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Factors Influencing Alzheimer's Disease Healthcare Utilization Patterns in Puerto Rico

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Carlamarie Noboa Ramos

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Walden University
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Abstract

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by

Carlamarie Noboa Ramos

MS, University of Puerto Rico-Medical Sciences Campus, 2010

BS, University of Puerto Rico-Cayey Campus, 2006

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health-Epidemiology

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Abstract

Alzheimer's disease (AD) is associated with substantial healthcare utilization costs, resulting in a public health priority. In this study, the relationship between the demographic characteristics of age, gender, and type of health insurance; the presence of comorbidities of older Puerto Rican residents diagnosed with AD; and their healthcare utilization patterns (i.e., medical office and emergency room visits and hospital admissions) was examined using Andersen's behavioral model. Data from the 2013 Puerto Rico Health Study was used in this retrospective cohort design study. All AD cases aged ≥ 60 years were extracted using systematic random sampling. One-way ANOVA-WELCH, Mann-Whitney U test, and negative binomial regressions determined if there was a relationship between independent and dependent variables. Results indicated a statistically significant relationship between age, gender, health insurance type, and presence of comorbidities factors and healthcare utilization patterns among older Puerto Ricans with AD. From the results, opportunities were identified for further research and changes in professional practices in order to initiate discussions and action plans to improve services coordination for older Puerto Ricans with AD. Findings might impact social change by inspiring modifications to the public health infrastructure. These modifications may lead to enhanced disease management support, promoted social justice, and increased resources to improve healthcare access and quality of care, and overall enhancement of health outcomes, for Puerto Ricans living with AD.

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Chapter 1: Introduction to the Study

Introduction

The growth of the elderly population presents public health challenges, including a substantial increase in the incidence and prevalence of Alzheimer's disease (AD; Hebert, Weuve, Scherr, & Evans, 2013). There has been increased attention in examining the healthcare utilization patterns related to AD; however, little research has been conducted on the factors that influenced the healthcare use of Latino populations living with AD. In this study, I evaluated, for the first time, the relationship between individual characteristics and healthcare utilization patterns among Puerto Ricans diagnosed with AD. The results of this study may provide information to initiate positive social change by supporting better public health resources for AD patients living in Puerto Rico. The study results could also spur healthcare infrastructure changes in the island, which could lead to improved service coordination for AD patients and decreased health resource utilization patterns, saving the government significant amounts of money that could potentially be used to increase the access to and quality of healthcare and preventive services to improve the health outcomes of Puerto Ricans diagnosed with AD.

In this chapter, I will provide a detailed description of the study background and clearly present the problem statement. In addition, the purpose statement, research questions, theoretical framework, and nature of the study will be presented. Concise definitions of key concepts will also be provided in this chapter. I will briefly discuss the assumptions, scope and delimitations as well as limitations of specific research aspects that were critical to the meaningfulness of the study, such as potential weaknesses and

biases of the study. To conclude the chapter, I will present the potential contributions of the research to the individual, community, society, and public health practice in the study significance section and highlight the main points covered in the chapter and provide a transition to the next chapter of the study in the summary.

Background

AD is one of the most rapidly increasing threats to public health globally (Smith, Ali, & Quach, 2014). The prevalence of AD among older Latinos is expected to increase almost six-fold from the current 200,000 to 1.3 million by 2050 in the United States (Mehta & Yeo, 2017). However, an explanation for the increase in the number of AD cases is unclear. According to the Centers for Disease Control and Prevention (CDC), AD symptoms usually develop slowly and get worse over time, becoming severe enough to interfere with daily tasks (CDC, 2015). The disease is associated with substantial and increasing healthcare costs, which make this chronic condition one of the most expensive disease in elderly population (Michalowsky et al., 2016).

The burden of AD on the public health system has been primarily driven by the healthcare utilization patterns of those living with the disease (Michalowsky et al., 2016). Chung et al. (2014) conducted a study in Asia and found that people ≥ 65 years old with AD had significantly ($p < 0.001$) higher healthcare utilization in terms of outpatient visits ($M = 36.7$) compared to same aged individuals without this disease ($M = 32.0$). The total healthcare cost was 1.6 times greater for people with AD ($M =$ US\$3,997) compared to individuals without this disease ($M =$ US\$2,409; Chung et al., 2014). In another study in the United Kingdom, researchers explored medical resource utilization before and after

an AD diagnosis and found that the mean primary care consultation rate was significant higher ($p < 0.001$) for AD patients 65 years and older compared with those without this disease at the same age (Chen et al., 2014).

In the United States, researchers examined the effect of AD on healthcare utilization in terms of emergency room visits and inpatient admissions and found statistical significance in healthcare utilization related to AD for emergency room visits ($p < 0.05$) and inpatient admissions ($p < 0.05$) compared to people without this disease (Zhao et al., 2008). The researchers reported the mean number of emergency room visits was significant higher for AD patients ($M = 1.04$) compared with the control group ($M = 0.64$; Zhao et al., 2008). The mean of inpatient admissions was also higher for AD patients ($M = 3.38$) compared with the control group ($M = 1.93$; Zhao et al., 2008).

A review of the literature indicated an association between demographic characteristics of people with AD and their healthcare utilization patterns (Albanese et al., 2011; Chin et al., 2011; Gilliagan et al., 2013; Godwin et al., 2014; Knapp et al., 2016; Mayeda, Glymour, Quensenberr, & Whitmer, 2016; Pinette et al., 2013; Walsh et al., 2015; Zeki Al Hazzouri et al., 2014). Studies found that the age of people with AD is a statistically significant factor ($p < 0.01$) to the use healthcare resources; when age increased, healthcare utilization patterns also increased (Albanese et al., 2011; Gialliagan et al., 2013; Hurd et al., 2013; Walsh et al., 2015). Females living with AD ($p = 0.01$) are more likely to increase their use of health services (Albanese et al., 2011; Walsh et al., 2015). Individuals with AD who had a higher education level ($p = 0.006$) had increased use of healthcare resources associated to this disease (Albanese et al., 2011). The marital

status ($p = 0.02$) and personal care dependency ($p = 0.01$) of people with AD are also significant factors that increase healthcare utilization patterns (Godwin et al., 2014).

Few studies support a relationship between financial or economic characteristics (e.g., income, pension, and health insurance) and geographical determinants of people with AD and their healthcare utilization (Albanese et al., 2011; Chung et al., 2014; Fischera et al., 2009; Gilliagan et al., 2013). The population-based study of Albanese et al. (2011) found that people living with AD and had more household assets ($p < 0.001$), and those who had health insurance ($p = 0.001$) were more likely to use healthcare services. Researchers found that people with AD with higher monthly incomes ($p < 0.001$) and a better geographical location ($p = 0.005$) had increased use of healthcare resources (Chung et al., 2014). Gilliagan et al. (2013) found that state of residency ($p < 0.01$) was associated to AD healthcare utilization patterns.

AD, like any other chronic condition, may have other medical and psychiatric comorbidities that require healthcare utilization and support. Zhu et al. (2013) found that the number of medical conditions that an individual living with AD in the United States has was associated with higher use of healthcare resources ($p < 0.001$). Similarly, Yu et al. (2015) reported that between 70% and 80% of all AD patients had more complicated disease management of age-related comorbidities, increasing the frequency and cost of healthcare services (e.g., hospital admission). Researchers discovered that psychosis ($OR = 2.68$), poor health status ($OR = 2.24$), mental disorder ($OR = 3.42$), and anxiety disorder ($OR = 1.85$) were factors related to emergency department visits for mental health reasons among patients with AD (Walsh et al., 2015).

Research has documented that the frequency and magnitude of healthcare utilization appears to be consistently higher for people with AD as compared to those individuals without this chronic disease (Hurd et al., 2013; Mayeda et al., 2016; Walsh et al., 2015; Zeki Al Hazzouri et al., 2014). Researchers demonstrated a tendency that healthcare utilization and costs associated to AD are increasing worldwide (Alzheimer's Association, 2017); however, little is known about factors related to healthcare utilization patterns among Latino populations living with AD, particularly in Puerto Rico. Furthermore, there are few studies that explored the economic and geographical determinants of people with AD (e.g., health insurance, income, location, and region) that influence healthcare utilization patterns, highlighting an important gap in the literature that requires further research. This study was needed to expand the knowledge and awareness of the burden of AD in Puerto Rico. The results of this study have the potential to provide information to reduce disparities in healthcare access and to improve and strengthen initiatives to prevent and control AD in Puerto Rico.

Problem Statement

The aging population in Latin America and Caribbean countries presents new challenges, bringing with it an explosion of chronic noncommunicable diseases, including AD (Bosch-Bayard et al., 2016). AD is the most common neurodegenerative disorder causing problems with memory, thinking, and behavior (Alzheimer's Association, 2015) among individuals 60 years or older (Prince et al., 2013). The fact that there is currently no cure for AD is a great challenge for society and healthcare systems

(CDC, 2015). AD is one of the leading causes of disability and represents high demand for healthcare services (Fillit et al., 2002).

In 2015, the Puerto Rico Department of Health (PRDH) ranked AD as the fourth leading cause of mortality among Puerto Ricans living on the island after cancer, cardiovascular disease, and diabetes. The impact of this disease in Puerto Rico has increased significantly over the past decade; between 2004 and 2013, the death rate related to AD rose from 34.2% to 41.0% (PRDH, 2015). Figueroa et al. (2013) found that the death rate related to AD is significantly higher for Puerto Ricans living on the island compared to those living in the United States ($p < 0.01$). Their study demonstrated that low socioeconomic status ($p < 0.01$) and poor access to preventive medicine and healthcare resources ($p < 0.01$) were significant contributors to mortality rates associated with AD in Puerto Ricans living on the island (Figueroa et al., 2013). Researchers from around the globe have explored healthcare utilization patterns associated with AD among target populations from United States (Gilligan et al., 2013; Hurd et al., 2013); Asia (Chen et al., 2014; Chung et al., 2014); Germany (Michalowsky et al., 2016), and France (Gerves, Chauvin, & Bellanger, 2014). The results of these studies have been useful in the fight to reduce the social and economic burden caused by this disease.

Figueroa et al. (2013) identified poor access to preventive care and healthcare resources as risk factors that increased the probability of AD related deaths in Puerto Ricans living on the island, indicating that further research was needed to better understand the factors that affect healthcare utilization patterns related to this population. With this study, I made an original contribution to the field by evaluating, for the first

time, the healthcare utilization patterns in a cohort of older adults ($\geq$ 60 years of age) with a diagnosis of AD residing in Puerto Rico and expanding the existing knowledge about the use of healthcare resources for Latino and Hispanic populations living with AD. The findings of this study increase the awareness of the burden of AD in the Puerto Rico public health system. The aim of this study was to improve healthcare utilization and health outcomes for AD patients through tailoring decisions and interventions to guide the efficient use and management of health resources in Puerto Rico.

Purpose of the Study

The purpose of this study was to determine if there is a relationship between certain demographic characteristics (i.e., age, gender, municipality of residence, type of health insurance, and personal income); the presence of comorbidities of older ($\geq$ 60 years old) Puerto Rican residents diagnosed with AD; and their healthcare utilization patterns (i.e., medical office and emergency room visits, and hospital admissions). I selected older adults $\geq$ 60 years of age as the study population because there is global evidence that the age of diagnosis for AD is in individuals 60 years or older (Alzheimer's Association, 2017; Camacho-Mercado et al., 2016; CDC, 2015). This study was focused on Puerto Rican residents living in Puerto Rico because there are few AD studies that include this population. It is not clear why the AD mortality rate is higher in Puerto Ricans living on the island compared to those living in the United States; Figueroa et al. (2013) observed that differences among these populations may be related to healthcare utilization patterns. Given the knowledge gap and disparities in healthcare access among

these populations, a better understanding of factors that influence health resource utilization patterns of Puerto Rican residents diagnosed with AD was needed.

Research Questions and Hypotheses

I developed the following research questions (RQ) and hypotheses to guide this study:

RQ1: Is there a relationship between predisposing factors, such as age and gender, and healthcare utilization patterns, such as medical office and emergency room visits, and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease?

$H_0 1$: There is no a relationship between predisposing factors, such as age and gender, and healthcare utilization patterns, such as medical office and emergency room visits, and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease.

$H_a 1$: There is a relationship between predisposing factors such as age and gender and healthcare utilization patterns such as medical office and emergency room visits and hospital admissions among older adult Puerto Ricans diagnosed with Alzheimer's disease.

RQ2: Is there a relationship between enabling factors, such as health insurance type, personal income, and municipality of residency, and healthcare utilization patterns, such as medical office and emergency room visits, and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease?

$H_0$2: There is no a relationship between enabling factors, such as health insurance type, personal income, and municipality of residency, and healthcare utilization patterns, such as medical office and emergency room visits, and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease.

H_a2: There is a relationship between enabling factors, such as health insurance type, personal income, and municipality of residency, and healthcare utilization patterns, such as medical office and emergency room visits, and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease.

RQ3: Is there a relationship between need factors, such as the presence of comorbidities, and healthcare utilization patterns, such as medical office and emergency room visits, and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease?

$H_0$3: There is no a relationship between need factors, such as comorbidities, and healthcare utilization patterns, such as medical office and emergency room visits, and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease.

H_a3: There is a relationship between need factors, such as comorbidities, and healthcare utilization patterns, such as medical office and emergency room visits, and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease.

Theoretical Framework for the Study

The theoretical framework for this study was the behavioral model (BM) of health services access, which was developed in 1968 by Ronald M. Andersen. Andersen's BM was originally established as a multilevel model that incorporates contextual and individual determinants of healthcare services utilization (Andersen, 1995). The propositions of the Andersen's BM include that health services utilization is a function of: (a) existing attributes that predispose individuals to use or not use healthcare services, (b) enabling characteristics that facilitate or impede use of healthcare services, and (c) needs or conditions that laypeople or healthcare providers recognize as requiring medical treatment (Andersen, 1995). Andersen's BM postulates that predisposing, enabling, and need factors directly influence healthcare use (Andersen, 2008). Predisposing factors focus on individuals' demographic characteristics and social factors such as age, sex, marital status, and education level (Andersen, 2008). Enabling factors are economic and organizational resources including the ability to pay for healthcare services such as income, health insurance, travel costs, and time required to wait for needed services (Andersen & Davidson, 2007). Need factors may include health-related characteristics, diagnosis of illness or disease, and perception of needs for healthcare (Andersen & Davidson, 2007).

In this study, I determined the relationship between certain individual characteristics of older Puerto Rican residents diagnosed with AD and their healthcare utilization patterns (i.e., medical office and emergency room visits, and hospital admissions). The outcomes variables were aligned with health services access, as defined

by the Andersen's BM. Figure 1 shows the theoretical framework for this study. The

constructs of predisposing, enabling and need factors in Andersen's BM guided my

selection of the independent variables (IVs) and the relationship between individual

characteristics and healthcare utilization patterns. The retrospective cohort design was the

most appropriate approach to explore individual determinants that influence healthcare

utilization such as: (a) the predisposition of older adult Puerto Ricans diagnosed with AD

(i.e., age and gender) to use healthcare services; (b) ability of older adult Puerto Ricans

diagnosed with AD (i.e., health insurance type, personal income, and municipality of

residence) to secure healthcare services; and (c) the needs (i.e., presence of

comorbidities) of older adult Puerto Ricans diagnosed with AD for healthcare services.

Using Andersen's BM was beneficial in furthering a more comprehensive understanding

of the results of my data analysis. In Chapter 2, I will provide further explanations

detailing the major theoretical propositions that were addressed in this study.
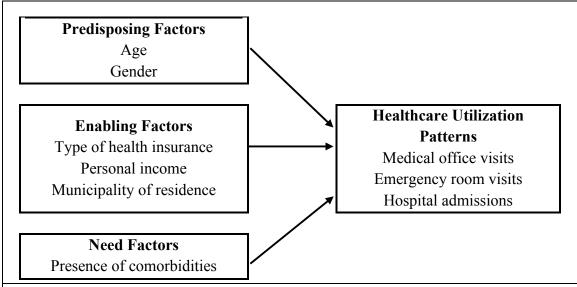
Figure 1. Theoretical framework of factors influencing Alzheimer's disease healthcare utilization patterns for older adult Puerto Ricans.

Nature of the Study

In this study, I used a retrospective cohort design by using primary quantitative data from January 1, 2013 to December 31, 2013 from the Puerto Rico Health Study (PRHS). The PRHS is sponsored by the PRDH and is a representative survey used to collect comprehensive health data of overall health claims from the insured Puerto Rican population (PRHD, 2014). Data from both private and public health insurance comprise the PRHS. I gained access to this primary data by obtaining permission from the Puerto Rico Department of Health.

I included all cases from the PRHS with a diagnosis of AD and an age of 60 years or more in this study. The dependent variables (DVs) and IVs of this study were extracted from the PRHS and constrained by what was available in the primary data. The DVs of healthcare utilization patterns were measured by the number of medical office, emergency room visits, and hospital admissions for the selected population. Ratio was the level of measurement for all DVs. Following the constructs of Andersen's BM, the IVs were predisposing (i.e., age and gender), enabling (i.e., health insurance type, personal income, and municipality of residency), and need (i.e., presence of comorbidities) factors. The variables of age and personal income were measured at the ordinal and ratio level, respectively. Gender, health insurance type, municipality of residency, and presence of comorbidities variables were measured at the nominal level. I used descriptive statistics to determine the study cohort demographic characteristics and to evaluate the assumptions of the statistical test.

I used bivariate analyses to evaluate the relationship between each IV and each DV. For those IVs with two independent groups, a sample *t* test was performed. Independent sample *t* tests compared the means of the number of medical office and emergency room visits, and hospital admissions between gender groups, health insurance type, and the presence of comorbidities for older adult Puerto Ricans living with AD. ANOVA was conducted for the IVs with more than two independent groups and determined differences in the mean of the number of medical office and emergency room visits, and hospital admissions by age, personal income, and municipality of residency groups. In addition, I conducted post hoc tests to determine whether at least one of the independent groups was statistically different from the other comparative groups and a Tukey-Kramer test was performed, assuming equal variances. Statistical significance for the bivariate tests was set at a level of significance (α) equal to 0.05 and *p* value 0.05.

Following the proposition of Andersen's BM model that healthcare services utilization is a function of predisposing, enabling and needed factors, I performed Poisson regressions. The Poisson regression is the best approach to analyzing count data regarding healthcare utilization patterns such as number of medical office and emergency room visits, and hospital admissions (Plan, 2014). This type of regression evaluates the relationship between multiple IVs (e.g., predisposing, enabling, and need factors) and continuous DVs (Plan, 2014). Poisson regressions were conducted to determine: (a) the probability of medical office and emergency room visits, and hospital admissions and (b) the probability of intensive healthcare services utilization among older adults Puerto Ricans with a diagnosis of AD. Table 1 presents the statistical analyses.

It should be noted that the variables of age and presence of comorbidities have been significantly related to healthcare utilization patterns (Chen et al., 2014; Chung et al., 2014; Michalowsky et al., 2016); therefore, I performed the likelihood ratio test to evaluate the presence of interactions between IVs. This was done by running the regression model both with and without the interaction terms in the model (see Davies et al., 2013). If any of the interaction terms are shown to be significant at $p = .05$, the variables will be stratifying and the regression results will be reported for each variable subgroup. This helps to identify the best fit model to explain factors that influence AD healthcare utilization patterns in Puerto Rico. The results were considered statistically significant at a confidence interval of 95%, level of significance (α) equal to 0.05, and p value 0.05. I analyzed the data using Statistical Package for the Social Sciences (SPSS), Version 24. In Chapter 3, I will provide further details about the data analysis plan for this study.

Definitions of Terms

Alzheimer's disease (AD): A type of dementia that causes problems with memory, thinking, and behavior (Alzheimer's Association, 2015).

Assumptions

The primary data source for this study was the PRHS. I assumed that the diagnosis of AD was confirmed by a licensed physician. In addition, I assumed that all demographic and healthcare data for those Puerto Ricans with either public or private health insurance is available and accurate.

Table 1

Statistical Analyses by Research Question

Research Question	Dependent Variables	Independent Variables	Bivariate Tests	Multivariate Test
RQ1: Is there a relationship between predisposing factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with Alzheimer's disease?	Medical office visits Emergency room visits Hospital admissions	Age Gender	One-way ANOVA Independent sample *t* test	Poisson regression
RQ2: Is there a relationship between enabling factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with Alzheimer's disease?	Medical office visits Emergency room visits Hospital admissions	Health insurance type Personal income Municipality of residency	Independent sample *t* test One-way ANOVA One-way ANOVA	Poisson regression
RQ3: Is there a relationship between need factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with Alzheimer's disease?	Medical office visits Emergency room visits Hospital admissions	Presence of comorbidities	Independent sample *t* test	Poisson regression

Scope and Delimitations

Because AD is one of the leading causes of mortality in Puerto Rico and poor access to preventive care and treatment has been associated to increased mortality rate related to this chronic disease on the island, with this study I aimed to increase the knowledge about factors that influence AD healthcare utilization patterns for the Puerto Rican population. The results of this study support a better understand of the burden of AD on the Puerto Rico public health system by using a retrospective cohort design. This design was used based on the fact that exposure and the outcomes of interest had already occurred at the time of study initiation, the data were available, and it gave me the opportunity to investigate potential relationships (see Frankfort-Nachmias & Nachmias, 2008).

The participants selected for inclusion in this study were Puerto Rican residents on the island with a primary diagnosis of AD, whose information was included in the primary data set available from the PRHS. Each selected participant was enrolled in the PRHS during the time of January 1, 2013 to December 31, 2013. Eligible participants selected were insured (private or public), age 60 years or more, and included both genders. I excluded Puerto Rican residents on the island with a diagnosed of AD who were less than 60 years of age. Puerto Rican residents with a diagnosis of AD and those who are uninsured were also excluded because the primary data source lacks this information. In addition, those eligible AD participants that had missing values relating to the study outcomes were excluded; this helped me adjust for an equal sample size across statistical analyses, increase statistical power, and have unbiased parameters estimations.

Although applicable, I did not use the social ecological model (SEM) as a contributing theory to guide this study. This model has been used for understanding the multifaceted and interactive effects of individuals and environmental factors that influence health interventions (Coreil, 2010). The SEM postulates that individual, interpersonal, community, organizational, and environmental factors determine health resources use and serves to understand behaviors of people with AD that lead to their use or their nonuse of health resources (Steffen & Jackson, 2012). Conversely, an understanding of the multiple factors at all SEM levels is needed to develop effective interventions according people's behaviors (Coreil, 2010). In this study, I focused on evaluating individual factors of the SEM, lacking data about other determinants, as this framework suggests.

As mentioned previously, I used primary data from the PRHS, a representative survey that collects comprehensive health data from overall health claims made by the insured Puerto Rican population in this study. A large sample size was part of the study, increasing the statistical power and external validity (see Sedwick, 2014). The results are generalizable for the selected population: Puerto Ricans residents on the island living with AD, aged 60 years old or more, and insured. The results of this study will be useful in providing preliminary and representative data about healthcare utilization patterns for the selected population and guiding the development of future research.

Limitations

Because of the retrospective design used for this quantitative study, it was important to note the threats to internal validity that existed. The inclusion criteria of the

study required a primary diagnosis of AD, which I identified from the primary data

source; patients who did not visit a physician or did not received a diagnosis between the

dates of January 1, 2013 to December 31, 2013 were not included in the study population.

The classification of an AD diagnosis in the PRHS was through the *International*

Classification of Disease, 10th Revision, Clinical Modification (*ICD-10-CM*) reported by

physicians and released by the PRDH; therefore, this assured that all selected AD cases

were diagnosed by a licensed physician, increasing the internal validity.

Confounding Variables

The absence of data on potential confounding variables was another limitation of

a retrospective design affecting the internal validity. Confounding variables are factors

other than the predictor variable that may affect the outcome variable (Field, 2013). The

primary data from the PRHS do not have information on the duration or severity of AD,

which is significantly associated to healthcare utilization patterns (Chen et al., 2014;

Chung et al., 2014; Michalowsky et al., 2016). Primary data do not include information

on living situation (e.g., home versus institution and marital status), which may also

affect healthcare resource use (Albanese et al., 2011; Gilliagan et al., 2013). To address

unmeasured confounding variables, diverse approaches have been applied, such as

instrumental variable analyses (Arah, 2017; Davies et al., 2013); methods that calculate

bounds for causal effects under increasingly restrictive assumptions about the

unmeasured confounder and the effect of the exposure (MacLehos et al., 2005); and

generalized bias analysis (Arah, 2017). Based on the design, information available in the

primary data, and resources to conduct this study, I was unable to control for unmeasured

confounders. Despite this limitation, I performed the likelihood ratio test in the analysis to examine the interaction between variables.

Bias

   Selection bias. Selection bias occurs when subjects have different probabilities of being selected according to exposure or outcomes of interest, which may create biased measures of association (Szklo & Nieto, 2014). Selection bias was present in this retrospective cohort study since the diagnosis of AD had already occurred at the time the research was initiated. I did not have a comparison group (participants without AD) to reduce the selection bias in this study; however, I used a random sampling methodology to ensure that each AD case that met the inclusion criteria had an equal opportunity of being selected for the study. In addition, it is possible that selection bias may have occurred due to the group of individuals who did not qualify as a result of their inability to access healthcare resources during the time period. In this study, I examined the effect of health insurance type on medical office and emergency visits, and hospital admissions for the selected population. In order to reduce selection bias, I adjusted the results by health insurance group.

   Maturation. Maturation is natural, biological, or psychological developments that results in changes within individuals (Fink, 2013). The maturity of older adults living with AD could affect their healthcare utilization patterns. To address this, I examined results between age groups with reservation and the understanding that preexisting differences may play an unknown role in any relationships identified.

Omitted variables bias. Omitted variables bias was present in this study. This bias refers to any variable not included as a predictor in the regression model that might influence the outcome (Fink, 2013). There were variables omitted based on data not available in the PRHS data set, such as treatments, social behaviors, and duration and stage of AD that could best explain factors related to healthcare utilization patterns for older adults living with AD in Puerto Rico. However, in this study, I used information available from the PRHS and provided preliminary data for further research on this topic in the island.

Significance

In this study, I uniquely addressed the need to understand factors that affect healthcare utilization patterns of older adult Puerto Rican residents diagnosed with AD by conducting a retrospective cohort study. Better understanding of the determinants influencing the utilization of services by Puerto Ricans living with AD may improve their health outcomes by transforming healthcare systems and reducing disparities in healthcare access. The results of this study have the potential to inform and shape policy to improve health services delivery for AD patients by establishing tailored interventions that facilitate the use of healthcare resources for this population. The study results may positively impact society through fostering health promotion and educational efforts to increase awareness about AD and the burden of this disease on Puerto Rico's healthcare systems. The findings might also serve to mobilize healthcare providers, patients, and the general community to prevent and control this disease by creating frameworks to ensure the welfare and health services needed for older adults living with AD in Puerto Rico.

The research findings may serve to encourage the allocation of resources by evidence-based decisions for the prevention, early diagnosis, and management of AD to improve the quality of life and health outcomes of Puerto Rican society as well. Finally, the results of this study may lay the foundation for future research on AD in the Puerto Rican population.

Summary

The World Health Organization (WHO) identified AD as one of the costliest health conditions in the United States (WHO, 2017). With the dramatically increasing burden of AD, countries are being urged to address this as a public health priority (Smith et al., 2014). In this regard, it is critical to understand the factors that influence AD healthcare utilization patterns in Latino populations, especially Puerto Ricans because this chronic disease is one of the leading causes of morbidity and mortality in the island (PRHD, 2015). In this study, I determined whether there is a relationship between certain demographic characteristics and the presence of comorbidities of older Puerto Rican residents diagnosed with AD and their healthcare utilization patterns. This study was guided by Andersen's BM of health services use. In previous studies, Andersen's BM has been a valuable tool to understand factors that influence healthcare utilization patterns for people living with AD (Godwin et al., 2014; Ostergren, 2017; Walsh et al., 2015; Zayas et al., 2016). The research findings might serve to reduce disparities in healthcare access and improve health services coordination in order to prevent and control AD in Puerto Rico.

In Chapter 2, I will provide a review of literature related to the healthcare resources use of people living with AD. In addition, the next chapter will include a thorough explanation of Andersen's BM, its relationship to healthcare utilization patterns, and its application as the theoretical framework of the study.

Chapter 2: Literature Review

Introduction

The purpose of this retrospective cohort study was to examine the relationship between certain demographic characteristics (i.e., age, gender, municipality of residence, type of health insurance, and personal income); the presence of comorbidities of older ($\geq$ 60 years old) Puerto Rican residents diagnosed with AD; and their healthcare utilization patterns (i.e., medical office and emergency room visits, and hospital admissions). In this chapter, I will further support how integral this study was in understanding the factors that influence the medical office, emergency room, and hospital admissions settings for older Puerto Ricans living with AD. The demographic characteristics and the presence of comorbidities of older Puerto Ricans were selected because of their effect on healthcare utilization patterns and the lack of existing literature on this topic within this population.

People living with AD disproportionately use healthcare resources when compared to the general population (Hurd et al., 2013; Knapp et al., 2016; Michalowsky et al., 2016). Researchers have found associations between AD and higher healthcare utilization for Asian people $\geq$ 65 years (Chung et al., 2014). Chen et al. (2014) examined retrospective data, which showed increased health-related utilization among AD patients 65 years and older in the United Kingdom. In the United States, Zhao et al. (2008) found that the mean number of emergency room visits and inpatient admissions were higher for AD patients as compared with the control group. The lack of data about factors influencing healthcare utilization patterns among Latino populations living with AD, especially Puerto Ricans communities, is scarce. Figueroa et al. (2013), the one primary

researcher in healthcare access and utilization among Puerto Ricans with AD, identified

poor access to preventive care and healthcare resources as risk factors that increased the

probability of AD-related deaths in Puerto Ricans living on the island. Clearly, there is a

need to expand the knowledge of this subject in this understudied population.

In this chapter, I will explain a detailed description of the process and criteria

used to locate appropriate content for inclusion in the literature review. The literature

search strategy will include current and relevant information related to the problem,

which served as the catalyst for this study; the topic; the variables that were examined;

the theory underpinning the study; and the research tradition employed. I will also present

Andersen's BM of health services access as the structure for the study rationale, design,

methods, and analysis. An exhaustive review and synthesis of extant studies conducted

globally regarding the constructs of interest and research tradition that were consistent

with the scope of this study will also be included. I will conclude this chapter with a

summary of available research literature and the gaps in knowledge that were addressed.

Literature Search Strategy

The Walden University Online library was the primary source that I used to

obtain peer-reviewed literature for this study. The majority of sources (81.4%) were

accessed through the ProQuest, Medline, and PUBMED databases. Other databases,

including Google Scholar, PsycInfo, EBSCO, and the Cochrane Database of Systematic

Reviews, were used, resulting in 10.2% of the sources accessed. I also explored

additional websites of local, national, and multinational organizations, such as the PRDH,

the Alzheimer's Disease Association, the WHO, and the CDC, as a means to expand and

validate the accuracy of information presented in some primary sources, resulting in 8.4%
of the total sources accessed.

Key search terms used to identify relevant sources included: *dementia,
Alzheimer's disease, older people, elderly population, healthcare utilization, health
resources use, factors associated, predisposing factors, enabling factors*, *needed factors*,
Andersen's behavioral model, *cohort,* and *retrospective*. In addition, these key terms
were combined as a strategy to maximize the search, as illustrated in Table 2. I searched
for peer-reviewed sources that contained quantitative data on the subjects of interest and
research tradition. My search strategy was restricted to: (a) quantitative studies published
in English or Spanish; (b) quantitative studies that include overall research design and
data sources (e.g., cross sectional design, secondary data analysis, and administrative
databases); (c) quantitative studies that reported AD healthcare utilization (e.g.,
hospitalization, emergency room, or department) as the primary outcome; and (d) AD or
dementia that was diagnosis by the *Diagnostics and Statistical Manual of Mental
Disorders, 4th edition* (*DSM-IV*), the *International Classification of Disease, 10th edition*
(*ICD-10*) or similar clinical criteria. Literature excluded included: (a) quantitative studies
that involved people under the age of 45, interventions solely targeting caregiver
outcomes, and purely lifestyle interventions or pharmaceutical trials; and (b) quantitative
studies published in languages other than Spanish or English.

I also searched for nonpeer-reviewed sources to expand my investigation of the
constructs of interest, validate the accuracy of information presented in some primary
sources, and provide up-to-date data about the research topic. The appropriateness of

these sources was determined by the following requirements: (a) information published within the past 5 years; (b) information cited from a reliable source (e.g., PRDH, WHO, CDC); (c) information that included the qualification of the authors; and (d) information that provided evidence from other sources (e.g., peer reviewed or non peer-reviewed). Overall, I evaluated the literature reviewed in detail to ensure their quality, reliable, and applicability to this study. The accuracy, authority, objectivity, and research tradition were my criteria for evaluating information from the search strategy. Works (e.g., articles, texts, white papers, etc.) that were not properly critiqued were excluded from the review of the literature.

Literature Review Summary

Depending on the isolation of the term or the combination of terms I used, my search yielded six to 22 relevant articles, while total results from each search ranged between eight and 1,107 articles. Interestingly, similar key terms, such *emergency room* and *emergency department* and *medical office* and *private doctor,* often produced different results. Each article that met the inclusion criteria also provided numerous additional sources within its content and reference section. For example, my search identified some dissertations that contained literature about healthcare utilization resources related to AD.

Table 2

Literature Review Search Themes

Key Search Terms	Search Terms
Alzheimer's disease (or dementia)	*healthcare utilization, health resources use, medical office, private doctor, emergency room, emergency department, hospital admissions, older people, elderly population, Latinos, Caribbean, Puerto Ricans, cohort, retrospective
Healthcare utilization (or health resources use, medical office [private doctor], emergency room [ER, emergency department] visits, or hospital admissions)	*Alzheimer's disease, dementia, factors associated, predictors, age, gender, health insurance, income, residence, comorbidities, older people, elderly population, Latinos, Caribbean, Puerto Ricans, Andersen behavioral model, Andersen BM, cohort, retrospective
Factors associated (or predictors)	*Alzheimer's disease, dementia, healthcare utilization, health resources use, medical office, private doctor, emergency room, emergency department, hospital admissions, older people, elderly population, Latinos, Caribbean, Puerto Ricans, Andersen behavioral model, Andersen BM, cohort, retrospective
Predisposing factors (or age or gender)	*Alzheimer's disease, dementia, healthcare utilization, health resources use, medical office, private doctor, private doctor, emergency room, ER, emergency department, hospital admissions, Andersen behavioral model, Andersen BM, cohort, retrospective
Enabling factors (or health insurance, income, municipality of residence)	*Alzheimer's disease, dementia, healthcare utilization, health resources use, medical office, private doctor, emergency room, emergency department, hospital admissions, Andersen behavioral model, Andersen BM, cohort, retrospective
Needed factors (or comorbidities)	*Alzheimer's disease, dementia, healthcare utilization, health resources use, medical office, private doctor, emergency room, emergency department, hospital admissions, Andersen behavioral model, Andersen BM, cohort, retrospective
Andersen behavioral model (or Andersen BM)	*Alzheimer's disease, dementia, healthcare utilization, health resources use, medical office, private doctor, emergency room, emergency department, hospital admissions, cohort, retrospective

Research literature about AD for the Puerto Rican population is extremely limited; therefore, there is little information on the effect of AD in healthcare utilization patterns for this population. In addition, in my review of the literature, I found there are few published articles that evidenced strong associations between enabling factors (e.g., income) and AD healthcare utilization patterns, suggesting further research was needed on this topic. This led me to examine other sources that could help fill the existing gaps in knowledge in this area. To gather the background and information on healthcare utilization patterns in Puerto Ricans living with AD, I accessed websites for organizations including the PRDH, Alzheimer's Disease Association, WHO, and Centers for Medicare and Medicaid Services (CMS).

My literature search included a global review of quantitative studies that examined the relationship between healthcare utilization patterns, certain demographic characteristics, and the presence of comorbidities among people diagnosed with AD. I obtained a total of 717 articles at the initial stage of the search, including 598 duplicated articles that were excluded. In the second stage, of the remaining 119 articles, I found that 64 articles were ineligible for review because they were studies not primarily related to AD healthcare utilization patterns, the study population was under the age of 45, or they were focused on lifestyle interventions or pharmaceutical trials. Therefore, a total of 55 articles were included in this literature review. The majority of studies (72.2%) used in the literature review were published within the last 5 years; however, relevant studies published between 1968 and 2012 were included to expand on current research.

Theoretical Foundation

Andersen's BM of health services access was the theoretical framework for this examination of the relationship between individual characteristics and healthcare utilization patterns among older Puerto Ricans diagnosed with AD. BM was developed by Ronald M. Andersen in 1968 to empirically test hypotheses about inequality of access to health services in the United States (Andersen, 1968). Andersen's BM defined access as the utilization of individual health services and everything that facilitates or impedes their use (Andersen, 1995). Through Andersen's BM, access is not only the use of or visit to healthcare resources but also accessing the right services at the accurate time to improve individuals' health outcomes (Petrovic & Blank, 2015). Conceptualizing and measuring healthcare services utilization has been key to understanding and fostering health policy by predicting access, promoting social justice, and improving the effectiveness and efficiency of public health resources (Andersen & Davidson, 2007).

Andersen's BM is considered a multilevel model that incorporates contextual and individual determinants of healthcare services utilization (Andersen, 1995). Contextual determinants are based on the circumstances and environment of healthcare access including factors related to the organization and provider as well as community characteristics (Andersen & Davidson, 2007). Individual determinants refer to personal characteristics (Andersen & Davidson, 2007). Predisposing, enabling, and need factors are the constructs of the Andersen's BM (Andersen & Davidson, 2007).

Andersen's BM assumes that predisposing, enabling, and need factors directly influence healthcare use (Andersen, 2008). The model proposes that healthcare services

utilization is a function of: (a) existing attributes that predispose individuals to use or not use healthcare services, (b) enabling characteristics that facilitate or impede use of healthcare services, and (c) need or conditions that laypeople or healthcare providers recognize as requiring health treatment (Andersen, 1995). The major hypothesis of the model is that access to healthcare services is considered equitable if it can be predicted by predisposing or need factors (Andersen & Aday, 1978). However, healthcare access is considered inequitable if it can be predicted wholly or partly by enabling factors (Andersen & Newman, 1973).

Predisposing Factors

Predisposing factors are focused on individuals' demographic and social characteristics (Andersen & Davidson, 2007). Demographic characteristics include the age, gender, and marital status, while social characteristics determine the status of a person in the community as well as their ability to cope with presenting problems and command resources to deal with those problems (Andersen, 1995). Relevant social measures include educational level, occupation, and ethnic and racial composition (Andersen & Davidson, 2007). Additional measures can include people's social network and interactions that can facilitate or impede the use of healthcare resources (Andersen, 1995). Health beliefs, are another predisposing factor, based on the attitudes, values, and knowledge that people have about health that can influence their subsequent perception of need and use of healthcare services (Andersen, 2008).

Enabling Factors

Enabling factors are considered health policies, and economic and organizational

resources (Andersen & Davidson, 2007). Health policies are authoritative decisions made pertaining to health or influencing the pursuit of health (Babitsch, Gohl, & von Lengerke, 2012). These policies can be public, made in the legislative, executive, or judicial branch of government, at all levels from local to national (Babitsch et al., 2012). They can also be policies made in the private sector by decision makers such as executives of managed care organizations concerning product lines, pricing, or marketing, or by accrediting agencies. Economic characteristics are described by the personal income and wealth available to the individual pay for services (Andersen & Davidson, 2007). Additional financial characteristics include the effective price of healthcare to the patient, determined by having insurance and cost-sharing requirements (Andersen & Davidson, 2007). Organizational healthcare resources for the individual describe whether or not the person has a regular source of care and it nature (i.e., private doctor, community clinic, emergency room). It also includes the transportation and travel time to and waiting time for healthcare.

Need Factors

Need factors may include health-related characteristics, diagnosis of illness or disease and perception of requiring medical care (Andersen & Davidson, 2007). Understanding the need factors represents professional judgment and objective measurement about an individual's physical status and the necessary healthcare services and/or treatments (e.g., diagnoses, prognoses, treatment). Perceived need is how people view their own general health status and how individuals experience and emotionally respond to symptoms of illness, pain, and worry about their health condition. Researchers

suggested that perceptions about the importance and magnitude of a health problem or symptom lead to a decision to seek healthcare (Andersen & Davidson, 2007).

Andersen's BM Applicability

Andersen's BM is useful because of its flexibility in allowing researchers to choose independent variables related to their specific hypothesis (Petrovic & Blank, 2015; Phillips et al., 1998). To date, this model has remained one of the most widely used frameworks to help understand healthcare utilization patterns. A systematic review demonstrated that Andersen's BM has been used extensively in studies exploring the use of health services for diverse chronic diseases (Babitsch et al., 2012). A total of 16 studies published between 1998 and 2011 examined this phenomenon (Babitsch et al., 2012). Furthermore, the literature replete with studies demonstrating the applicability of Andersen's BM to examine AD healthcare services use as a function of predisposing, enabling, and need factors (Galvin et al., 2008; Godwin et al., 2014; Ostergren, 2017; Voisin et al., 2011; Walsh et al., 2015; Zayas et al., 2016), as this study propose.

In the United States, researchers determined the predisposing, enabling, and need characteristic of persons aged 66 years and older seeking services at the emergency department by using a retrospective cohort design (Walsh et al., 2015). A cross sectional study used Andersen's BM to examine the predisposing characteristics that affect inpatient hospitalization among a population of veterans who were at least 50 years old, had AD and resided in the United States (Godwin et al., 2014). In addition, a prospective study explored factors related to hospitalizations in AD adult patients in France (Voisin et al., 2011). Overall, this research has been key to reducing inequalities in healthcare

access of people living with AD.

The theoretical framework of Andersen's BM was integrated into this study as the foundation and structure for the study rationale, problem statement, purpose, significance, and research questions. Andersen's BM provides a grounding base for the research design, methods and analysis to be employed in order to explore factors related to healthcare utilization patterns for older adults living in Puerto Rico. The constructs in the theory were incorporated into the research questions. In addition, this theoretical framework logically guides the development and understandings of the literature review for each construct of interest and study variable.

Constructs of Andersen's BM guided this study by providing lenses for understanding the result of relationship between certain individual characteristics of older Puerto Rican residents diagnosed with AD and their healthcare utilization patterns. Previous researchers have examined the effect of predisposing, enabling, and need factors of older people seeking services at medical office, emergency departments, and hospital settings (Godwin et al., 2014; Voisin et al., 2011; Walsh et al., 2015), suggesting the importance of the relationship that this study will examine. The first research question was to determine the relationship between predisposing factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with AD. Andersen's BM, in this case, provided a better understanding of about how the age and gender of older Puerto Ricans diagnosed with AD influence their healthcare seeking process and adherence to a healthcare regimen. The second research question was to evaluate the relationship between enabling factors and healthcare utilization patterns for the selected population.

Andersen's BM explored the influence of health insurance type, personal income, and municipality of residency of Puerto Ricans living with AD (either facilitating or impeding) access to healthcare resources. The third research question explored the relationship between need factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with AD. Andersen's BM examined the kind and amount of healthcare treatment that is given when the older adult Puerto Ricans with AD and who has comorbidities presents to a healthcare provider.

Alzheimer Disease

AD is one form of dementia, accounting for 60% to 80% of disease cases with a rising prevalence in elderly populations (Fag de Bruijn & Arfan-Ikram, 2014). The CDC (2015) defined AD as a progressive disease that begins with mild memory loss, possibly leading to the loss of the ability to carry on a conversation and respond to the environment. This chronic disease affects more than 35 million people worldwide and this number is expected to double worldwide by year 2025 (Mayedan et al., 2016). Due to the lack of effective treatments and cure, the number of new AD cases could rise close to 1.5 million per year by 2050 (Mehta & Yeo, 2017). In the United States, there are more than 5 million people living with AD and the cost associated to the treatment of these patients is calculated at $150 billion annually (Taylor et al., 2017). The expected increase in AD cases and the cost associated to this disease may inevitably lead to a public healthcare crisis.

Studies have demonstrated that AD is more prevalent among elderly African Americans and Latino/Hispanics compared with non-Hispanic Whites (Mayeda et al.,

2016; Reitz & Mayeux, 2014). Those ethnic and racial groups showed more severe symptoms when they are first diagnosed. Chin, Negash, and Hamilton (2011) identified that African Americans and Latinos/Hispanics are most likely to be diagnosed during the later stages of AD, resulting in higher use of public health services, which translates to an increase in healthcare costs too. Under Medicare, the average per person payment is 45.0% higher for African Americans with an AD diagnosis and 37.0% higher for Latinos/Hispanics as compared with Whites (Chin et al., 2011).

Little research has been performed about AD among older Puerto Rican residents. Although research about the clinical presentation of AD among Hispanics in the United States is available, they do not necessarily show the same AD features and disease progression for Puerto Ricans in the island. Unfortunately, robust data of the prevalence and incidence AD in Puerto Rico does not exist (Bryce et al., 2013; Camacho et al., 2016; Carrión-Baralt et al., 2011; Lee et al., 2015). The lack of medical and healthcare utilization records for patients with AD is the cause of the little research done in this area.

Currently, AD in Puerto Rico has a higher mortality rate compared with that observed in the United States, resulting in it being the fourth and sixth cause of death, respectively (CDC, 2017). This data demonstrates a clear disparity in the mortality rate associated to AD comparing Puerto Rico and United States. Researchers found that low socioeconomic status ($p < 0.01$) and poor access to preventive medicine and healthcare resources ($p < 0.01$) were significant contributors to mortality rates associated to AD for Puerto Ricans living in the island comparing those living in the United States (Figueroa et al., 2013). In addition, in 2016, scientists found that Caribbean ethnicity was associated

with a lower probability of healthcare resource access (*OR* = 0.68; 95% *CI* [0.53, 0.88]),

when compared to Whites (Knapp et al., 2016). Considering this fact, is important to

identify which factors influence healthcare utilization patterns of a cohort of Puerto

Ricans on the island suffering of AD. These preliminary results will help to expand

knowledge in this field and might be used to compare findings with a group of Puerto

Ricans living in the United States.

Healthcare Utilization Patterns

Central to any AD plan or policy framework is the question of how to achieve the

best health and quality of life outcomes for people diagnosed with this disease, while

ensuring affordable resources and support is available (Smith & Yaffe, 2014). Therefore,

healthcare utilization patterns have become complex and costly when considered by

country (Zayas et al., 2016). The 2012 Institute of Medicine report, "*Best care at Lower

Costs: The Path to Continuously Learning Health Care in America*", emphasizes that the

growing complexity and fragmented nature of healthcare systems, resulting in areas of

inefficiencies and uncoordinated access, causes harm to not only patients' financial life

but also their health outcomes (Smith, Saunders, Stuckhardt, & McGinnis, 2013).

Healthcare utilization patterns are often complex; where fragmented care often leads to

duplicative, but avoidable, health services. Healthcare systems are also facing a

continuous rise in the number of people with multiple comorbidities, who exhibit higher

healthcare use patterns (Burns, Dyer, & Bailit, 2014). Wide variations in the utilization of

healthcare services, unrelated to health outcomes, have been observed across healthcare

organizations, geographic areas, providers, and payers (Smith et al., 2013).

There is a wealth of published literature on the healthcare utilization impact of AD, but the burden of this chronic condition in Latino populations, especially Puerto Ricans has not been as well described. Studies have examined direct healthcare costs associated with the disease and compared differences in healthcare utilization patterns between patients with and without AD (Chen et al., 2014; Gerves, Chauvin, & Bellanger, 2014; Hurd et al., 2013; Michalowsky et al., 2016; Zhao et al., 2008). Overall, this research demonstrated that people living with AD used more healthcare resources and incurred higher costs than people without this disease, regardless of the general population. Typically, a different combination and a greater number of comorbidities accounted for the higher resource utilization and costs in the AD population (Vossius et al., 2014; Yu et al., 2015; Zhu et al., 2013).

Predisposing Factors

According to Andersen (2008), predisposing factors are related to individuals' demographic and social characteristics. However, this study is focused on demographic characteristics, such as age and gender, of older adult Puerto Ricans diagnosed with AD. Literature regarding these factors are presented below.

Age. It is widely accepted that the primary factor linked to an increased the risk of developing AD is age (CDC, 2015; Lee et al., 2015). In nations with an aging population, this means that the occurrence of AD is likely to increase. The longitudinal population-based study of Herber et al. (2013) found that the prevalence doubles every 5 years beyond the age of 65, with data indicating a prevalence rate as high as 47.0% in people 85 years and older. Therefore, age is considered a strong factor affecting the use of

healthcare resources among individuals living with AD (Fischera et al., 2009; Gervės et al., 2016; Gilliagan et al., 2013; Knapp et al., 2016; Pinette et al., 2013).

The cross sectional study of Pinette et al. (2013) examined the trends in hospitalizations for AD in the United States using data from the National Hospital Discharge Survey. This study found that in 2009, the estimated number of all diagnoses of AD in the United States was 372,000. Of those individuals diagnosed with AD, 98.0% were people at ages more than 65 years. Between 1999 and 2009, for people 65 years and older, the rate of hospitalization with AD showed an increase by 1.9% compared with other age's group (Pinette et al., 2013).

Gilliagan et al. (2013) conducted a retrospective study to explore the predictors of hospitalization in Medicaid populations with AD in the United States. This study showed that age ($p < 0.01$) was positively and significantly associated with hospitalization. The retrospective cohort study of Knapp et al. (2016) examined the relationship between demographic characteristics of older people with AD living in London, and the likelihood of hospital admissions. Results demonstrated that age ($p < 0.01$) was related to the use of healthcare resources (Knapp et al., 2016). This study found, after adjustment, that when age increased, the probability of hospital admission also increased (*OR* = 1.04, 95% *CI* [1.02, 1.05]). Furthermore, the longitudinal study of Zhu et al. (2013) found that the age ($p = 0.04$) of an AD patient was associated with higher healthcare resources utilization. A greater likelihood of healthcare utilization was also related with older age (*OR* = 1.22, $p = 0.03$).

Gender. Gender has also been related to AD (Pinette et al., 2013). The prospective study of Zeki Al Hazzouri et al. (2014) found that two thirds of people with AD are women. Researchers suggested that gender differences associated to this chronic disease are based on disparities in lifespan as females typically live longer than men (Zeki Al Hazzouri et al., 2014). Knapp et al. (2016), through their retrospective cohort study, determined the effect of demographic characteristics on hospital admissions for older people diagnosed with AD living in London. The results suggested that gender ($p = 0.04$) contributed to an increased use of healthcare resources (Knapp et al., 2016). Researchers showed that females had higher rates of hospital admissions than males ($OR = 1.36$, 95% CI [1.16, 1.61]).

In the United States, through a secondary cross-sectional analysis of the Medical Expenditure Panel Survey, scientists showed that being female ($OR = 1.56$, $p = 0.034$) is a significant predisposing factor associated with emergency department visits for older adults with AD (Walsh et al., 2015). In addition, the cross-sectional study of Godwin et al. (2014) examined the predictors of inpatient hospitalizations among a population of veterans with dementia. Researchers found that the gender ($p = 0.029$) of people with dementia is a significant predisposing factor for hospitalizations.

The population-based cross-sectional study of Albanese et al. (2011) evaluated patterns of AD healthcare utilization and consequent out of pocket expenses among older people living in low and middle income countries. Researchers found that sex ($p = 0.01$) is associated to healthcare services related to AD. Results demonstrated that being a

female (meta-analysed prevalence ratio 0.93, 95% *CI* [0.91, 0.96]) increased the use of healthcare services for AD.

Enabling Factors

Enabling factors are considered health policies, and economic and organizational resources (Andersen & Davidson, 2007). Socioeconomic status (SES) is known to be a risk factor associated with the development of AD. The systematic review of Seifan, Schelke, Obeng-Aduasare, and Isaacson (2015) explored the relationship of AD and early-life factors such as SES. This comprehensive review demonstrated that low socioeconomic status (*p* < 0.001) increased the risk of clinical diagnosis of AD. The cross-sectional study of Fischera et al. (2009) demonstrated that low annual income (*p* < 0.01) is statistically significant in predicting a diagnosis of AD. The economic characteristics that result in a person's SES have also been related to facilitating or impeding the use of healthcare resources among people with AD (Albanese et al., 2011; Chung et al., 2014; Gilliagan et al., 2013). However, the literature review conducted found there are few published articles that support strong associations with enabling factors (e.g., income) and AD healthcare utilization patterns, suggesting further research is needed on this topic. Therefore, this study was focused on the personal income, the municipality of residence and the health insurance of older Puerto Rican diagnosed with AD.

Income. A population based study with samples in Latin America, China, India and Nigeria, found that household assets (*p* < 0.001) is related with the use of healthcare services for older people living with dementia (Albanese et al., 2011). This multisite

study suggested that household assets (meta-analysis prevalence ratio 1.08, 95% *CI* [1.00, 1.17]) were positively associated with healthcare use in the Dominican Republic, Puerto Rico, urban China and urban India for older people living with AD.

Researchers examined data from a national sample of people aged 65 years or older from Asia to explore their healthcare utilization patterns (Chung et al., 2014). This study found that people with AD and higher incomes ($p < 0.001$) had increased use of outpatient visits and inpatient days. The multiple regression analyses revealed that individuals with an AD diagnosis and a higher income had significantly more use of healthcare services compared to subjects without an AD diagnosis after adjusting for urbanization level (from "most urbanized" to "least urbanized"), and geographic region (Chung et al., 2014).

Health insurance. The retrospective study of Zayas et al. (2016) used data from the 2013 Medical Expenditures Panel Survey of elderly patients, aged 65 or older from the United States to explore their healthcare utilization patterns. Researchers found that the insurance status ($p < 0.01$) of people living with AD is related to healthcare utilization patterns. Results suggested that elderly patients with health insurance increased the probability of using healthcare resources (e.g., office based physicians, emergency room visits, and hospital stays). The cross-sectional study of Albanese et al. (2011) also found a positive relationship between having health insurance (meta-analyse prevalence ratio 1.27, 95% *CI* [1.16, 1.38]) and the healthcare utilization patterns for diverse populations. Researchers found that health insurance coverage was high in Peru and urban Mexico (between 50.0% to 75.0% coverage), and in Puerto Rico where 95.4% of participants

were covered by Medicare; modest in rural Mexico and Venezuela (between 25.0% to 50.0% coverage); low in the Dominican Republic (21.4% coverage) and negligible in India.

Municipality of residence. In Asia, Chung et al. (2014) analyzed a nationwide population-based dataset and found that people with AD with a better geographical location (p = 0.005), had increased use of outpatient visits and inpatient days. People with AD, living in the Eastern of Taiwan were 21.0% more likely to use healthcare services compared to those from the Northern region of the country. In Germany, Schwarzkopf et al. (2013) examined claims data to compare community-living and institutionalized AD patients regarding their healthcare service utilization profiles and to contrast respective expenditures. Researchers found that residency location (p = 0.003) of AD patients is related to use healthcare resources (e.g., hospital, medical specialist).

In the United States, Gilliagan et al. (2013) conducted a secondary analysis to examine factors that influence hospitalization among individuals with AD. Data from the Centers for Medicare and Medicaid Services of individuals enrolled in Florida, New Jersey, and New York Medicaid programs were part of this study. Researchers found that the state of residency (p < 0.01) was associated to healthcare utilization associated to having a diagnosis of AD (Gilliagan et al., 2013). Residents of New York were significantly more likely to be hospitalized than Florida residents (OR = 1.30, 99% CI [1.17, 1.44]), whereas New Jersey residents were less probable to be hospitalized (OR = 0.75, 99% CI [0.66, 0.85]).

Need Factors

Need factors included health conditions, the number of comorbidities, perceived physical health status, perceived mental health status, having at least one activity limitation, and having cognitive limitations (Anderson, 2008). AD, as with any other chronic condition, might have multiples comorbidities that require coordination and management of public health resources. There is literature that supports strong associations between cardiovascular disease, and its risk factors and with the incidence and prevalence of AD (Mayeux & Stern, 2012). Diabetes (Crane et al., 2013); hypertension (Power et al., 2013); high levels of cholesterol (Exalto et al., 2014); stroke (Ballard & O'Sullivan, 2013); and obesity (Tolppanen et al., 2013) have been also related to AD.

Presence of comorbidities. The study of Beydoun et al. (2017) used a nationwide sample of patients hospitalized with AD to explore trends, predictors, and outcomes of resource utilization in the United States. Results demonstrated that patterns of hospital resources were positively associated with the number of medical conditions ($p < 0.001$) that an AD patient had. In Germany, Brüggenjürgen, Andersohn, Ezzat, Lacey, and Willich (2015) explored the medical and economic differences between patients with and without diagnosed AD. Through a retrospective analyses of health claims data using a matched cohort approach, Brüggenjürgen et al. (2015) found that the number of comorbidities was substantially higher in patients with AD as compared of people without this disease (42.0 vs 29.9, $p < 0.001$).

In the United States, Kahle-Wrobleski et al. (2015) conducted a secondary analysis to examine how the presence of comorbidities impact healthcare utilization patterns associated to AD. Results demonstrated that cancer was significantly associated with higher healthcare utilization patterns ($p = 0.003$), whereas cardiac ischemia was significantly associated with lower resources use ($p = 0.002$). Another cross-sectional study in the United States found that psychosis ($OR = 2.68$), poor health status ($OR = 2.24$), mental disorder ($OR = 3.42$), and anxiety disorder ($OR = 1.85$) were factors that predicted emergency department visits for mental health reasons among patients with AD aged 66 years or more (Walsh et al., 2015).

The study of Suehs et al. (2014) evaluated the medical condition burden, healthcare resource use, and healthcare costs of household members (HHMs) of individuals diagnosed with AD with those matched individuals without AD in the United States. This retrospective cohort study used administrative claims data collected from individuals enrolled in Medicare Advantage programs. Study findings demonstrated that AD HHMs had greater medical condition burden scores than non-AD HHMs, with mood disorders ($p < 0.001$), anxiety disorders ($p < 0.001$), insomnia ($p < 0.001$), substance abuse or dependence ($p = 0.002$), cardiovascular disease ($p < 0.001$), and rheumatoid arthritis ($p < 0.001$) being more prevalent in AD HHMs (Suehs et al., 2014).

A longitudinal study conducted in the United States assessed difference in healthcare resources utilization (e.g., hospitalization, medical provider visits) and its cost comparing older adults with and without AD (Zhu et al., 2013). This study found that the number of medical conditions ($p < 0.001$) that an individual living with AD has was

related with higher healthcare resources utilization. In addition, the retrospective study of Hurd et al. (2013) examined the healthcare utilization of dementia in the United States. This study found that the number of coexisting medical conditions ($p < 0.001$) are associated with increased healthcare utilization related to dementia.

Researchers examined the AD effect on healthcare cost and utilization and explored factors that influence emergency room visits and inpatient admissions for AD patients (Zhao et al., 2008). This study used a matched cases-control cohort design and data were collected from the MEDSTAT MarketScan Medicare Supplemental and Coordination of Benefits. Scientists found that the comorbidities conditions were higher for AD patients compared to controls (Zhao et al., 2008). There were statistically significant excesses in healthcare utilization related to AD for inpatient services ($p < 0.05$) and emergency room visits ($p < 0.05$).

Needs to Understand Alzheimer's Disease Healthcare Utilization Patterns

As AD is associated with a substantial and increasing healthcare utilization and cost; making AD one of the most expensive diseases in old age and a serious public health priority (WHO, 2017). Understanding factors influencing older Puerto Ricans living with AD's healthcare utilization, such as demographic characteristics and comorbidities, can be a vital part of interventions for increasing access and improving utilization of public health resources. There is a need to identify effective and ineffective healthcare utilization patterns to highlight where targeted interventions could be placed to enable better health and quality of life for older Puerto Ricans. Understanding these patterns can be used to advocate for action among healthcare providers, administrators,

caregivers, policy makers, health professionals, and public health organizations to respond adequately to the needs raised by this population.

Summary and Conclusions

In this chapter, I presented a review of literature about the AD and the healthcare utilization patterns related to this disease. The literature review performed illustrated the factors associated to AD, the impact of AD on healthcare utilization patterns, and the individuals' characteristics that contribute to using or not using healthcare resources. The published evidence demonstrated that AD imposes a burden on healthcare utilization. Most research that explored the patterns of healthcare utilization related to AD used Anderson's BM and were observational studies including retrospective cohort design, as this study proposed.

Andersen's BM was described for the role it plays in the overall scheme of healthcare utilization patterns and how it can contribute to a better understanding of the intentions of this study and analysis of results. The literature illustrated that age and gender were factors that predispose the use of healthcare resources for people living with AD. Health insurance, personal income and geographical location were considered enabling factors related to healthcare utilization patterns for AD individuals; however, there is a need of further research on this area. In terms of needed factors, the presence of comorbidities has been strongly associated to healthcare utilization patterns for people with AD.

As the prevalence and incidence of AD continues to increase worldwide, there is scare data on which to base projection of future needs of Puerto Rican residents living

with AD. Since the burden of AD has been related with the magnitude of healthcare utilization patterns, a better understanding of factors that influence these patterns can be used to guide public health policy and practices to improve outcomes in the AD population living in the island. In Chapter 3, I will discuss the research methodology, including data collection and analysis. Research setting and study sample are also detailed. Internal and external threats to validity were also identified.

Chapter 3: Research Method

Introduction

The purpose of this retrospective cohort study was to determine a relationship between certain demographic characteristics (i.e., age, gender, municipality of residence, type of health insurance, and personal income); the presence of comorbidities of older ($\geq$ 60 years old) Puerto Rican residents diagnosed with AD; and their healthcare utilization patterns (i.e., medical office and emergency room visits, and hospital admissions). I selected the retrospective cohort design to provide a comprehensive view of any association between individual-based factors of older adult Puerto Ricans living with AD and their healthcare utilization patterns. In this chapter, I will provide an overview of the research design and rationales that were used to address the research questions concerning the predisposing, enabling, and need factors that influence AD healthcare utilization patterns in Puerto Rico. The population selection and sampling procedures of this study will also be described. The chapter will also include an outline of the data analysis plan with an explanation detailing how research questions were addressed using specific variables and circumstances that influenced the study. Finally, the ethical issues and methods used to preserve research integrity will be presented in this chapter.

Research Design and Rationale

Study Variables

For this study, I used a cohort research design employing quantitative retrospective data. Using the diagnosis of AD from the primary data, I retrospectively examined a cohort of AD patients aged 60 years or more over a 12-month period of time,

from January 1, 2013 to December 31, 2013. The DVs of healthcare utilization patterns

were measured by the number of medical office and emergency room visits, and hospital

admissions for the selected population. Following the constructs of Andersen's BM, the

IVs were predisposing (i.e., age and gender), enabling (i.e., health insurance type,

personal income, and municipality of residency), and need (i.e., presence of

comorbidities) factors. Past research has indicated that age and the presence of

comorbidities can contribute to a predisposition to AD as well as healthcare utilization

patterns (Beydoun et al., 2017; Brüggenjürgen et al., 2015; Exalto et al., 2014; Gilliagan

et al., 2013; Lee et al., 2015; Tolppanen et al., 2013); therefore, I identified their potential

role as moderating variables in this study.

Design

I used a nonexperimental design to address the research questions in this study. A

nonexperimental design involves variables that are not manipulated by the researchers

but are instead studied as they exist (see Frankfort-Nachmias & Nachmias, 2008). From

the available nonexperimental designs, I used a retrospective cohort design that has been

valuable in generating ideas about potential associations and explore relationships

between variables in other studies (see Szklo & Nieto, 2014). Most research with a

retrospective cohort design has examined data from primary studies, administrative

databases, electronic medical records, and vital registers to expand new knowledge and

discoveries (Smith et al., 2014). In this study, healthcare utilization patterns for Puerto

Ricans diagnosed with AD could not be manipulated due to the retrospective design;

however, the knowledge gained from this research can be used to improve healthcare access and health outcomes for this population.

Researchers have used retrospective designs to explore research questions guided by the conceptual framework of Andersen's BM and to examine factors that influence AD healthcare utilization patterns (Godwin et al., 2014; Ostergren, 2017; Petrovic & Blank, 2015; Walsh et al., 2015; Zayas et al., 2016), as I did in this study. I used inferential statistics to explore the potential existence of a relationship between certain demographic characteristics (i.e., age, gender, municipality of residence, type of health insurance, and personal income); the presence of comorbidities in older ($\geq$ 60 years old) Puerto Rican residents diagnosed with AD; and their healthcare utilization patterns (i.e., medical office and emergency room visits, and hospital admissions). The appropriateness of the retrospective design was reinforced based on the fact that the exposure and outcomes of interest had already occurred at the time of study initiation, the availability of data, and the resource and time constraint. The use of this design was intended to establish a baseline of knowledge on this topic, which had been previously unexplored in Puerto Rican populations living on the island.

Methodology

Population

The population from this study was Puerto Ricans with a diagnosis of AD that were 60 years old or more and enrolled in the PRHS during the time from January 1, 2013 to December 31, 2013. Puerto Ricans with a diagnosis of AD are defined by *ICD-10* (2010) as a beneficiary in 2013 under a health insurance plan (private or public) who

had claims listing a primary diagnosis of AD. Other dementia-related codes were not taken into consideration to achieve greater diagnostic specificity for AD within the cohort. According to the PRDH (2015), the eligible study population was comprised of 32,899 individuals.

Sampling and Sampling Procedures

I selected participants with a primary diagnosis of AD who were aged 60 years old or more from the PRHS for this study. Data regarding their pertinent healthcare utilization patterns (i.e., medical office and emergency room visits, and hospital admissions); demographic characteristics (i.e., age, gender, municipality of residence, type of health insurance, and personal income); and presence of comorbidities were extracted for each participant in the sample. Details of the sampling procedures are presented below.

Inclusion and exclusion criteria. To be eligible for this study, Puerto Rican residents on the island with a primary diagnosis of AD had to be enrolled in the PRHS from January 1, 2013 to December 31, 2013. Since the studied health condition was AD, study participants needed to have a primary diagnosis of AD. A first diagnosis of AD helped to ensure unbiased results of healthcare utilization patterns attributable to AD. I selected eligible AD participants of both genders that were insured (either privately or publically). I included adults ≥ 60 years of age of both genders because there is global evidence that the age of diagnosis for AD is in individuals 60 years or older (see Alzheimer's Association, 2017; Camacho-Mercado et al., 2016; CDC, 2015).

I excluded Puerto Rican residents on the island with a diagnosis of AD who were less than 60 years of age from this study. Puerto Rican residents with a diagnosis of AD who were uninsured were also excluded because the primary data source lacked this information. Missing data on outcome variables can reduce the statistical power of a study and can produce biased estimates, leading to invalid conclusions (Kang, 2013). For this reason, eligible AD participants that had missing study outcome values (i.e., medical office and emergency room visits, and hospital admissions) were also excluded; this helped to adjust for an equal sample size across statistical analyses, increase statistical power, and have unbiased parameters estimations.

Power analysis. The power analysis serves to determine the probability that a given statistical test will detect an accuracy relationship between variables (Kang, 2013). I used G*Power, Version 3.1.9.3 software to calculate the power analysis and determine the optimal sample size. The G*Power software is considered an appropriate tool to calculate the correct sample size; this has been supported by its wide use in a number of studies (Faul, Erdfelder, Buchner, & Lang, 2009; Lu & Askin, 2014). The type of power analysis chosen within G*Power was "A priori: Compute required sample size-given α, power, and effect size," the test family selected was "z tests" with the variance correction procedure of Demidenko (2007), and the statistical test was "Poisson regression."

Within the input parameters, I identified a two-tailed test, due to the nondirectional, null hypotheses. I assumed the X or IV was normal distributed with parameters. The base rate exp (β0) was 0.1, which means the event rate assumed there was not a relationship between predisposing, enabling, and need factors and healthcare

utilization patterns in the selected population. The mean exposure time was 1 and this referred to the response rate; researchers recommended report "1" if the response rates are for 1 year (Faul et al., 2009), which was the length of this study with data collected from January 1, 2013 to December 31, 2013.

The power analysis of this study followed the methods and effect size definitions of Cohen (1988). The classification of the effect sizes by Cohen included small ($d = 0.2$), medium ($d = 0.5$), and large ($d \geq 0.8$). The PRHS effect size was unknown, so I used a small effect size ($d = 0.20$). A small effect size will result in a large sample size to avoid a Type II or β, which is the probability of concluding there is no effect when one actually exists (see Cheng & Phillips, 2014). Researchers have also reported an effect of 0.20 to determine factors associated to AD healthcare utilization patterns (Chung et al., 2014; Schneider, Kennedy, & Cutter, 2011; Walsh et al., 2015).

The power level for this study was 0.95, which means that if there was really a relationship, there was a 95% chance of detecting that in this study (Kang, 2013). This power level has been used in previous behavioral and social research (Dumas-Mallet et al., 2017; Ranstad, Midlöv, & Halling, 2014; Trochim, 2006). I used an alpha level of 0.05, which is the standard for social science research because of its power to persuade the scientific community to accept or not accept the research hypothesis (see Palesch, 2014). In addition, previous studies that examined factors associated to AD healthcare utilization patterns have also used an alpha level of 0.05 (De Felice, 2013; Fag de Bruijn & Arfan-Ikram, 2014; Steffen & Jackson, 2012).

I determined the total sample size for my study to be 2,280 participants. This means that 2,280 individuals were needed to have a sufficient sample size that was appropriate for the analyses. However, I gathered data for 2,380 participants. Increasing the sample size over what was determined served to accommodate potential participants that could have missing data and to ensure an adequate and representative sample.

Procedures for Recruitment, Participation, and Data Collection

Recruitment and participation. The PRHS is a representative survey used to collect comprehensive health data from overall health claims for the insured Puerto Rican population (PRHD, 2014). Data gathered from 13 health insurance companies comprised the PRHS in 2013 (PRHD, 2014). Health insurance companies included in the PRHS were (a) First Medical Health Plan, Inc.; (b) Humana Health Plans of Puerto Rico, Inc.; (c) MCS Advantage, Inc.; (d) MCS Health Management Options, Inc.; (e) Mennonite General Hospital, Inc.; (f) MMM Healthcare, Inc.; (g) Plan de Servicios de Salud Bella Vista; (h) Preferred Medical Choice; (i) Humana Insurance of Puerto Rico, Inc.; (j) Humana Health Plans of Puerto Rico, Inc. (k) Pan American Life Insurance Co of PR; (l) Triple S Salud (private); and (m) Triple S Salud (public). The unit of analysis was the individual, and the information was gathered from the claims of these health insurance companies. Active recruiting for participation was not necessary for this; however, I secured the permission of the PRDH in order to access the primary data necessary to execute the study. The permission received from the PRDH is included in the Appendix.

Informed consent. Informed consent for study participation was not required for all Puerto Ricans enrolled in the PRHS. Lack of consent has been acceptable in research

with clinical or administrative purposes, where it is not necessary to obtain permission

from the population (Plough & Holm, 2017). The *Federal Policy for the Protection of*

Human Subject explains that research activities to which the policy does not apply and

includes research involving the collection or study of existing data, documents, or

records, if the information is recorded by the investigator in such a manner that subjects

cannot be identified, directly or through identifiers linked to the subjects, or if research is

conducted by or subject to the approval of department or agency administration, and

which are designed to study, evaluate, or otherwise examine public benefit or services

programs; procedures for obtaining benefits or services under those programs; and

possible changes in or alternatives to those programs or procedures (Office for Human

Research Protections, 2009). This study met the requirement for federal exemption

because it met the aforementioned criteria.

  Data collection. PRHS data were collected in the absence of any specific

instrument since January 1st, 2013. On September 8, 2012, the secretary of health in

collaboration with the Commission of the Puerto Rico Health Insurance Administration,

established a policy for health insurance companies to request data about the health

indicators of Puerto Rican population. This policy was established based on the need to

obtain utilization data that helped the PRDH improve health services and population

health across the island. Based on this need, the secretary of planning and development

designed and implemented a survey designed to gather demographic information, health,

and utilization data. Protocols were designed to facilitate data collection procedures. The

protocols provide details and guidelines to gather and disseminate each health claim by

the insurance company including how the data will be organized, managed, and stored in order to ensure the protection of the information for the insured population. The IP address of each insurance company was requested to allow the data entry to the PRHS database. For 2013, a total of 51,349,185 files with health claims were included in the database of the PRHS.

Information used to address the research questions of this study was obtained from the PRHS database. The PRDH, as an organization, needs to consent that this study will provide valuable data for the continuous quality improvement of the organization and to support data driven decisions. I accessed the primary by obtaining permission of the PRDH. A data sharing agreement was signed and included in the Appendix.

Medical offices and emergency room visits, and hospital admissions for the selected population were included in the study. All names were removed from the sample, with sequential numbers used as identifiers, to protect participants' identity in the analysis phase. Since the study is retrospective, there were no debriefing procedures or opt-out forms for the sample. Following final approval of the study, information will be presented to the PRDH, with results being available.

Variables Operationalization Definition

Table 3

Study Variables Operational Definition

Variables	Level of Measurement	Description
Healthcare utilization patterns		
Medical office visits	Ratio	Represent the number of medical office visits that an individual had in 2013.These visits comprised a meeting between a patient with a physician to get health advice or treatment in the medical office.
Emergency room visits	Ratio	Represent the number of emergency room visits that an individual had in 2013. These visits consisted of a meeting between a patient with a physician in a hospital facility, particularly emergency department, to get health advice or treatment.
Hospital admissions	Ratio	Represent the number of admission that involves staying at a hospital for at least one night that an individual had in 2013.
Predisposing factors		
Gender	Nominal	Represent the gender at the time of birth of the individual where 1 = *Female* and 2 = *Male.*
Age	Ordinal	Represents the years an individual has lived according the date of birth where 1= *60-69*, 2= *70-79*, 3=*80-89*, and *4=90 or older*.
Enabling factors		
Personal income	Ratio	Represent the annual income of the individual.
Health insurance type	Nominal	Represent the type of health insurance of the individual where 1= *Public* and 2= *Private*.
Municipality of Residency	Nominal	Represent the municipality of residence of the individual where 1= *Arecibo*, 2 =*Bayamón*, 3= *Caguas*, 4=*Fajardo*, 5= *Mayagüez/Aguadilla*, 6= *Metro*, and 7= *Ponce*.
Need factors		
Presence of comorbidities	Nominal	Represent the presence of comorbidities of the individual where 0= *No* and 1= *Yes*.

Data Analysis Plan

The SPSS Version 24 was the software used for data analysis. Descriptive statistics, with numeric representations of data, were conducted to determine the cohort demographic characteristics. From frequency distributions, a table was used to present the gender, type of health insurance, presence of comorbidities, age, and municipality of residence of the cohort. Additional descriptive statistics were used to evaluate the assumptions of the proposed statistical test. Kurtosis and skewness were computed to determine normality in the dataset. Measures of dispersion (e.g., variance and standard deviation) and central tendency (e.g., median, mode, and mean) measures were calculated for the dependent variables. These measures served to determine outliers and if the mean and variance of the dependent variables are close. These measures were presented in tables. The research questions and hypothesis that address this study are illustrated in the Table 4.

Table 5 presents the statistical analysis to answer the research questions. Bivariate analyses conducted to determine if there is a relationship between each IV and each DV. For those IVs with two independent groups (gender, health insurance, and presence of comorbidities), an independent sample *t* test was performed to compare the means of the number of medical office and emergency room visits, and hospital admissions. The assumptions underlying the independent sample *t* test was examined to ensure appropriate representation of data.

Table 4

Study Research Questions and Hypothesis

Research Questions	Null Hypothesis	Alternative Hypothesis
RQ1: Is there a relationship between predisposing factors such as age and gender and healthcare utilization patterns such as medical office visits, emergency room visits, and hospital admissions among older adult Puerto Ricans diagnosed with Alzheimer's disease?	There is no a relationship between predisposing factors such as age and gender and healthcare utilization patterns such as medical office visits, emergency room visits, and hospital admissions among older adult Puerto Ricans diagnosed with Alzheimer's disease.	There is a relationship between predisposing factors such as age and gender and healthcare utilization patterns such as medical office visits, emergency room visits, and hospital admissions among older adult Puerto Ricans diagnosed with Alzheimer's disease.
RQ2: Is there a relationship between enabling factors such as health insurance type, personal income, and municipality of residency and healthcare utilization patterns such as medical office visits, emergency room visits, and hospital admissions among older adult Puerto Ricans diagnosed with Alzheimer's disease?	There is no a relationship between enabling factors such as health insurance type, personal income, and municipality of residency and healthcare utilization patterns such as medical office visits, emergency room visits, and hospital admissions among older adult Puerto Ricans diagnosed with Alzheimer's disease.	There is a relationship between enabling factors such as health insurance type, personal income, and municipality of residency and healthcare utilization patterns such as medical office visits, emergency room visits, and hospital admissions among older adult Puerto Ricans diagnosed with Alzheimer's disease.
RQ3: Is there a relationship between need factors such as presence of comorbidities and healthcare utilization patterns such as medical office visits, emergency room visits, and hospital admissions among older adult Puerto Ricans diagnosed with Alzheimer's disease?	There is no a relationship between need factors such as comorbidities and healthcare utilization patterns such as medical office visits, emergency room visits, and hospital admissions among older adult Puerto Ricans diagnosed with Alzheimer's disease.	There is a relationship between need factors such as comorbidities and healthcare utilization patterns such as medical office visits, emergency room visits, and hospital admissions among older adult Puerto Ricans diagnosed with Alzheimer's disease.

Table 5

Statistical Analyses by Research Question

Research Questions	Dependent Variables	Independent Variables	Bivariate Tests	Multivariate Test
RQ1: Is there a relationship between predisposing factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with Alzheimer's disease?	Medical office visits Emergency room visits Hospital admissions	Age Gender	One-way ANOVA Independent sample t-test	Poisson regression
RQ2: Is there a relationship between enabling factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with Alzheimer's disease?	Medical office visits Emergency room visits Hospital admissions	Health insurance type Personal income Municipality of Residency	Independent sample t-test One-way ANOVA One-way ANOVA	Poisson regression
RQ3: Is there a relationship between need factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with Alzheimer's disease?	Medical office visits Emergency room visits Hospital admissions	Presence of Comorbidities	Independent sample t-test	Poisson regression

Assumptions underlying the independent sample *t* test are: (a) the DV is continuous, (b) the IV divides cases into two mutually exclusive groups, (c) each case must have a value on the IV and DVs, (d) the DV is normally distributed in each independent group, and (e) the variances of the normally distributed DV for the groups

are equal (Creswell, 2009). The measures of skewness and kurtosis were calculated to examine the distribution of the DV in each independent group. A normal distribution was considered if a value of skewness and kurtosis is 0 and 3, respectively (Green & Salkindm, 2014). The Levene's test evaluated the homogeneity of variances for the two groups; therefore, if the test was nonsignificant, the assumption was met. If the data violates the assumption of homogeneity of variances a Mann-Whitney U test was performed.

One-way ANOVA was conducted for the IVs with more than two independent groups (age, personal income, and municipality of residency) to determine differences in the mean of the number of medical office and emergency room visits, and hospital admissions. The assumptions underlying this bivariate test were examined to ensure appropriate representation of data. The assumptions underlying the one-way ANOVA are: (a) the DV is continuous, (b) the IV divides cases into two or more groups, (c) each case must have a value on the IV and DVs, (d) the DV is normally distributed for each level of the IV, and (e) the variances of the DV are the same for all populations (Creswell, 2009). The measures of skewness and kurtosis were examine the DV distribution in each level of the IV. A normal distribution was considered if a value of skewness and kurtosis is 0 and 3, respectively (Green & Salkindm, 2014). The Levene's test evaluated the assumption of the homogeneity of variances for the population groups. If the test was nonsignificant, the assumption was met; however, if the data violates the assumption of homogeneity of variances a Welch ANOVA was performed. In addition, post hoc tests were conducted if at least one of the independent groups is statistically

different from the other comparative groups; therefore, Tukey-Kramer test was performed assuming equal variances. Statistical significance for the bivariate tests was set at a level of significance (α) equal to 0.05 and p value 0.05.

Poisson regressions were performed to examine the relationship between multiple IVs (predisposing, enabling, and needed factors) and DV (healthcare utilization patterns). These regressions evaluated: (a) the probability of medical office and emergency room visits, and hospital admissions, and (b) the probability of intensive healthcare services utilization among older adults Puerto Ricans with a diagnosis of AD. The assumptions underlying the Poisson regression were examined to ensure appropriate representation of data. The assumptions underlying the Poisson regression are: (a) the DV is a count, (b) the IVs are discrete (continuous or categorical), (c) the distribution of counts follow a Poisson distribution, and (d) the mean and variance of the model are identical (Plan, 2014). To determine the Poisson distribution, a ratio of the variance to the mean of the DV were calculated; a ratio of 1 was considered a Poisson distribution (Plan, 2014). The Kolmogorov-Sminov Test was performed to determine if the counts follow a Poisson distribution; if the "Asymptotic sig (2-tailed)" was not statistically significant ($p > 0.05$), then the DV follows the Poisson distribution. Descriptive analyses of the dependent variables were conducted to determine if the mean and variance are close. If the mean and variance were very close, then data follow the Poisson distribution and the assumption was met. If these tests reveal that the count data do not follow a Poisson distribution, then a negative binomial regression was performed.

It should be noted that variables of age and presence of comorbidities have been significantly related to healthcare utilization patterns (Chen et al., 2014; Chung et al., 2014; Michalowsky et al., 2016); therefore, the likelihood ratio test was performed to evaluate the presence of interactions between independent variables. This was done by running the regression model both with and without the interaction terms in the model (Davies et al., 2013). If any of the interaction terms are shown to be significant at $p =$ 0.05, variables were stratifying and the regression results were reported for each variable subgroup. This helps to identify the best fit model to explain factors that influence AD healthcare utilization patterns in Puerto Rico.

Results to be considered statically significant were set at a confidence interval of 95%, level of significance (α) equal to 0.05 and p value 0.05. The p value was compared to α; if the p value was equal to or less than α, the null hypothesis was rejected. If the p value is greater than α, then the researcher failed to reject the null hypothesis.

Results from the independent t test and one-way ANOVA were reported by the mean and 95% confidence interval, the t statistic or F ratio, the degrees of freedom, the significance value and effect size. In addition, an error bar graph or boxplot were used to display mean differences and standard deviations across groups. Findings from the regressions were reported by the regression coefficients, standard errors, 95% confidence interval, and p value. Tables were used to illustrate the results of the regression models.

Threats to Validity

External Validity

Threats to external validity arise when researchers make inaccurate inferences from the sample to other people, settings, and past or future situations (Creswell, 2009). In order to address threats to external validity, no generalizations will be made outside of the selected population. The study results are limited to generalization among Puerto Ricans residents on the island living with AD, aging 60 years or more, and insured. Study findings will provide preliminary and representative results for future investigations in this research topic in Puerto Rico.

Internal Validity

Threats to the internal validity include experiences, treatments, or procedures that threaten the researcher's ability to make correct inferences from the data about the population being studied (Creswell, 2009). Since the population of this study is older adults living with AD, maturity of these individuals posed a threat to internal validity. It is possible that the maturity of selected population has an impact in healthcare utilization patterns. This study examined results between age groups with reservation and the understanding that preexisting differences may play an unknown role in any relationships identified.

Selection bias is presented in this retrospective cohort study since AD has already occurred at the time the research was initiated. Despite this, this study does not have a comparison group to reduce the selection bias; the interaction effects of selection biases was carefully considered and groups were randomly and systematically selected to ensure

that each AD case that meets the inclusion criteria has an equal opportunity of being selected for the study. Also, selection bias might occur due to the group of individuals who did not qualify because of their inability to access healthcare resources during the time period; therefore, the effect of health insurance type on healthcare utilization patterns for the selected population was evaluated. In order to reduce selection bias, this study proposes to adjust the results by type of health insurance.

Construct validity occurs when researchers use accurate definitions and measures of variables (Dembe, Lynch, Guigiu, & Jackson, 2014). Construct validity is supported by the strong operationalization of variables and multiple sources of evidence when possible. Healthcare utilization patterns is defined as the number of medical office and emergency room visits, and hospital admissions to a health facility in Puerto Rico, whose visits and admissions were coded with a primary diagnosis of AD. Medical office and emergency room visits and hospital admissions with other diagnoses (i.e., second diagnosis, third diagnosis) were not included in the study, potentially allowing for pertinent healthcare utilization patterns being excluded.

Ethical Procedures

Prior to study data collection, the Institutional Review Board from Walden University was approved (Approval Number: 06-20-18-048534). The consent approval from the PRDH and data sharing agreement to gain access to data collected from the PRHS is included in Appendix. There are no identified risks for participants and because the study is retrospective, treatment of participants is not affected by inclusion in the study. Participants were unaware of the study, as well as whether or not they would be

anonymous. Withdrawal from the study is not possible because of the inclusion criteria and retrospective design.

Participant's anonymity was protected as individual identification was replaced with a numeric representation. All individual identifying information was removed after the data is extracted from the PRHS. All data will remain confidential, protected and stored on secured computers and can be accessed only with a password. Data will be backed up on an encrypted flash drive, which is password-protected. Data will also void of individual identifiers. Five years following the study, all data stored within the computer and on the flash drive will be destroyed.

Summary

In this chapter, I provided an explanation of the study methodology, with research questions focusing on whether or not there is a relationship between certain demographic characteristics (age, gender, municipality of residence, type of health insurance, and personal income); the presence of comorbidities of older ($\geq$ 60 years old) Puerto Rican residents diagnosed with AD; and their healthcare utilization patterns (medical office and emergency room visits, and hospital admissions). I used a retrospective cohort design to obtain a representative sample size to analyse and interpret results accurately. Threats to the validity and ethical procedures were also presented to preserve the research integrity of this study. In the next chapter, the results of the study will be presented, each research question will be addressed, and supported by a quality discussion.

Chapter 4: Results

Introduction

The purpose of this retrospective cohort study was to determine if there is a relationship between certain demographic characteristics (i.e., age, gender, municipality of residence, type of health insurance, and personal income); the presence of comorbidities of older ($\geq$ 60 years old) Puerto Rican residents diagnosed with AD; and their healthcare utilization patterns (i.e., hospital admissions, emergency room and medical office visits). In this study, I focused on older Puerto Rican residents living on the island because there is little extant research about determinants influencing AD healthcare utilization patterns in this population. Available literature identifies some risk factors (i.e., low SES and poor access to preventive medicine and health resources) attributable to increased likelihood of deaths in this AD population (Figueroa et al., 2013); however, there is an urgent need to expand the knowledge in this research topic and with this population. Given the observed knowledge gap and disparities in healthcare access, I conducted this study to develop a better understanding of the factors influencing healthcare utilization patterns in Puerto Rican residents diagnosed with AD.

With the first research question, I explored whether there is a relationship between predisposing factors, such as age and gender, and healthcare utilization patterns, such as medical office and emergency room visits, and hospital admissions, among older adult Puerto Ricans diagnosed with AD. The null hypothesis was that there is no a relationship between predisposing factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with AD. The alternative hypothesis was there is a

relationship between predisposing factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with AD. With the second research question, I examined whether there is a relationship between enabling factors, such as health insurance type, personal income, and municipality of residency, and healthcare utilization patterns, such as medical office and emergency room visits, and hospital admissions, among older adult Puerto Ricans diagnosed with AD. The null hypothesis was that there is no a relationship between enabling factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with AD. The alternative hypothesis was that there is a relationship between enabling factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with AD. The third research question determined whether there is a relationship between need factors, such as the presence of comorbidities, and healthcare utilization patterns, such as medical office and emergency room visits, and hospital admissions, among older adult Puerto Ricans diagnosed with AD. The null hypothesis was that there is no relationship between need factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with AD. The alternative hypothesis was that there is a relationship between need factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with AD.

In this chapter, I will present an overview of the data collection process that was used to gather and then analyze data that addressed each research question in order to examine factors that influence healthcare utilization patterns for older Puerto Ricans diagnosed with AD. The procedures and discrepancies in the data will be detailed to justify the methodology applied, the statistical analyses performed, and the results

obtained. The descriptive statistics, demographics characteristics, and representativeness will also be described to provide a robust understanding of the sample that was used. The chapter will include a discussion of the statistical assumptions for each test to determine whether or not the underlying requirements for the analyses were met. The results will then be presented to explain the relationships between predisposing, enabling, and need factors and healthcare utilization patterns for older Puerto Rican residents living with AD.

<div align="center">

Data Collection
</div>

Sample Selection

The population from which the sample was selected was comprised of Puerto Ricans with a primary diagnosis of AD, who were aged 60 years or more and enrolled in the PRHS from January 1, 2013 to December 31, 2013. The study population was comprised of 32,899 individuals. I extracted data regarding the medical office and emergency room visits, hospital admissions, age, gender, municipality of residence, type of health insurance, personal income, and presence of comorbidities from the PRHS results for each participant.

The participants consisted of older Puerto Ricans with a primary diagnosis of AD who were defined as a beneficiary in 2013 under a health insurance plan (private or public). Therefore, I employed a systematic, random sampling technique with equal opportunity of health insurance type to identify the optimal sample size of 2,380 participants. I calculated this sample size with a small effect size of 0.20, power level of 95%, and alpha level of 0.05. The study results are generalizable for Puerto Ricans residents on the island living with AD, who are 60 years old or more and insured.

I calculated descriptive statistics to describe the variables associated with the participant sample. The variables of personal income and municipality of residency showed 86% and 75% missing values, respectively. The use of variables with missing values can significantly impact the conclusions that can be drawn from the data (Pampaya, Hutcheson, & Willians, 2016). For this reason, I excluded the variables of personal income and municipality of residency from the study.

Sample Demographics

The majority of participants were women (69.4%, $n = 1,651$) and without comorbidities (70.8%, $n = 1,684$). The largest group of AD participants were between 80 and 89 years old (37.3%, $n = 887$), followed by participants between 70 and 79 years old (30.5%, $n = 725$). The distribution of health insurance type was equal for the AD participants, representing 50.0% ($n = 1,190$) public and private health insurance, respectively. The demographics characteristics of the sample are further described in Table 6.

Table 7 presents the descriptive statistics of healthcare utilization patterns for older Puerto Ricans diagnosed with AD. The mean of hospital admissions for AD participants, defined as ≥ one night in an in-patient hospital, was 0.95 ± 1.75, with a minimum of zero admissions and a maximum of 14 admissions. The mean of emergency room visits of the sample was 0.20 ± 0.67, with a minimum of zero and a maximum of six visits. The mean of medical office visits for AD participants was 3.90 ± 7.50, with a minimum of zero visits and a maximum of 69 visits.

Table 6

Sample Demographic Characteristics

Characteristics	Frequency	Percent
Gender		
Female	1,651	69.4
Male	729	30.6
Age		
60-69	430	18.1
70-79	725	30.5
80-89	887	37.3
90 or older	338	14.2
Health insurance type		
Public	1,190	50.0
Private	1,190	50.0
Presence of comorbidities		
No	1,684	70.8
Yes	696	29.2

Table 7

Descriptive Statistics of the Healthcare Utilization Patterns

Healthcare Utilization Patterns	M (SD)	Mdn	P_{25}, P_{75}	R
Hospital admissions	0.95 (1.75)	0.00	0, 1	14
Emergency room visits	0.20 (0.67)	0.00	0, 0	6
Medical office visits	3.90 (7.50)	1.00	0, 4	69

Results

Testing Statistical Assumptions

I examined the assumptions underlying each statistical test prior to the analysis.

Using IBM SPSS, Version 24, the identification of outliers; data distributions (e.g.,

normality, Poisson, and other); and homogeneity of variances were explored. I will

discuss opportunities for addressing the violations in the following subsections.

Outliers. I used SPSS, Version 24, to identify extreme values and create boxplots.

There were outliers for the all DVs. Extreme values were reverified within the PRHS

database for each variable. Large variation in hospital admissions and medical office

visits for a small number of cases was an important aspect of the data set that added value

to the calculation and my interpretation of results.

Data distribution. To determine the normal distribution of the DVs in each level

of the IVs, I performed skewness and kurtosis tests. The mean and variance of each DV

was calculated to determine if these measures were close. Kolmogorov-Sminov tests

were performed to determine if the counts, DVs, followed a Poisson distribution.

Hospital admissions. Table 8 presents the descriptive statistics between hospital

admissions and each IV. For hospital admissions, the values of skewness and kurtosis in

each level of the IVs were above 0 and 3, respectively. Thus, the variable of hospital

admissions did not have a normal distribution in each level of the IVs; therefore, the

assumptions of normality distribution were not met. There was a difference beyond 1.4

between the mean and variance of hospital admissions in each level of the IVs;

consequently, the mean and variance were not close. All Kolmogorov-Smirnov tests were

statistically significant ($p < 0.001$); therefore, data does not follow a Poisson distribution

and the assumption was not met. For this reason, I determined a negative binomial

regression to be the most appropriate test because. it provides the opportunity to perform

a Poisson regression despite the variance not being close to the mean score.

Table 8

Statistics between Hospital Admissions and Independent Variables

Hospital Admissions	*M*	Variance	Skewness	Kurtosis	*p* value‡
Gender					
Female	1.02	3.34	2.87	10.83	<0.001
Male	0.79	2.43	3.08	12.18	<0.001
Age					
60-69	1.22	3.47	2.33	6.89	<0.001
70-79	0.75	2.44	3.55	17.95	<0.001
80-89	0.97	3.24	2.92	11.04	<0.001
90 or older	1.01	3.35	2.91	10.50	<0.001
Health insurance type					
Public	1.62	3.66	2.10	6.01	<0.001
Private	0.28	1.60	6.39	48.83	<0.001
Presence of Comorbidities					
No	0.90	2.53	2.78	10.58	<0.001
Yes	1.07	4.38	2.90	9.94	<0.001

Note: ‡ Results of the Kolmogorov-Sminov test, if *p* < 0.05 the number of hospital admissions do not follow a Poisson distribution.

Emergency room visits. Table 9 presents the descriptive statistics between emergency room visits and each IV. For emergency room visits, the values of skewness and kurtosis in each level of the IVs were above 0 and 3, respectively. Thus, the variable of emergency room visits did not have a normal distribution in each level of the IVs; therefore, the assumptions of normality distribution were not met. The mean and variance of the number of emergency room visits in each level of the IVs were close. All Kolmogorov-Smirnov tests were statistically significant (*p* < 0.001); consequently, the number of emergency room visits does not follow a Poisson distribution and the

assumption was not met. For this reason, I determined a negative binomial regression to be the most appropriate test.

Table 9

Statistics between Emergency Room Visits and Independent Variables

Emergency Room Visits	*M*	Variance	Skewness	Kurtosis	*p* value‡
Gender					
Female	0.21	0.49	4.80	28.33	<0.001
Male	0.16	0.36	5.17	32.98	<0.001
Age					
60-69	0.21	0.58	5.17	30.44	<0.001
70-79	0.16	0.34	5.44	39.49	<0.001
80-89	0.23	0.53	4.49	24.32	<0.001
90 or older	0.18	0.33	4.08	19.70	<0.001
Health insurance type					
Public	0.25	0.55	4.50	25.62	<0.001
Private	0.14	0.34	5.45	34.77	<0.001
Presence of comorbidities					
No	0.16	0.35	5.50	37.72	<0.001
Yes	0.30	0.69	3.98	19.16	<0.001

Note. ‡ Results of the Kolmogorov-Sminov test, if *p* < 0.05 the number of hospital admissions do not follow a Poisson distribution.

Medical office visits. Table 10 presents the descriptive statistics between medical office visits and each IV. For medical office, the values of skewness and kurtosis in each level of the IVs were above 0 and 3, respectively. Thus, the variable of medical office did not have a normal distribution in each level of the IVs; therefore, the assumptions of normality distribution were not met. There was a difference above 22.13 between the mean and variance of the medical office visits in each level of the IVs; therefore, the mean and variance were not close. All Kolmogorov-Smirnov tests were statistically

significant ($p < 0.001$); consequently, the number of medical office visits did not follow a

Poisson distribution and the assumption was not met.

Table 10

Statistics between Medical Office Visits and Independent Variables

Medical Office Visits	*M*	Variance	Skewness	Kurtosis	*p* value‡
Gender					
Female	4.02	62.83	4.24	23.02	<0.001
Male	3.62	41.52	3.82	19.74	<0.001
Age					
60-69	2.34	24.47	4.85	31.96	<0.001
70-79	3.42	38.36	4.41	26.05	<0.001
80-89	4.41	71.27	4.27	23.14	<0.001
90 or older	5.60	89.42	2.83	9.76	<0.001
Health insurance type					
Public	7.53	81.17	7.53	81.17	<0.001
Private	6.35	84.73	3.32	13.93	<0.001
Presence of comorbidities					
No	2.98	37.17	5.00	35.02	<0.001
Yes	6.14	95.65	3.17	12.27	<0.001

Note. ‡ Results of the Kolmogorov-Sminov test, if $p < 0.05$ the number of hospital admissions do not follow a Poisson distribution.

Homogeneity of variances. For those IVs with two independent groups (gender,

health insurance, and presence of comorbidities), an independent sample *t* test was

proposed to compare the means of healthcare utilization patterns. One-way ANOVA was

considered to determine differences in the mean of healthcare utilization patterns for

those IVs with at least three groups (age). In order to conduct the proposed bivariate tests,

the Levene's test was performed to evaluate the assumption of the homogeneity of

variances for the groups. The null hypothesis was that the variance is equal across groups. The alternative hypothesis was that the variance is not equal across groups.

For gender, there was a statistically significant Levene's test for hospital admissions ($p = 0.003$), emergency room visits ($p = 0.002$), and medical office visits ($p = 0.021$), rejecting the null hypothesis. Therefore, the test of homogeneity was not satisfied and a Mann-Whitney U was needed to be performed. The Mann-Whitney U test is recommended to compare the median differences between two independent groups, as gender, when the DV is either ordinal or continuous, as was the case with each DV of this study, but the variance is not equal distributed between groups (Green & Salking, 2014). For the age groups, there was a statistically significant Levene's test for hospital admissions ($p = 0.001$), emergency room visits ($p = 0.003$), and medical office visits ($p < 0.001$), rejecting the null hypothesis. Therefore, the variance is not equally distributed across age groups and a Welch ANOVA needed to be performed. The Welch ANOVA is recommended to examine whether differences between the means of the DV for at least three groups, such as age groups, even if the data violates the assumption of homogeneity of variances (Green & Salking, 2014), as the case in this study.

For health insurance, there was a statistically significant Levene's test for hospital admissions ($p < 0.001$), emergency room visits ($p < 0.001$), and medical office visits ($p < 0.001$), rejecting the null hypothesis. Therefore, the variance is not equal between health insurance groups and a Mann-Whitney U needed to be performed. The Mann-Whitney U test is considered the most appropriated test to evaluate median differences between two independent groups, such as health insurance type, when each DV is at ratio level, but the

variance is not equally distributed between groups. For presence of comorbidities, the results of the Levene's test were statistically significant for hospital admissions ($p < 0.001$), emergency room visits ($p < 0.001$), and medical office visits ($p < 0.001$), rejecting the null hypothesis. Therefore, the test of homogeneity was not satisfied and a Mann-Whitney U test needed to be performed. The Mann-Whitney U test is recommended to compare median differences between two independent groups, such as the presence of comorbidities, when the DV is continuous, as they are in this study, but the variance is not equally distributed between groups (Green & Salking, 2014).

Bivariate Analyses

RQ1: Is there a relationship between predisposing factors, such as age and gender, and healthcare utilization patterns, such as medical office and emergency room visits and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease?

Age. The results of the one-way ANOVA-WELCH test revealed that there was a non-significant difference in the mean of the number of emergency room visits [$F(3, 1040.09) = 1.32$, $p = 0.27$], comparing age groups of older Puerto Ricans diagnosed with AD. However, there was a statistically significant difference in the mean of the number of hospital admissions [$F(3, 1009.71) = 7.01$, $p < 0.001$] and medical office visits [$F(3, 1037.52) = 16.89$, $p < 0.001$], when comparing age groups, causing the null hypothesis to be rejected. Therefore, there is a relationship between age and the number of hospital admissions; and the number of medical office visits among older adult Puerto Ricans diagnosed with AD.

Follow-up tests were conducted to evaluate mean differences. Because the variances among the age groups were not homogeneous, I conducted post hoc comparisons with the use of the Games-Howell, a test that does not assume equal variances among groups. Table 11 illustrates the means differences in healthcare utilization patterns by age group. There was a statistically significant difference ($p <$ 0.001) in the means of the hospitalization admissions between the Puerto Ricans living with AD at ages from 70 and 79 years ($M = 0.75$; $SD = 1.56$) compared to those aging from 60 and 69 years ($M = 1.22$; $SD = 1.86$). The difference in means of hospital admissions was -0.47 (95% CI: -0.75, -0.20).

There was a statistically significant difference ($p < 0.001$) in the means of the medical office visits between Puerto Ricans living with AD at ages from 70 and 79 years ($M = 3.42$; $SD = 6.19$) compared those between 60 and 69 years of age ($M = 2.34$; $SD = 4.95$). The difference in means of medical office visits was 1.08 (95% CI: 0.23, 1.93). In addition, there was a statistically significant difference ($p < 0.001$) in the means of medical office visits between Puerto Ricans living with AD at ages between 80 and 89 years ($M = 4.41$; $SD = 8.84$) compared to those at ages from 60 to 69 years ($M = 2.34$; $SD = 4.95$). The difference in means of medical office visits was 2.07 (95% CI; 1.12, 3.03).

Table 11

Means Differences in Healthcare Utilization Patterns by Age

		Hospital admissions M Differences (95% CI)		
Age	M (SD)	60-69 years	70-79 years	80-89 years
60-69 (n=430)	1.22 (1.86)			
70-79 (n=725)	0.75 (1.56)	-0.47 (-0.75, -0.20)*		
80-89 (n=887)	0.97 (1.80)	-0.26 (-0.53, 0.02)	0.22 (0.00, 0.43)	
90 or older (n=338)	1.01 (1.83)	-0.21 (-0.55, 0.02)	-0.26 (-0.04, 0.56)	-0.05 (-0.25, 0.35)

		Medical office visits M Differences (95% CI)		
Age	M (SD)	60-69 years	70-79 years	80-89 years
60-69 (n=430)	2.34 (4.95)			
70-79 (n=725)	3.42 (6.19)	1.08 (0.23, 1.93)*		
80-89 (n=887)	4.41 (8.84)	2.07 (1.12, 3.03)*	1.00 (0.06, 1.93)*	
90 or older (n=338)	5.60 (9.46)	3.26 (1.80, 4.73)*	2.19 (0.73, 3.64)*	1.19 (-0.32, 2.70)

Note. *P-value statistically significant at < 0.05.

There was a statistically significant difference ($p < 0.001$) in the means of the medical office visits between Puerto Ricans living with AD at ages from 80 to 89 years ($M = 4.41$; $SD = 8.84$) compared to those aging between 70 and 79 years ($M = 3.42$; $SD = 6.19$). The difference in means of medical office visits was 1.00 (95% CI: 0.06, 1.93). There was a statistically significant difference ($p < 0.001$) in the means of the medical office visits between Puerto Ricans living with AD aging 90 years or older ($M = 5.60$; SD

= 9.46) compared to those at ages from 60 and 69 years ($M = 2.34$; $SD = 4.95$). The difference in means of medical office visits was 3.26 (95% CI: 1.80, 4.73). There was a statistically significant difference ($p < 0.001$) in the means of the medical office visits between Puerto Ricans living with AD aging 90 years or older ($M = 5.60$; $SD = 9.46$) compared to those at ages from 70 to 79 years ($M = 3.42$; $SD = 6.19$). The difference in means of medical office visits was 2.19 (95% CI: 0.73, 3.64).

Gender. The results of the Mann-Whitney U test demonstrated that there was no significant difference in the mean rank of the number of emergency room visits ($z = -1.95$, $p = 0.05$, $r = 0.04$); and the medical office visits ($z = -0.60$, $p = 0.55$, $r = 0.01$) comparing by gender. However, there was a statistically significant difference in the mean rank of the number of hospital admissions by gender groups ($z = -3.24$, $p < 0.001$, $r = 0.07$), rejecting the null hypothesis. Therefore, there is a relationship between gender and hospital admissions among older adult Puerto Ricans diagnosed with AD. Older Puerto Rican females diagnosed with AD ($M = 1.02$; $SD = 1.83$), on average, had more hospital admissions than males diagnosed with AD ($M = 0.79$; $SD = 1.56$). The difference in means of hospital admissions was 0.23 (95% CI: 0.09, 0.37). Table 12 illustrates the healthcare utilization patterns by gender.

Table 12

Healthcare Utilization Patterns by Gender

Healthcare Utilization Patterns	Female (n=1,651) M (SD)	Male (n=729) M (SD)	M Differences	95% CI M Differences	p value
Hospital admissions	1.02 (1.83)	0.79 (1.56)	0.23	0.09, 0.37	<0.001*
Emergency room visits	0.21 (0.70)	0.16 (0.60)	0.05	-0.004, 0.11	0.05
Medical office visits	4.02 (7.93)	3.62 (6.44)	0.04	-0.20, 1.01	0.55

Note. *P-value statistically significant at <0.05.

RQ2: Is there a relationship between enabling factors, such as health insurance type, and healthcare utilization patterns, such as medical office and emergency room visits and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease?

Health insurance. The results of the Mann-Whitney U test evidenced there is a statistically significant difference in the means rank of the number of hospital admissions ($z = -28.70$, $p < 0.001$, $r = 0.59$); emergency room visits ($z = -5.91$, $p < 0.001$, $r = 0.12$); and medical office visits ($z = -28.95$, $p < 0.001$, $r = 0.59$) comparing by health insurance type, rejecting the null hypothesis. Therefore, there is a relationship between health insurance type and medical office visits; and emergency room visits; and hospital admissions among older adult Puerto Ricans diagnosed with AD. Older Puerto Ricans living with AD with public health insurance ($M = 1.62$; $SD = 1.91$), on average, had more

hospital admissions than those with private health insurance ($M = 0.28$; $SD = 1.26$). The difference in means of hospital admissions was 1.34 (95% *CI*: 1.21, 1.47).

In terms of emergency room visits, older Puerto Ricans diagnosed with AD and with public health insurance ($M = 0.25$; $SD = 0.75$), on average, had more visits than those with private health insurance ($M = 0.14$; $SD = 0.59$). The difference in means of emergency room visits was 0.11 (95% CI: 0.06, 0.17). Results suggest that older Puerto Ricans living with AD who had public health insurance ($M = 1.46$; $SD = 4.00$), on average, had fewer medical office visits compared to those with private health insurance ($M = 6.35$; $SD = 9.21$). The difference in means of emergency room visits was -4.89 (95% *CI:* -5.46, -4.32). Table 13 illustrates healthcare utilization patterns by health insurance type.

Table 13

Healthcare Utilization Patterns by Health Insurance Type

Healthcare Utilization Patterns	Public (n=1, 190) M (SD)	Private (n=1, 190) M (SD)	M Differences	95% CI M differences	p value
Hospital Admissions	1.62 (1.91)	0.28 (1.26)	1.34	1.21, 1.47	<0.001*
Emergency room visits	0.25 (0.74)	0.14 (0.59)	0.11	0.06, 0.17	<0.001*
Medical Office visits	1.46 (4.00)	6.35 (9.21)	-4.89	-5.46, -4.32	<0.001*

Note. *P-value statistically significant at <0.05.

RQ3: Is there a relationship between need factors, such as presence of comorbidities, and healthcare utilization patterns, such as medical office and emergency room visits and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease?

Presence of comorbidities. The results of the Mann-Whitney U test revealed that there was a no significant difference in the means rank of the number of hospital admissions ($z = -0.82$, $p = 0.41$, $r = 0.02$) when taking into consideration the presence of comorbidities. However, there was a statistically significant difference in the means of the number of emergency room visits ($z = -4.89$, $p < 0.001$, $r = 0.10$); and medical office visits ($z = -10.42$, $p < 0.001$, $r = 0.21$) when taking into consideration the presence of comorbidities, rejecting the null hypothesis. Therefore, there is a relationship between the presence of comorbidities and emergency room visits; and medical office visits among older adult Puerto Ricans diagnosed with AD. Older Puerto Ricans living with AD and other comorbidities ($M = 0.30$; $SD = 0.83$), on average, had more emergency room visits compared to those without comorbidities ($M = 0.16$; $SD = 0.59$). The difference in means of emergency room visits was -0.14 (95% CI: -0.21, -0.07). In terms of the medical office visits, older Puerto Ricans diagnosed with AD and other comorbidities ($M = 6.14$; $SD = 9.78$), on average, had more visits compared to those without comorbidities ($M = 2.98$; $SD = 6.10$). The difference in means of medical office visits was -3.17 (95% CI: -3.95, -2.38). Table 14 illustrates the healthcare utilization patterns by presence of comorbidities.

Table 14

Healthcare Utilization Patterns by Presence of Comorbidities

Healthcare utilization patterns	No (*n*=1, 684) M (*SD*)	Yes (*n*=696) M (*SD*)	M Differences	95% CI M Differences	*p* value
Hospital admissions	0.90 (1.59)	1.07 (2.09)	-0.17	-0.34, 0.01	0.41
Emergency room visits	0.16 (0.59)	0.30 (0.83)	-0.14	-0.21, -0.07	<0.001*
Medical office visits	2.98 (6.10)	6.14 (9.78)	-3.17	-3.95, -2.38	<0.001*

Note. *P-value statistically significant at <0.05.

Multivariate Analyses

RQ1: Is there a relationship between predisposing factors, such as age and gender, and healthcare utilization patterns, such as medical office and emergency room visits and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease?

Hospital admissions. Results revealed that there is a relationship between predisposing factors (age and gender) and the hospital admissions, $\lambda^2 (4) = 48.35$, $p <$ 0.001, rejecting the null hypothesis. This model suggests that the number of hospital admissions of older Puerto Ricans living with AD is statistically significant predicted by age ($p < 0.001$) and gender ($p < 0.001$). After controlling for gender, the probability of hospital admissions for Puerto Ricans living with AD 90 years or more decreased 19% (95% *CI*: 0.66, 0.98); 80-89 years, 24% (95% *CI*: 0.65, 0.90); 70-79 years, 39% (95% *CI*: 0.52, 0.72); as compared to those aged from 60 to 69 years. After controlling for age, the

probability of hospital admissions decreased 23% (95% *CI*: 0.68, 0.88) in older Puerto

Ricans males diagnosed with AD compared to females living with this disease.

Emergency room visits. The results demonstrated that there is a relationship

between predisposing factors (age and gender) and emergency room visits, λ^2 (4) = 12.01,

p = 0.02, rejecting the null hypothesis. This model suggests that the number of

emergency room visits of older Puerto Ricans living with AD is statistically significant

predicted by gender (*p* < 0.001) but not by age (*p* = 0.10). After controlling for age, the

probability of emergency room visits decreased 22% (95% *CI*: 0.62, 0.97) in older Puerto

Ricans males diagnosed with AD, compared to females living with this health condition.

Medical office visits. The results demonstrated that there is a relationship

between predisposing factors (age and gender) and the number of medical office visits, λ^2

(4) = 135.43, *p* < 0.001, rejecting the null hypothesis. This model suggests that the

number of medical office visits for older Puerto Ricans living with AD is statistically

significant predicted by age (*p* < 0.001) and not for gender (*p* = 0.45). After controlling

for gender, the probability of medical office visits for AD Puerto Ricans at ages of 90

years or older increased two times (95% *CI*: 2.03, 2.80), compared to those between 60

and 69 years of age. After controlling for gender, the probability of medical office visits

for Puerto Ricans living with AD between 80-89 years of age and 70-79 years of age

increased 88% (95% *CI*: 1.64, 2.15) and 46% (95% *CI*: 1.27, 1.68), respectively as

compared with 60 to 69 years of age. Table 15 illustrates the regression models that

explain the healthcare utilization patterns by age and gender.

Table 15

Regression Models to Explain Healthcare Utilization Patterns by Age and Gender

	Hospital admissions			
	β (SE)	Exp (β)	95% CI Exp(β)	*p* value
Age				
60-69				
70-79	-0.49 (0.09)	0.61	0.52, 0.72	<0.001*
80-89	-0.27 (0.08)	0.76	0.54, 0.90	<0.001*
90 or older	-0.21 (0.10)	0.81	0.66, 0.98	0.034*
Gender				
Female				
Male	-0.26 (0.07)	0.77	0.68, 0.88	<0.001*
	Emergency room visits			
	β (SE)	Exp (β)	95% CI Exp(β)	*p* value
Age				
60-69				
70-79	-0.26 (0.15)	0.77	0.57, 1.04	0.08
80-89	0.03 (0.14)	1.03	0.78, 1.35	0.83
90 or older	-0.18 (0.18)	0.84	0.59, 1.19	0.33
Gender				
Female				
Male	-0.26 (0.12)	0.78	0.62, 0.97	0.027*
	Medical office visits			
	β (SE)	Exp (β)	95% CI Exp(β)	*p* value
Age				
60-69				
70-79	0.38 (0.07)	1.46	1.27, 1.68	<0.001*
80-89	0.63 (0.07)	1.88	1.64, 2.15	<0.001*
90 or older	0.87 (0.08)	2.38	2.03, 2.80	<0.001*
Gender				
Female				
Male	-0.38 (0.05)	0.96	0.87, 1.06	0.45

Note. *P-value statistically significant at <0.05.

RQ2: Is there a relationship between enabling factors, such as health insurance type, and healthcare utilization patterns, such as medical office and emergency room visits and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease?

Hospital admissions. The results demonstrated that there is a relationship between enabling factors (health insurance type) and the number of hospital admissions, $\lambda^2(1) = 677.41$, $p < 0.001$, rejecting the null hypothesis. This model suggests that the number of hospital admissions for older Puerto Ricans living with AD is statistically significant predicted by health insurance ($p < 0.001$). The probability of hospital admissions for older Puerto Ricans diagnosed with AD and with private health insurance decreased 82% (95% CI: 0.15, 0.20), compared to those with public health insurance.

Emergency room visits. The results demonstrated that there is a relationship between enabling factors (health insurance type) and the number of emergency room visits, $\lambda^2(1) = 31.70$, $p < 0.001$, rejecting the null hypothesis. This model suggests that the number of emergency room visits for older Puerto Ricans living with AD is statistically significant predicted by health insurance ($p < 0.001$). The probability of emergency room visits for older Puerto Ricans diagnosed with AD and with private health insurance decreased 44% (95% CI: 0.46, 0.69), compared to those with public health insurance.

Medical office visits. The results demonstrated that there is a relationship between enabling factors (health insurance type) and the number of medical office visits, $\lambda^2(1) = 895.23$, $p < 0.001$, rejecting the null hypothesis. This model suggests that the

number of medical office visits for Puerto Ricans diagnosed with AD is statistically significant predicted by health insurance ($p < 0.001$). For older Puerto Ricans living with AD and with private health insurance, the probability visiting a medical office increased four times (95% *CI*: 3.96, 4.79), compared to those with public health insurance. Table 16 illustrates the regression models that explain the healthcare utilization patterns by health insurance type.

Table 16

Regression Models to Explain Healthcare Utilization Patterns by Health Insurance Type

	Hospital admissions			
	β (SE)	Exp (β)	95% CI Exp(β)	*p* value
Health insurance type				
Public				
Private	-1.74 (0.07)	0.18	0.15, 0.20	<0.001*
	Emergency room visits			
	β (SE)	Exp (β)	95% CI Exp(β)	*p* value
Health insurance type				
Public				
Private	-0.58 (0.10)	0.56	0.46, 0.69	<0.001*
	Medical office visits			
	β (SE)	Exp (β)	95% CI Exp(β)	*p* value
Health insurance type				
Public				
Private	1.47 (0.05)	4.35	3.96, 4.79	<0.001*

Note. *P-value statistically significant at <0.05.

RQ3: Is there a relationship between need factors, such as presence of comorbidities, and healthcare utilization patterns, such as medical office and emergency room visits, and hospital admissions, among older adult Puerto Ricans diagnosed with Alzheimer's disease?

Hospital admissions. The results demonstrated that there is a relationship between need factors (presence of comorbidities) and the number of hospital admissions, $\lambda^2(1) = 7.28$, $p = 0.01$, rejecting the null hypothesis. This model suggests that the number of hospital admissions for older Puerto Ricans living with AD is statistically significant predicted by the presence of comorbidities ($p = 0.01$). The probability of hospital admissions for older Puerto Ricans with AD and other comorbidities increased 19% (95% *CI*: 1.05, 1.34), compared to those without comorbidities.

Emergency room visits. The results demonstrated that there is a relationship between need factors (presence of comorbidities) and emergency room visits, $\lambda^2(1) = 36.8$, $p < 0.001$, rejecting the null hypothesis. This model suggests that the number of emergency room visits for older Puerto Ricans living with AD is statistically significant predicted by the presence of comorbidities ($p < 0.001$). The probability of using emergency room services by older Puerto Ricans with AD and other comorbidities increased 88% (95% *CI*: 1.54, 2.30), compared to those without comorbidities.

Medical office visits. The results demonstrated that there is a relationship between need factors (presence of comorbidities) and the number of medical office visits, $\lambda^2(1) = 225.51$, $p < 0.001$, rejecting the null hypothesis. This model suggests that the number of medical office visits for Puerto Ricans living with AD is statistically

significantly predicted by the presence of comorbidities ($p < 0.001$). The probability to

use a medical office services for older Puerto Ricans with AD and other comorbidities

increased two times (95% CI: 1.87, 2.28) compared to those without comorbidities. Table

17 illustrates the regression models that explain the healthcare utilization patterns by

presence of comorbidities.

Table 17

Regression Models to Explain Healthcare Utilization Patterns by Presence of Comorbidities

	Hospital admission			
	β (SE)	Exp (β)	95% CI Exp (β)	*p* value
Presence of comorbidities				
No				
Yes	0.17 (0.06)	1.19	1.05, 1.34	0.01*
	Emergency room visits			
	β (SE)	Exp (β)	95% CI Exp (β)	*p* value
Presence of comorbidities				
No				
Yes	0.63 (0.10)	1.88	1.54, 2.30	<0.001*
	Medical office visits			
	β (SE)	Exp (β)	95% CI Exp (β)	*p* value
Presence of comorbidities				
No				
Yes	0.73 (0.05)	2.06	1.87, 2.28	<0.001*

Note. *P-value statistically significant at <0.05.

Summary

In this chapter, I presented the results from the study. Demographic results demonstrated that the sample drawn was mostly female and presented without comorbidities. The largest group of sample was between 80 and 89 years, followed by those between 70 and 79 years of age. The distribution of health insurance type was equal for the sample. In addition, there were violations of assumptions underlying the statistical tests regarding normality, Poisson distribution and homogeneity of regression; however, these were addressed.

Based on the results from the bivariate and multivariate analyses to determine factors that influence AD healthcare utilization patterns in Puerto Rico, data supported the rejection of null hypotheses. The first research question was to examine a relationship between predisposing factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with AD. I rejected the null hypothesis; therefore, there is a relationship between predisposing factors (age and gender) and healthcare utilization patterns among older adult Puerto Ricans diagnosed with AD. There was a statistically significant difference in the means of the number of hospital admissions and medical office visits by age groups. In addition, there was a statistically significant difference in the mean scores of the number of hospital admissions by gender.

Overall, results to examine if there is a relationship between enabling factors and healthcare utilization patterns among older adult Puerto Ricans diagnosed with AD were found to be statistically significant. Therefore, I rejected the null hypothesis; there is a relationship between health insurance type and medical office visits; and emergency

room visits; and hospital admissions among older adult Puerto Ricans diagnosed with AD. In addition, study findings identified a statistically significant relationship between need factors (presence of comorbidities) and healthcare utilization patterns among older adult Puerto Ricans diagnosed with AD. Therefore, I rejected the null hypothesis; there is a relationship between presence of comorbidities and emergency room visits; and medical office visits among older adult Puerto Ricans diagnosed with AD.

Chapter 5 will discuss what the findings mean in the context from which they were gathered and explain how the results answered the research questions. Also, findings were interpreted within the theoretical concept of the Andersen BM. Limitations of the study and recommendations for future practice and research were identified to better understand how the study contributes both generally and specifically to knowledge of public health and healthcare access and their impact on the AD population. Social change implications were described at the individual, organizational, and societal/policy level to identify appropriate methodological, theoretical, and empirical implications.

Chapter 5: Discussion, Conclusion, and Recommendations

Introduction

The purpose of this study was to examine the relationship between individual characteristics (i.e., age, gender, health insurance type, and the presence of comorbidities) and healthcare utilization patterns (i.e., medical office and emergency room visits, and hospital admissions) of older adult Puerto Ricans living with AD. I used a retrospective cohort design to gather information and IBM SPSS, Version 24 to analyze data and generate results. The study population for this research was comprised of Puerto Rican residents on the island, who were 60 years old or more, primarily diagnosed with AD, and enrolled in the PRHS in 2013. The mean of the number of medical office visits, emergency room visits, and hospital admissions were compared by each group of the IVs to determine relationships with the DVs. In addition, I evaluated the probability of intensive healthcare services utilization among older adults Puerto Ricans with a diagnosis of AD.

The key findings of the study revealed a statistically significant relationship between predisposing factors (i.e., age and gender) and healthcare utilization patterns (i.e., medical office and emergency room visits, and hospital admissions). The results of the negative binomial regression supported the rejection of the null hypothesis that there is a relationship between enabling factors (i.e., health insurance type) and healthcare utilization patterns (i.e., medical office and emergency room visits, and hospital admissions) among the selected population. Furthermore, the research findings demonstrated a statistically significant relationship between need factors (i.e., presence of

comorbidities) and healthcare utilization patterns (i.e., medical office and emergency room visits, and hospital admissions) among older adult Puerto Ricans diagnosed with AD. The findings of this study also determined the participant characteristics that influenced their healthcare utilization patterns. The results of this study expand on current research knowledge that may led to positive social change and improve healthcare resources and health outcomes for Latinos, particularly Puerto Ricans, living with this chronic disease.

Interpretation of the Findings

The results from this study served to better understand the burden of AD on the Puerto Rico public health system. The research findings extend knowledge about factors that influence AD healthcare utilization patterns for the older Puerto Rican population who are insured. The findings are generalizable to Puerto Ricans residents living on the island who have been diagnosed with AD, are 60 years old or older, and are insured. The application of these research results outside the scope in which they were gathered and for the selected population would be irresponsible.

Healthcare Utilization Patterns

In this study, I described the intensive use of healthcare resources in 2013 by examining hospital admissions, emergency room visits, and medical office visits for older AD Puerto Rican residents on the island. The results demonstrated that the participants were more likely to use healthcare services at medical office visits, followed by hospital settings. These healthcare utilization patterns provide valuable information because the services provided at medical office visits are focused on primary care; therefore, there is

an opportunity to improve the coordination and planning of healthcare resources to address the needs of older Puerto Ricans living with AD. I applied the Andersen BM to structure analysis of factors related to use healthcare services by older AD Puerto Ricans and will present the findings in the following subsections.

Predisposing Factors

Age. The literature strongly suggested that age influences healthcare utilization among individuals living with AD (Gilliagan et al., 2013; Knapp et al., 2016). In this study, I found that there is a negative and statistically significant relationship between age and hospital admissions. For the participants between the ages of 70 and 79 years old, the mean of hospital admissions decreased compared to those between the ages of 60 and 69 years old. It was surprising that, controlling for gender, the probability of hospital admissions for participants 90 years old or older decreased compared to those between the ages 60 to 69 years old. These results showed an inverse relationship compared with previous studies (Fischera et al., 2009; Gervės et al., 2016; Gilliagan et al., 2013; Knapp et al., 2016; Pinette et al., 2013). This finding merits further analysis to better understand this pattern. A possible explanation of this result is that the oldest participants had less access or were less likely to seek services at a hospital facility because they lacked transportation, family support, and other resources to reach this facility compared to youngest age cohort of participants.

The results of this study showed a positive and statistically significant relationship between age and medical office visits. It is well known that when the age of AD patients increases, the healthcare utilization patterns increase (Gervės et al., 2016; Knapp et al.,

2016; Pinette et al., 2013). There was a statistically significant difference in the means of medical office visits between participants aged 90 years old or older compared to those between the ages of 60 and 69 years. It was not surprising that, after adjusting for gender, the intensive use of medical services was two times more for participants aged of 90 years old or older compared to those between 60 and 69 years of age. These results provide a better understanding about the magnitude and burden of seeking health services through medical office visits amongst the oldest Puerto Ricans living with AD.

The results also demonstrated that age did not have a statistically significant relationship with emergency room visits for the target population; therefore, findings were not consistent with the literature that suggested an association between these variables (Walsh et al., 2015). There is a possibility that the inclusion criteria for this study impacted the number of visits to the emergency room for participants. For example, in this study, I only examined emergency room visits with a primary diagnosis of AD; it is possible that the target population's emergency room visits usage for reasons other than AD decreased or presented preferences to use other healthcare resources.

Gender. Researchers have suggested that the gender of an individual with AD affected their use of healthcare resources (Albanese et al., 2012; Knapp et al., 2016; Walsh et al., 2015). The findings from this study indicated that older Puerto Rican women with AD had more hospital admissions than men with AD. Not surprisingly, after controlling for age, the probability of a stay at a hospital for $\geq$ one night decreased in older AD Puerto Ricans men compared to women with AD. These results were consistent

evidence that women are more likely to have higher rates of hospital admissions than men (Knapp et al., 2016).

The findings from the Mann-Whitney U test revealed that there was not a significant relationship between gender and emergency room visits. However, when both predisposing factors (i.e., age and gender) were analyzed, the negative binomial regression revealed a statistically significant relationship between gender and emergency room visits. After controlling for age, the probability of emergency room visits decreased in older Puerto Ricans men with AD compared to women with AD. These results were similar to Walsh et al.'s (2015) that showed that being a woman is a significant factor that predisposed the person to use healthcare resources through an emergency department in older individuals living with AD.

The findings from the Mann-Whitney U test revealed that that there was no significant difference in the mean rank of the number of the medical office visits. These results were not consistent with the literature, which indicated a gender influence on the use of medical office visits to get health advice or treatment (Albanese et al., 2011). Women living with AD use healthcare services more frequently at medical office visits than men with AD (Albanese et al., 2011). Therefore, further research is needed to explore the reasons why older Puerto Ricans diagnosed with AD are predisposed to use healthcare services at medical office settings.

Enabling Factors

Health insurance. The coverage of health insurance facilitates access to healthcare and protects individuals and families from catastrophic health expenses

(Aryeetey et al., 2016). The findings from this study demonstrated that there is a statistically significant relationship between health insurance type and hospital admissions, emergency room visits, and medical office visits among older adult Puerto Ricans diagnosed with AD. I found that the participants with public health insurance had more hospital admissions and emergency room visits than those with private health insurance. In Puerto Rico, the public health insurance is a public health policy established to improve the access to healthcare resources access on the island (PRHD, 2014). The study findings demonstrated that the intensive use of health services at hospital settings related to AD in Puerto Rico are primarily driven by those with public health insurance. These results were consistent with the literature, which demonstrated that the health insurance status of individuals diagnosed with AD is associated to healthcare utilization patterns (Zayas et al., 2016).

Compared to the patterns identified for hospital admissions and emergency room visits, I found that the participants with public health insurance had fewer medical office visits compared to those with private health insurance in this study. There was a significant, intensive use of healthcare services at medical office visits for participants with private health insurance compared to those with public health insurance. This finding suggests that private health insurance facilitates the ability of older adult Puerto Ricans diagnosed with AD to secure health services at medical office visits. In Puerto Rico, there are some clinicians at medical offices that are not providing services to patients with public health insurance because the doctor gets a minimum amount of money for the person's care or for problems with the payments by the health insurance

companies. This information might explain the dramatic difference in the frequency of utilization by health insurance type. These results were consistent with the literature that suggested that having health insurance among older individuals diagnosed with AD is associated with healthcare utilization patterns (Albanese et al., 2011; Zayas et al., 2016).

Need Factors

Presence of comorbidities. The results of this study indicated that there was a statistically significant relationship between the presence of comorbidities and emergency room visits and medical office visits. The findings suggested that the participants with other comorbidities had more visits to the emergency room and sought more healthcare services at the medical office compared to those individuals without comorbidities. These results were consistent with the literature that reported that the presence of comorbidities influenced healthcare utilization patterns associated to AD (Beydoun et al., 2017; Brüggenjürgen et al., 2015; Kahle-Wrobleski et al., 2015).

The findings from the Mann-Whitney U test demonstrated that there was no significant relationship between need factor and hospital admissions. However, the results from the negative binomial regression revealed a statistically significant relationship between the presence of comorbidities and hospital admissions. The probability of hospital admissions for participants with other comorbidities increased compared to those without comorbidities. These results were consistent with other studies that demonstrated that the presence of comorbidities in people with AD is related with higher use of healthcare services (Hurd et al., 2013; Suehs et al., 2014; Zhu et al., 2013).

Limitations of the Study

I identified limitations to this study that are relevant to its validity. The study inclusion criteria consisted of a primary diagnosis of AD, insured, and an age 60 years old or more. I extracted data from this population from the PRHS database for the year 2013. Therefore, patients who did not visit a physician or did not received a diagnosis of AD between the dates of January 1, 2013 to December 31, 2013 were excluded. The study population may have unique characteristics, exposures, or patterns that would not be appropriate in describing another population. Applying outcomes and results to explain other healthcare utilization patterns to populations outside of those who met the inclusion criteria for this study would be inappropriate and threaten the external validity of the study.

Time was considered a study limitation. Selection bias posed a threat due to the group of individuals who did not qualify as a result of their inability to access healthcare resources during the time period from January 1, 2013 to December 31, 2013. Omitting this group might decrease the generalizability of the current study in representing older Puerto Ricans diagnosed with AD enrolled in the PRHS. The length of required enrollment for inclusion presented another limitation. The research period was limited to 12 months. There is a potential that the effect of healthcare utilization patterns takes longer to identify that the period of time included in this study. There were no previous studies regarding the healthcare utilization patterns in older Puerto Ricans living with AD, allowing this research to serve as a basis for further exploration of tendencies about the healthcare utilization patterns related to older Puerto Ricans living with AD.

Unobservable confounding variables was another limitation of this study. The PRHS does not have information on the duration or severity of AD and the individual's living situation (e.g., home versus institution, marital status) that may influenced the use of healthcare services among older individuals living with AD (Albanese et al., 2011; Chen et al., 2014; Chung et al., 2014; Gilliagan et al., 2013). Based on the design, information available in the PRHS, and resources to conduct this research, this study was unable to control for unmeasured confounders. However, I performed the likelihood ratio test to examine the interaction between variables and control for them.

Omitted variables bias was another limitation of this study. There were variables omitted based on data not available in the PRHS data set such as municipality of residency, income, medical treatments, social behaviors, and duration and stage of AD that could best explain factors influencing AD healthcare utilization patterns for older Puerto Ricans. However, this study used information available from the PRHS and provided preliminary data for further research on this topic in Puerto Rico. Maturation was another naturally-occurring limitation that is evident in research focused on older populations. The natural progression of aging and the impact of the progressive nature of AD alone could impact the use of healthcare services at hospital admissions, and emergency room and medical office visits. When making between-group comparisons in this study, I examined results with reservation, understanding that preexisting differences may play an unknown role in the relationships that were identified.

Recommendations

I identify opportunities for further research and changes in practices that may result in enhanced public health services coordination, care, and outcomes for older Puerto Ricans living with AD. Results were consistent with the literature that supports that there is a relationship between age, gender, health insurance, and presence of comorbidities; and healthcare utilization patterns of older people diagnosed with AD. However, there are some digressions from previous research that require further evaluations. It is recommended that the trends of healthcare resources used, including at least five consecutive years, by the selected population be examined. This longitudinal examination will provide a better understanding of healthcare resources use over time and might be valuable for the strategic planning and continued improvements of resources at diverse healthcare settings in order to address the demand and needs of older Puerto Ricans living with AD.

I found some discordant associations between IV and DVs. Study findings demonstrated an inverse association between age and hospital admissions and a lack of a significant relationships between gender and medical office visits; therefore, these results merit further investigation to better understand these relationships. It is also recommended that a quantitative study be conducted to explore factors, at multiple levels, that could better explain the relationship between age and hospital admissions such as family support, caregiver, transportation services, stage and severity of AD, and municipality of residency. In addition, consideration should be given to conducting a qualitative study that targets patients, families, and caregivers to understand the reasons

to predispose and facilitate AD individuals to use healthcare services at medical office settings versus at emergency departments.

Based on the preliminary results of this study, it would also be valuable to expand the research scope to examine additional factors (i.e., severity and stage of AD, income, municipality of residence, caregiver) that could influence AD healthcare utilization patterns by conducting a longitudinal study. This longitudinal study might consider the exploration of contextual determinants (factors related to the organization, provider, and community) that affect the healthcare utilization patterns among Puerto Ricans living with AD. Further analysis regarding factors influencing AD healthcare utilization patterns would bring new insights to whether certain determinants impact the use of healthcare resources by AD populations living in Puerto Rico.

The results of this study provided information to reduce the burden of AD in healthcare services and to improve and strengthen initiatives to prevent and control this chronic disease in Puerto Rico. It is recommended that the factors related to healthcare utilization patterns be used as an entryway to AD healthcare services and support for older AD Puerto Ricans. Identifying and targeting specific individual characteristics and care needs before sentinel events occur that result in medical office and emergency room visits, and hospital admissions which could influence AD healthcare treatment and outcomes. Application of a healthcare utilization model, such as the Andersen BM, can assist in this effort.

Implications

The findings of this study indicate the opportunities that exist in Puerto Rico health systems to improve public health resources according the needs of older AD Puerto Ricans. The statistically significant relationships between age, gender, health insurance, and presence of comorbidities and healthcare utilization patterns has the potential to impact social change by inspiring modifications to the public health system and healthcare and disease management support that is provided to older AD Puerto Ricans. This study provides valuable information to promote the development of a public health policy to achieve best health and quality of life outcomes for Puerto Ricans living with Alzheimer's disease. It is well known that healthcare for people with AD is an investment, and payers and the governments should be willing to pay to preserve the individual's quality of life (WHO, 2017). Therefore, the Puerto Rico government should invest in biomarkers, cognitive assessment tools, healthcare support and treatments and prevention initiatives to address AD. Public health initiatives should be focused on the prevention, early detection, control and management of AD should be implemented across the island with needs to be guided by the factors identified in this study; this could help to reduce the burden of this chronic disease on the Puerto Rico healthcare system.

The results of this research expand the existing knowledge about the use of healthcare resources for Latino populations living with AD. The results can encourage other countries with Latino communities to examine factors that influence AD healthcare utilization patterns that remain unknown. This exploration might help to identify disparities in healthcare access and cost-effective support, and to design and implement

interventions to improve the access, quality, leading to the creation of disease

management of healthcare services according the population's needs. In addition, these

preliminary results can motivate researchers to compare data with a group of AD Puerto

Ricans living in the United States. This comparative research might serve the determine

differences in the intensive use of healthcare services to achieve the best health outcomes

among populations.

Theoretical implications of the study suggest motivation for transformation of the

healthcare system in Puerto Rico. This study established a baseline of knowledge on

healthcare utilization patterns associated to AD, which has been previously unexplored in

Puerto Rican populations living in the island. Thus, this study provides data about

existing attributes that predispose (age and gender) older AD Puerto Ricans; enabling

characteristics (health insurance) that facilitate; and need conditions (presence of

comorbidities); to use healthcare services in the island. This data can be considered as the

starting point for developing strategies to address the AD burden in Puerto Rico health

system. As mentioned previously, the most frequent healthcare services utilized by older

AD Puerto Ricans was at medical office visits, which is considered primary care.

Therefore, there is a need to enhance professional development of medical personnel who

treat patients with AD, offer incentives for neurologists to stay in the island and to

provide care to this population, educate families in AD patient care, and develop health

promotion and education actions to prevent, management and control AD.

Conclusion

This study adds to the body of literature regarding factors related to AD healthcare utilization patterns in Latino communities, particularly older adult Puerto Ricans. Using a representative sample of older Puerto Ricans living with AD who were enrolled in the PRHS in 2013, the relationship between certain individual and healthcare utilization patterns was explored. SPSS Version 24.0 was used to perform bivariate and multivariate analyses. Constructs of the Andersen's BM guided this study to better understand the relationship between variables.

Findings of this study supported the rejection of all null hypotheses. Following the first research question, data supported the rejection of the null hypothesis; therefore, there is a relationship between predisposing factors (age and gender) and healthcare utilization patterns among older adult Puerto Ricans diagnosed with AD. Similarly, findings from the second research question, results supported the rejection of the null hypothesis; there is a relationship between health insurance type and medical office visits, emergency room visits, and hospital admissions among older adult Puerto Ricans diagnosed with AD. Likewise, findings from the third research question, data supported the rejection of the null hypothesis; there is a relationship between presence of comorbidities and emergency room visits and medical office visits among older adult Puerto Ricans diagnosed with AD.

The results of this study expanded the knowledge and awareness of the burden of AD in Puerto Rico. Data analyses highlighted are opportunities, with resulting recommendations offering the potential to impact healthcare systems, resources, and

overall AD individuals' health outcomes. Medical offices in the island that serve populations with higher proportions of older adult Puerto Ricans that are females, with private health insurance, and the presence of comorbidities should expect to have a greater likelihood of older individuals seeking health services for AD reasons. Conversely, emergency departments and hospital settings that serve populations with higher proportions of older adults Puerto Ricans that are females, with public health insurance and with the presence of comorbidities should expect to have a greater likelihood of older persons visiting these facilities for AD reasons. Future research is warranted to expand the comprehensive addition of elements in the Andersen BM, as well as interventions and treatments that can best explain factors that influence AD healthcare utilization patterns in older populations. Findings may have meaningful impact on public health practice, encourage the allocation of resources, improve the quality of care for AD individuals, and provide the groundwork for future research in this topic and with this population.

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Appendix: Data Sharing Agreement

GOBIERNO DE PUERTO RICO

Departamento de Salud

Acuerdo de confidencialidad y utilización de la Base de Datos de Utilización de las Aseguradoras de Salud de Puerto Rico

COMPARECEN

DE LA PRIMERA PARTE: La Secretaria de Salud del Departamento de Salud representada por el Secretario Auxiliar de Planificación y Desarrollo, **JAPHET C. RIVERA DÍAZ, MBA** en adelante denominado como la **PRIMERA PARTE.**

DE LA SEGUNDA PARTE: CARLAMARIE NOBOA RAMOS mayor de edad, **ESTUDIANTE DOCTORAL DE WALDEN UNIVERSITY,** en adelante denominado como la **SEGUNDA PARTE.**

Teniendo ambas partes la facultad y capacidad necesaria para este otorgamiento:

EXPONEN

PRIMERO: La Secretaría Auxiliar de Planificación y Desarrollo fue creada al amparo de la Orden Administrativa Núm. 240, según enmendada, a los fines de, entre otras cosas, desarrollar bases de datos de mortalidad y morbilidad de la población de Puerto Rico para así poder establecer la política pública sobre salud en Puerto Rico y propiciar el desarrollo de investigaciones científicas y facilitar el proceso de toma de decisiones en la planificación e implantación de la salud a la población.

SEGUNDO: En cumplimiento con este mandato, en 2014 se solicitó a las aseguradoras de salud a que sometieran al departamento información sobre sus facturaciones, así como las enfermedades por las cuales ellos pagaron parte de sus primas a los proveedores de servicios de salud.

TERCERO: A pesar de que al departamento de Salud no le aplica la Ley HIPPA, según las disposiciones del Protocolo de Excepción a la Prohibición de Intercambiar Información de Salud sin Autorización del Paciente Aplicable al Departamento de Salud publicado en abril de 2009, reconocemos que la Base de Datos de Utilización contiene información privilegiada de negocios así como información personal de los pacientes atendidos por los diferentes planes privados y el público que debe ser protegida en todo momento y sin excepciones.

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ACUERDOS

PRIMERO: La PRIMERA PARTE proveerá a la SEGUNDA PARTE **BASES DE DATOS DE RECLAMACIONES DE ASEGURADORAS DE SALUD CON DIAGNÓSTICO PRIMARIO DE ALZHEIMER PARA LOS AÑOS 2013 Y 2014** que se utilizará/n con el propósito del estudio de investigación **FACTORS INFLUENCING ALZHEIMER'S DISEASE HEALTHCARE UTILIZATION PATTERNS IN PUERTO RICO.**

SEGUNDO: Se prohíbe a la **SEGUNDA PARTE** el traspaso de la información personal identificable, más allá de los colaboradores del estudio; entendiéndose que la titularidad (el dueño) de los datos que se provean bajo este acuerdo seguirá siendo la **PRIMERA PARTE**; que el acuerdo del uso de datos constituye una licencia para usar los datos provistos solamente para el propósito y forma aquí establecida y deberá reconocerse a la **PRIMERA PARTE** como la **fuente de datos** en todo trabajo publicado. La cita debe estar asociada con el archivo de datos utilizado y debe aclarar las limitaciones de los datos. La referencia será:

Departamento de Salud de Puerto Rico, Secretaría Auxiliar de Planificación y Desarrollo. Base de Datos de Utilización de las Aseguradoras de Salud de Puerto Rico, Año.

TERCERO: Se prohíbe la reproducción por la **SEGUNDA PARTE** de cualquier información que pueda identificar a una persona o cualquier record individual, identificable o no, sin la previa autorización de la **PRIMERA PARTE**.

- No utilizará o permitirá que otros utilicen los datos suministrados por la **PRIMERA PARTE** para ningún otro propósito que no sea realizar investigaciones científicas (informes estadísticos y análisis).

- No puede utilizar, ni permitir que persona alguna utilice la información para intentar conocer la identidad de una persona incluida en la información provista.

- Si la identidad de una persona es descubierta inadvertidamente, el recipiente de la información: no hará uso de la misma; notificará inmediatamente a la **PRIMERA PARTE** y; no informará la identidad descubierta a ninguna otra persona.

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- La **SEGUNDA PARTE** reconoce y acuerda que es responsable de cualquier violación de la seguridad, incluyendo pero no limitado a notificar a las personas afectadas según requiere la Ley y la **PRIMERA PARTE**, y por cualquier multa, penalidad u otras sanciones que puedan imponerse.

CUARTO: Se prohíbe el uso de los datos provistos para cualquier otro propósito no explícitamente identificado y aprobado en este acuerdo de uso de datos.

QUINTO: La **SEGUNDA PARTE** no deberá copiar, distribuir, realizar ingeniería inversa, obtener ganancias por la venta o su uso, ni incorporar en ningún otro sistema computadorizado, los datos provistos por la **PRIMERA PARTE**.

SEXTO: Al terminar la investigación, la **SEGUNDA PARTE**, devolverá o destruirá (según acordado) todos los datos que no necesite para el objetivo especificado en la petición.

SÉPTIMO: La **SEGUNDA PARTE** no enlazará o permitirá que otros enlacen los datos provistos por la **PRIMERA PARTE** con archivos individuales de cualquier otra base de datos, excepto con el permiso especial de la **PRIMERA PARTE**.

OCTAVO: La **SEGUNDA PARTE** entiende y acepta que será considerado un asociado de negocios, según definido por y para todos los efectos legales bajo la ley federal Health Insurance Portability and Accountability Act of 1996 ("HIPAA"). Solo utilizará la información de la forma aquí descrita y de acuerdo a la legislación local y federal aplicable existente. En dicho carácter reconoce y acuerda además lo siguiente:

1. Que la **SEGUNDA PARTE** y sus colaboradores mantendrán y utilizarán la información protegida de salud de pacientes, información privilegiada y de otro tipo con la cual venga en contacto, en estricta confidencialidad y privacidad, para los únicos fines de ejecutar las funciones descritas en éste acuerdo, limitándose al mínimo necesario que permita el desempeño apropiado de las tareas descritas.

2. Que establecerá medidas apropiadas para prevenir el uso inapropiado de la información; no utilizará o divulgará información provista por la **PRIMERA PARTE** sin el previo consentimiento escrito de ésta, salvo para los fines aquí permitidos y requeridos por el acuerdo o según requerido por ley.

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3. Que la **SEGUNDA PARTE** suscribirá un Acuerdo de Confidencialidad con cualquier agente, empleado o subcontratista con el cual contrate y le suministre información protegida que haya recibido y/o creado en nombre de la **PRIMERA PARTE**, ejerza el mismo grado de control y limitación sobre uso de información que le compete en lo que respecta a las obligaciones contractuales aquí asumidas.

4. Que adoptará prácticas internas, procedimientos, políticas manuales y registros requeridos para proteger la integridad, privacidad y la confidencialidad de la información mantenida por esta y/o sus asociados, conforme a los estándares de privacidad de la Ley HIPAA y la reglamentación del 45 CFR sección 164.504-506 y a esos fines hará accesible dichos documentos al Secretario de Salud para cualquier pesquisa o gestión de cumplimiento relacionada.

5. Que la **PRIMERA PARTE** no releva a la **SEGUNDA PARTE** de responsabilidad por el daño que pueda ocasionar el uso no autorizado de la información provista.

EN TESTIMONIO DE LO CUAL, LAS PARTES suscriben este acuerdo obligándose así formalmente a cumplir con todas sus cláusulas y condiciones.

Certifico que he leído y comprendido lo especificado en este acuerdo y que daré fiel cumplimiento a lo aquí expresado.

En San Juan, Puerto Rico a _Noviembre_ de 2017.

JAPHET C. RIVERA DÍAZ, MBA

PRIMERA PARTE

CARLAMARIE NOBOA RAMOS MS, PhDc

SEGUNDA PARTE

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