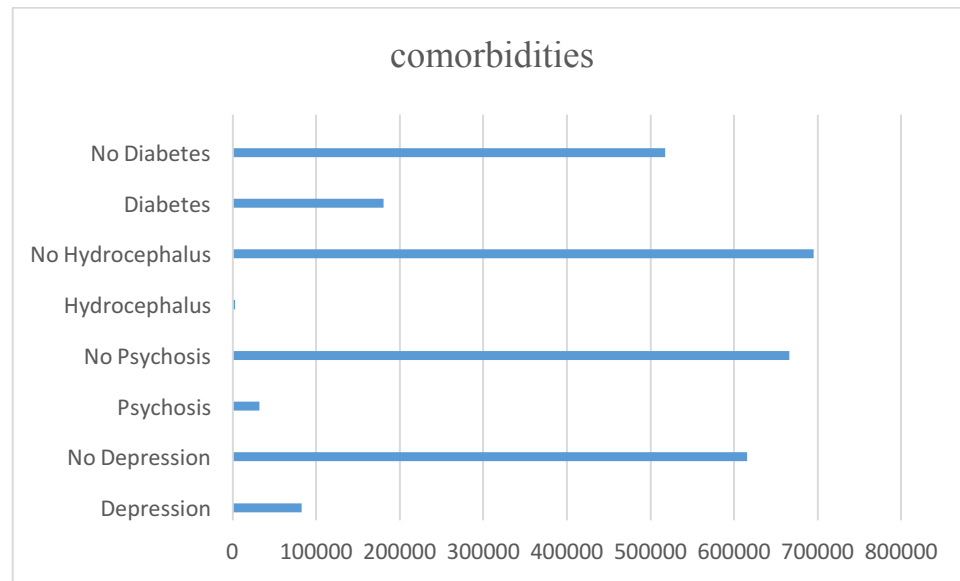


Figure 5: Alzheimer's Patient Comorbidities

#### 4.2.2 Hospital contexts

The hospital contexts included in this study hospital location and teaching status, hospital region.

##### 4.2.2.1 Hospital Location and teaching status

As given in **Table 10**, urban non-teaching has the highest number of Alzheimer's patients while the rural has the lowest number of patients with 119,857 patients from 2007-2012.

Table 10: Hospital location counts and teaching status

| Hospital Location and Teaching Status | Count  | Percentage |
|---------------------------------------|--------|------------|
| Rural                                 | 119857 | 17.17%     |
| Urban non-teaching                    | 326386 | 46.75%     |
| Urban teaching                        | 247952 | 35.51%     |
| Missing                               | 3975   | 0.57%      |
| Total                                 | 698170 | 100%       |

#### 4.2.2.2 Hospital Regions

The highest region with Alzheimer's patients' incidences is the south while the lowest incidences of Alzheimer's patients is West region as given in **Table 11**.

Table 11: Hospital regions and number of Alzheimer's patients in each regions

| Hospital Region | Count  | Percentage |
|-----------------|--------|------------|
| Northeast       | 137591 | 19.71%     |
| Midwest         | 164048 | 23.50%     |
| South           | 294175 | 42.14%     |
| West            | 102356 | 14.66%     |
| Total           | 698170 | 100%       |

#### 4.2.3 Mean and Median of Length of Stay of AD 2007-2012

The mean of length of stay of Alzheimer's patients from 2007 to 2012 in the United States is 6.11 days and the median is 4 days as given in **Table 12**.

Table 12: Mean and median of length of stay of AD

|                | Mean     | Median |
|----------------|----------|--------|
| Length of stay | 6.109059 | 4      |

#### 4.2.4 Mean and Median of Charges of Alzheimer patients 2007-2012

The mean of total of charges of Alzheimer's patients in the United States for the years 2007 to 2012 is \$30407.97 while the median was \$19812 as given in **Table 13**.

Table 13: Mean and median of Charges of AD

|               | Mean     | Median |
|---------------|----------|--------|
| Charges of AD | 30407.97 | 19812  |

#### 4.2.5 Frequencies of Mortality of AD

The incidences of mortality in United States from 2007 to 2012 is 32728 Alzheimer's patients with a percentage of 4.69 as given in **Table 14**.

Table 14: Frequency of Mortality of AD

| Mortality status | Count  | Percentage |
|------------------|--------|------------|
| Did not die      | 664932 | 95.24%     |
| Died             | 32728  | 4.69%      |
| Missing          | 510    | 0.07%      |
| Total            | 697660 | 100        |

#### 4.3 Total Number of Discharges years 1993 - 2012

Total number of discharges graph was obtained by querying the NIS database through utilizing the HCUPnet website by ICD-9-CM principle diagnosis code 331.0, Alzheimer's Disease as indicated in **Figure 6**.

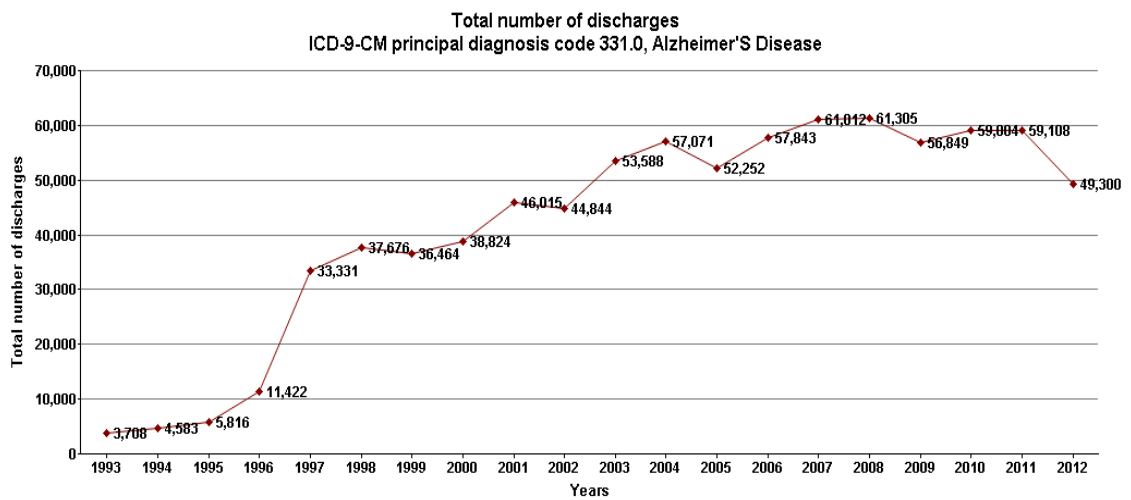


Figure 6: Total number of discharges for the years 1993-2012

#### 4.4 Percent In-hospital mortality

Percent in-hospital mortality graph, years 1993-2012, was obtained by querying the NIS database through utilizing the HCUPnet website by ICD-9-CM principle diagnosis code 331.0, Alzheimer's Disease as indicated in Figure 7.

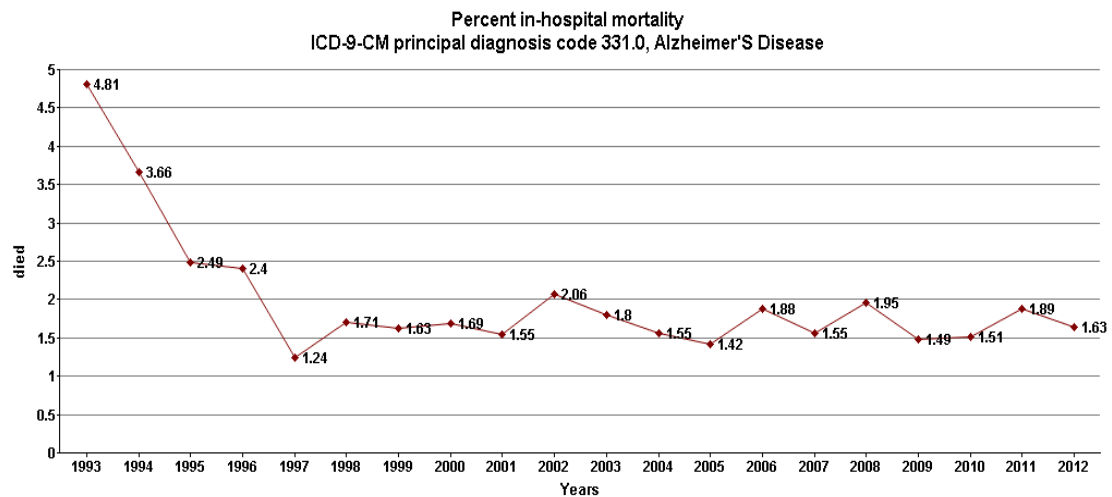


Figure 7: Percent in-hospital mortality for the years 1993-2012

#### 4.5 Average Length of Stay 1993-2012

Average length of stay graph, years 1993-2012, was obtained by querying the NIS database through utilizing the HCUPnet website by ICD-9-CM principle diagnosis code 331.0, Alzheimer's Disease as indicated in Figure 8.

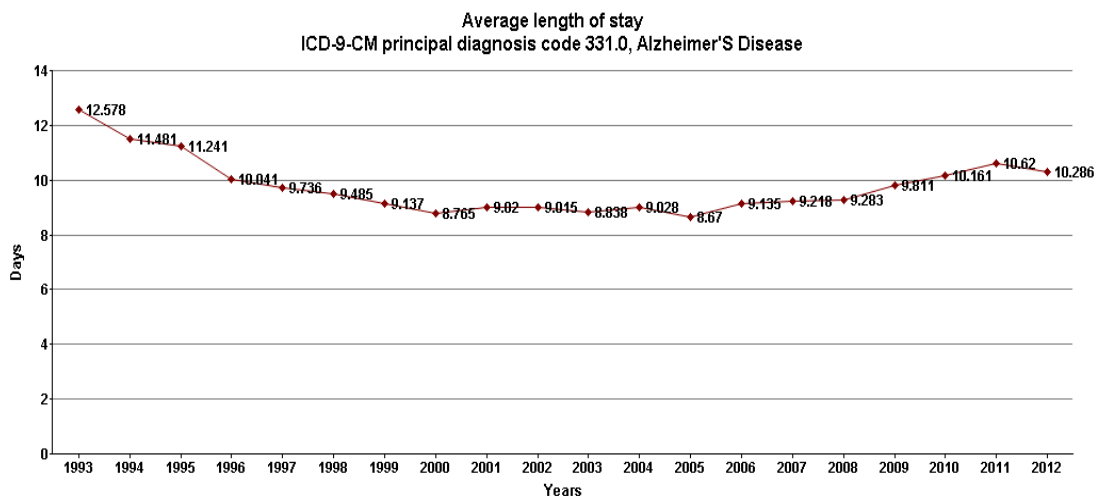


Figure 8: Average length of stay for the years 1993-2012

#### 4.6 Average Total Charges

Average total charges graph, years 1993-2012, was obtained by querying the NIS database through utilizing the HCUPnet website by ICD-9-CM principle diagnosis code 331.0, Alzheimer's Disease as indicated in Figure 9.

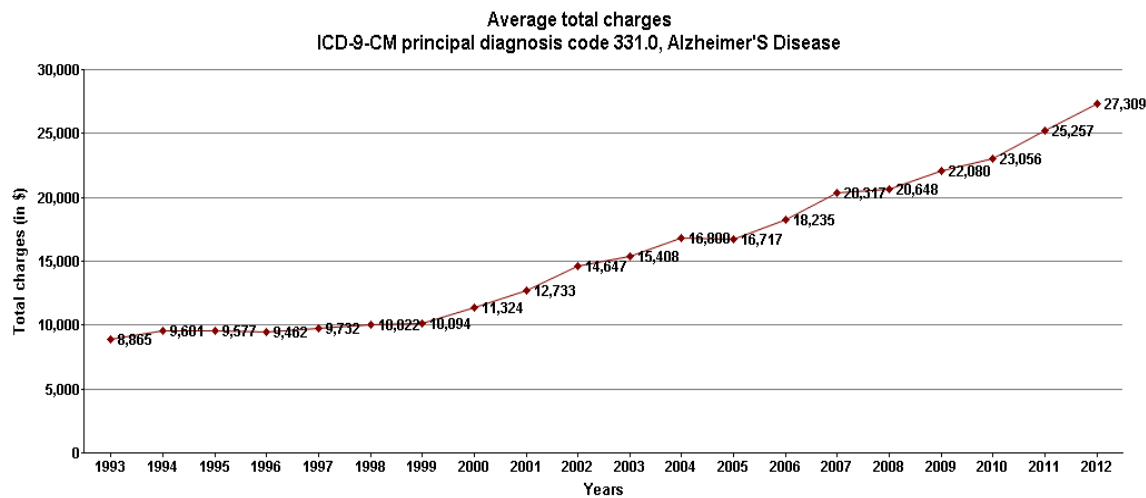


Figure 9: Average total charges for the years 1993-2012

## 4.7 Median Total Charges

Median total charges graph, years 1993-2012, was obtained by querying the NIS database through utilizing the HCUPnet website by ICD-9-CM principle diagnosis code 331.0, Alzheimer's Disease as indicated in Figure 10.

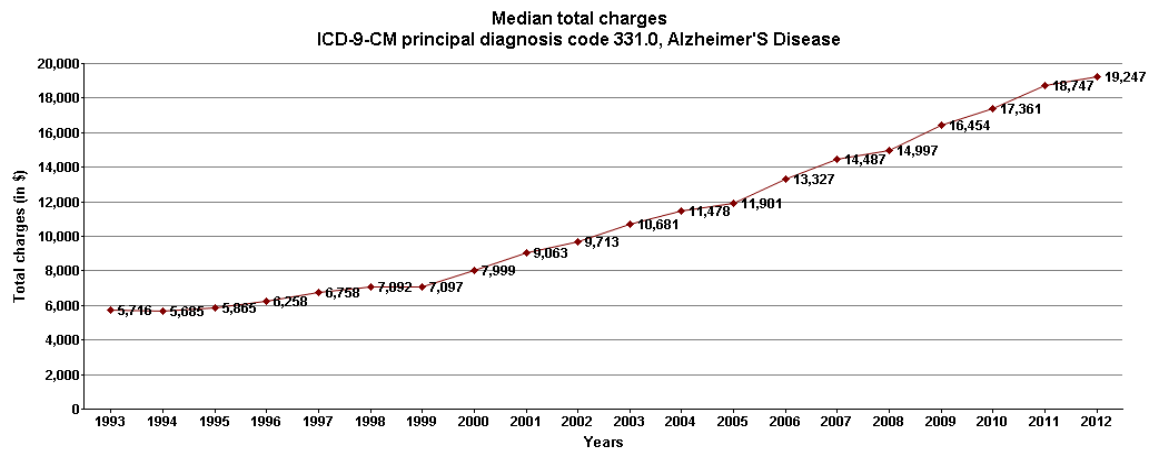


Figure 10: Median total charges for the years 1993-2012

## 4.8 Inferential Statistical Analysis (Achievement of the Objectives)

The inferential statistical analysis includes Multi Regression and logistic regression. It also includes Pearson's Chi-squared test to test the significance of the relationship between independent and dependent variables.

### 4.8.1 Hypothesis 1

**Hypothesis 1:** There are statistically significant associations between the number and types of comorbidities and procedures in length of stay.

#### 4.8.1.1 Multiple Regression Analysis - Length of Stay vs. comorbidities

The first objective was to find out whether there is an influence of the comorbidities of Alzheimer's disease on the length of stay of a hospital patient. Multiple regression was used to analyze this relationship. The dependent variable in the regression model was the length of stay. The independent variables in the model were comorbidities including, normal pressure hydrocephalus, depression, psychosis, and diabetes. The model was statistically significant ( $p < .001$ ). Alzheimer's patients who were admitted to the hospital with normal pressure hydrocephalus on average stayed .34 days longer than those without normal pressure hydrocephalus ( $p = .008$ ). Alzheimer's patients who were admitted to the hospital with depression on average stayed .06 days shorter than those without depression ( $p = .024$ ). Alzheimer's patients who were admitted to the hospital with psychosis on average stayed 2.20 days longer than those without psychosis ( $p < .001$ ). Alzheimer's patients who were admitted to the hospital with diabetes on average stayed .22 days longer than those without diabetes ( $p < .001$ ).

Table 15: Multiple Regression Analysis for Length of Stay vs. comorbidities

|                               | <i>B</i> | <i>SE</i> | <i>T</i> -value | <i>p</i> -value |
|-------------------------------|----------|-----------|-----------------|-----------------|
| Intercept                     | 5.96     | 0.01      | 563.22          | < .001          |
| Normal Pressure Hydrocephalus | 0.34     | 0.13      | 2.66            | 0.008           |
| Depression                    | -0.06    | 0.03      | -2.26           | 0.024           |
| Psychosis                     | 2.20     | 0.04      | 54.12           | <.001           |
| Diabetes                      | 0.22     | 0.02      | 11.46           | <.001           |

The equation from the regression model was:

$$\text{Length of Stay} = 5.96 + .34* \text{Normal Pressure Hydrocephalus} - 0.06* \text{Depression} + 2.20* \text{Psychosis} + 0.22* \text{Diabetes}$$

#### 4.8.1.2 Regression Analysis – Length of Stay vs. Number of Procedures

The relationship between the number of procedures and the length of stay was investigated. Regression was used to analyze this relationship. The dependent variable in the regression model was the length of stay. The independent variable was the number of procedures. The model was statistically significant ( $p < .001$ ). Alzheimer's patients on average stayed .95 days longer per procedure performed ( $p < .001$ ).

Table 16: Regression Analysis – Length of Stay vs. Number of Procedures

|           | B    | SE    | <i>t</i> -value | <i>p</i> -value |
|-----------|------|-------|-----------------|-----------------|
| Intercept | 5.24 | 0.01  | 544.2           | < .001          |
| NPR       | 0.95 | 0.005 | 181.3           | < .001          |

The equation from the regression model was:

$$\text{Length of Stay} = 5.24 + .95 * \text{NPR}$$

#### 4.8.2 Hypothesis 2

**Hypothesis 2:** There are statistically significant associations between the number and types of comorbidities and procedures and costs of Alzheimer's disease inpatients.

##### 4.8.2.1 Multiple Regression Analysis – Total Charge vs. Comorbidities

The first objective was to find out whether there is an influence of the comorbidities of Alzheimer's disease on the total cost of stay of a hospital patient. Multiple regression was used to analyze this relationship. The dependent variable in the regression model was total charges. The independent variables in the model were comorbidities including, normal pressure hydrocephalus, depression, psychosis, and diabetes. The model was statistically significant,  $p < .001$ . Alzheimer's patients who were admitted to the hospital with normal pressure hydrocephalus on average were charged \$4569.03 more than those without with

normal pressure hydrocephalus ( $p < .001$ ). Alzheimer's patients who were admitted to the hospital with depression were charged \$1749.79 less than those without depression ( $p = .024$ ). Alzheimer's patients who were admitted to the hospital with psychosis were charged on average \$210.30 less than those without psychosis (not statistically significant) ( $p < .334$ ). Alzheimer's patients who were admitted to the hospital with diabetes were charged \$3246.83 more than those without diabetes ( $p < .001$ ).

Table 17: Multiple Regression Analysis – Total Charge vs. Comorbidities

|                               | B        | SE     | <i>t</i> -value | <i>p</i> -value |
|-------------------------------|----------|--------|-----------------|-----------------|
| Intercept                     | 29763.68 | 56.67  | 525.17          | <.001           |
| Normal Pressure Hydrocephalus | 4569.03  | 681.40 | 6.71            | <.001           |
| Depression                    | -1749.79 | 141.36 | -12.38          | <.001           |
| Psychosis                     | -210.30  | 217.74 | -0.97           | 0.334           |
| Diabetes                      | 3246.83  | 104.26 | 31.14           | <.001           |

The equation from the regression model was:

$$\text{Length of Stay} = 29763.68 + 4569.03 * \text{Normal Pressure Hydrocephalus} - 1749.79 * \text{Depression} - 210.30 * \text{Psychosis} + 3246.83 * \text{Diabetes}$$

#### 4.8.2.2 Regression Analysis – Total Charge vs. Number of Procedures

The relationship between the number of procedures and the total cost was also analyzed. Regression was used to analyze this relationship. The dependent variable in the regression model was the length of stay. The independent variable was the number of procedures. The model was statistically significant ( $p < .001$ ). Alzheimer's patients on average were billed \$11,895.48 more per procedure performed ( $p < .001$ ).

Table 18: Regression Analysis – Total Charge vs. Number of Procedures

|           | B        | SE    | <i>t</i> -value | <i>p</i> -value |
|-----------|----------|-------|-----------------|-----------------|
| Intercept | 19529.03 | 45.69 | 427.5           | <.001           |
| NPR       | 11895.48 | 24.91 | 477.5           | <.001           |

The equation from the regression model was:

$$\text{Total Charge} = 19529.03 + 11895.48 * \text{NPR}$$

### 4.8.3 Hypothesis 3

**Hypothesis 3:** There are statistically significant associations between the number and types of comorbidities and procedures in mortality.

#### 4.8.3.1 Logistic Regression Analysis – Mortality vs. Comorbidities

The first objective was to find out whether there is an influence of the comorbidities of Alzheimer's disease on whether an Alzheimer's patient lived or died. Logistic regression was used to analyze this relationship. The dependent variable in the regression model was whether a patient lived or died. The independent variables in the model were comorbidities including, normal pressure hydrocephalus, depression, psychosis, and diabetes. The model was statistically significant,  $p < .001$ . Alzheimer's patients who were admitted to the hospital with normal pressure hydrocephalus on average were .59 times as likely to die as those without normal pressure hydrocephalus ( $p < .001$ ). Alzheimer's patients who were admitted to the hospital with depression were .68 times as likely to die as those without depression ( $p < .001$ ). Alzheimer's patients who were admitted to the hospital with psychosis were .47 times as likely to die as those without psychosis (not statistically significant) ( $p < .001$ ). Alzheimer's patients who were admitted to the hospital with diabetes were .92 times as likely to die as those without diabetes (not statistically significant) ( $p < .001$ ).

Table 19: Logistic Regression Analysis – Mortality vs. Comorbidities

|                               | B     | OR  | SE    | <i>z-value</i> | <i>p-value</i> |
|-------------------------------|-------|-----|-------|----------------|----------------|
| Intercept                     | -2.92 | .05 | 0.007 | -428.82        | <.001          |
| Normal Pressure Hydrocephalus | -0.52 | .59 | 0.11  | -4.84          | <.001          |
| Depression                    | -0.39 | .68 | 0.02  | -19.28         | <.001          |
| Psychosis                     | -0.75 | .47 | 0.4   | -19.94         | <.001          |

|          |       |     |      |       |       |
|----------|-------|-----|------|-------|-------|
| Diabetes | -0.08 | .92 | 0.01 | -6.41 | <.001 |
|----------|-------|-----|------|-------|-------|

The equation from the logistic regression model was:

$$\text{Odds of Mortality} = -2.92 + -0.52 * \text{Normal Pressure Hydrocephalus} - 0.39 * \text{Depression} - 0.75 * \text{Psychosis} + -0.08 * \text{Diabetes}$$

#### 4.3.3.2 Logistic Regression Analysis – Mortality vs. Number of Procedures

The relationship between the number of procedures and the likelihood of mortality. Logistic regression was used to analyze this relationship. The dependent variable in the regression model was whether the patient lived or died. The independent variable was the number of procedures. The model was statistically significant,  $p < .001$ . For each additional procedure performed patients were 20% less likely to die ( $p < .001$ ).

Table 20: Logistic Regression Analysis – Mortality vs. Number of Procedures

|           | B     | OR   | SE    | t-value | p-value |
|-----------|-------|------|-------|---------|---------|
| Intercept | -3.22 | .04  | 0.007 | -476.67 | <.001   |
| NPR       | 0.18  | 1.20 | 0.002 | 72.46   | <.001   |

The equation from the logistic regression model was:

$$\text{Odds of Mortality} = -3.22 + 0.18 * \text{NPR}$$

#### 4.8.4 Hypothesis 4

**Hypothesis 4:** There are statistically significant differences in length of stay, mortality, and costs of Alzheimer's disease patients with regards to race, age, or socioeconomic status.

##### 4.8.4.1 Multiple Regression Analysis – Length of Stay vs. Race, Income, and Age groups

The fourth objective was to find out whether there is a relationship between race, income, and Age of Alzheimer's patients on Alzheimer's patient's length of stay in hospital. Multiple regression was used to analyze this relationship. The dependent variable in the regression model was length of stay. The independent variables in the model were race, income, and age groups. The model was statistically significant ( $p < .001$ ). The length of stay for African Americans was half a day longer than for Whites (reference) ( $p < .001$ ), the length of stay for Hispanics was .43 days longer than for Whites ( $p < .001$ ), the length of stay for Asian or Pacific Islanders was .75 days longer than for whites ( $p < .001$ ), the length of stay for Native Americans was .28 days longer than for whites ( $p = .0057$ ), and the length of stay for patients of Other races was .71 days longer than for whites ( $p < .001$ ). Compared to those patients who were older than 85, patients between 65 and 74 on average stayed .91 days longer in the hospital ( $p < .001$ ), patients between 75 and 84 years old stayed .38 days longer in the hospital ( $p < .001$ ) and patients less than 65 years old stayed 1.64 days longer in the hospital ( $p < .001$ ). Compared to those patients who earned less than \$39,000, patients who earned between \$39,000 and 47,999 stayed .3 days less in the hospital ( $p < .001$ ), and patients who earned between \$48,000 and \$62,999 stayed .39 days less in the hospital ( $p < .001$ ) and patients who earned more than \$63,000 on average stayed .26 days less ( $p < .001$ ).

Table 21: Multiple Regression Analysis – Length of Stay vs. Race, Income, and Age groups

|                            | B    | SE   | t-value | p-value |
|----------------------------|------|------|---------|---------|
| Intercept                  | 5.96 | 0.02 | 255.3   | <.001   |
| White (reference category) |      |      |         |         |
| Black                      | 0.5  | 0.03 | 15.1    | <.001   |
| Hispanic                   | 0.43 | 0.04 | 10.9    | <.001   |
| Asian or Pacific Islander  | 0.75 | 0.08 | 9.5     | <.001   |
| Native American            | 0.28 | 0.15 | 1.9     | 0.057   |

|                                |       |      |        |       |
|--------------------------------|-------|------|--------|-------|
| Other                          | 0.71  | 0.06 | 11.1   | <.001 |
| Greater than 85 (reference)    |       |      |        |       |
| Between 65 and 74              | 0.91  | 0.03 | 26.33  | <.001 |
| Between 75 and 84              | 0.38  | 0.02 | 17.20  | <.001 |
| Less than 65                   | 1.64  | 0.07 | 24.09  | <.001 |
| Less than \$39,000 (reference) |       |      |        |       |
| \$39,000 - \$47,999            | -0.30 | 0.03 | -10.80 | <.001 |
| \$48,000 – 62,999              | -0.39 | 0.03 | -13.47 | <.001 |
| \$63,000 or more               | -0.26 | 0.03 | -8.83  | <.001 |

#### 4.8.4.2 Multiple Regression Analysis – Total of Charge vs. Race, Income, and Age groups

The fourth objective was to find out whether there is a relationship between race, income, and Age of Alzheimer's patients and Alzheimer's patient's total of charge. Multiple regression was used to analyze this relationship. The dependent variable in the regression model was total of charge. The independent variables in the model were race, income, and age groups. The model was statistically significant ( $p < .001$ ). Total charge of African Americans was \$5096.6 more than for Whites (reference) ( $p < .001$ ), the total of charge for Hispanics was \$16582.6 more than for Whites ( $p < .001$ ), the total of charge for Asian of Pacific Islanders was \$22271.0 more than for whites ( $p < .001$ ), the total of charge for Native Americans was \$1160.6 more than for whites ( $p = 0.155$ ), and the total of charge for patients of other races was \$8516.3 days more than for whites ( $p < .001$ ). Compared to those patients who were older than 85, patients between 65 and 74 on average were charged \$4178.6 more in the hospital ( $p < .001$ ), patients between 75 and 84 years old were charged \$1962.9 more in the hospital ( $p < .001$ ) and patients less than 65 years old were charged \$5546.2 more in the hospital ( $p < .001$ ). Compared to those patients who earned less than \$39,000, patients who earned between \$39,000 and 47,999 were charged \$1725.1 more in the hospital ( $p < .001$ ), and patients who earned between \$48,000 and \$62,999 were

charged \$4946.0 more in the hospital ( $p < .001$ ) and patients who earned more than \$63,000 on average were charged \$8596.3 ( $p < .001$ ).

Table 22: multiple Regression Analysis – Total of Charge vs. Race, Income, and Age groups

|                                | B       | SE    | t-value | p-value |
|--------------------------------|---------|-------|---------|---------|
| Intercept                      | 23990.6 | 127.9 | 187.611 | <.001   |
| White (reference category)     |         |       |         |         |
| Black                          | 5096.6  | 183.1 | 27.835  | <.001   |
| Hispanic                       | 16582.6 | 217.5 | 76.225  | <.001   |
| Asian or Pacific Islander      | 22271.0 | 437.7 | 50.880  | <.001   |
| Native American                | 1160.6  | 815.9 | 1.422   | 0.155   |
| Other Races                    | 8516.3  | 351.1 | 24.258  | <.001   |
| Greater than 85 (reference)    |         |       |         |         |
| Age Group Between 65 and 74    | 4178.6  | 188.6 | 22.154  | <.001   |
| Age Group Between 75 and 84    | 1962.9  | 120.8 | 16.245  | <.001   |
| Age Group Less than 65         | 5546.2  | 372.7 | 14.883  | <.001   |
| Less than \$39,000 (reference) |         |       |         |         |
| ZIPINC_Q \$39,000 - \$47,999   | 1725.1  | 153.7 | 11.221  | <.001   |
| ZIPINC_Q \$48,000 – 62,999     | 4946.0  | 156.7 | 31.557  | <.001   |
| ZIPINC_Q \$63,000 or more      | 8596.3  | 159.2 | 53.991  | <.001   |

#### 4.8.4.3 Logistic Regression Analysis – Mortality vs. Race, Income, and Age groups

The forth objective was to find out whether there is a relationship between race, income, and Age of Alzheimer's patients and Alzheimer's patient's mortality in hospital. Logistic regression was used to analyze this relationship. The dependent variable in the regression model was mortality. The independent variables in the model were race, income, and age groups. The model was statistically significant ( $p < .001$ ). The mortality for African Americans was 0.07 less than for Whites (reference) ( $p = 0.00117$ ), the mortality for Hispanics was 0.02 more than for Whites ( $p = 0.55078$ ), the mortality for Asian of Pacific Islanders was 0.33 more than for whites ( $p < .001$ ), the mortality for Native Americans was 0.15 less than for whites ( $p = 0.15964$ ), and the mortality for patients of Other races was 0.07 more than for whites ( $p = 0.11094$ ). Compared to those patients who were older than

85, patients between 65 and 74 on average died 0.73 less in the hospital ( $p < .001$ ), patients between 75 and 84 years old died 0.34 less in the hospital ( $p < .001$ ) and patients less than 65 years old died 0.80 less in the hospital ( $p < .001$ ). Compared to those patients who earned less than \$39,000, patients who earned between \$39,000 and 47,999 died 0.12 less in the hospital ( $p < .001$ ), and patients who earned between \$48,000 and \$62,999 died .08 less in the hospital ( $p < .001$ ) and patients who earned more than \$63,000 on average died .06 less ( $p = 0.00192$ ).

Table 23: Logistic Regression Analysis Mortality vs. Race, Income, and Age groups

|                                | B     | SE    | t-value  | p-value |
|--------------------------------|-------|-------|----------|---------|
| Intercept                      | -2.72 | 0.015 | -185.498 | <.001   |
| White (reference category)     |       |       |          |         |
| Black                          | -0.07 | 0.023 | -3.247   | 0.00117 |
| Hispanic                       | 0.02  | 0.026 | 0.597    | 0.55078 |
| Asian or Pacific Islander      | 0.33  | 0.044 | 7.373    | <.001   |
| Native American                | -0.15 | 0.107 | -1.406   | 0.15964 |
| Other                          | 0.07  | 0.041 | 1.594    | 0.11094 |
| Greater than 85 (reference)    |       |       |          |         |
| Age Group Between 65 and 74    | -0.73 | 0.03  | -26.472  | <.001   |
| Age Group Between 75 and 84    | -0.34 | 0.01  | -23.641  | <.001   |
| Age Group Less than 65         | -0.80 | 0.06  | -13.710  | <.001   |
| Less than \$39,000 (reference) |       |       |          |         |
| ZIPINC_Q \$39,000 - \$47,999   | -0.12 | 0.02  | -6.295   | <.001   |
| ZIPINC_Q \$48,000 – 62,999     | -0.08 | 0.02  | -4.074   | <.001   |
| ZIPINC_Q \$63,000 or more      | -0.06 | 0.02  | -3.102   | 0.00192 |

#### 4.8.5 Hypothesis 5

**Hypothesis 5:** There are statistically significant differences in length of stay, mortality, and costs of Alzheimer’s disease patients across the various regions of the US.

##### 4.8.5.1 Multiple Regression Analysis – Length of stay vs. Region

The fifth objective was to find out whether there is a relationship between region of Alzheimer’s patients and Alzheimer’s patient’s length of stay in hospital. Multiple

regression was used to analyze this relationship. The dependent variable in the regression model was length of stay. The independent variable in the model was region. The model was statistically significant ( $p < .001$ ). The length of stay for Midwest patients was 0.95 shorter than for Northeast region's patients (reference) ( $p < .001$ ), the length of stay for South was 0.53 days shorter than for Northeast region's patients ( $p < .001$ ), the length of stay for West region patients was 0.67 days shorter than for Northeast region's patients ( $p < .001$ ).

Table 24: Multiple Regression Analysis – Length of stay vs. Region

|                                | B     | SE      | <i>t</i> -value | <i>p</i> -value |
|--------------------------------|-------|---------|-----------------|-----------------|
| Intercept                      | 6.65  | 0.01922 | 346.23          | <.001           |
| Northeast (reference category) |       |         |                 |                 |
| Region Midwest                 | -0.95 | 0.02606 | -36.65          | <.001           |
| Region South                   | -0.53 | 0.02328 | -22.62          | <.001           |
| Region West                    | -0.67 | 0.02943 | -22.60          | <.001           |

#### 4.8.5.2 Multiple Regression Analysis – Total of Charge vs. Region

The fifth objective was to find out whether there is a relationship between region of Alzheimer's patients and Alzheimer's patient's total of charge. Multiple regression was used to analyze this relationship. The dependent variable in the regression model was total of charge. The independent variable in the model was region. The model was statistically significant ( $p < .001$ ). The total of charge for Midwest region's patients was \$11300.2 less than for Northeast region's patients (reference) ( $p < .001$ ), the total of charge for South region's patients was \$6195.9 less than for Northeast region's patients ( $p < .001$ ), the total of charge for West region patients was \$12807.1 more than for Northeast region's patients ( $p < .001$ ).

Table 25: Multiple Regression Analysis – Total of Charge vs. Region

|                                | B        | SE    | <i>t</i> -value | <i>p</i> -value |
|--------------------------------|----------|-------|-----------------|-----------------|
| Intercept                      | 33980.9  | 100.2 | 339.24          | <.001           |
| Northeast (reference category) |          |       |                 |                 |
| Midwest Region                 | -11300.2 | 136.0 | -83.08          | <.001           |
| South Region                   | -6195.9  | 121.4 | -51.03          | <.001           |
| West Region                    | 12807.1  | 157.3 | 81.43           | <.001           |

#### 4.8.5.3 Logistic Regression Analysis – Mortality vs. Region

The fifth objective was to find out whether there is a relationship between region of Alzheimer's patients and Alzheimer's patient's Mortality. Logistic regression was used to analyze this relationship. The dependent variable in the regression model was mortality. The independent variable in the model was region. The model was statistically significant ( $p < .001$ ). The mortality for Midwest region's patients was 0.2 less than for Northeast region's patients (reference) ( $p < .001$ ), the mortality for South region's patients was 0.01 more than for Northeast region's patients ( $p = 0.589$ ), the mortality for West region patients was 0.15 more than for Northeast region's patients ( $p < .001$ ).

Table 26: Multiple Regression Analysis – Mortality vs. Region

|                | B    | SE   | <i>t</i> -value | <i>p</i> -value |
|----------------|------|------|-----------------|-----------------|
| Intercept      | -2.9 | 0.01 | -236.4          | <.001           |
| Region Midwest | -0.2 | 0.02 | -10.9           | <.001           |
| Region South   | 0.01 | 0.02 | 0.5             | 0.589           |
| Region West    | 0.15 | 0.02 | 8.1             | <.001           |

#### 4.8.5.4 Pearson's Chi-squared test

Table 27: Cross tabulation of Region by Morality

| Status      | North East | Midwest | South  | West  |
|-------------|------------|---------|--------|-------|
| Did Not Die | 130831     | 157415  | 280024 | 96662 |
| Died        | 6537       | 6467    | 14108  | 5616  |

A Chi-square test was performed, as given in **Table 28**, to test whether there was a statistically significant relationship between the region, and whether a patient admitted

to that hospital died. There was a statistically significant relationship between region and the mortality of the patient; patients admitted to hospitals in the West were more likely to die ( $p < .001$ ).

Table 28: Pearson's Chi-squared test

| X-squared | df | p-value |
|-----------|----|---------|
| 358.47    | 3  | <.001   |

#### 4.8.6 Hypothesis 6

**Hypothesis 6:** There are statistically significant differences in length of stay, mortality, and costs of Alzheimer's disease patients amongst the different types of hospital settings – rural, urban non-teaching, urban teaching hospital.

##### 4.8.6.1 Multiple Regression Analysis – Length of Stay vs. Hospital Location and Teaching Status

The sixth objective was to find out whether there is a relationship between hospital location and teaching status of hospital and Alzheimer's patient's length of stay in hospital. Multiple regression was used to analyze this relationship. The dependent variable in the regression model was length of stay. The independent variable in the model was hospital location and teaching status. The model was statistically significant ( $p < .001$ ). The length of stay for urban non-teaching patients was 0.25 longer than for rural hospital's patients (reference) ( $p < .001$ ), the length of stay for urban teaching hospital's patients was 0.17 days longer than for rural hospital's patients ( $p < .001$ ).

Table 29: Multiple Regression Analysis – Length of Stay vs. Hospital Location and Teaching Status

|                            | B    | SE   | t-value | p-value |
|----------------------------|------|------|---------|---------|
| Intercept                  | 5.93 | 0.02 | 287.69  | <.001   |
| Rural (reference category) |      |      |         |         |

|                    |      |      |       |       |
|--------------------|------|------|-------|-------|
| Urban Non-Teaching | 0.25 | 0.02 | 10.21 | <.001 |
| Urban Teaching     | 0.17 | 0.03 | 6.86  | <.001 |

#### 4.8.6.2 Multiple Regression Analysis – Total of Charge vs. Hospital Location and Teaching Status

The sixth objective was to find out whether there is a relationship between hospital location and teaching status of hospital and Alzheimer's patient's total of charge in hospital. Multiple regression was used to analyze this relationship. The dependent variable in the regression model was total of charge. The independent variable in the model was hospital location and teaching status. The model was statistically significant ( $p < .001$ ). The total of charge for urban non-teaching patients was \$15387.1 more than for rural hospital's patients (reference) ( $p < .001$ ), the total of charge for urban teaching hospital's patients was \$15411.9 days more than for rural hospital's patients ( $p < .001$ ).

Table 30: Multiple Regression Analysis – Total of Charge vs. Hospital Location & Teaching Status

|                            | B       | SE    | <i>t</i> -value | <i>p</i> -value |
|----------------------------|---------|-------|-----------------|-----------------|
| Intercept                  | 17700.1 | 108.7 | 162.9           | <.001           |
| Rural (reference category) |         |       |                 |                 |
| Urban Non-Teaching         | 15387.1 | 127.1 | 121.1           | <.001           |
| Urban Teaching             | 15411.9 | 132.8 | 116.1           | <.001           |

#### 4.8.6.3 Logistic Regression Analysis – Mortality vs. Hospital Location and Teaching Status

The sixth objective was to find out whether there is a relationship between hospital location and teaching status of hospital and Alzheimer's patient's mortality in hospital. Logistic regression was used to analyze this relationship. The dependent variable in the regression model was mortality. The independent variable in the model was hospital

location and teaching status. The model was statistically significant ( $p < .001$ ). The mortality for urban non-teaching patients was 0.14 less than for rural hospital's patients (reference) ( $p < .001$ ), the mortality for urban teaching hospital's patients was 0.12 less than for rural hospital's patients ( $p < .001$ ).

Table 31: Logistic Regression Analysis – Mortality vs. Hospital Location and Teaching Status

|                            | B     | SE   | <i>t</i> -value | <i>p</i> -value |
|----------------------------|-------|------|-----------------|-----------------|
| Intercept                  | -2.91 | 0.01 | -223.04         | <.001           |
| Rural (reference category) |       |      |                 |                 |
| Urban Non-Teaching         | -0.14 | 0.02 | -8.87           | <.001           |
| Urban Teaching             | -0.12 | 0.02 | -7.26           | <.001           |

#### 4.8.6.4 Pearson's Chi-squared test

A Chi-square test was performed to test whether there was a statistically significant relationship between the hospital location and whether the it was a teaching hospital, and whether a patient admitted to that hospital died. There was a statistically significant relationship between hospital location and whether the it was a teaching hospital and the mortality of the patient; patients admitted to rural hospitals were more likely to die ( $p < .001$ ).

Table 32: Cross tabulation of Hospital Location/Type by Morality

|             | Rural  | Non-Teaching | Urban Teaching |
|-------------|--------|--------------|----------------|
| Did Not Die | 113590 | 311284       | 236287         |
| Died        | 6212   | 14836        | 11492          |

Table 33: Pearson's Chi-squared test

| X-squared | df | p-value |
|-----------|----|---------|
| 81.667    | 2  | <.001   |

#### 4.8.7 Hypothesis 7

**Hypothesis 7:** There are statistically significant differences in length of stay, mortality, and costs of Alzheimer's disease patients amongst the different types of health insurance – Medicare, Medicaid, Private, and self-pay.

##### 4.8.7.1 Multiple Regression Analysis – Length of Stay vs. Health Insurance Types

The seventh objective was to find out whether there is a relationship between health insurance type and Alzheimer's patient's length of stay in hospital. Multiple regression was used to analyze this relationship. The dependent variable in the regression model was length of stay. The independent variable in the model was health insurance type. The model was statistically significant ( $p < .001$ ). The length of stay for Medicaid patients was 2.85 longer than for Medicare (reference) ( $p < .001$ ), the length of stay for private including HMO patients was 0.17 days shorter than for Medicare patients ( $p < .001$ ). The length of stay for Medicaid patients was 2.85 longer than for Medicare (reference) ( $p < .001$ ), the length of stay for Self-pay patients was 1.81 days longer than for Medicare patients ( $p < .001$ ), the length of stay for No Charge patients was 0.34 days longer than for Medicare patients ( $p = 0.4317$ ), the length of stay for other patients was 0.19 days shorter than for Medicare patients ( $p = 0.0342$ ).

Table 34: Multiple Regression Analysis – Length of Stay vs. Health Insurance Types

|                       | B     | SE   | <i>t</i> -value | <i>p</i> -value |
|-----------------------|-------|------|-----------------|-----------------|
| Intercept             | 6.07  | 0.01 | 680.13          | <.001           |
| Medicare (reference)  |       |      |                 |                 |
| Medicaid              | 2.85  | 0.07 | 42.12           | <.001           |
| private including HMO | -0.17 | 0.04 | -4.64           | <.001           |
| Self-pay              | 1.81  | 0.13 | 13.24           | <.001           |
| No Charge             | 0.34  | 0.43 | 0.79            | 0.4317          |

|       |       |      |       |        |
|-------|-------|------|-------|--------|
| Other | -0.19 | 0.09 | -2.12 | 0.0342 |
|-------|-------|------|-------|--------|

#### 4.8.7.2 Multiple Regression Analysis – Total of Charge vs. Health Insurance Types

The seventh objective was to find out whether there is a relationship between health insurance type and Alzheimer's patient's total of charge. Multiple regression was used to analyze this relationship. The dependent variable in the regression model was total of charge. The independent variable in the model was health insurance type. The model was statistically significant ( $p < .001$ ). The total of charge for Medicaid patients was \$10619.20 more than for Medicare (reference) ( $p < .001$ ), the total of charge for private including HMO patients was \$980.02 less than Medicare patients ( $p < .001$ ). The total of charge for self-pay patients was \$1499.08 less than Medicare patients (reference) ( $p = 0.0406$ ), the total of charge for No Charge patients was 2288.93 more than Medicare patients ( $p = 0.3215$ ), the total of charge for other patients was 7064.71 less than Medicare patients ( $p < .001$ ).

Table 35: Multiple Regression Analysis – Total of Charge vs. Health Insurance Types

|                       | B        | SE      | <i>t</i> -value | <i>p</i> -value |
|-----------------------|----------|---------|-----------------|-----------------|
| Intercept             | 30366.83 | 47.78   | 635.490         | <.001           |
| Medicare (reference)  |          |         |                 |                 |
| Medicaid              | 10619.20 | 361.92  | 29.341          | <.001           |
| private including HMO | -980.02  | 200.56  | -4.886          | <.001           |
| Self-pay              | -1499.08 | 732.14  | -2.048          | 0.0406          |
| No Charge             | 2288.93  | 2308.62 | 0.991           | 0.3215          |
| Other                 | -7064.71 | 478.80  | -14.755         | <.001           |

#### 4.8.7.3 Logistic Regression Analysis – Mortality vs. Health Insurance Types

The seventh objective was to find out whether there is a relationship between health insurance type and Alzheimer's patient's mortality. Logistic regression was used to analyze

this relationship. The dependent variable in the regression model was mortality. The independent variable in the model was health insurance type. The model was statistically significant ( $p < .001$ ). The mortality for Medicaid patients was 0.09 more than Medicare patients (reference) ( $p = 0.0355$ ), the mortality for private including HMO patients was 0.49 more than Medicare patients ( $p < .001$ ). The mortality for self-pay patients was 0.83 more than Medicare patients (reference) ( $p < .001$ ), the mortality for No Charge patients was 0.99 more than Medicare patients ( $p < .001$ ), the mortality for other patients was 1.29 more than Medicare patients ( $p < .001$ ).

Table 36: Logistic Regression Analysis – Mortality vs. Health Insurance Types

|                       | B     | SE   | <i>t</i> -value | <i>p</i> -value |
|-----------------------|-------|------|-----------------|-----------------|
| Intercept             | -3.07 | 0.01 | -504.587        | <.001           |
| Medicare (reference)  |       |      |                 |                 |
| Medicaid              | 0.09  | 0.04 | 2.102           | 0.0355          |
| Private including HMO | 0.49  | 0.02 | 23.268          | <.001           |
| Self-pay              | 0.83  | 0.06 | 12.650          | <.001           |
| No Charge             | 0.99  | 0.19 | 5.109           | <.001           |
| Other                 | 1.29  | 0.04 | 35.805          | <.001           |

## **CHAPTER V: CONCLUSION, STUDY LIMITATION AND FUTURE RESEARCH**

### **5.1 Conclusion**

AD has become a severe problem in the developed nations during the past several decades that come together with the increased longevity. The social and economic consequences of AD are immense and devastating. This research focused on the outcome of AD hospital care and strives to shed light on the various factors that impact the outcome of AD healthcare in the United States. The findings will ultimately lead to the reduction of healthcare cost and an increase of care quality. Specifically, the factors affecting length of stay, mortality, and costs associated with AD in various clinical settings are investigated via answering the following five research questions.

The overall objective of this study is to find out the factors and costs associated with Alzheimer's disease patients in terms of length of stay, mortality, costs in various kinds of clinical setting across the United States. Accordingly, the NIS dataset for the years 2007 to 2012 was analyzed in this study to find out the relationships and impacts of patients characteristics and hospital context on the length of stay, mortality, and total of charge. In particular, the study was studying the following:

1. The influence that comorbidities have on the length of stay of Alzheimer's patients.
2. The influence that comorbidities have on mortality of Alzheimer's patients.
3. The influence that comorbidities have on costs of Alzheimer's patients.
4. The impact of race on the length of stay, mortality, and costs of Alzheimer's patients.

5. The impact of income on length of stay, mortality, and costs of Alzheimer's patients.
6. The impact of age on length of stay, mortality, and costs of Alzheimer's patients.
7. The impact that different types of health insurances have on length of stay, mortality, and costs of Alzheimer's patients.

After conducting the analysis by using different descriptive and inferential statistical modeling for the years 2007 to 2012, the following were concluded:

1. The patient characteristics including the age and gender are a highly risk factor of the incidence of Alzheimer's disease while the race is not a significant risk factor.
2. Alzheimer's patients who were admitted to the hospital with normal pressure hydrocephalus on average stayed .34 days longer than those without with normal pressure hydrocephalus ( $p = .008$ ). Alzheimer's patients who were admitted to the hospital with depression on average stayed .06 days shorter than those without depression ( $p = .024$ ). Alzheimer's patients who were admitted to the hospital with psychosis on average stayed 2.20 days longer than those without psychosis ( $p < .001$ ). Alzheimer's patients who were admitted to the hospital with diabetes on average stayed .22 days longer than those without diabetes ( $p < .001$ ). The model was statistically significant,  $p < .001$ .
3. Alzheimer's patients on average stayed .95 days longer per procedure performed ( $p < .001$ ).
4. Alzheimer's patients who were admitted to the hospital with normal pressure hydrocephalus on average were charged \$4569.03 more than those without with normal pressure hydrocephalus ( $p < .001$ ). Alzheimer's patients who were admitted

to the hospital with depression were charged \$1749.79 less than those without depression ( $p = .024$ ). Alzheimer's patients who were admitted to the hospital with psychosis were charged on average \$210.30 less than those without psychosis (not statistically significant) ( $p < .334$ ). Alzheimer's patients who were admitted to the hospital with diabetes were charged \$3246.83 more than those without diabetes ( $p < .001$ ).

5. Alzheimer's patients on average were billed \$11,895.48 more per procedure performed ( $p < .001$ ).
6. Alzheimer's patients who were admitted to the hospital with normal pressure hydrocephalus on average were .59 times as likely to die as those without normal pressure hydrocephalus ( $p < .001$ ). Alzheimer's patients who were admitted to the hospital with depression were .68 times as likely to die as those without depression ( $p < .001$ ). Alzheimer's patients who were admitted to the hospital with psychosis were .47 times as likely to die as those without psychosis (not statistically significant) ( $p < .001$ ). Alzheimer's patients who were admitted to the hospital with diabetes were .92 times as likely to die as those without diabetes (not statistically significant) ( $p < .001$ ).
7. For each additional procedure performed patients were 20% less likely to die ( $p < .001$ ).
8. The length of stay of native American population was the lowest 0.28, while; Alzheimer's patients from Asian and pacific islander were the highest with 0.75 more than other races. The age group 65 and less has a length of stay of 1.6 more than other patients on other age groups.

9. There was a statistically significant relationship between hospital location and whether the it was a teaching hospital or not and the mortality of the patient; patients admitted to rural hospitals were more likely to die ( $p < .001$ ).
10. The length of stay for Medicaid patients was 2.85 longer than for Medicare (reference) ( $p < .001$ ), the length of stay for private including HMO patients was 0.17 days shorter than for Medicare patients ( $p < .001$ ). The length of stay for Medicaid patients was 2.85 longer than for Medicare (reference) ( $p < .001$ ), the length of stay for Self-pay patients was 1.81 days longer than for Medicare patients ( $p < .001$ ), the length of stay for No Charge patients was 0.34 days longer than for Medicare patients ( $p = 0.4317$ ), the length of stay for other patients was 0.19 days shorter than for Medicare patients ( $p = 0.0342$ ).
11. The total of charge for Medicaid patients was \$10619.20 more than for Medicare (reference) ( $p < .001$ ), the total of charge for private including HMO patients was \$980.02 less than Medicare patients ( $p < .001$ ). The total of charge for self-pay patients was \$1499.08 less than Medicare patients (reference) ( $p = 0.0406$ ), the total of charge for No Charge patients was 2288.93 more than Medicare patients ( $p = 0.3215$ ), the total of charge for other patients was 7064.71 less than Medicare patients ( $p < .001$ ).
12. The mortality for Medicaid patients was 0.09 more than Medicare patients (reference) ( $p = 0.0355$ ), the mortality for private including HMO patients was 0.49 more than Medicare patients ( $p < .001$ ). The mortality for self-pay patients was 0.83 more than Medicare patients (reference) ( $p < .001$ ), the mortality for No Charge

patients was 0.99 more than Medicare patients ( $p < .001$ ), the mortality for other patients was 1.29 more than Medicare patients ( $p < .001$ ).

13. In many studies, depression as a co-morbidity has been shown to increase the length of stay. Despite the fact that the  $p$  value for “Depression” is less than the significance level of 0.05 and thus the variable “Depression” is statistically significant, this  $p$  value is the largest among all the  $p$  values.
14. The results indicate that the mortality odds is decreased with the number of procedures. The results are very encouraging and further research should be performed to find out which procedure among the many procedures are responsible for decreasing the mortality.
15. The results indicated that the minority group had a significantly longer length of stay, in comparison to white. For younger people, the length of stay are all longer. And for people who have higher income, the length of stay is shorter.
16. The results indicated that the minority group had a significantly longer length of stay, in comparison to white. For younger people, the length of stay are all longer. And for people who have higher income, the length of stay is shorter.
17. Consistent with the length of stay results, the total charge is higher for minorities, younger people. However, for people who are of higher income, even though the length of stay is shorter, the total charge is longer. Our interpretation is that this is a result of income-dependent health insurance policy.
18. Interestingly, the mortality odds are lower for Black, higher for Hispanics and Asians. In the literature, it has been reported that African Americans had a lower mortality rate than White Americans. However, in the study, Hispanic and Asians

were reported to have lower mortality rates. Our study is more reliable because our sample size is much larger spanning all the states of the United States, while the previous study only covered 5 states. The mortality odds is lower for people with younger age, which is as predicted. In addition, the absolute values of the coefficients (which are all negative) were larger for patients with younger age. The addition the mortality odds is lower for patients with higher income. The patients with higher income may have higher disposable income to care for their health. Over time, this resulted in lower mortality.

## **5.2 Study Limitation**

This project relied on ICD-9 coding registered in NIS dataset for diagnosis and procedure. The study was limited for only one code for Alzheimer's disease which is without any details such as those codes for Alzheimer's disease in ICD-10. For example, the ICD-10 offers early-on-set Alzheimer's code which is not available in the ICD-9. The researcher believes that ICD-10 can add a more comprehensive analysis of the disease.

## **5.3 Implications**

Our results from analyzing the AD patient care data have multiple implications for improving the hospital care of AD. Overall, the occurrence of comorbidities caused complication in the care of AD patients, resulting in an increase of length of stay and total charge. However, the mortality rate is decreased with the occurrence of comorbidity. One possibility is that the AD patients lived longer, thereby causing an increase of length of stay and total charge. In addition, the minorities got a significantly longer length of stay, in

comparison to white. The Medicaid supported patients also had significantly longer length of stay and higher cost. It is possible that this is caused by the fact that these minorities received more Medicaid support than the white. For younger patients or those with higher income, the length of stay are all longer. The morbidity rates are lower for the Black patients, lower for younger patients and for patients with higher incomes.

The Midwest region is performed the best in terms of total charge, length of stay and mortality rate. Their experience should be applied to other regions to increase the overall hospital care performance of the US. Overall, these findings should be used in adjustment of payment structures and care schedules to decrease the cost and mortality.

#### **5.4 Future research**

Although the study has analyzed the NIS dataset in depth, however, it could be more comprehensive if other dementia diseases were included to be compared to Alzheimer's disease. The future study may also include broader dataset to contain more than 6 years which are 20107-2012 in this study. In addition, the utilization of ICD-10 coding with the NIS will provide more detailed results if this will be available in the future.

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